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SPACE WEATHER SYSTEM REQUIREMENTS DOCUMENT FOR THE ESA SPACE SAFETY PROGRAMME

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APPROVAL

Title	Space Weather System Requirements Document for the ESA Space Safety Programme		
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CHANGE LOG

Reason for change	Issue Nr	Revision Number	Date
This issue addresses updates to the core Services and has been prepared as an intermediate step in order to handle flow-down of requirements from the SWE Customer Requirements Document updated in 2023 (ESA-S2P-SWE-CRD-0001) and other identified product specific needs. A further update addressing other elements of the document as applicable is expected in the 2024-2025 timeframe.	1	0	02/08/2024
Review and update mainly of performance, availability and environments requirements	1	1	03/11/2025

CHANGE RECORD

Issue Number 1	Revision Number 1
Reason for change	Paragraph(s)
General re-work and re-structuring of section 1, section 2 and section 3	1, 2, 3
Moved section 1.2 “The Space Safety Programme” to section 2.1	1.2, 2.1
Changed heading, original §2 “SWE System Overview downgraded to section 2.2	2

Update of main section: Added descriptions of space weather effects and events; re-placed figure 1 with system overview; added definitions of roles in the context of the Space Weather System; Added section 2.2.1.2 “Federated Service Network”	2.2.1
Added section 2.2.2 “Research-to-operations (R2O2R) concept”	2.2.2
Added section 2.2.3 “Environment Structure”	2.2.3
Removed first paragraph which was duplicated; inserted caption for table 1	2.2.5
Added sub-sections section 2.2.5.1, section 2.2.5.2, section 2.2.5.3 and section 2.2.5.4 containing definitions for different data levels	2.2.6
Complete restructuring of section 3: Section 3.1 Services Section 3.2 Overall System Requirements Section 3.3 Data Acquisition Segment Section 3.4 SWE Data System Section 3.5 Space Weather Model Access via Service Provision Segment Section 3.6 User Interface Segment	3
Original section 3.1.2 was upgraded to section 3.1; added, updated and deleted requirements in this section	3.1
Added, updated and deleted requirements in this section	3.2, 3.3, 3.4, 3.5, 3.6

DISTRIBUTION

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Table of Contents

1. INTRODUCTION

1.1. Scope of the Document

This document contains the Space Weather System Requirements for the ESA Space Safety Programme. The document addresses the high-level system requirements derived from the Customer Requirements and presents requirements for a complete end-to-end space weather system from measurement systems through to service provision.

It should be noted that this is an intermediate update and some sections are currently under review. These sections are marked within the document. In case of questions, please contact the Space Weather Office.

1.2. Definition of Terms

(see Customer Requirements Document and Annex 1)

1.3. Acronyms

AD	Applicable Document
CME	Coronal Mass Ejection
COSPAR	Committee on Space Research
CRD	Customer Requirements Document
ECSS	European Cooperation for Space Standardization
ESA	European Space Agency
EVA	Extra-Vehicular Activity
GEN	General Requirement
GEO	Geostationary Earth Orbit
GNSS	Global Navigation Satellite Systems
GTO	Geostationary Transfer Orbit
HEO	highly elliptical orbit
I/F	Interface
ICD	Interface Control Document
IERS	International Earth Rotation systems Service
IG12	12-month-running mean of the ionospheric IG index
IMF	Interplanetary Magnetic Field
ISES	International Space Environment Service
ISO	International Organization for Standardization
ISS	international space station
IT	Information Technology
ITRF	International Terrestrial Reference Frame

L1	first Lagrangian point
L2	second Lagrangian point
LAU	Launch Operation Service Domain
LEO	Low Earth Orbit
LEOP	Launch and Early Operations
MEDS	Mean Elements Data Set
MEO	Medium Earth Orbit
N/A	Not applicable
NASA	National Aeronautics and Space Administration
NIEL	Non ionising energy loss
NOAA	National Oceanic and Atmospheric Administration
R2O2R	Research-to-Operations-to-Research
RD	Reference Document
RER	Re-entry Predictions for Risk Objects Service
RMS	Root Mean Square
RSSD	Research and Scientific Support Department
RTK	Real-time kinematic
S/C	Spacecraft
SCD	Spacecraft Design Service Domain
SCH	Human Space Flight Service Domain
SCO	Spacecraft Operation Service Domain
SEE	Single Event Effect
SMS	Short Message Service
SEP	Solar energetic particle event
SRD	System Requirements Document
SSA	Space Situational Awareness
SSN	Smoothed Sunspot Number
SST	Space Surveillance and Tracking
STC	Space Traffic Coordination Service Domain
SWE	Space Weather
TBC	To Be Confirmed
TBD	To Be Defined
TEC	Total Electron Content
TIO	Communication and Navigation Service Domain
UTC	Universal Time Coordinated

1.4. Applicable and Reference Documents

1.4.1. Applicable Documents

[AD-03]	ECSS standards documentation	http://www.ecss.nl
[AD-04]	Director General's Office "Space Debris Mitigation for Agency Projects", Paris	
[AD-05]	ISO 24113 "Space Debris Mitigation" standard in development	
[AD-06]	SSA General Definitions of Terms and Acronyms	SSA-DC-QA-GLO-0001, Issue 1.1, 05/03/2012
[AD-07]	ECSS-Q-ST-80C Space product assurance – Software product assurance: Tailoring for Ground Segment Systems	QMS-EIMO-GUID-CKL-9501-OPS, Issue 1.2 (September 2011)
[AD-08]	ECSS-E-ST-40C Space engineering – Software: Tailoring for Ground Segment Systems.	QMS-EIMO-GUID-CKL-9500-OPS Issue 1.0, July 2009
[AD-09]	Space Weather System Requirements Document for the ESA Space Safety Programme Annex A – Product Specification	ESA-S2P-SWE-SP-0001
[AD-10]	Space Weather Customer Requirements for the ESA Space Safety Programme	ESA-S2P-SWE-CRD-0001, Issue 1.1, 28/02/2023
[AD-SEC-01]	Information technology -- Security techniques -- Evaluation criteria for IT security	ISO/IEC 15408
[AD-SEC-02]	ESA Security Regulations	https://esastar-publication-ext.sso.esa.int/
[AD-SEC-03]	Information Technology – Security Techniques – Information Security Management Systems Requirements	ISO/IEC 27001
[AD-SEC-04]	CCSDS Recommended Practice for Security Algorithms	CCSDS 353.0-B-1
[AD-SEC-05]	Programme Security Instructions for the ESA Space Situational Awareness Programme	ESA-LEX-S-9/02, Issue 1.0, 10/10/2011

1.4.2. Reference Documents

[RD-01]	ECSS-E-ST-70C European Cooperation for Space Standardisation "Space Engineering - Ground Segment and Operation"	31 July 2008
[RD-50]	ESA SSA Application Security Framework	Issue 1.0, rev 1, 19/07/2011
[RD-51]	Space Weather Cost Benefit Analysis ESA 2016	https://esamultimedia.esa.int/docs/business_with_esa/Space_Weather_Cost_Benefit_Analysis_ESA_2016.pdf
[RD-52]	ESA Space Weather Service Network	https://swe.ssa.esa.int

2. GENERAL DESCRIPTION

2.1. The Space Safety Programme

The goal of the Space Safety Programme is to contribute to the protection of our planet, humanity and assets in space and on Earth from threats originating in Space and to contribute to Europe providing safety from such threats as a service to society. This goal encompasses the development and provision of timely and reliable space weather information and services to end users whose activities and infrastructures may be influenced by space weather phenomena.

ESA's Space Safety activities support effective space weather risk management through:

- ensuring availability of data through either dedicated or shared assets, and the capability to extract information from this data through end-to-end modelling and forecasting
- supporting the exploitation of the information gained and its distribution to users as well as technological advancements for protection and/or prevention

Consequently, the requirements elaborated in later sections of this document target the following capabilities:

- the provision of comprehensive knowledge, understanding and maintained awareness of the natural space environment and dynamic space weather conditions.
- the detection and forecasting of space weather conditions and resulting impacts and effects.
- the prediction and/or detection of permanent or temporary disruption of mission and/or service capabilities due to space weather conditions.
- the monitoring of the Sun, the solar wind, the radiation belts, the magnetosphere and ionosphere to the extent that it supports services related to effects that include radiation and spacecraft charging hazards, spacecraft drag, navigation, positioning and communication disruption, aircraft radiation hazards, solar radio interference with

aviation radars, geomagnetic disturbances and current induced in large conductive networks such as power lines and pipelines.

2.2. SWE System overview

This section gives a general overview of the SWE system in terms of its services, the products and main functions.

2.2.1. SWE System Context

The purpose of the Space Weather System is to provide for its customers and end users a source of space weather data and processed information based on relevant ground based and space based sensors and appropriate data processing elements. Space weather effects are commonly associated with or caused by particular space weather events, such as solar flares, solar energetic particle (SEP) events, coronal mass ejections (CMEs), high-speed solar wind streams, corotating interaction regions (CIR), radiation belt enhancements, ionospheric disturbances and scintillation, and geomagnetic storms and substorms. Effects addressed include for example space radiation and spacecraft charging hazards, spacecraft drag, ionospheric perturbations on transionospheric radio links, aircraft radiation hazards, geomagnetic disturbances and currents induced in large conductive networks such as power lines and pipelines. The SWE System also provides its customers an access to archives of space weather data and all products generated by the system including latest data.
Figure 1 shows a high level overview of the Space Weather System.

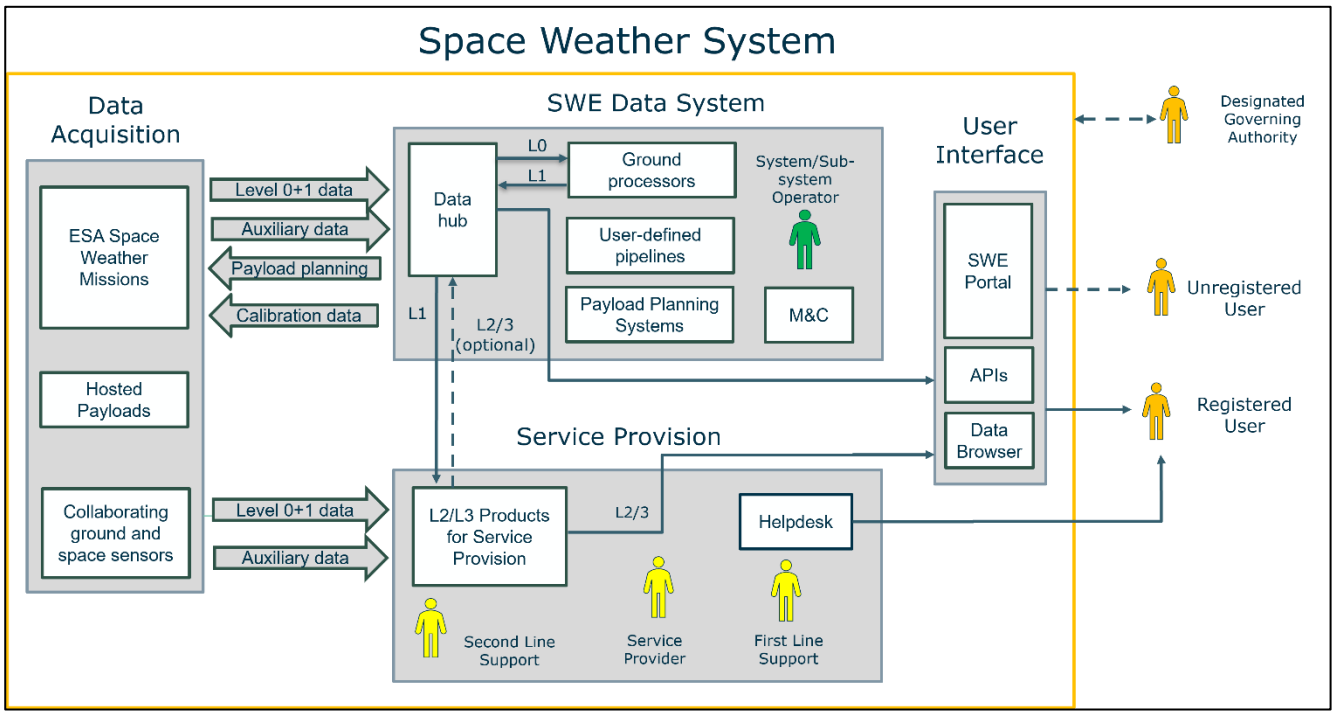

Figure 1:High Level Overview Architecture Space Weather System

In the context of the Space Weather System, as shown in Figure 1 four main segments with following scope were identified:

1. Data Acquisition Segment
   In the data acquisition segment the raw observation data is produced by diverse space and ground based sensors, from which the Level-0 data products are generated. Here particular are meant the data from:
   - ESA operated SWE missions,
   - industry operated SWE missions and sensors,
   - the hosted payloads on other satellite missions,
   - collaborating ground and space sensors.

   As relevant for the Space Weather System design are mainly considered the exchange and transfer of Level-0 and auxiliary data as well as of the payload planning and calibration data.
2. SWE Data System, implemented by Space Weather Office and including the Payload Data Centre:
   - Payload Data Centre (PDC) contains at least the following modules:
     - Data hub
     - Instrument ground processors
     - User-defined pipelines
     - Payload planning facilities
     - Monitoring and Control systems

   The PDC handles principally Level-1 data products, either producing them internally or ingesting from external sources.
3. Service Provision segment, currently implemented to pre-operational level by the

federated service network is described in section 2.2.1.2. The Level-2/Level-3 products for the service provision are generated by the federated service network. Additionally also the helpdesk for the first line and second line space weather expert support is provided by the federated service network.

4. User Interface Segment
   The user interface segment consists of the SWE portal, and a data browser as well as APIs.

Related to the design and operation of the Space Weather System and its segments following relevant roles were identified:

- Designated Governing Authority
- Users based on definition in the Space Weather Customer Requirements for the ESA Space Safety Programme Document [AD-10]:
  - Unregistered user
  - Registered user (SWE end-user interested in at least one of the 12 service domains, including downstream service providers)
- Service Provision:
  - Service Provider
  - First line support at Helpdesk providing general support
  - Second line support providing service specific and expert support
- SWE Data System:
  - System/Subsystem Operator

2.2.1.1. International Context

Due to the nature of Space Weather events, global coverage from ground based and space borne observation systems is essential for providing operational services. International collaboration is a well established tradition in the area of space weather research, providing access to geographically distributed measurements. International service coordination is currently implemented within the framework of the International Space Environment Service (ISES) with both COSPAR and WMO also increasingly taking a role in international coordination efforts across the domain.

The development of the SWE System shall take into account existing collaborations and partnerships and aim to establish new agreements where necessary.

2.2.1.2. Federated Service Network

Europe has historically a wealth of expertise and assets providing high-quality scientific observations, results and models in the domain of space weather, together with a growing

number of space-weather products - processed, usable data - which are being used by customers across Europe in industry, government and research institutes. ESA's Space Weather Service Network builds upon this foundation to implement a federated European Space Weather service provision concept, avoiding duplication and ensuring that these existing assets and resources are best organised to play a key role in Europe's new coordinated Space Weather Service provision system. The network currently provides pre-operational service provision incorporating important elements of an R2O2R framework while at the same time demonstrating service maturity in preparation for operational service delivery. Future evolution of this model is expected as service provision continues to mature and operational services are gradually deployed within the European landscape.

The Space Weather Service Network aims to provide timely and reliable space weather information to end users. Individual products, reports, toolkits and user support are grouped into targeted services according to the needs of user communities from spacecraft operators through to power system operators. The online component of the SWE Services can be accessed via the SWE Portal. These online services are complemented by the SWE Helpdesk which is available to respond to queries and requests for support from registered users.

The Space Weather Service Network targets developing both service end user-tailored interfaces and key models, as well as other building blocks that will contribute to improving the accuracy of the information that can be provided to end-users. With time, the service provision system will be further developed and steps taken to transition the Network towards an operational framework, providing information to impacted users whenever it is most needed.

Five distributed Expert Service Centres (ESCs) have been established across Europe. These centres build on existing expertise and link a network of Expert Groups: institutes and organisations with specific expertise and capabilities in space weather. The ESCs are organised according to space weather domain, ensuring full coverage of space weather phenomena and impacts from solar eruptions through to impacts on ground-based infrastructure.

The ESCs provide the products, toolkits and reporting which are federated as part of the SWE Network. They also provide second line expert support for end users, ensuring that users registering for the SWE Services are able to access a very broad range of space weather expertise and support via the SWE Helpdesk.

2.2.2. Research-to-operations-to-Research (R2O2R) concept

This document describes the requirements and architecture for two distinct systems: the fully operational Space Weather System, and the Research-to-Operations-to-Research (R2O2R) Space Weather System.

There is a large overlap of requirements between the two, however some aspects are only required for the R2O2R system, whereas others only apply for the fully operational system. The following Venn diagram illustrates this.

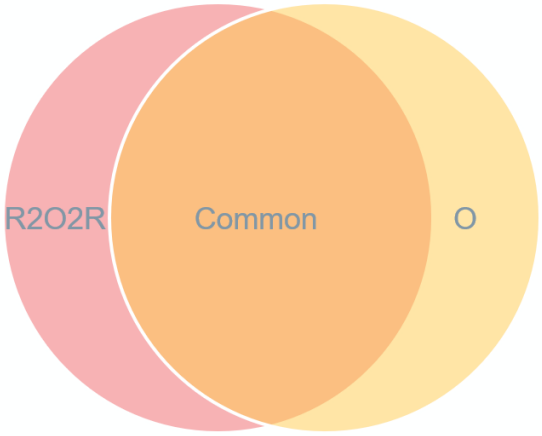

Figure 2 Requirements Overlap

The R2O2R system's purpose is to foster collaboration between researchers, developers, forecasters, system operators and end users in order to facilitate the overall R2O2R process and ensure smooth and efficient transition of new capabilities into improved service capabilities. It shall be representative of the operational system and shall support the validation and demonstration of advanced product concepts and technology capabilities targeting improved services.

Both systems shall run independently, possibly operated by different organisations. Both systems shall follow the environments concept described in section 2.2.2 as well as defined in section 3.2.5.2, including development, testing, staging, production environments.

2.2.3. Environment structure

It is envisaged that both the operational Space Weather System and the R2O2R system each have the same environment structure.

Following terminology regarding the name and definition of environments shall be considered:

- development environment
- testing environment
- staging environment
- production environment

This structure is commonly used in the IT industry. The individual environments are defined below.

Production environment

The production environment is the environment used to provide the services. It can be considered as equivalent to the typical operational environments used in ESA space missions. The production environment has access to live data from the acquisition segment.

Staging environment

The staging environment is the environment supposed to be used for:

- operational validation of new elements, which can be hardware or software parts as wells as new service capabilities;
- development, testing and validation of operational procedures
- training, qualification and operational simulation activities of personnel as well as end-users.

The staging environment should, as much as possible, mirror the production environment.

The staging environment can be typically used either with having continuous or periodically access to live data from the acquisition segment as well as importing simulated, synthetical or historical data.

Depending on the operational and trainings concept it may be that several environments from the type staging environment are going to be used.

It is expected that prior to the operational validation of new elements the acceptance tests on the testing environment are completed.

The operational validation may happen as a campaign running for a certain time period on the staging environment in the new configuration and validating the results against the data from the production environment.

Testing environment

The testing environment shall be used for testing and AIV activities. New elements usually need to be qualified and pass the acceptance test on the testing environment before deploying them on a staging environment.

The testing environment can be optionally used either with having continuous or periodically access to live instrument data from the acquisition segment as well as with synthetical data or historical data.

Development environment

The development environment is supposed to be used for:

- development of improved capability and upgrades of the system,
- maintenance activities of the system,
- investigation and analysis of operational problems,
- replay of system processes from the other environments of the system.

In the case of federated service provision each federated service provider also needs their own local development environment.

The data acquisition segment of the Space Weather System includes also the different sensors and instruments on ground as well as in space. This means in reality, these instruments and sensors are only available in the production environment. In a certain scope and justified purposes the staging environment may have access directly to the live data from the data acquisition segment. The development environment does not necessarily need direct access to live data and may utilize historical, archived or simulated data. Figure 3 shows a simplified overview on the four environment types.

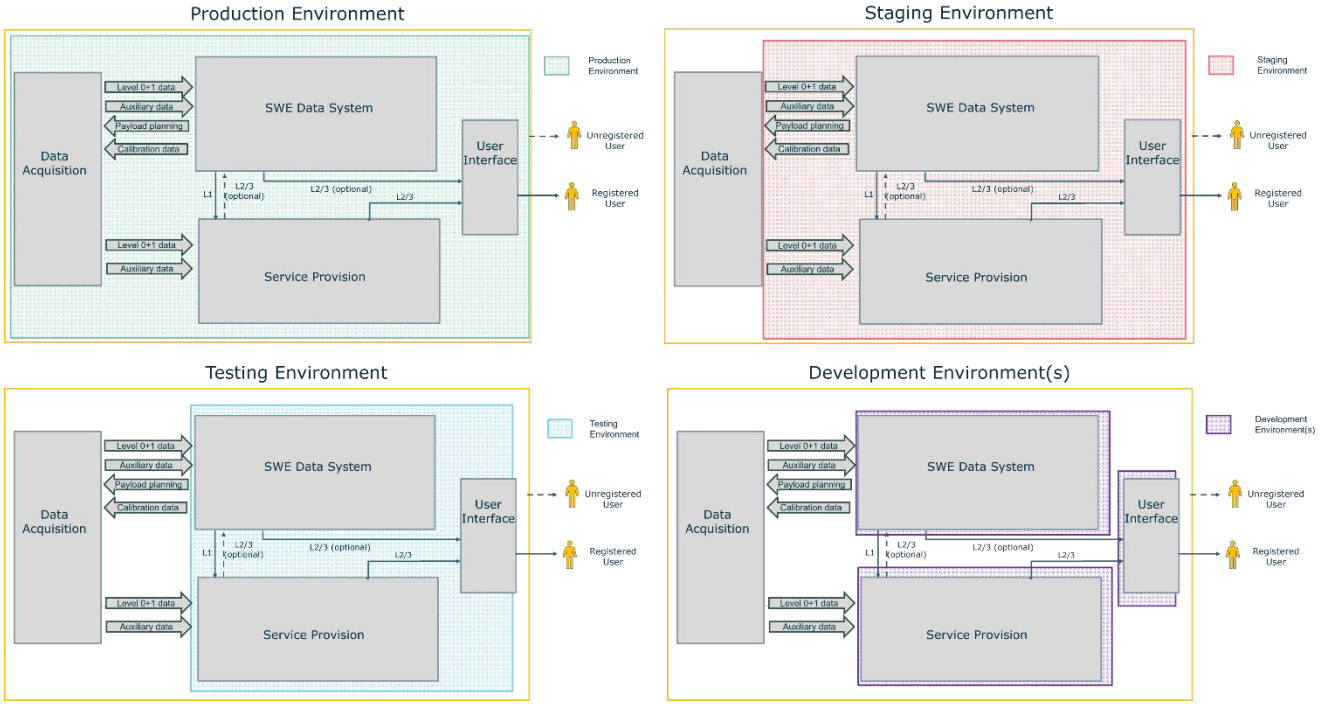

Figure 3: Overview Environment Structure

The typical workflow of the deployment and transition of a new element is schematically shown in Figure 4.

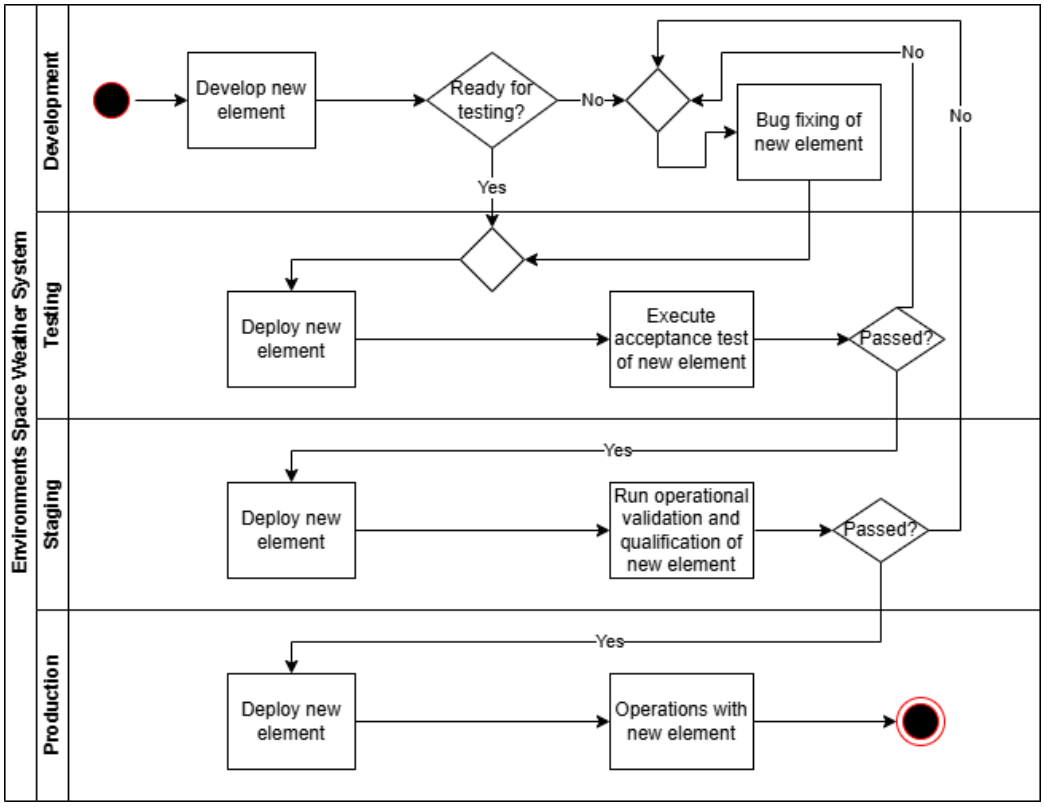

Figure 4: Workflow deployment new element

2.2.4. SWE Sensors

2.2.4.1. Observation Requirements

A comprehensive space weather observation network will include ground based and spaceborne observatories. In particular, ground based ionospheric sensors, tailored GNSS receivers, and magnetometers are key elements to be considered to support the provision of information on the ionospheric and the geomagnetic environments. Space based measurements of the ionosphere and of the geomagnetic field will enhance the measurement coverage to a planetary scale. Detailed information on local aerospace vehicle environments can only be obtained from spaceborne observations especially of ionising radiation and magnetospheric plasma. The exception for this is the atmospheric drag, which can be deduced from ground based satellite tracking systems or from the data from onboard orbit determination instruments.

The forecast of all these environments is enabled by monitoring precursor phenomenon that take place on the Sun and propagate in the interplanetary medium before reaching Earth. This should be based on the detection of eruptive and pre-eruptive structures on the solar disk, as derived from measurements made at visible light, (E)UV and X-ray wavelengths, and of the plasma density along with speed and magnetic field in the solar wind which flows out from the solar surface, eventually impacting the Earth's geomagnetic field. Monitoring of energetic particles in the solar wind is also very important. Solar wind measurements and solar observations in the X-ray and (E)UV wavelength ranges can only be performed from space. Solar observations at radio wavelengths (e.g. F10.7) may also be made from the ground.

2.2.4.2. Space Segment Sensors

The three main system requirements drivers for spaceborne sensors are:

- Physical quantities to measure,
- Continuity of observation (with only gaps that are compatible with service requirements),
- Near real-time data access for nowcasting and forecasting.

2.2.4.2.1. Solar Activity Monitoring

For solar disk imagers and coronagraphs the crucial design drivers are the continuity of the observation and pointing to the Sun. These imagers also produce large amount of data requiring high data download rates. From the pointing and continuity point of view the vicinity of the L1 point is a key location for these types of sensors. However, the requirement for near real-time data implies that as minimum three ground stations equally distributed in longitude or a data relay via a geostationary or a geo-transfer spacecraft will be required. A Sun-synchronous orbit would also be an option for solar imaging instruments, but this option requires a trade-off between the number of ground stations and the number of spacecraft to ensure near real-time data download and continuous observations. Results from the STEREO mission have shown that heliospheric imaging from a vantage point away from the Sun-Earth line offers significant benefits in solar monitoring and space weather forecasting. STEREO has also demonstrated the capability for stereographic heliospheric imaging from two spacecraft located outside of the Sun-Earth line with a wide angle visibility over the space between the Sun and the Earth. Furthermore, observations made continuously from the L5 vantage point bring the additional advantage of being able to observe activity evolving on the solar disk before it rotates into a geoeffective position.

Spaceborne sensors will have to be used for observations of the solar radio wave spectra below ionospheric cut-off frequency.

2.2.4.2.2. Solar Wind Monitoring

For measurements of the solar wind plasma and the interplanetary magnetic field a spacecraft orbiting around the first Lagrangian point, L1, provides an essential vantage point because it is a unique location for a spacecraft remaining at a stable, intermediate distance between the Sun and the Earth. Required data rates and masses of instruments are low but near real- time data download would require at least 3 ground stations or data relay via a geostationary or geo-transfer spacecraft. Additional options for a spacecraft location closer to the sun would provide potential benefits as the warning time before geomagnetic impacts would increase. The station keeping for a spacecraft between the L1 point and the Sun is naturally a major

challenge and the complexity of the mission against the potential benefits would have to be carefully assessed before implementing a mission like this is considered. In-situ measurements made from the L5 vantage point provide the possibility to detect co-rotating solar wind features several days before they interact with the Earth.

2.2.4.2.3. Space Radiation Environment Monitoring

Sensors will measure both trapped radiation and solar energetic particles. Sensors will have to cross the radiation belts to measure the trapped radiation. A geo-transfer orbit (GTO) provides a comprehensive sampling of the trapped radiation environment. In contrast, SEP monitoring should be done either at GEO or from a location outside the magnetosphere. Combination of sensor locations can provide feasible observation scenarios especially when hosted payload opportunities are utilised. Naturally all in-situ observations of space radiation environment need to include spacecraft orbit information at the times of the data sampling. This applies also to cases where radiation data is collected by sensors that are part of the spacecraft bus and the data is considered as part of the spacecraft telemetry.

2.2.4.2.4. Geomagnetic Environment Monitoring

Spaceborne sensors are required for in-situ observations of the local magnetic field. Global coverage is required at altitude ranges from LEO to GEO. Spaceborne sensors are also needed for the observations of the low frequency magnetospheric radio wave spectra. They are also required for particle precipitation measurement (fluxes and average energies) and the plasma environment.

Spaceborne Auroral observations require sensors for auroral visible and UV imaging and auroral kilometric radiation

2.2.4.2.5. Upper Atmosphere Monitoring

Planetary coverage of ionospheric monitoring can be achieved by polar orbiting satellites. The number of sensors needed depends on the continuity and sampling requirements. Timeliness requirements are the driver for the number of ground based stations and/or relay satellites

needed in the system. Space based radio occultation measurements can provide global measurements of the ionospheric electron density profiles.

Spaceborne thermospheric neutral wind and density observations are the only way to achieve global measurement coverage as ground based FPI observations only allow local sampling.

2.2.4.3. Ground Based Sensors

The main system requirements drivers for the SWE System ground based sensors are the same as for the spaceborne sensors. The main limitation for ground based observations is the filtering of the atmosphere for the solar EM and particle radiation. Global coverage in ground based observations typically requires either establishing sensors outside the ESA Member States or international collaboration with sensor owners outside Europe.

2.2.4.3.1. Solar Activity Monitoring

The basic ground based observations for solar activity include solar radio observations, white light imaging, H-alpha imaging and measurements of the solar surface magnetic field with line-of-sight and vector magnetograph techniques. The solar radio emissions are observed with broad frequency radio spectrographs and radio imaging of the sun.

2.2.4.3.2. Solar Wind Monitoring

Solar wind observations from the ground are very limited. Potential instruments for estimation of the solar wind characteristics include scatter radars, radio telescopes and muon and neutron monitors

2.2.4.3.3. Geomagnetic Environment Monitoring

Observations of geomagnetic field disturbances are required globally using data from networks of ground based magnetometers. Ground based geomagnetic monitoring also includes Auroral imaging by all sky cameras.

2.2.4.3.4. Upper Atmosphere Monitoring

Ground based observation of the upper atmosphere includes ionospheric monitoring by e.g. GNSS receivers, ionospheric scintillation receivers, ionosondes, riometers and scattering radars. Observations of the neutral wind are performed by ground based Fabry-Perot interferometers (FPIs).

2.2.5. SWE Services

The SWE System described in this document is intended to provide for its customers and end users a reliable source of space weather observed data and processed information based on relevant ground based and space based sensors and appropriate data processing elements. Space weather effects explicitly addressed include radiation and spacecraft charging hazards, spacecraft drag, ionospheric perturbations, aircraft radiation hazards, geomagnetic disturbances and current induced in large conductive networks such as power lines and pipelines [AD2]. Capabilities will be established with the aim to build on and further develop European expertise and assets in the domain while also developing international partnerships and data exchange agreements where necessary to ensure the necessary global coverage.

Service Number	Service Shortname	Service Name
1-1	SCD/ARV	Environment Specification: Data Archive
1-2	SCD/PST	Post Event Analysis
1-3	SCD/PLA	Space Weather in the Solar System
2-1	SCO/ORB	In Orbit Environment and Effects Monitoring
2-2	SCO/PST	Post Event Analysis
2-3	SCO/FOR	In-orbit Environment and Effects Forecast
2-4	SCO/ANA	Mission Risk Analysis
2-5	SCO/PLA	Space Weather in the Solar System
3-1	SCH/ORB	In-flight Crew Radiation Exposure
3-2	SCH/PST	Cumulative Crew Radiation Exposure
3-3	SCH/FOR	Increased Crew Radiation Exposure Risk
4-1	LAU/ORB	Radiation Environment Monitoring
4-2	LAU/PST	Estimate of Radiation Effects in Sensitive Electronics
4-3	LAU/FOR	Forecast of Radiation Storms
4-4	LAU/IOS	Risk Estimate of Service Disruption Caused by Ionospheric Scintillations
5-1	TIO/TCR	Near-Real Time TEC Maps
5-2	TIO/TCF	Forecast TEC Maps
5-3	TIO/QUA	Quality Assessment of Ionospheric Correction
5-4	TIO/SCI	Near-Real Time Ionospheric Scintillation Maps
5-5	TIO/FOR	Monitoring and Forecast of Ionospheric Disturbances
6-1	STC/ATM	Atmospheric Estimates for Drag Calculation
6-2	STC/ARV	Archive of Geomagnetic and Solar Indices for Drag Calculation
6-3	STC/FOR	Nowcast and Forecast of Geomagnetic and Solar Indices for Drag Calculation
6-4	STC/ION	Nowcast of Ionospheric Group Delay
7-1	SRV/POW	Service to Power System Operation
8-1	SRV /PPL	Service to Pipeline Operation
9-1	SRV /AVI	Service to Aviation
10-1	SRV /RES	Service to Resource Exploitation and Exploitation
11-1	SRV /AUR	Service to Aurora Observation and Forecast
12-1	GEN/ARV	Space Weather Data Archive
12-2	GEN/LST	Latest Data Service
12-3	GEN/FOR	Space Weather Nowcast and Forecast Products
12-4	GEN/ALM	Event Based Alarms
12-5	GEN/MOD	Virtual Space Weather Modelling Service
12-6	GEN/SPM	Space Weather Support Material

Table 1: List of SWE Services

2.2.6. SWE Service Products

The specification and description of the products provided to the SWE services is given in the SWE Products Specification Document [AD-09]. The observation data as captured by the SWE system's assorted sensors are processed to various data levels - e.g. Level-0, Level-1A, Level-2 – according to the necessary processing steps, to provide the service products that are offered to the SWE services' end users.

2.2.6.1. Definitions

Observation Data

Observation data is the primary data collected by a scientific instrument or sensor during the execution of its measurement activities. It represents the direct output of the observation process, corresponding to the physical quantity or phenomenon being measured, recorded in a raw or processed form. This data forms the core scientific content of the dataset and is the principal basis for subsequent analysis, interpretation, and product generation. Observation data is typically accompanied by metadata and ancillary data, which provide the contextual and supporting information necessary for its correct understanding and use.

Meta data

Metadata is the set of data that describes other data. Its specification is associated with the information that is needed by the different functionalities and applications of the system which handles and utilises the data, for the benefit of the system's users. The metadata provides the supporting information needed for the system's applications to perform the assorted anticipated tasks.

Ancillary data

Data generated in support of the observation data, both by the instrument and the platform, such as, navigation, temperature, housekeeping telemetry, timing data and configuration. There exists both instrument and platform ancillary data for which a distinction can be made if necessary. Ancillary data may be produced by a process that is independent from the observation, for example by Precise Orbit Determination.

2.2.6.2. Space Weather Data Levels and Key Characteristics

Raw data

- Data generated by an instrument or platform and transmitted to the Mission Operations Centre (MOC) for further processing to Level-0.
- No data processing of any kind has been applied to the Raw data since it has been transmitted from the spacecraft or platform.
- The data may consist of observation data, and/or ancillary data.
- CCSDS format is typical for space-based observations.
- Depending on the instrument, raw data may have undergone processing and/or compression prior to transmission.

Level-0 Data

- Data has been processed from a binary format into data numbers by decoding the Raw data.
- Timestamps from the relevant instrument have been appended for the purposes of ordering data chronologically and annotation with relevant meta data has been completed.
- Relevant ancillary packets, consisting of calibration coefficients, georeferencing parameters, etc., as well as meta data have been appended to the science data, but calibrations are not applied.

Note: Utilisation of this data will require the users to apply their own calibration and quality checking procedures, and any other data correction procedures that are normally part of Level 1-3 processing.

Level-1A

- Single instrument data in instrument units,
- Image data may be rectified (e.g. solar north is approximately up).

Level-1B

- All calibration parameters and data correction steps are applied to single instrument data in instrument units.

Level-2 Data

- Single instrument data transformed into physical units (or equivalent) at the same resolution and location as Level-1B source data.

Note: Transformations applied to the data may be irreversible so that transformation back to lower data levels will not be possible.

Level-3 Data

- Single instrument data in physical units mapped on uniform space and time grid, as applicable.

Level-4 Data

- Added value products that may be composite of multi-sensor and/or multi-satellite data, or results of model analysis.

General note

Some instruments may carry out processing to Level-2, Level-3 or Level-4 onboard the spacecraft or ground-based observation system. In those cases, the the lower level data products may not be present.

2.2.7. SWE Service Tools

Some of the services provided by the SWE System are based on tools that are made available for the users. These tools allow the users themselves to perform analysis of the potential space weather impact on their infrastructure, post event analysis of a space weather impact and other types of functions. The tools provided by the SWE System are rigorously verified and validated. The SWE System also ensures the availability of the databases needed for the tools. SWE System also provides the first level support for the correct use of the tools and provides the necessary information for the users to be able to find further levels of support, if necessary.

3. SPACE WEATHER SYSTEM REQUIREMENTS

The requirements are structured as follows:

- 3.1 – Services
- 3.2 – Overall System Requirements
- 3.3 – Data Acquisition Segment
- 3.4 – SWE Data System
- 3.5 – Space Weather Model Access via the Service Provision Segment
- 3.6 – User Interface Segment

The last four sections reflect the main system segments identified and as described in section 2.2.1 and shown in Figure 1. Section 3.2 to section 3.6 have sub sections for at least following categories:

- Functional Requirements
- Performance Requirements
- Interface Requirements
- Design and Implementation Requirements
- Availability and Reliability Requirements
- Security and Data Policy Requirements
- Operational Requirements

3.1. Services

3.1.1. General Service Functions

SWE-SRD-10913			
Each Service shall provide the data products, reports, tools and user manuals requested by the user by means of web-services and mechanisms for file transfer.			
Justification:			
Comments:	The tools may be available for download. Alternatively these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20007			
Each Service shall have a visible online access point via web portal. This shall be accessible via all commonly used operating systems including those designed for use on mobile devices.			
Justification:	In order to ensure that the services provided by the Space Weather system can actually be accessed by the intended user community.		
Comments:			
Source Requirements:	SYS-CRD-SYS-3211		
Related Requirements:		**Verification Method:**	

SWE-SRD-10966			
Each Service shall provide the alert to the user by means of web-services, email and sms.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10880			
Each Service shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with additional metadata as necessary.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20008			
Services and products shall be presented as numerical data along with a visual representation, wherever appropriate			
Justification:	Service output formats shall be defined in order to best support the user in reducing the time needed to take critical decisions.		
Comments:			
Source Requirements:	SYS-CRD-PRE-3200		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12884			
The system shall allow to define by configuration, for each service, whether it is to be provided either: • "broadcast"; • "on request"; • "by subscription".			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.1.1. Space Weather System Analysis Reports

SWE-SRD-11851			
The system shall support the automatic generation of analysis reports for a given event and/or period of interest			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11852			
The system shall support the manual generation of analysis reports for a given event and/or period of interest			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11853			
The system shall support the manual editing of analysis reports for a given event and/or period of interest.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11854			
The user shall be able to select the format of the SWE analysis report.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11855			
The user shall be able to select the content of an analysis report from the service elements available (graphical and numerical outputs shall be supported).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11856			
Analysis reports shall identify the models, input parameters, tools and data used to generate the content (with the exception of cases where an existing agreement to maintain data confidential is in place).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.1.2. User management

SWE-SRD-11857			
Known limitations arising from data and/or model availability shall be identified and listed.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11858			
Uncertainties in model and data output shall be listed where available.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10857			
All the services of the Space Weather System shall be provided to registered users only.			
Justification:	Registration is required in order to provide user tailoring of service content and related announcements of events/training, user online working areas and to maintain overall statistics of service access/usage.		
Comments:			
Source Requirements:	SYS-CRD-DAT-3242		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11448			
The Space Weather System shall make available to non-registered users general space weather information including an overview on current and forecast conditions based on sample service outputs, in compliance to the overall data policy.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-DAT-3243		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20009			
Users' proprietary data shall be treated as commercial in confidence.			
Justification:	Some service functionalities may require the user to upload their own data in order to achieve the best results. In these cases, these data shall be accessible to the data owner only and not shared with other users.		
Comments:	Some elements of the system will require creation of dedicated user project/working areas in order to store results.		
Source Requirements:	SYS-CRD-DAT-3240		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10858			
An on-subscription service shall offer the possibility to a non-registered user to subscribe to the service in agreement with the Governance and Data Policy.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10867			
An on-subscription service shall offer the possibility to a registered user to un-subscribe to the service.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10866			
The services of the Space Weather System shall be either on-request or broadcasted.			
Justification:			
Comments:	The broadcast means shall include e-mail, web page or RSS feed.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10865			
In case of on-request service, the services of the Space Weather System shall give the possibility to the user to receive tailored service output based on their request.			
Justification:			
Comments:	Examples of tailoring would include setting thresholds on key parameters and the ability to select the frequency at which information is received from a service.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10864			
In case of on-request service, the services of the Space Weather System shall provide to the user with feedback on the feasibility of the request (i.e. availability of the requested data) before the delivery of the service output.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10863			
In case of on-request services, the services shall recall the input parameters of the request in the provided output.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10862			
The Space Weather System shall inform its users of the limitations of service that may occur due to planned unavailability periods.			
Justification:			
Comments:	For example, scheduled maintenance periods.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11847			
The Space Weather System shall inform users of foreseen downtime of the system 30 days in advance.			
Justification:			
Comments:	For example, scheduled maintenance periods.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10861			
The Space Weather System shall inform its users of any limitations of the service that may occur due to unexpected unavailability with a minimum delay and within a maximum of 1hour from the start of the unavailability.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:	SWE-SRD-9564	**Verification Method:**	Design Review

SWE-SRD-10860			
The Space Weather System shall inform its users when it is functioning normally following an unavailability period with a minimum delay and within a maximum of 1hour from the end of the unavailability.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10859			
The Space Weather System shall inform its users of the limitations on the provided data due to Governance and Data Policy restrictions.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11450			
The Space Weather System shall define a set of general alarms per service domain.			
Justification:			
Comments:	As applied to data and nowcast products: e.g. in case of data value is crossing a threshold due to environment change.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.1.1.3. Provide User Support

SWE-SRD-10868			
All services shall provide an on-line help to the users in order to help them provide appropriate inputs and also to explain the format and contents of the service outputs.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3198		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10870			
A service delivering tools to the user shall also deliver the tools user manuals.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3198		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10869			
A service delivering tools to the user shall also provide an on-line help to the user to help use the tools properly.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3198		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11449			
In case of on-request service, the services of the Space Weather System shall give the user the possibility to enter proprietary information with the appropriate security measures.			
Justification:			
Comments:	The user may be encouraged to submit proprietary information about their system in order to support the generation of tailored service output.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.1.1.4. Public awareness and education

SWE-SRD-10871			
The information generated for public awareness and education shall be handled by a dedicated service, "General data and modelling service – space weather training and support material" (number 12-6), that shall provide access to web based content and educational material including tutorials, covering aspects of space weather geared towards users and customers, and include information on the types of products available and associated caveats.			
Justification:			
Comments:	This service shall be web-based and linked from other tailored SWE services as applicable.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10872			
General information generated to support public awareness and education shall be accessible without registration.			
Justification:			
Comments:	Note that Elements of service 12-6 may be accessible on a registration basis e.g. interactive tutorials.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.1.5. Service quality control

SWE-SRD-10874			
For the data sources that provide calculated values (whether indices, derived parameters, extrapolations of basic parameters or any result from a calculation process), the Space Weather System shall provide accurate description of the model and parameters used for their generation as well as which exact information is provided by each parameter and its domain of applicability.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-QUA-3224		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10875			
The Space Weather System shall make its estimation of the accuracy and confidence of the provided services and make it available to the users.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10876			
Uncertainties in the presented data shall be quantified in the form of quality metrics.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-SYS-3216		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10888			
Uncertainties in the model outputs shall be quantified in the form of quality metrics.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-SYS-3217		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10887			
The Space Weather System shall warn the user when the accuracy and confidence of the delivered service products are degraded.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20010			
The Space Weather System shall record all accesses to space weather information being either internal or external to the Space Weather system.			
Justification:	This is a precaution to be able to respond to legal issues.		
Comments:	Data shall be stored for a limited time of 6 months (*) only.		
Source Requirements:	SYS-CRD-QUA-3221		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20011			
The overall performance of the Space Weather System shall be measured at regular intervals against a set of agreed KPIs. KPIs shall address the services ability to reach end users, increasing customer engagement, service user satisfaction, service quality, service maturity and operationality.			
Justification:	Required in order to monitor service and system performance		
Comments:	KPIs shall be reviewed at least annually.		
Source Requirements:	SYS-CRD-QUA-3222		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20012			
Datasets shall include information on their origin (including the information to the user about the nature of the source e.g. “operational system”, “science-quality source", ...) and their terms of usage.			
Justification:	Needed for assessment of accuracy of the services and to ensure correct usage.		
Comments:	Supported by the use of consistent metadata		
Source Requirements:	SYS-CRD-QUA-3223		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20013			
All Space Weather System elements shall be supported by consistent metadata.			
Justification:	Consistent metadata supports searchability and interoperability within the service system.		
Comments:			
Source Requirements:	SYS-CRD-SYS-3218		
Related Requirements:		**Verification Method:**	Design Review

3.1.2. Domain 1 services - Spacecraft design

3.1.2.1. Service 1-1: Spacecraft design - Environment specification: data archive

SWE-SRD-12551			
The Space Weather System shall provide a Service 1-1: Spacecraft design - Environment specification: data archive.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10878			
Service 1-1 shall provide statistical data to derive environments and effects on space systems, including: • Statistical information (median and other percentiles) for a spacecraft in any orbit as a function of time (in past and future) and location for the following space environment: ionising radiation, plasma, radio flux (F10.7 to be provided as a proxy), neutral particles and UV, • Statistical information (median and other percentiles) for spacecraft in any orbits as a function of time (in past and future) and location for the following space environment effects: dose, single event effects, sensor background, cumulated charging, spacecraft anomalies			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1508		
Related Requirements:		**Verification Method:**	Design Review

3.1.2.1.1. Handle service requests

SWE-SRD-10882			
The following set of user criteria shall be requested by service 1-1 prior to the generation of the outputs of the service: • Orbit or range of orbits for the considered spacecraft • time span of the analyses • parameters to be retrieved from database/predicted.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10886			
Service 1-1 shall allow its users to specify freely the orbits and time spans for their historical data retrieval and/or reconstruction requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-2635		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10885			
Service 1-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific user request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10884			
Service 1-1 shall inform its users of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually declared by collaborating spacecraft owners in the Space Weather System spacecraft database or the applicable models.			
Justification:			
Comments:	Data will come from sensors in-orbit and modelling to fill gaps.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10883			
Service 1-1 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.2.1.2. Deliver products/tools/reports

SWE-SRD-10879			

Service 1-1 shall request the user to identify which measured or forecast parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database, compute the statistics and percentiles, and provide them to the user:
• Radiation and plasma data:
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-001-F, L1-003-P, L1-003-F, MR-006-P, MR-006-F, MR-008-P, MR-008-F]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-002-F, L1-004-P, L1-004-F, MR-007-P, MR-007-F, MR-009-P, MR-009-F]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-006-F, L1-007-P, L1-007-F, MR-011-P, MR-011-F]
  ○ High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, L1-005-F, MR-010-P, MR-010-F,]
  ○ Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P, MR-012-F]
  ○ Thermal ions density and temperature. [product codes MR-014-P, MR-014-F]
  ○ Plasma drift velocity [product code MR-016-M]
• Neutral particles:
  ○ Atmospheric density [product codes AG-007-P, AG-007-F]
  ○ Atomic oxygen density [product codes IT-010-P, IT-010-F]
• UV and soft X-ray, with spectral information [product codes SU-029-P, SU-029-F, SU-027-P]
• Sun Spot Number [product codes SU-007-P, SU-007-F],
• Solar Flux EUV [product codes SU-028-P, SU-028-F],
• F10.7 [product codes SU-008-P, SU-008-F],
• expected flare activity level [product codes SU-001-P, SU-001-F],
• mean and standard deviation of interplanetary magnetic field strength [product codes L1-008-P, L1-008-F],
• median and sextiles of solar wind pressure [to be processed from product codes L1-009-P, L1-009-F, L1-010-P, L1-010-F, L1-011-P, L1-011-F].			

Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1512 SWE-CRD-SCD-1513 SWE-CRD-SCD-1514 SWE-CRD-SCD-1515 SWE-CRD-SCD-1516 SWE-CRD-SCD-1517 SWE-CRD-SCD-1518 SWE-CRD-SCD-1519 SWE-CRD-SCD-1523 SWE-CRD-SCD-3166 SWE-CRD-SCD-3167		

Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10877			
Service 1-1 shall request the user to identify which measured or derived parameters within the list of products below (addressing spacecraft effects) the user wants to be delivered, request them from the Space Weather System database, compute the statistics and percentiles, and provide them to the user: • statistical dose (ionising and non-ionising dose), along with associated assumptions including reference material considered [derived from product code SC-005-P] • single event effects and associated probability of occurrence [from product code SC-001-P] • sensor background [product code SC-002-P], • deep dielectric charging [product code SC-006-P], • surface charging [product code SC-007-P], • floating spacecraft potential [product code SC-008-P], • spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P]			
Justification:			
Comments:	This may be archived data or statistics generated based on effect models.		
Source Requirements:	SWE-CRD-SCD-1520 SWE-CRD-SCD-1521 SWE-CRD-SCD-1522 SWE-CRD-SCD-1526		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12301			
Service 1-1 shall provide the capability for the user to generate specific reports related to the analysis performed.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12299			
Service 1-1 shall deliver tools to the user enabling them to perform an analysis as a function of orbit and spacecraft type.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.2.2. Service 1-2: Spacecraft design - Post event analysis

SWE-SRD-12552			
The Space Weather System shall provide a Service 1-2: Spacecraft design - Post event analysis.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10889			
Service 1-2 shall provide means to correlate a particular (spacecraft) event with measured or estimated space environment and effects data, including: • a best estimate of the local environment that has been experienced by a spacecraft either through measurements or reconstruction (ionising radiation, plasma, neutral particles, UV and local magnetic field variations) for in-flight validation of specifications of environments and effects • data and tools to analyse the space environment at a given time and/or location, allowing the user to correlate it with effects and anomaly events on specific spacecraft, equipment or components.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1509 SWE-CRD-SCD-1510		
Related Requirements:		**Verification Method:**	Design Review

3.1.2.2.1. Handle service requests

SWE-SRD-10898			
The following set of user criteria shall be requested by service 1-2 prior to the generation of the outputs of the service: • Orbit or range of orbits for the considered spacecraft • time span of the analyses • parameters to be retrieved from database/reconstructed • type of analysis envisaged by the user			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10899			
Service 1-2 shall inform its users of the limitations of accuracy and reliability that may result in the service due to the need to strongly extrapolate from measurements, in particular in regions where measurements are highly variable in space and time: the resulting uncertainties shall be in any case provided to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.2.2.2. Deliver products/tools/reports

SWE-SRD-10905			

Service 1-2 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows:
• Osculating Element Data Set (OEDS) for the considered Orbit
• Time span of the required measurement/product data retrieval or a-posteriori analysis
• Publication date
• Position of spacecraft as a function of time within the specified time span:
  ○ formally defined in inertial coordinates
  ○ but then assessed in terms of magnetospheric coordinate systems (in particular McIlwain L parameter and magnetic field for radiation belt assessment, geomagnetic for near Earth plasma effects and geocentric-solar-magnetospheric coordinates for the outer magnetosphere),
• Flag indicating if information from third parties is included.			

Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10906			

Service 1-2 shall request the user to identify which measured or reconstructed parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Radiation and plasma data:
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-001-M, L1-003-P, L1-003-M, MR-006-P, MR-006-M, MR-008-P, MR-008-MF]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-002-M, L1-004-P, L1-004-M, MR-007-P, MR-007-M, MR-009-P, MR-009-M]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-006-M, L1-007-P, L1-007-M, MR-011-P, MR-011-M]			

○ High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, L1-005-M, MR-010-P, MR-010-M,] ○ Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P, MR-012-M] ○ Energetic particles at L5 [product codes IP-007-P, IP-008-P, IP-009-P, IP-007-M, IP-008-M, IP-009-M] ○ Thermal ions density and temperature [product codes MR-014-P, MR-014-M] ○ Plasma drift velocity [product code MR-016-M] • Neutral particles: ○ Atmospheric density [product codes AG-007-P, AG-007-M] ○ Atomic oxygen density [product codes IT-010-P, IT-010-M] • UV and soft X-ray flux [product codes SU-029-P, SU-029-M, SU-027-P] • Solar Flux EUV [product codes SU-028-P, SU-028-M]			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1512 SWE-CRD-SCD-1513 SWE-CRD-SCD-1514 SWE-CRD-SCD-1515 SWE-CRD-SCD-1516 SWE-CRD-SCD-1517 SWE-CRD-SCD-1518 SWE-CRD-SCD-1519 SWE-CRD-SCD-1523 SWE-CRD-SCD-3166 SWE-CRD-SCD-3167		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12300			
Service 1-2 shall deliver tools to the user that allows them to perform an analysis as a function of the orbit and spacecraft type, and the type of analysis envisaged by the user.			
Justification:			
Comments:	The tools may be available for download. Alternatively these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12302			
Service 1-2 shall provide the capability for the user to generate specific reports related to the analysis performed.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10919			
Service 1-2 shall inform the user that the environmental data that are needed as input to the tools shall be obtained by the user from Service 1-1, as a preliminary step to the use of the tools provided by this service.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10912			
Service 1-2 shall inform its users of the limitations of accuracy and reliability that may result from a specific request when using a provided tool.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10920			
Service 1-2 shall include links to Service 1-1, so as to guide the user towards the related environment data generators, if they require so.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1520 SWE-CRD-SCD-1521 SWE-CRD-SCD-1522 SWE-CRD-SCD-1526		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10924			
Service 1-2 shall provide the capability for the user to generate specific reports related to the analysis performed.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

Service 1-2 is not required to deliver user's specific reports.

3.1.2.3. Service 1-3: Spacecraft design - Space weather in the Solar System

SWE-SRD-12553			
The Space Weather System shall provide a Service 1-3: Spacecraft design - Space weather in the Solar System.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10893			
Service 1-3 shall provide information supporting the specification and design of spacecraft that will operate within the heliospheric domain, including: • statistical information (median and other percentiles) for a spacecraft in any orbit as a function of time (in past and future) and location for the following space environment: ionising radiation, plasma, neutral particles, and UV • statistical information (median and other percentiles) for spacecraft in any orbit as a function of time (in past and future) and location for the following space environment effects: dose, single event effects, sensor background, cumulated charge, spacecraft anomalies • best estimate of the local environment that has been experienced by a spacecraft either through measurements or reconstruction (ionising radiation, plasma, neutral particles, and UV) for in-flight validation of specifications of environments and effects			
Justification:			
Comments:	For space environment effects, the user shall be informed of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used.		
Source Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1508 SWE-CRD-SCD-1509		
Related Requirements:		**Verification Method:**	Design Review

3.1.2.3.1. Handle service requests

SWE-SRD-10918			
The following set of user criteria shall be requested by service 1-3 prior to the generation of the outputs of the service: • Orbit or range of orbits for the considered spacecraft • time span of the analyses • parameters to be retrieved from database/predicted/reconstructed			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20014			
Service 1-3 shall allow its users to specify freely the orbits and time spans for their historical data retrieval and/or reconstruction requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-2635		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20015			
Service 1-3 shall inform its users of the limitations of accuracy and reliability that may result from a specific user request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20016			
Service 1-3 shall inform its users of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually declared by collaborating spacecraft owners in the Space Weather System's spacecraft database or the applicable models.			
Justification:			
Comments:	Data will come from sensors in-orbit and modelling to fill gaps.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20017			
Service 1-3 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20018			
Service 1-3 shall inform its users of the limitations of accuracy and reliability that may result in the service due to the need to strongly extrapolate from measurements, in particular in regions where measurements are highly variable in space and time: the resulting uncertainties shall be in any case provided to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.2.3.2. Deliver products/tools/reports

SWE-SRD-20019			

Service 1-3 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows:
• Osculating Element Data Set (OEDS) for the considered Orbit
• Time span of the required measurement/product data retrieval or a-posteriori analysis
• Publication date
• Position of spacecraft as a function of time within the specified time span:
  ○ formally defined in inertial coordinates
  ○ but then assessed in terms of local coordinate systems as appropriate for the particular orbit,
• Flag indicating if information from third parties is included.			

Justification:			
Comments:	Local coordinate systems would be the orbital equivalents of e.g. the McIlwain L parameter and magnetic field for radiation belt assessment, geomagnetic for near Earth plasma effects and geocentric-solar-magnetospheric coordinates for the outer magnetosphere		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20020			

Service 1-3 shall request the user to identify which measured or forecast parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database, compute the statistics and percentiles, and provide them to the user:
• Radiation and plasma data:
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-001-F, L1-003-P, L1-003-F, MR-006-P, MR-006-F, MR-008-P, MR-008-F]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-002-F, L1-004-P, L1-004-F, MR-007-P, MR-007-F, MR-009-P, MR-009-F]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-006-F, L1-007-P, L1-007-F, MR-011-P, MR-011-F]
  ○ High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, L1-005-F, MR-010-P, MR-010-F,]
  ○ Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P, MR-012-F]
  ○ Thermal ions density and temperature. [product codes MR-014-P, MR-014-F]
  ○ Plasma drift velocity [product code MR-016-M]
• Neutral particles:
  ○ Atmospheric density [product codes AG-007-P, AG-007-F]
  ○ Atomic oxygen density [product codes IT-010-P, IT-010-F]
• UV and soft X-ray, with spectral information [product codes SU-029-P, SU-029-F, SU-027-P]
• Sun Spot Number [product codes SU-007-P, SU-007-F],
• Solar Flux EUV [product codes SU-028-P, SU-028-F],
• F10.7 [product codes SU-008-P, SU-008-F],
• expected flare activity level [product codes SU-001-P, SU-001-F],
• mean and standard deviation of interplanetary magnetic field strength [product codes L1-008-P, L1-008-F],
• median and sextiles of solar wind pressure [to be processed from product codes L1-009-P, L1-009-F, L1-010-P, L1-010F, L1-011-P, L1-011F].
• Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P],
• Energetic particles at L5 [product codes IP-007-P, IP-007-F, IP-008-P, IP-008-F, IP-009-P, IP-009-F].			

Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCD-1512 SWE-CRD-SCD-1513 SWE-CRD-SCD-1514 SWE-CRD-SCD-1515 SWE-CRD-SCD-1516 SWE-CRD-SCD-1517 SWE-CRD-SCD-1518 SWE-CRD-SCD-1519 SWE-CRD-SCD-1523 SWE-CRD-SCD-3166 SWE-CRD-SCD-3167		

Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20021			
Service 1-3 shall request the user to identify which measured or derived parameters within the list of products below (addressing spacecraft effects) the user wants to be delivered, request them from the Space Weather System database, compute the statistics and percentiles, and provide them to the user: • statistical dose (ionising and non-ionising dose), along with associated assumptions including reference material considered [derived from product code SC-005-P] • single event effects and associated probability of occurrence [from product code SC-001-P] • sensor background [product code SC-002-P], • deep dielectric charging [product code SC-006-P], • surface charging [product code SC-007-P], • floating spacecraft potential [product code SC-008-P], • spacecraft anomalies, for the spacecraft in the Space Weather system database [product code SC-001-P].			
Justification:			
Comments:	This may be archived data or statistics generated based on effect models.		
Source Requirements:	SWE-CRD-SCD-1520 SWE-CRD-SCD-1521 SWE-CRD-SCD-1522 SWE-CRD-SCD-1526		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20022			
Service 1-3 shall provide the capability for the user to generate specific reports related to the analysis performed.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20023			
Service 1-3 shall deliver tools to the user enabling them to perform an analysis as a function of orbit and spacecraft type.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20024			
Service 1-3 shall inform its users of the limitations of accuracy and reliability that may result in the service due to the need to strongly extrapolate from measurements, in particular in regions where measurements are highly variable in space and time: the resulting uncertainties shall be in any case provided to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.2.4. Performance Requirements

No additional requirements are identified at this stage.

3.1.3. Domain 2 Services – Spacecraft operation

3.1.3.1. Service 2-1: Spacecraft operation - In-orbit environment and effects monitoring

SWE-SRD-12554			
The Space Weather System shall provide a Service 2-1: Spacecraft operation - In-orbit environment and effects monitoring.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10901	
Service 2-1 shall perform a near real-time estimate of the environment and of its effects by providing: • near real-time quantitative assessment of the space environment, • near real-time monitoring of space weather events (including as minimum: magnetic storm, substorms, high-speed streams, solar energetic particle events, Earth-directed CMEs) that can lead to potentially hazardous effects on spacecraft with a minimum level of latency and with a qualitative accuracy at least sufficient to asses which type of event is happening during those events, and with improved accuracy at most 10 minutes after acquisition from sensors according to the performance requirements • nowcasts of effects on the user spacecraft as a function of time and location, in the case the user has agreed to provide the inputs allowing the modelling of the spacecraft, including: single event effects, radiation dose in spacecraft sensitive components and charge build-up. • reports of S/C anomalies detected across a predefined S/C fleet to a subset of authorised users • near real-time assessment of the effects of ionospheric disturbances on spacecraft operations • nowcast of the atmospheric data required for drag calculation, • nowcast of solar and geomagnetic activity indices.	
Justification:	For this domain, the space environment data is required in real time so as to relate to sudden effects that could occur on the spacecraft, SEE, ESD, errors in magneto-torquing and sudden drag-induced orbit changes in LEO. Continuous real-time monitoring of space weather environment conditions provides the relevant information to take informed decisions related to S/C operations and help the correlation of results in future analysis.
Comments:	
Source Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCO-1531 SWE-CRD-SCO-1535 SWE-CRD-SCO-1536 SWE-CRD-SCO-1539 SWE-CRD-SCO-1540

	SWE-CRD-SCO-1546 SWE-CRD-SCO-3093 SWE-CRD-SCO-3011		
Related Requirements:		**Verification Method:**	Design Review

3.1.3.1.1. Handle service requests

SWE-SRD-10902			
The following set of user criteria shall be requested by service 2-1 prior to the generation of the outputs of the service: • orbit • time span • parameters to be requested as measurements / nowcast • spacecraft ID (for effects prediction only) • spacecraft/component characteristics (for effects prediction only)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10903			
Service 2-1 shall allow its users to specify freely the orbits for their nowcast / near real time requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10904			
Service 2-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10890			
Service 2-1 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10891			
Service 2-1 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:	Access to anomaly data may be limited to a subset of users.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.1.2. Deliver products/tools/reports

SWE-SRD-10926			

Service 2-1 shall request the user to identify which measured and nowcasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Measurements of solar flares [product code SU-001-N], CMEs [product code SU-002-N], coronal holes [product code SU-004-N], and solar magnetic fields [product codes SU-005-M, SU-005-N],
• Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-M],
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-N],
  ○ A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M],
  ○ Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P],
• Geomagnetic storm condition [product code MR-001-N],
• Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons):
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-M, L1-003-M, MR-006-M, MR-008-M, L1-001-N, L1-003-N, MR-006-N, MR-008-N]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-M, L1-004-M, MR-007-M, MR-009-M, L1-002-N, L1-004-N, MR-007-N, MR-009-N]			

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High energy (>30keV) electron energy spectrum [product codes L1-006-M, L1-007-M, MR-011-M, L1-006-N, L1-007-N, MR-011-N]
High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-M, MR-010-M, L1-005-N, MR-010-N]
Energetic particles at L5 [product codes IP-007-M, IP-007-N, IP-008-M, IP-008-M, IP-009-M, IP-009-N]
Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-M, MR-012-N]
Plasma drift velocity [product code MR-016-M]
Thermal ions density and temperature [product codes MR-014-M, MR-014-N]

Neutral particles:

Atmospheric density [product codes AG-007-M, AG-007-N]
Atomic oxygen density [product codes IT-010-M, IT-010-N]]

UV and soft X-ray flux [product codes SU-029-M, SU-029-N, SU-027-M, SU-027-N]
Solar Flux EUV [product codes SU-028-M, SU-028-N],
Ground based geomagnetic field [product codes AG-005-M, AG-005-N]
Cosmic rays energy and ion-species flux spectra [product codes L1-002-M, L1-002-N, MR-007-M, MR-007-N]
Ionosphere:

Altitude dependent TEC (Total Electron Content) maps [product codes IT-001-M, IT-001-N]
3D Electron density grids [product codes IT-002-M, IT-002-N]
Ionosonde measurements [product codes IT-005-M, IT-005-N]
Ionospheric scintillation, location and intensity [product codes IT-009-M, IT-009-N]

Indices: geomagnetic (Kp, Ap, AE, Dst) [product codes MR-002-N, MR-003-N, MR-004-N], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-N, SU-008-M, SU-008-N, SU-009-N, SU-010-N, SU-011-N, SU-012-N], and other indices (IG12, IMF) [product codes SU-013-N, L1-008-M, L1-008-N],
Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-M, IT-007-N, IT-008-M, IT-008-N]
Solar Wind velocity, density and magnetic field [product codes L1-008-M, L1-008-N, L1-009-M, L1-009-N, L1-010-M, L1-010-N],
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-M, IP-003-N, IP-004-M, IP-004-N, IP-006-M, IP-006-N],
Net electrical current to spacecraft surface [product codes SC-006-M, SC-006-N, SC-007-M, SC-007-N, SC-008-M, SC-008-N]

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<tr><td>Comments:</td><td></td></tr>
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SWE-CRD-SCO-1549
SWE-CRD-SCO-1550
SWE-CRD-SCO-2637
SWE-CRD-SCO-1551
SWE-CRD-SCO-2650
SWE-CRD-SCO-1553
SWE-CRD-SCO-1554</td></tr>
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	SWE-CRD-SCO-1555 SWE-CRD-SCO-1556 SWE-CRD-SCO-1557 SWE-CRD-SCO-1558 SWE-CRD-SCO-1559 SWE-CRD-SCO-1560 SWE-CRD-SCO-1561 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1564 SWE-CRD-SCO-1565 SWE-CRD-SCO-1566 SWE-CRD-SCO-1568 SWE-CRD-SCO-1569 SWE-CRD-SCO-1570 SWE-CRD-SCO-1571 SWE-CRD-SCO-1572 SWE-CRD-SCO-3260		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11782			
Service 2-1 shall deliver tools to the user that allows them to perform an analysis as a function of the orbit and the spacecraft type.			
Justification:			
Comments:	The tools may be available for download. Alternatively, these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10932			
Service 2-1 shall, upon request from a user, provide nowcasts of effects on the user spacecraft as a function of time and location.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10933			
Service 2-1 shall deliver those nowcasts in the form of an analysis report that shall be based on correlated models and shall include the associated assumptions including the reference materials and geometry considered.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10934			
Service 2-1 shall provide the spacecraft effects nowcast report to the user by means of web-services and mechanisms for file transfer.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.2. Service 2-2: Spacecraft operation - Post event analysis

SWE-SRD-12555			
The Space Weather System shall provide a Service 2-2: Spacecraft operation - Post event analysis.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10895			
Service 2-2 shall correlate a particular spacecraft event with space environment data by providing: • the capability to correlate pre-selected subsets of user relevant spacecraft housekeeping data with space environment parameters, in the case the user has agreed to provide those data • reports of S/C anomalies detected across a predefined S/C fleet to an authorised subset of users • data for Post Event Analysis by allowing the user to retrieve (or display) Space Weather environmental data and compare them with the spacecraft conditions (e.g. effects) and housekeeping data at any past time and spacecraft location and annotate further data/information • access to historical Space Weather Environment data, Spacecraft Effects, and Space Weather Events data • data and tools to correlate the space environment with anomaly events on specific spacecraft, equipment or components.			

Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1534 SWE-CRD-SCO-1536 SWE-CRD-SCO-1537 SWE-CRD-SCO-1538 SWE-CRD-SCO-1542		
Related Requirements:		**Verification Method:**	Design Review

3.1.3.2.1. Handle service requests

SWE-SRD-10938			
The following set of user criteria shall be requested by Service 2-2 prior to the generation of the outputs of the service: • orbit • time span • parameters to be retrieved from database / reconstructed • spacecraft ID (for effects prediction only) • spacecraft/component characteristics (for effects prediction only)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10939			
Service 2-2 shall allow its users to specify freely the orbits for their data/product retrieval / a posteriori reconstruction requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10940			
Service 2-2 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10941			
Service 2-2 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10936			
Service 2-2 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.2.2. Deliver products/tools/reports

SWE-SRD-10943			

Service 2-2 shall request the user to identify which measurements and a posteriori reconstruction parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Measurements of solar flares [product code SU-001-P], CMEs [product code SU-002-P], coronal holes [product code SU-004-P], and solar magnetic fields [product code SU-005-P],
  ○ Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-P],
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-P],
  ○ A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-P],
• Geomagnetic storm condition [product code MR-001-P],
• Ionising radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons):
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-003-P, MR-006-P, MR-008-P]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-004-P, MR-007-P, MR-009-P]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-007-P, MR-011-P]			

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High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, MR-010-P]
Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P]
Energetic particles at L5 [product codes IP-007-P, IP-008-P, IP-009-P],
Plasma drift velocity [product code MR-016-P]

Thermal ions density and temperature [product codes MR-014-P]
Neutral particles:

Atmospheric density [product code AG-007-P]
Atomic oxygen density [product code IT-010-P]]

UV and soft X-ray flux [product codes SU-029-P, SU-027-P]
Solar Flux EUV [product code SU-028-P],
Ground based geomagnetic field [product code AG-005-P]
Cosmic rays energy and ion-species flux spectra [product code L1-002-P, MR-007-P]
Ionosphere:B173

Altitude dependent TEC (Total Electron Content) maps [product code IT-001-P]
Ionosonde measurements [product code IT-005-P]
Ionospheric scintillation, location and intensity [product code IT-009-P]

Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P], and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P],
Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-P, IT-008-P]
Solar Wind velocity, density and magnetic field [product codes L1-008-P, L1-009-P, L1-010-P],
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P],
Net electrical current to spacecraft surface [product codes SC-006-P, SC-007-P, SC-008-P].
</td></tr>
<tr><td>Justification:</td><td></td></tr>
<tr><td>Comments:</td><td></td></tr>
<tr><td>Source Requirements:</td><td>SWE-CRD-SCO-1548
SWE-CRD-SCO-1549
SWE-CRD-SCO-1550
SWE-CRD-SCO-2637
SWE-CRD-SCO-1551
SWE-CRD-SCO-2650
SWE-CRD-SCO-1553
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SWE-CRD-SCO-1560
SWE-CRD-SCO-1561
SWE-CRD-SCO-1562</td></tr>
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	SWE-CRD-SCO-1563 SWE-CRD-SCO-1564 SWE-CRD-SCO-1565 SWE-CRD-SCO-1566 SWE-CRD-SCO-1568 SWE-CRD-SCO-1569 SWE-CRD-SCO-1570 SWE-CRD-SCO-1571 SWE-CRD-SCO-1572 SWE-CRD-SCO-3260		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10944			
Service 2-2 shall request the user to identify which parameters within the list of products below (addressing spacecraft effects) the user wants to be delivered, request them from the Space Weather System database, and provide them to the user: • statistical dose (equivalent dose, dose equivalent, ambient dose, non-ionising dose), along with associated assumptions including reference material considered [derived from product code SC-005-P] • single event effects and associated probability of occurrence [from product code SC-001-P] • sensor background [product code SC-002-P], • deep dielectric charging [product code SC-006-P], • surface charging [product code SC-007-P], • spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1549 SWE-CRD-SCO-1557 SWE-CRD-SCO-1567 SWE-CRD-SCO-1568		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10937			
Service 2-2 shall deliver tools to the user that allow them to correlate the space environment with anomaly events on specific spacecraft, equipment or components, as a function of the orbit, the spacecraft type and the type of analysis envisaged by the user.			
Justification:			
Comments:	The tools may be available for download. Alternatively these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10950			
Service 2-2 shall provide the user with the capability to correlate pre-selected subsets of user relevant spacecraft housekeeping data with space environment parameters, in the case the user has agreed to provide those data.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10951			
Service 2-2 shall provide data for Post Event Analysis by allowing the user to retrieve (or display) Space Weather environmental data and compare them with the S/C conditions (e.g. effects) and data at any past time and S/C location.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10952			
Service 2-2 shall deliver those a posteriori reconstructions in the form of an analysis report that shall be based on correlated models and shall include the associated assumptions including the reference materials and geometry considered.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.3. Service 2-3: Spacecraft operation - In-orbit environment and effects forecast

SWE-SRD-12556			
The Space Weather System shall provide a Service 2-3: Spacecraft operation - In-orbit environment and effects forecast.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10892			
Service 2-3 shall provide a forecast of the environment and of its effects by providing: • forecasts over a user-defined period with estimates of probability of occurrence of space weather events (including as a minimum: magnetic storm, solar energetic particle events, Earth-directed CMEs) and of "All quiet conditions", with users being given the confidence level of the forecast • forecasts of effects for the user spacecraft in any orbit as a function of time and location for the following space environment effects: single event effects, expected radiation dose in spacecraft sensitive components, charge build-up • forecasts of the effects of ionospheric disturbances on spacecraft operations • forecasts of atmospheric parameters required for drag calculation • -forecast of solar and geomagnetic activity indices, as per list of indices defined below.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1532 SWE-CRD-SCO-1533 SWE-CRD-SCO-3088 SWE-CRD-SCO-3089 SWE-CRD-SCO-3091 SWE-CRD-SCO-3092		
Related Requirements:		**Verification Method:**	Design Review

3.1.3.3.1. Data Policy Enforcement

SWE-SRD-10954			
Service 2-3 shall be a service for registered users only, delivering its outputs on request for the forecast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.3.2. Handle service requests

SWE-SRD-10956			
The following set of user criteria shall be requested by service 2-2 prior to the generation of the outputs of the service: • orbit • time span • parameters to be forecasted • spacecraft ID (for effects prediction only) • spacecraft/component characteristics (for effects prediction only)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10957			
Service 2-3 shall allow its users to specify freely the orbits for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10955			
Service 2-3 shall inform its users of the limitations of accuracy and reliability that may result from a request outside the validated domain of the forecast models.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10962			
Service 2-3 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10964			
Service 2-3 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.3.3. Deliver products/tools/reports

SWE-SRD-10958			

Service 2-3 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows:
• Osculating Element Data Set (OEDS) for the considered Orbit
• Time span of the required forecast
• Publication date
• Position of spacecraft as a function of time within the specified time span:
  ○ formally defined in inertial coordinates
  ○ but then assessed in terms of magnetospheric coordinate systems (in particular McIlwain L parameter and magnetic field for radiation belt assessment, geomagnetic for near Earth plasma effects and geocentric-solar-magnetospheric coordinates for the outer magnetosphere),
• Flag indicating if information from third parties is included
• Spacecraft ID and characteristics (for effects prediction only).			

Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10959			

Service 2-3 shall request the user to identify which forecasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Measurements of solar flares [product code SU-001-F], CMEs [product code SU-002-F], coronal holes [product code SU-004-F], and solar magnetic fields [product code SU-005-F],
• Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-F],			

- Geomagnetic storm condition [product code MR-001-F], - Ionising radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons): - High energy >1 MeV protons energy spectrum [product codes L1-001-F, L1-003-F, MR-006-F, MR-008-F] - High energy (>1 MeV) ions energy spectrum [product codes L1-002-F, L1-004-F, MR-007-F, MR-009-F] - High energy (>30keV) electron energy spectrum [product codes L1-006-F, L1-007-F, MR-011-F] - High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-F, MR-010-F] - Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-F] - Energetic particles at L5 [product codes IP-007-F, IP-008-F, IP-009-F], - Thermal ions density and temperature [product codes MR-014-F] - Neutral particles: - Atmospheric density [product code AG-007-F] - Atomic oxygen density [product code IT-010-F]] - UV and soft X-ray flux [product codes SU-029-F, SU-027-F] - Solar Flux EUV [product code SU-028-F], - Ground based geomagnetic field [product code AG-005-F] - Cosmic rays energy and ion-species flux spectra [product code L1-002-F, MR-007-F] - Ionosphere: - Altitude dependent TEC (Total Electron Content) maps [product code IT-001-F] - Ionosonde measurements [product code IT-005-F] - Ionospheric scintillation, location and intensity [product code IT-009-F] - Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-F, MR-003-F, MR-004-F], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-F, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], and other indices (IG12, IMF) [product codes SU-013-F, L1-008-F], - Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-F, IT-008-F] - Solar Wind velocity, density and magnetic field [product codes L1-008-F, L1-009-F, L1-010-F], - Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-F, IP-04-F, IP-006-F], - Net electrical current to spacecraft surface [product codes SC-006-F, SC-007-F, SC-008-F].	
Justification:	
Comments:	
Source Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1549 SWE-CRD-SCO-1550 SWE-CRD-SCO-2637 SWE-CRD-SCO-1551 SWE-CRD-SCO-2650 SWE-CRD-SCO-1553

	SWE-CRD-SCO-1554 SWE-CRD-SCO-1555 SWE-CRD-SCO-1556 SWE-CRD-SCO-1557 SWE-CRD-SCO-1558 SWE-CRD-SCO-1559 SWE-CRD-SCO-1560 SWE-CRD-SCO-1561 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1564 SWE-CRD-SCO-1565 SWE-CRD-SCO-1566 SWE-CRD-SCO-1568 SWE-CRD-SCO-1569 SWE-CRD-SCO-1570 SWE-CRD-SCO-1571 SWE-CRD-SCO-1572 SWE-CRD-SCO-3260		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10963			
Service 2-3 shall provide the user with event-based alarms, All-Quiet and End-Of-Quiet alerts. Alerts will be provided with a refreshing period of one minute			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10965			
Service 2-3 shall allow the user to set thresholds on parameters for real-time notification of conditions.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 2-3 is not required to deliver tools.

3.1.3.4. Service 2-4: Spacecraft operation - Mission risk analysis

SWE-SRD-12557			
The Space Weather System shall provide a Service 2-4: Spacecraft operation - Mission risk analysis.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10968			
Service 2-4 shall provide a risk analysis based on expected space environment conditions and an assessment of the mission susceptibility, by providing: • access to historical Space Weather Environment data, Spacecraft Effects, and Space Weather Events data and appropriate statistical models • upon request, an assessment of mission/system susceptibility before operations phase for a given spacecraft, defined as per section 1.3.1 • upon request, an assessment of mission/system risks before operations phase for a given spacecraft • a long-term solar cycle prediction of 1-2 cycles (with a quantification of the forecast uncertainties) including at least Sunspot Number, Solar EUV Flux, F10.7, expected flare activity level, mean and standard deviation of interplanetary magnetic field strength, median and upper/lower sextiles of solar wind pressure.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCO-1544 SWE-CRD-SCO-1545 SWE-CRD-SCO-3146		
Related Requirements:		**Verification Method:**	Design Review

3.1.3.4.1. Handle service requests

SWE-SRD-10974			
The following set of user criteria shall be requested by service 2-4 prior to the generation of the outputs of the service: • orbit • time span • parameters to be retrieved from database /reconstructed • spacecraft ID (for effects prediction only) • spacecraft/component characteristics (for effects prediction only)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10975			
Service 2-4 shall allow its users to specify freely the orbits for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10976			
Service 2-4 shall inform its users of the limitations of accuracy and reliability that may result from a request outside the validated domain of the reconstruction models.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10972			
Service 2-4 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10973			
Service 2-4 shall inform its users of the limitations on anomalies database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.4.2. Deliver products/tools/reports

SWE-SRD-10978			

Service 2-4 shall request the user to identify which measurements and a posteriori reconstruction parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Measurements of solar flares [product code SU-001-P], CMEs [product code SU-002-P], coronal holes [product code SU-004-P], and solar magnetic fields [product code SU-005-P],
• Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-P],
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-P],
  ○ A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-P],
• Geomagnetic storm condition [product code MR-001-P],
• Ionising radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons):
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-003-P, MR-006-P, MR-008-P]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-004-P, MR-007-P, MR-009-P]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-007-P, MR-011-P]
  ○ High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, MR-010-P]
  ○ Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P]
  ○ Energetic particles at L5 [product codes IP-007-P, IP-008-P, IP-009-P],
  ○ Plasma drift velocity [product code MR-016-M]
• Thermal ions density and temperature [product codes MR-014-P]
• Neutral particles:
  ○ Atmospheric density [product code AG-007-P]
  ○ Atomic oxygen density [product code IT-010-P]]
• UV and soft X-ray flux [product codes SU-029-P, SU-027-P]			

• Solar Flux EUV [product code SU-028-P],
• Ground based geomagnetic field [product code AG-005-P]
• Cosmic rays energy and ion-species flux spectra [product code L1-002-P, MR-007-P]
• Ionosphere:
  ○ Altitude dependent TEC (Total Electron Content) maps [product code IT-001-P]
  ○ Ionosonde measurements [product code IT-005-P]
  ○ Ionospheric scintillation, location and intensity [product code IT-009-P]
• Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P], and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P],
• Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-P, IT-008-P]
• Solar Wind velocity, density and magnetic field [product codes L1-008-P, L1-009-P, L1-010-P],
• Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P],
• Net electrical current to spacecraft surface [product codes SC-006-P, SC-007-P, SC-008-P].	

Justification:	
Comments:	
Source Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1549 SWE-CRD-SCO-1550 SWE-CRD-SCO-2637 SWE-CRD-SCO-1551 SWE-CRD-SCO-2650 SWE-CRD-SCO-1553 SWE-CRD-SCO-1554 SWE-CRD-SCO-1555 SWE-CRD-SCO-1556 SWE-CRD-SCO-1557 SWE-CRD-SCO-1558 SWE-CRD-SCO-1559 SWE-CRD-SCO-1560 SWE-CRD-SCO-1561 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1564 SWE-CRD-SCO-1565 SWE-CRD-SCO-1566 SWE-CRD-SCO-1568 SWE-CRD-SCO-1569 SWE-CRD-SCO-1570 SWE-CRD-SCO-1571 SWE-CRD-SCO-1572 SWE-CRD-SCO-3260

Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10979			
Service 2-4 shall request the user to identify which effects parameters within the list of products below (addressing spacecraft effects) the user wants to be delivered, request them from the Space Weather System database, and provide them to the user: • statistical dose (equivalent dose, dose equivalent, ambient dose, non-ionising dose), along with associated assumptions including reference material considered [derived from product code SC-005-P] • single event effects and associated probability of occurrence [from product code SC-001-P] • sensor background [product code SC-002-P], • deep dielectric charging [product code SC-006-P], • surface charging [product code SC-007-P], • spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1549 SWE-CRD-SCO-1557 SWE-CRD-SCO-1567 SWE-CRD-SCO-1568		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12520			
Service 2-4 shall ask the user to specify which statistical models are to be applied.			
Justification:	The user should be able to select between different models when available. Repeat analysis using alternate models should be possible.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10986			
Service 2-4 shall provide the user with a report on mission/system susceptibility before operations phase for a given spacecraft: the report shall be based on correlated models and shall include the associated assumptions including the reference materials and geometry considered.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10987			
Service 2-4 shall provide the user with a report on mission/system risks before operations phase for a given spacecraft: the report shall be based on correlated models and shall include the associated assumptions including the reference materials and geometry considered.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10984			
Service 2-4 shall provide the reports to the user by means of web-services and mechanisms for file transfer.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.5. Service 2-5: Spacecraft operation – Space weather in the Solar System

SWE-SRD-20026			
The SWE system shall provide a Service 2-5: Spacecraft operations - Space weather in the Solar System.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20025			
Service 2-5 shall provide forecasts, nowcasts and alerts related to space weather in the heliosphere supporting mission operators who require information, at locations away from the Earth, in order to make informed decisions on the planning and execution of spacecraft operations, including: • near real-time quantitative assessment of the space environment • near real-time monitoring of space weather events (including as a minimum: magnetic storm, substorms, high-speed streams, solar energetic particle events, Earth-directed CMEs) that can lead to potentially hazardous effects on spacecraft, with a minimum level of latency • forecasts over a use-defined period with estimates of probability of occurrence of space weather events (including as a minimum: geomagnetic storm, solar energetic particle events, Earth-directed CMEs) and of "All-quiet conditions", with users being given the confidence level of the forecast • nowcasts of atmospheric density for drag calculation on Mars, Venus and other relevant planets • forecast of atmospheric properties for drag calculation on Mars, Venus and other relevant planets.			
Justification:			
Comments:	The service should also be capable of considering the lunar environment.		
Source Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCO-1531 SWE-CRD-SCO-1532 SWE-CRD-SCO-1541 SWE-CRD-SCO-3090		
Related Requirements:		**Verification Method:**	Design Review

3.1.3.5.1. Handle service requests

SWE-SRD-20027			
The following set of user criteria shall be requested by service 2-5 prior to the generation of the outputs of the service: • orbit • time span • parameters to be requested as measurements / nowcast /to be forecasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20028			
Service 2-5 shall allow its users to specify freely the orbits for their nowcast / near real time requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20029			
Service 2-5 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20030			
Service 2-5 shall allow its users to specify freely the orbits for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2636		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20031			
Service 2-5 shall inform its users of the limitations of accuracy and reliability that may result from a request outside the validated domain of the forecast models.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.5.2. Deliver products/tools/reports

SWE-SRD-20032			

Service 2-5 shall request the user to identify which measured and nowcasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:

- Measurements of solar flares [product code SU-001-N], CMEs [product code SU-002-N], coronal holes [product code SU-004-N], and solar magnetic fields [product codes SU-005-M, SU-005-N],
- Data from spacecraft:
  - Measurements from spacecraft radiation monitors [product code SC-002-M],
  - Orbital data of spacecraft carrying space weather instruments [product code SC-003-N],
  - A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M],
  - Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P],
- Geomagnetic storm condition [product code MR-001-N],
- Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons):
  - High energy >1 MeV protons energy spectrum [product codes L1-001-M, L1-003-M, MR-006-M, MR-008-M, L1-001-N, L1-003-N, MR-006-N, MR-008-N]
  - High energy (>1 MeV) ions energy spectrum [product codes L1-002-M, L1-004-M, MR-007-M, MR-009-M, L1-002-N, L1-004-N, MR-007-N, MR-009-N]
  - High energy (>30keV) electron energy spectrum [product codes L1-006-M, L1-007-M, MR-011-M, L1-006-N, L1-007-N, MR-011-N]
  - High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-M, MR-010-M, L1-005-N, MR-010-N]
  - Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-M, MR-012-N]
  - Energetic particles at L5 [product codes IP-007-M, IP-007-N, IP-008-M, IP-008-N, IP-009-M, IP-009-M],
  - Plasma drift velocity [product code MR-016-M]
- Thermal ions density and temperature [product codes MR-014-M, MR-014-N]
- Neutral particles:
  - Atmospheric density [product codes AG-007-M, AG-007-N]
  - Atomic oxygen density [product codes IT-010-M, IT-010-N]]
- UV and soft X-ray flux [product codes SU-029-M, SU-029-N, SU-027-M, SU-027-N]
- Solar Flux EUV [product codes SU-028-M, SU-028-N],
- Ground based geomagnetic field [product codes AG-005-M, AG-005-N]
- Cosmic rays energy and ion-species flux spectra [product codes L1-002-M, L1-002-N, MR-007-M, MR-007-N]
- Ionosphere:
  - Altitude dependent TEC (Total Electron Content) maps [product codes IT-001-M, IT-001-N]
  - Ionosonde measurements [product codes IT-005-M, IT-005-N]

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Ionospheric scintillation, location and intensity [product codes IT-009-M, IT-009-N]

Indices: geomagnetic (Kp, Ap, AE, Dst) [product codes MR-002-N, MR-003-N, MR-004-N], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-N, SU-008-M, SU-008-N, SU-009-N, SU-010-N, SU-011-N, SU-012-N], and other indices (IG12, IMF) [product codes SU-013-N, L1-008-M, L1-008-N],
Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-M, IT-007-N, IT-008-M, IT-008-N]
Solar Wind velocity, density and magnetic field [product codes L1-008-M, L1-008-N, L1-009-M, L1-009-N, L1-010-M, L1-010-N]
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-M, IP-003-N, IP-004-M, IP-004-N, IP-006-M, IP-006-N],
Net electrical current to spacecraft surface [product codes SC-006-M, SC-006-N, SC-007-M, SC-007-N, SC-008-M, SC-008-N].

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SWE-SRD-20033			
Service 2-5 shall deliver tools to the user that allows them to perform an analysis as a function of the orbit and the spacecraft type.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20034			

Service 2-5 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows:
• Osculating Element Data Set (OEDS) for the considered Orbit
• Time span of the required forecast
• Publication date
• Position of spacecraft as a function of time within the specified time span:
  o formally defined in inertial coordinates
  o but then assessed in terms of local coordinate systems as appropriate for the particular orbit,
  o Flag indicating if information from third parties is included
• Spacecraft ID and characteristics (for effects prediction only).			

Justification:			
Comments:	Local coordinate systems would be the orbital equivalents of e.g. the McIlwain L parameter and magnetic field for radiation belt assessment, geomagnetic for near Earth plasma effects and geocentric-solar-magnetospheric coordinates for the outer magnetosphere.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20035			

Service 2-5 shall request the user to identify which forecasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Measurements of solar flares [product code SU-001-F], CMEs [product code SU-002-F], coronal holes [product code SU-004-F], and solar magnetic fields [product code SU-005-F],
• Data from spacecraft:
  o Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
  o Orbital data of spacecraft carrying space weather instruments [product code SC-003-F],
• Geomagnetic storm condition [product code MR-001-F],
• Ionising radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons):			

<table>
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High energy >1 MeV protons energy spectrum [product codes L1-001-F, L1-003-F, MR-006-F, MR-008-F]
High energy (>1 MeV) ions energy spectrum [product codes L1-002-F, L1-004-F, MR-007-F, MR-009-F]
High energy (>30keV) electron energy spectrum [product codes L1-006-F, L1-007-F, MR-011-F]
High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-F, MR-010-F]
Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-F]
Energetic particles at L5 [product codes IP-007-F, IP-008-F, IP-009-F],

Thermal ions density and temperature [product codes MR-014-M, MR-014-F]
Neutral particles:

Atmospheric density [product code AG-007-F]
Atomic oxygen density [product code IT-010-F]]

UV and soft X-ray flux [product codes SU-029-F, SU-027-F]
Solar Flux EUV [product code SU-028-F],
Ground based geomagnetic field [product code AG-005-F]
Cosmic rays energy and ion-species flux spectra [product code L1-002-F, MR-007-F]
Ionosphere:

Altitude dependent TEC (Total Electron Content) maps [product code IT-001-F]
Ionosonde measurements [product code IT-005-F]
Ionospheric scintillation, location and intensity [product code IT-009-F]

Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-F, MR-003-F, MR-004-F], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-F, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], and other indices (IG12, IMF) [product codes SU-013-N, L1-008-M, L1-008-N].

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SWE-SRD-20036			
Service 2-5 shall provide the user with event-based alarms, All-Quiet and End-Of-Quiet alerts. Alerts will be provided with a refreshing period of one minute.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20037			
Service 2-5 shall allow the user to set thresholds on parameters for real-time notification of conditions.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.3.6. Performance Requirements

SWE-SRD-11610			
The near real time monitoring of space weather events shall be provided with the following accuracy in table below:			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-1531		
Related Requirements:		**Verification Method:**	

Event	Accuracy of first fast level processing	Accuracy of fine processing	Time after the event for which the fine accuracy is required to be met
magnetic storm	70-80%	TBD	24 hours
substorms	70-80%	TBD	24 hours
high-speed streams	TBD	TBD	TBD
solar energetic particle events	95%	98%	TBD
Earth-directed CMEs	*	*	12 hours

*Earth-directed CMEs:

- Automated detection:
  - significant levels of false events
  - poor velocity estimation
- Human confirmed detection:
  - velocity accurate to within projection limits

SWE-SRD-11611			
The estimates of probability of occurrence of space weather events and of "All quiet conditions" shall be provided with the following warning times and confidence levels in table below: Event / Warning times for event forecast / Confidence level (sigma) Magnetic storm / 1-2 days / 3s Solar energetic particle events / 1-2 days / 3s Earth-directed CMEs / 1-2 hours (confirmed by L1 measurement) / 1s			
Justification:			
Comments:	Expanded from SWE-CRD-SCO-1532 requirement description.		
Source Requirements:	SWE-CRD-SCO-1532		
Related Requirements:		**Verification Method:**	

SWE-SRD-9142			
The forecast of "All quiet conditions" and "End-of-quiet" conditions for all space weather parameters shall be provided 3 to 7 days in advance along with their confidence level.			
Justification:	The usability and usefulness of the forecasted data depend on its quality and the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1583		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9143			
Nowcasts of space weather events or potentially dangerous conditions shall be provided in near real-time, and with less than the following delays after event occurrence/detection: • 60 min for CME onset, • 5 min for SEP, 5 min for radio bursts, • 5 min for high-speed streams, • 5 min for flares, • 30 minutes for other L1 in-situ measurements and • 1min for nowcasts based on other data measured in the vicinity of the spacecraft.			
Justification:	The usability and usefulness of the data depends on the timely availability to the final users. Current timeliness requirements are assumed for routine spacecraft operations. Stronger timeliness requirements may apply for human space flight, launch operation or some critical operations.		
Comments:	Nowcast delays have to be lower than 30 minutes, CME's observation on the Sun does not require very urgent notice but confirmation from L1 that the CME is actually reaching the Earth is urgent.		
Source Requirements:	SWE-CRD-SCO-1584		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9144			
The forecasts or risk estimate of hazardous space environment conditions and of the atmospheric environment shall be provided for the following days, in advance within the following time ranges: • 48 hrs for CME onset, • 48 hours for (I)CME or other interplanetary transient structure arrival at L1, • up to 27 days for high-speed stream arrival at Earth, • 24-28 hours for solar flares.			
Justification:	For a forecast service to be useful, the anticipation in time must be longer than the time required to configure the instruments in safe-mode: e.g. for XMM-Newton it means 10-30 minutes.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1585		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9145			
The Space Weather System shall provide, as part of service domain 2, the forecast of S/C effects with a minimum of 48 hours in advance.			
Justification:	The usability and usefulness of the forecasted data depend on the timely availability to the final users.		
Comments:	Individual products may also be delivered with 24 hours and 48 hours forecast. This is flown down directly from the CRD.		
Source Requirements:	SWE-CRD-SCO-1586		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9150			
The ionospheric products used by the domain services shall have 1 day (TEC maps: 5 min) rate updates.			
Justification:	The usability and usefulness of the forecasted data depend on the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1590		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9135			
A subset of spacecraft payload data relevant to Space Weather services (e.g. from radiation monitors) shall be made available to the authorised users within 10 minutes in spacecraft telemetry reception mode.			
Justification:	The usability and usefulness of data correlations (S/C conditions, effects, and space weather environment and events) depend on the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1576		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9146			
The anomalies information shall be made available after detection with a target of within 48hrs.			
Justification:	The usability and usefulness of the forecast data depend on timely availability to the final users.		
Comments:	This relates to SWE-CRD-SCO-1536 and defines the timeliness of accessing the anomaly data. This requires an agreement with operators who would supply information (in all likelihood anonymously) on actual anomalies, e.g. spurious commands, uncommanded instrument switch-off, increased SEU-induced error rate, spacecraft entering non-nominal states. Depending on the agreement with the operator, the information could be made public or distributed only to authorised recipients.		
Source Requirements:	SWE-CRD-SCO-1587		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9147			
The nowcast shall be continuous.			
Justification:	Data persistence and the possibility to “replay” past conditions are required to conduct post event analysis and identify possible causes for S/C anomalies and effects.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1588		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9149			
The forecast of uncertainties caused by the ionosphere shall be available 1 hour in advance.			
Justification:	The usability and usefulness of the forecasted data depends on the timely availability to the final users. The uncertainties mean potential problems due to ionosphere, atmospheric scintillation impacting telecommunication with satellites.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1589		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9151			
Daily forecasts, 3-day forecast, 14-day forecast and 27-day forecast of the atmospheric environment shall be available.			
Justification:	The usability and usefulness of the forecasted data depend on the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1591		
Related Requirements:		**Verification Method:**	Design Review Test

3.1.4. Domain 3 services - Human spaceflight

3.1.4.1. Service 3-1: Human spaceflight - In-flight crew radiation exposure

SWE-SRD-12558			
The Space Weather System shall provide a Service 3-1: Human spaceflight - In-flight crew radiation exposure.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10991			
Service 3-1 shall provide near real-time estimate of the radiation dose received by a person in space, including: • notification of SEP onsets with protons/ions with lower energy limits of >10 MeV, >30 MeV, >100 MeV and >300 MeV above given flux threshold • near real-time estimate of the dose for a given mission profile			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-3087 SWE-CRD-SCH-3258		
Related Requirements:		**Verification Method:**	Design Review

3.1.4.1.1. Data Policy Enforcement

SWE-SRD-10994			
Service 3-1 shall be a service for registered users only, delivering its outputs on request for the nowcast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.4.1.2. Handle service requests

SWE-SRD-10997			
The following set of user criteria shall be requested by service 3-1 prior to the generation of the outputs of the service: • orbit • time span • parameters to be measured / nowcasted • crewed spacecraft ID (for effects prediction only) • crewed spacecraft characteristics (for effects prediction only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10998			
Service 3-1 shall allow its users to specify freely the orbits for their nowcast / near real time requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10992			
Service 3-1 shall inform its users of the limitations of accuracy and reliability that may result from a particular request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10993			
Service 3-1 shall inform those of its users who require dose estimates of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.4.1.3. Deliver products/tools/reports

SWE-SRD-11001			

Service 3-1 shall request the user to identify which measured and/or nowcasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:

- Solar disk imaging: X-ray, EUV, visible, including magnetograph [product codes SU-020-M, SU-015-M, SU-021-M, SU-017-M, SU-022-M, SU-020-N, SU-015-N, SU-021-N, SU-017-N SU-022-N],
- Wide-angle coronagraphic and heliospheric imaging [product codes SU-025-M, SU-025-N, SU-032-M, SU-032-N],
- Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-M, SU-041-M, SU-040-N, SU-041-N],
- Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-M, SU-045-N, SU-050-M, SU-050-N],
- Measurements of solar flares [product code SU-001-N], CMEs [product code SU-002-N], coronal holes [product code SU-004-N], and solar magnetic fields [product codes SU-005-M, SU-005-N],
- Data from spacecraft:
  - Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
  - Orbital data of spacecraft carrying space weather instruments [product code SC-003-N],
  - A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M],
  - Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P],
- Geomagnetic storm condition [product code MR-001-N],
- Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium:
  - High energy >1 MeV protons energy spectrum [product codes L1-001-M, L1-003-M, MR-006-M, MR-008-M, L1-001-N, L1-003-N, MR-006-N, MR-008-N]
  - High energy (>1 MeV) ions energy spectrum [product codes L1-002-M, L1-004-M, MR-007-M, MR-009-M, L1-002-N, L1-004-N, MR-007-N, MR-009-N]
  - High energy (>30keV) electron energy spectrum [product codes L1-006-M, L1-007-M, MR-011-M, L1-006-N, L1-007-N, MR-011-N]
  - High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-M, MR-010-M, L1-005-N, MR-010-N]
  - Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-M, MR-012-N]
  - Energetic particles at L5 [product codes IP-007-M, IP-007-N, IP-008-M, IP-008-M, IP-009-M, IP-009-N]
  - Plasma drift velocity [product code MR-016-M]
- Thermal ions density and temperature [product codes MR-014-M, MR-014-N]
- UV and soft X-ray flux [product codes SU-029-M, SU-029-N, SU-027-M, SU-027-N]

• Solar Flux EUV [product codes SU-028-M, SU-028-N], • Ground based geomagnetic field [product codes AG-005-M, AG-005-N] • Cosmic rays energy and ion-species flux spectra [product codes L1-002-M, L1-002-N, MR-007-M, MR-007-N] • Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-N, MR-003-N, MR-004-N], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-N, SU-008-M, SU-008-N, SU-009-N, SU-010-N, SU-011-N, SU-012-N], and other indices (IG12, IMF) [product codes SU-013-N, L1-008-M, L1-008-N], • Solar Wind velocity, density and magnetic field [product codes L1-008-M, L1-008-N, L1-009-M, L1-009-N, L1-010-M, L1-010-N], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-M, IP-003-N, IP-004-M, IP-004-N, IP-006-M, IP-006-N].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-1599 SWE-CRD-SCH-1600 SWE-CRD-SCH-1601 SWE-CRD-SCH-1602 SWE-CRD-SCH-1603 SWE-CRD-SCH-1604 SWE-CRD-SCH-3085 SWE-CRD-SCH-3086 SWE-CRD-SCH-3246		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11006			
Service 3-1 shall, upon request from a user, provide near real-time estimate of the radiation dose received by a person aboard the user's crewed spacecraft as result of SEP onset with protons/ions in the range 30 MeV to 200 MeV above given flux threshold, with lead times of TBD.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11003			
Service 3-1 shall provide the alerts to the user with a refresh rate of one minute.			
Justification:			
Comments:	Alerts shall be available by means of web-services, email and sms.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 3-1 is not required to deliver tools.

3.1.4.2. Service 3-2: Human spaceflight - Cumulative crew radiation exposure

SWE-SRD-12559			
The Space Weather System shall provide a Service 3-2: Human spaceflight - Cumulative crew radiation exposure.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11027			
Service 3-2 shall provide estimate of the past radiation dose accumulated by a person in space, including: • post-event analysis with the reconstruction of the environment at a given time and location to allow the accurate evaluation of doses inside human bodies • estimated mission related exposure from the start to end of a given mission and highlight activities that could result in increased exposure like vehicle altitude changes, EVAs and ESPEs. • weekly reports collating information on solar activity, geomagnetic conditions, estimated dose and UV exposure • post-EVA summary of expected conditions including solar activity, geomagnetic conditions and estimated dose for the EVA period.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-1595 SWE-CRD-SCH-1596 SWE-CRD-SCH-3081 SWE-CRD-SCH-3084		
Related Requirements:		**Verification Method:**	Design Review

3.1.4.2.1. Handle service requests

SWE-SRD-11015			
The following set of user criteria shall be requested by service 3-2 prior to the generation of the outputs of the service: • orbit • time span • parameters to be retrieved from database / reconstructed • crewed spacecraft ID (for effects prediction only) • crewed spacecraft characteristics (for effects prediction only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11016			
Service 3-2 shall allow its users to specify freely the orbits for their data retrieval / reconstruction requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11017			
Service 3-2 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11018			
Service 3-2 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11012			
Service 3-2 shall inform its users of any limitations on the database that may occur due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.4.2.2. Deliver products/tools/reports

SWE-SRD-11020			
Service 3-2 shall request the user to identify which parameters to be recovered from archive and/or reconstructed within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Solar disk imaging: X-ray, EUV, visible, including magnetogram [product codes SU-020-P, SU-015-P, SU-021-P, SU-017-P SU-022-P], • Wide-angle coronagraphic and heliospheric imaging [product codes SU-025-P, SU-032-P], • Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-P, SU-041-P], • Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-P, SU-050-P], • Measurements of solar flares [product code SU-001-P], CMEs [product code SU-002-P], coronal holes [product code SU-004-P], and solar magnetic fields [product codes SU-005-M, SU-005-P], • Data from spacecraft: o Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements), o Orbital data of spacecraft carrying space weather instruments [product code SC-003-P], o A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M], o Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P], • Geomagnetic storm condition [product code MR-001-P], • Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium: o High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-003-P, MR-006-P, MR-008-P] o High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-004-P, MR-007-P, MR-009-P] o High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-007-P, MR-011-P]			

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High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, MR-010-P]
Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P]
Energetic particles at L5 [product codes IP-007-P, IP-008-P, IP-009-P]
Plasma drift velocity [product code MR-016-M]

Thermal ions density and temperature [product codes MR-014-P]
UV and soft X-ray flux [product codes SU-029-P, SU-027-P]
Solar Flux EUV [product codes SU-028-P],
Ground based geomagnetic field [product codes AG-005-P]
Cosmic rays energy and ion-species flux spectra [product codes L1-002-P, MR-007-P]
Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-M, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P], and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P],
Solar Wind velocity, density and magnetic field [product codes L1-008-P, L1-009-P, L1-010-P],
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P].

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SWE-CRD-SCH-1602
SWE-CRD-SCH-1603
SWE-CRD-SCH-1604
SWE-CRD-SCH-3085
SWE-CRD-SCH-3086
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<table>
<tr><td>SWE-SRD-11013</td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Service 3-2 shall, upon request from a user, provide post-event estimate of the radiation dose received by a person aboard the user's crewed spacecraft as result of SEP onset with protons/ions in the range 30 MeV to 200 MeV above given flux threshold.</td></tr>
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<tr><td>Source Requirements:</td><td colspan="3"></td></tr>
<tr><td>Related Requirements:</td><td></td><td>Verification Method:</td><td>Design Review</td></tr>
</table>

SWE-SRD-11004			
Service 3-2 shall, upon request from a user, provide data on the radiation doses in human bodies accumulated over a period defined by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 3-2 is not required to deliver tools.

3.1.4.3. Service 3-3: Human spaceflight - Increased crew radiation exposure risk

SWE-SRD-12560			
The Space Weather System shall provide a Service 3-3: Human spaceflight - Increased crew radiation exposure risk.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11014			
Service 3-3 shall provide estimate of the risk of increased level of radiation along trajectory, including: • forecast estimate of SEP onset with protons/ions with lower energy limits of >10 MeV, >30 MeV, >100 MeV and >300 MeV above given flux threshold (an evolving forecast should be provided with lead time from a few hours (3-6) to several (up to 3) days) • daily solar activity forecast as an evolving forecast with lead time from a few hours (3-6) to several (up to 3) days. • "All-quiet conditions" forecast for 48 hours, extending to 7 days. • Daily geomagnetic activity forecast • 24-hour forecast of UV exposure. • pre-EVA summary of expected conditions including solar activity, geomagnetic conditions and estimated dose for the EVA period with lead times of 7 days and 24 hours.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-1592 SWE-CRD-SCH-1593 SWE-CRD-SCH-1594 SWE-CRD-SCH-3080 SWE-CRD-SCH-3082 SWE-CRD-SCH-3083		
Related Requirements:		**Verification Method:**	Design Review

3.1.4.3.1. Data Policy Enforcement

SWE-SRD-11025			
Service 3-3 shall be a service for registered users only, delivering its outputs on request for the forecast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.4.3.2. Handle service requests

SWE-SRD-11032			
The following set of user criteria shall be requested by service 3-3 prior to the generation of the outputs of the service: • orbit • time span • parameters to be forecasted • crewed spacecraft ID (for effects prediction only) • crewed spacecraft characteristics (for effects prediction only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11033			
Service 3-3 shall allow its users to specify freely the orbits for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11034			
Service 3-3 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11035			
Service 3-3 shall inform those of its users who require prediction of effects on their spacecraft of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their spacecraft due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.4.3.3. Deliver products/tools/reports

SWE-SRD-11038			

Service 3-3 shall request the user to identify which forecasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Solar disk imaging: X-ray, EUV, visible, including magnetogram [product codes SU-020-F, SU-015-F, SU-021-F, SU-017-F SU-022-F],
• Wide-angle coronagraphic and heliospheric imaging [product codes SU-025-F, SU-032-F],
• Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-F, SU-041-F],
• Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-F, SU-050-F],
• Measurements of solar flares [product code SU-001-F], CMEs [product code SU-002-F], coronal holes [product code SU-004-F], and solar magnetic fields [product codes SU-005-F],
• Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-F],
• Geomagnetic storm condition [product code MR-001-F],
• Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium:			

<table>
<tr><td colspan="4">

High energy >1 MeV protons energy spectrum [product codes L1-001-F, L1-003-F, MR-006-F, MR-008-F]
High energy (>1 MeV) ions energy spectrum [product codes L1-002-F, L1-004-F, MR-007-F, MR-009-F]
High energy (>30keV) electron energy spectrum [product codes L1-006-F, L1-007-F, MR-011-F]
High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-F, MR-010-F]
Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-F]
Energetic particles at L5 [product codes IP-007-F, IP-008-F, IP-009-F]
Plasma drift velocity [product code MR-016-M]

Thermal ions density and temperature [product codes MR-014-F]
UV and soft X-ray flux [product codes SU-029-F, SU-027-F]
Solar Flux EUV [product codes SU-028-F],
Ground based geomagnetic field [product codes AG-005-F]
Cosmic rays energy and ion-species flux spectra [product codes L1-002-F, MR-007-F]
Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-F, MR-003-F, MR-004-F], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-F, SU-008-M, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], and other indices (IG12, IMF) [product codes SU-013-F, L1-008-F],
Solar Wind velocity, density and magnetic field [product codes L1-008-F, L1-009-F, L1-010-F],
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-F, IP-004-F, IP-006-F].

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<tr><td>Comments:</td><td colspan="3"></td></tr>
<tr><td>Source Requirements:</td><td colspan="3">SWE-CRD-SCH-1599
SWE-CRD-SCH-1600
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SWE-CRD-SCH-1602
SWE-CRD-SCH-1603
SWE-CRD-SCH-1604
SWE-CRD-SCH-3085
SWE-CRD-SCH-3086
SWE-CRD-SCH-3246</td></tr>
<tr><td>Related Requirements:</td><td></td><td>Verification Method:</td><td>Design Review</td></tr>
</table>

SWE-SRD-11040			
Service 3-3 shall, upon request from a user, provide a forecast of the radiation dose expected to be received by a person aboard the user's crewed spacecraft as result of SEP onset with protons/ions in the range 30 MeV to 200 MeV above given flux threshold.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11041			
Service 3-3 shall, upon request from a user, provide an All-quiet alert with the threshold defined by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11044			
Service 3-3 shall, upon request from a user, provide an End-of-quiet alert with the threshold defined by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 3-3 is not required to deliver tools.

3.1.4.4. Performance Requirements

SWE-SRD-9152			
During crewed operations, the maximum contiguous downtime of service 3 (SEP forecast) shall be less than 30 minutes.			
Justification:	The max down time is driven by the error acceptable for dose estimate for post-event analysis, by the acceptable dose level that can be received by astronauts in EVA during downtime.		
Comments:			
Source Requirements:	SWE-CRD-SCH-1606		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9153			
Forecast of SPE onset shall be calculated for the next 24 hours and, during EVA scheduling, updated every 30 minutes during a time window to be agreed prior to EVA start.			
Justification:	The lead time and update time are driven by the lead time required for taking decision on scheduling EVA.		
Comments:			
Source Requirements:	SWE-CRD-SCH-1607		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12867			
During crewed operations, the maximum contiguous downtime of service 3 (real-time notification of SEP onset) shall be less than 5 minutes.			
Justification:	The max down time is driven by the error acceptable for dose estimate for post-event analysis, by the acceptable dose level that can be received by astronauts in EVA during downtime.		
Comments:			
Source Requirements:	SWE-CRD-SCH-1606		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9154			
During crewed operations, the maximum contiguous downtime of the real-time provision of: • solar X-ray levels, • solar X-ray and UV-image, • and energetic proton and electron fluxes, all a subset of service domain 3, shall be less than 5 minutes.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-1608		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9157			
For the service domain 3, the Space Weather System shall provide information on the proton and electron environment with an update rate of one minute.			
Justification:	Interplanetary is not enough because of transport effects through magnetic field (e.g., for LEO) and effects of neighbouring planetary bodies.		
Comments:			
Source Requirements:	SWE-CRD-SCH-1609		
Related Requirements:		**Verification Method:**	Design Review Test

3.1.5. Domain 4 services - Launch operation

3.1.5.1. Service 4-1: Launch operation - Radiation environment monitoring

SWE-SRD-12561			
The Space Weather System shall provide a Service 4-1: Launch operation - Radiation environment monitoring.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11036			
Service 4-1 shall provide near real-time estimate of the radiation effects in sensitive electronics along trajectory, including: • in-flight monitoring of radiation effects in sensitive electronics, • near real-time information on the space radiation environment including protons and heavy ions with energies above a pre-defined threshold in the range 1MeV to 300MeV.			
Justification:			
Comments:	The requirement for energy range 1-10MeV comes from teams conducting radar and rocket campaigns in the Arctic region and relates to ionospheric conditions rather than SEEs.		
Source Requirements:	SWE-CRD-LAU-2683 SWE-CRD-LAU-3013		
Related Requirements:		**Verification Method:**	Design Review

3.1.5.1.1. Handle service requests

SWE-SRD-11047			
The following set of user criteria shall be requested by service 4-1 prior to the generation of the outputs of the service: • trajectory • time span • parameters to be measured / nowcasted • launcher ID (for effects prediction only) • launcher characteristics (for effects prediction only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11048			
Service 4-1 shall allow its users to specify freely the trajectories for their nowcast / near real time requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11049			
Service 4-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11050			
Service 4-1 shall inform users of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their launcher due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.1.2. Deliver products/tools/reports

SWE-SRD-11055			
Service 4-1 shall request the user to identify which measured and/or nowcasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Solar disk imaging: X-ray, EUV, visible, including magnetogram [product codes SU-020-M, SU-015-M, SU-021-M, SU-017-M, SU-022-M, SU-020-N, SU-015-N, SU-021-N, SU-017-N SU-022-N], • Wide-angle coronagraphic and heliospheric imaging [product codes SU-025-M, SU-025-N, SU-032-M, SU-032-N], • Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-M, SU-041-M, SU-040-N, SU-041-N],			

- Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-M, SU-045-N, SU-050-M, SU-050-N],
- Measurements of solar flares [product code SU-001-N], CMEs [product code SU-002-N], coronal holes [product code SU-004-N], and solar magnetic fields [product codes SU-005-M, SU-005-N],
- Data from spacecraft:
    - Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
    - Orbital data of spacecraft carrying space weather instruments [product code SC-003-N],
    - A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M],
    - Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P],
- Geomagnetic storm condition [product code MR-001-N],
- Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium:
    - High energy >1 MeV protons energy spectrum [product codes L1-001-M, L1-003-M, MR-006-M, MR-008-M, L1-001-N, L1-003-N, MR-006-N, MR-008-N]
    - High energy (>1 MeV) ions energy spectrum [product codes L1-002-M, L1-004-M, MR-007-M, MR-009-M, L1-002-N, L1-004-N, MR-007-N, MR-009-N]
    - High energy (>30keV) electron energy spectrum [product codes L1-006-M, L1-007-M, MR-011-M, L1-006-N, L1-007-N, MR-011-N]
    - High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-M, MR-010-M, L1-005-N, MR-010-N]
    - Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-M, MR-012-N]
    - Energetic particles at L5 [product codes IP-007-M, IP-007-N, IP-008-M, IP-008-M, IP-009-M, IP-009-N]
    - Plasma drift velocity [product code MR-016-M]
- Thermal ions density and temperature [product codes MR-014-M, MR-014-N]
- Neutral particles:
    - Atmospheric density [product codes AG-007-M, AG-007-N]
    - Atomic oxygen density [product codes IT-010-M, IT-010-N]]
- UV and soft X-ray flux [product codes SU-029-M, SU-029-N, SU-027-M, SU-027-N]
- Solar Flux EUV [product codes SU-028-M, SU-028-N],
- Ground based geomagnetic field [product codes AG-005-M, AG-005-N]
- Cosmic rays energy and ion-species flux spectra [product codes L1-002-M, L1-002-N, MR-007-M, MR-007-N]
- Ionosphere:
    - Altitude dependent TEC (Total Electron Content) maps [product codes IT-001-M, IT-001-N]
    - Ionosonde measurements [product codes IT-005-M, IT-005-N]
    - Ionospheric scintillation, location and intensity [product codes IT-009-M, IT-009-N]

• Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-N, MR-003-N, MR-004-N], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-N, SU-008-M, SU-008-N, SU-009-N, SU-010-N, SU-011-N, SU-012-N], and other indices (IG12, IMF) [product codes SU-013-N, L1-008-M, L1-008-N], • Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-M, IT-007-N, IT-008-M, IT-008-N] • Solar Wind velocity, density and magnetic field [product codes L1-008-M, L1-008-N, L1-009-M, L1-009-N, L1-010-M, L1-010-N], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-M, IP-003-N, IP-004-M, IP-004-N, IP-006-M, IP-006-N].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1623 SWE-CRD-LAU-1624 SWE-CRD-LAU-1625 SWE-CRD-LAU-3012 SWE-CRD-LAU-3016 SWE-CRD-LAU-3094 SWE-CRD-LAU-3247 SWE-CRD-LAU-3248		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11056			
Service 4-1 shall, upon request from a user, provide near real-time estimate of the effects observed in electronics aboard the user's launcher.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 4-1 is not required to deliver tools.

3.1.5.2. Service 4-2: Launch operation - Estimate of radiation effects in sensitive electronics

SWE-SRD-12562			
The Space Weather System shall provide a Service 4-2: Launch operation - Estimate of radiation effects in sensitive electronics.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11051			
Service 4-2 shall provide an estimate of past radiation effects in sensitive electronics along trajectory by carrying out a Post Event Analysis and recreating the environment at a given time and location to accurately evaluate SEE in launcher's electronics.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1617		
Related Requirements:		**Verification Method:**	Design Review

3.1.5.2.1. Handle service requests

SWE-SRD-11058			
The following set of user criteria shall be requested by service 4-2 prior to the generation of the outputs of the service: • trajectory • time span • parameters to be recovered from archive and/or reconstructed • launcher ID (for effects prediction only) • launcher/component characteristics (for effects analysis only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11059			
Service 4-2 shall allow its users to specify freely the trajectories for their archive recovery / reconstruction requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11026			
Service 4-2 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11067			
Service 4-2 shall inform those of its users who require prediction of effects on their launcher of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their launcher due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.2.2. Deliver products/tools/reports

SWE-SRD-11062			
Service 4-2 shall request the user to identify which parameter to be recovered from archive and/or reconstructed within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Solar disk imaging: X-ray, EUV, visible, including magnetogram [product codes SU-020-P, SU-015-P, SU-021-P, SU-017-P SU-022-P], • Wide-angle coronagraphic and heliospheric imaging [product codes SU-025-P, SU-032-P], • Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-P, SU-041-P], • Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-P, SU-050-P],			

- Measurements of solar flares [product code SU-001-P], CMEs [product code SU-002-P], coronal holes [product code SU-004-P], and solar magnetic fields [product codes SU-005-M, SU-005-P],
- Data from spacecraft:
  - Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements), Orbital data of spacecraft carrying space weather instruments [product code SC-003-P],
  - A relevant subset of spacecraft housekeeping telemetry data [product code SC-004-M],
  - Spacecraft anomalies, for the spacecraft in the Space Weather System database [product code SC-001-P],
- Geomagnetic storm condition [product code MR-001-P],
- Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium:
  - High energy >1 MeV protons energy spectrum [product codes L1-001-P, L1-003-P, MR-006-P, MR-008-P]
  - High energy (>1 MeV) ions energy spectrum [product codes L1-002-P, L1-004-P, MR-007-P, MR-009-P]
  - High energy (>30keV) electron energy spectrum [product codes L1-006-P, L1-007-P, MR-011-P]
  - High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-P, MR-010-P]
  - Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-P]
  - Energetic particles at L5 [product codes IP-007-P, IP-008-P, IP-009-P]
  - Plasma drift velocity [product code MR-016-M]
- Thermal ions density and temperature [product codes MR-014-P]
- Neutral particles:
  - Atmospheric density [product codes AG-007-P]
  - Atomic oxygen density [product codes IT-010-P]]
- UV and soft X-ray flux [product codes SU-029-P, SU-027-P]
- Solar Flux EUV [product codes SU-028-P],
- Ground based geomagnetic field [product codes AG-005-P]
- Cosmic rays energy and ion-species flux spectra [product codes L1-002-P, MR-007-P]
- Ionosphere:
  - Altitude dependent TEC (Total Electron Content) maps [product codes IT-001-P]
  - Ionosonde measurements [product codes IT-005-P]
  - Ionospheric scintillation, location and intensity [product codes IT-009-P]
- Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-M, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P], and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P],
- Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-P, IT-008-P],

• Solar Wind velocity, density and magnetic field [product codes L1-008-P, L1-009-P, L1-010-P], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1623 SWE-CRD-LAU-1624 SWE-CRD-LAU-1625 SWE-CRD-LAU-3012 SWE-CRD-LAU-3016 SWE-CRD-LAU-3094 SWE-CRD-LAU-3247 SWE-CRD-LAU-3248		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11064			
Service 4-2 shall, upon request from a user, provide a post-event reconstruction of the environment supporting the evaluation of SEEs experienced by an electronic unit aboard the user's launcher.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 4-2 is not required to deliver tools.

3.1.5.3. Service 4-3: Launch operation - Forecast of radiation storms

SWE-SRD-12563			
The Space Weather System shall provide a Service 4-3: Launch operation - Forecast of radiation storms.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11070			
Service 4-3 shall provide an estimate of the risk of increased level of radiation along trajectory by forecasting: • an estimate of Solar Particle Event onset with ions (including protons and heavy ions) with energy above pre-defined thresholds in the range 1MeV/nuc to 1000MeV/nuc. • Solar activity for the next 72 hours, including at a minimum X-ray flux, sunspot number, SPE, current active regions, and solar activity evolution • "All quiet" conditions			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11084			
Service 4-3 shall provide an estimate of the neutral density along trajectory, including an atmospheric density forecast along the trajectory of the launcher up to TBD km (*) altitude.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1618		
Related Requirements:		**Verification Method:**	Design Review

3.1.5.3.1. Data Policy Enforcement

SWE-SRD-11072			
Service 4-3 shall be a service for registered users only, delivering its outputs on request for the forecast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.3.2. Handle service requests

SWE-SRD-11074			
The following set of user criteria shall be requested by service 4-3 prior to the generation of the outputs of the service: • trajectory • time span • parameters to be forecasted • thresholds to be considered for all-quiet and end-of-quiet alerts • energy thresholds for the forecast request of high-energy protons and ions • launcher ID (for effects prediction only) • launcher/component characteristics (for effects prediction only)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11075			
Service 4-3 shall allow its users to specify freely the trajectories for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11071			
Service 4-3 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11073			
Service 4-3 shall inform those of its users who require prediction of effects on their launcher of the limitations of service that may occur due to variability of effects as a function of the materials and designs actually used, if they could not declare all the materials and designs of their launcher due to data confidentiality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.3.3. Deliver products/tools/reports

SWE-SRD-11077			

Service 4-3 shall request the user to identify which forecasted parameters within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Solar disk imaging: X-ray, EUV, visible, including magnetogram [product codes SU-020-F, SU-015-F, SU-021-F, SU-017-F SU-022-F],
• Wide-angle coronagraphic and heliopsheric imaging [product codes SU-025-F, SU-032-F],
• Solar disk imaging from L5: magnetograph and EUV [product codes SU-040-F, SU-041-F],
• Wide-angle coronagraphic and heliospheric imaging from L5 [product codes SU-045-F, SU-050-F],
• Measurements of solar flares [product code SU-001-F], CMEs [product code SU-002-F], coronal holes [product code SU-004-F], and solar magnetic fields [product codes SU-005-F],
• Data from spacecraft:
  ○ Measurements from spacecraft radiation monitors [product code SC-002-M] (includes too local area radiation flux and dosimeter measurements)
  ○ Orbital data of spacecraft carrying space weather instruments [product code SC-003-F],
• Geomagnetic storm condition [product code MR-001-F],
• Data on Radiation / Plasma / Magnetospheric and solar energetic particles fluxes (electrons and protons), including also Near real-time high energy >10MeV protons and ions in interplanetary medium and Plasma and fields in the interplanetary medium:
  ○ High energy >1 MeV protons energy spectrum [product codes L1-001-F, L1-003-F, MR-006-F, MR-008-F]
  ○ High energy (>1 MeV) ions energy spectrum [product codes L1-002-F, L1-004-F, MR-007-F, MR-009-F]
  ○ High energy (>30keV) electron energy spectrum [product codes L1-006-F, L1-007-F, MR-011-F]
  ○ High energy (> 30 keV and < 1 MeV) ion energy spectrum [product codes L1-005-F, MR-010-F]
  ○ Thermal and supra-thermal electrons energy spectrum (0-30 keV) [product codes MR-012-F]			

<table>
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Energetic particles at L5 [product codes IP-007-F, IP-008-F, IP-009-F]
Plasma drift velocity [product code MR-016-M]

Thermal ions density and temperature [product codes MR-014-F]
Neutral particles:

Atmospheric density [product codes AG-007-F]
Atomic oxygen density [product codes IT-010-F]]

UV and soft X-ray flux [product codes SU-029-F, SU-027-F]
Solar Flux EUV [product codes SU-028-F],
Ground based geomagnetic field [product codes AG-005-F]
Cosmic rays energy and ion-species flux spectra [product codes L1-002-F, MR-007-F]
Ionosphere:

Altitude dependent TEC (Total Electron Content) maps [product codes IT-001-F]
Ionosonde measurements [product codes IT-005-F]
Ionospheric scintillation, location and intensity [product codes IT-009-F]

Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-F, MR-003-F, MR-004-F], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-F, SU-008-M, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], and other indices (IG12, IMF) [product codes SU-013-F, L1-008-F],
Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time) [product codes IT-007-F, IT-008-F]
Solar Wind velocity, density and magnetic field [product codes L1-008-F, L1-009-F, L1-010-F],
Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-F, IP-004-F, IP-006-F].

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SWE-CRD-LAU-1625
SWE-CRD-LAU-3012
SWE-CRD-LAU-3016
SWE-CRD-LAU-3094
SWE-CRD-LAU-3247
SWE-CRD-LAU-3248</td></tr>
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SWE-SRD-11091			
Service 4-3 shall produce and deliver to the user: • The forecasted estimate of the neutral density along trajectory, including an atmospheric density forecast along the trajectory of the launcher up to TBD km (*) complying with the Products Specification for product code IT-007-F • The assumptions and inputs obtained from the data products used for the establishment of the prediction, • A description of the model used, • For all provided forecasted parameters: associated accuracy and reliability			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11081			
Service 4-3 shall, upon request from a user, provide a forecast of the radiation environment expected in the vicinity of the launcher as the result of Solar Particle Event onset with ions (including protons and heavy ions) with energy above pre-defined threshold in the range 10MeV to 300MeV.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11082			
Service 4-3 shall, upon request from a user, provide an All-Quiet forecast.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 4-3 is not required to deliver tools.

3.1.5.4. Service 4-4: Launch operation - Risk estimate of service disruption caused by ionospheric scintillations

SWE-SRD-12565			
The Space Weather System shall provide a Service 4-4: Launch operation - Risk estimate of service disruption caused by ionospheric scintillations.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11098			
Service 4-4 shall provide an estimate of the level of ionospheric scintillations between ground station and launch vehicle along the trajectory, by reporting an ionospheric scintillation forecast/nowcast.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-1619		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11079			
Service 4-4 shall use as inputs the data products (nowcast and forecast) and ionosphere models needed for the application of the predictions to the specific trajectory of the launcher.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.4.1. Handle service requests

SWE-SRD-11101			
The following set of user criteria shall be requested by service 4-4 prior to the generation of the outputs of the service: • trajectory • time span			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11102			
Service 4-4 shall allow its users to specify freely the trajectories for their forecast/nowcast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11100			
Service 4-4 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.5.4.2. Deliver products/tools/reports

SWE-SRD-11104			
Service 4-4 shall produce and deliver to the user: • Nowcasted/forecasted estimate of ionospheric scintillations (scintillations indices and parameters: S4, sigma_phi, fading depth, fade duration, time between fades) between ground station and launch vehicle along the trajectory, complying with the Products Specification for product codes IT-009-N and IT-009-F • The assumptions and inputs obtained from the data products used for the establishment of the prediction, • A description of the model used • For all provided nowcasted/forecasted parameters: associated accuracy and reliability			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-LAU-3012 SWE-CRD-LAU-3016		
Related Requirements:		**Verification Method:**	Design Review

Service 4-4 is not required to deliver tools.

3.1.5.5. Performance Requirements

SWE-SRD-9161			
Forecast of SPE onset shall be calculated for the next 72 hours and updated every 30 minutes from 72 hours to 48 hours ahead of launch to 5 minutes during the last 48 hours before launch.			
Justification:	The lead time and update time are driven by the lead time required for taking decision on scheduling launch.		
Comments:	A requirement on the avoidance of false alarms may be needed.		
Source Requirements:	SWE-CRD-LAU-1628		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9162			
For service domain 4, the Space Weather System shall provide for spacecraft launches information on current solar activity including interplanetary high energy protons and heavy ions fluxes every 30 minutes.			
Justification:	The update time is driven by the lead time required for taking decision on scheduling launch. An analysis of the more potentially eruptive active regions at higher resolution than 1 day ideally every 2 hours is relevant when their morphology or structure are changing (surface, magnetic complexity, eruption classification…).		
Comments:	This requirement is applicable for the time periods of launch campaigns (see SWE-SRD-20245).		
Source Requirements:	SWE-CRD-LAU-1629		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20246			
For service domain 4, the Space Weather System shall provide for the launch of sounding rockets information on current solar activity including interplanetary high energy protons and heavy ions fluxes every 5 minutes.			
Justification:	The update time is driven by the lead time required for taking decision on scheduling launch. An analysis of the more potentially eruptive active regions at higher resolution than 1 day ideally every 2 hours is relevant when their morphology or structure are changing (surface, magnetic complexity, eruption classification…).		
Comments:	The requirement for updating rates <30 min comes from Arctic end users (teams conducting radar and rocket campaigns) and relates to conditions under study rather than to SEE risk. This requirement is applicable for the time periods of launch campaigns (see SWE-SRD-20245).		
Source Requirements:	SWE-CRD-LAU-1629		
Related Requirements:		**Verification Method:**	

SWE-SRD-9163			
For the service domain 4, the Space Weather System shall provide information on the proton and electron environment with a five minute resolution.			
Justification:	Allow accurate identification of the onset time of a solar particle event for post event analysis.		
Comments:	This requirement is applicable for the time periods of launch campaigns (see SWE-SRD-20245).		
Source Requirements:	SWE-CRD-LAU-1630		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9164			
The solar activity forecast shall be provided for the preceding 2 weeks on a daily basis, then refined during the 48 hours ahead of launch on a schedule to be agreed with the user in advance.			
Justification:	This lead time allows short term planning of launch activities.		
Comments:			
Source Requirements:	SWE-CRD-LAU-1631		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9165			
Kp and EUV flux forecast shall be available as time series from 48 hours before launch to 3 hours after launch using measured data where available and forecast data where not.			
Justification:	This lead time allows updating drag estimate that is available for the launch period.		
Comments:			
Source Requirements:	SWE-CRD-LAU-1632		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9166			
The accuracy of the provided services and data shall be available to the users.			
Justification:	Required to increase the level of confidence of the users in the system and assess the integrity of data for specific uses. This can be possibly provided through quality flag.		
Comments:			
Source Requirements:	SWE-CRD-LAU-1621 SYS-CRD-QUA-3226		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

3.1.6. Domain 5 services – Communication and Navigation

3.1.6.1. Service 5-1: Communication and Navigation - Near-real time TEC maps

SWE-SRD-12567			
The Space Weather System shall provide a Service 5-1: Communication and navigation - Near-real time TEC maps.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11124			
Service 5-1 shall provide near real-time TEC maps, including near real-time TEC core products and GNSS satellites Inter-frequency biases core products for the following service users: • Users of GNSS Single frequency services with average accuracy, no integrity (e.g. typical GNSS mass market user) • Users of GNSS Single frequency services with average accuracy, using integrity (e.g. EGNOS user) • Users of multi-frequency GNSS systems with very high accuracy (e.g. GNSS geodetic users, RTK) • Other transionospheric radio systems such as radars			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1633		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11125			
The GNSS satellites Inter-frequency biases core products shall be provided with update rates required by the different service users.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11126			
Service 5-1 shall use as inputs the data products (nowcast) concerning TEC needed for the delivery of the nowcasts to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.1.1. Handle service requests

SWE-SRD-11132			
The following set of user criteria shall be requested by service 5-1 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be nowcasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11133			
Service 5-1 shall allow its users to specify freely the location and time frame for their nowcast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11111			
Service 5-1 shall inform its users informed of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.1.2. Deliver products/tools/reports

SWE-SRD-11135			
Service 5-1 shall request the user to identify which parameter to be nowcasted or forecasted within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Nowcast of TEC core products including TEC maps and 3D electron density grids, complying with the Products Specification for product code IT-001-N, IT-001-F, IT-002-N, IT-002-F (includes too Height of maximum electron density in F2 layer) • Nowcast of GNSS satellites Inter-frequency biases core products • The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user, • A description of the model used, • More generally, nowcast parameters as per user's request within the list below that encompasses the assessed ionosphere properties but too some of the inputs to the ionosphere models that the user may be interested in: o Ionosphere: ▪ Riometer data / Ionosonde measurements [product codes IT-005-N , IT-005-F] ▪ URSI ionospheric parameter values [product codes IT-006-N, IT-006-F] ▪ Ionospheric scintillation, location and intensity [product codes IT-009-N, IT-009-F] o Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F] o Vector measurements of local geomagnetic field [product codes AG-005-N, AG-006-N, AG-005-F, AG-006-F] o Solar data: ▪ SSN [product codes SU-007-N, SU-007-F] ▪ Solar index F10.7 [product codes SU-008-N, SU-008-F] ▪ X-ray flares [product codes SU-001-N, SU-001-F] ▪ Solar radiometric fluxes [product codes SU-027-N, SU-027-F, SU-028-N, SU-028-F, SU-029-N, SU-029-F] ▪ Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F] ▪ CME propagation [products code SU-036-F] o Solar wind data: ▪ Solar wind bulk velocity [product codes L1-009-M, L1-009-N, L1-009-P, L1-009-F], ▪ Solar wind bulk velocity at L5 [product codes IP-003-M, IP-003-N, IP-003-P, IP-003-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644		

	SWE-CRD-TIO-1645 SWE-CRD-TIO-1646 SWE-CRD-TIO-1647 SWE-CRD-TIO-1648 SWE-CRD-TIO-3033		
Related Requirements:		**Verification Method:**	Design Review

Service 5-1 is not required to deliver tools.

3.1.6.2. Service 5-2: Communication and Navigation - Forecast TEC maps

SWE-SRD-12568			
The Space Weather System shall provide a Service 5-2: Communication and navigation - Forecast TEC maps.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11113			
Service 5-2 shall provide longer term forecasts of TEC maps, including: • up to 7 day forecast of the TEC core products with prediction of geomagnetic storms, • detection of geomagnetic storms and local geomagnetic events, to the following service users: • Users of GNSS Single frequency services with average accuracy, no integrity (e.g. typical GNSS mass market user), • Users of GNSS Single frequency services with average accuracy, using integrity (e.g. EGNOS user), • Users or multi-frequency GNSS systems with very high accuracy (e.g. GNSS geodetic users, RTK), • Other transionospheric radio systems such as radars.			
Justification:			
Comments:	For RTK applications short lead times of 5 minutes are considered useful with the caveat that a very high confidence level (>90%) would be required. For longer lead time forecasts lower confidence levels may be acceptable.		
Source Requirements:	SWE-CRD-TIO-1637 SWE-CRD-TIO-3028		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20038			
The Space Weather System shall provide forecasts preferentially over 7 days, but at least with 1-2 day lead times.			
Justification:			
Comments:	1-2 days is considered to be the threshold, and 7 days the target.		
Source Requirements:	SWE-CRD-TIO-3028		
Related Requirements:		**Verification Method:**	

SWE-SRD-11114			
The service shall use as inputs the data products (nowcast and forecast) concerning TEC needed for the delivery of the forecasts to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.2.1. Handle service requests

SWE-SRD-11123			
The following set of user criteria shall be requested by service 5-2 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be forecasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11141			
Service 5-2 shall allow its users to specify freely the location and time frame for their forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11147			
Service 5-2 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.2.2. Deliver products/tools/reports

SWE-SRD-11806			
Service 5-2 shall request the user to identify which parameter to be forecasted within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • 7 day forecast of TEC core products including TEC maps and 3D electron density grids, complying with the Products Specification for product code IT-001-N, IT-001-F, IT-002-N, IT-002-F (includes too Height of maximum electron density in F2 layer) • The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user, • A description of the model used, • More generally, forecasted parameters as per user's request within the list below that encompasses the assessed ionosphere properties but too some of the inputs to the ionosphere models that the user may be interested in: o Ionosphere: ▪ Riometer data / Ionosonde measurements [product codes IT-005-F] ▪ URSI ionospheric parameter values [product codes IT-006-F] ▪ Ionospheric scintillation, location and intensity [product codes IT-009-F] o Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product code MR-001-F] o Vector measurements of local geomagnetic field [product codes AG-005-F, AG-006-F] o Solar data: ▪ SSN [product code SU-007-F] ▪ Solar index F10.7 [product code SU-008-F] ▪ X-ray flares [product code SU-001-F] ▪ Solar radiometric fluxes [product codes SU-027-F, SU-028-F, SU-029-F] ▪ Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F] ▪ CME propagation [products code SU-036-F] o Solar wind data: ▪ Solar wind bulk velocity [product codes L1-009-M, L1-009-N, L1-009-P, L1-009-F], ▪ Solar wind bulk velocity at L5 [product codes IP-003-M, IP-003-N, IP-003-P, IP-003-F].		

Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644 SWE-CRD-TIO-1645 SWE-CRD-TIO-1646 SWE-CRD-TIO-1647 SWE-CRD-TIO-1648 SWE-CRD-TIO-3033		
Related Requirements:		**Verification Method:**	

Service 5-2 is not required to deliver tools.
Service 5-2 is not required to deliver user's specific reports.

3.1.6.3. Service 5-3: Communication and Navigation - Quality assessment of ionospheric correction

SWE-SRD-12569			
The Space Weather System shall provide a Service 5-3: Communication and navigation - Quality assessment of ionospheric correction.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11148			
Service 5-3 shall provide information on whether standard corrections to GNSS signal are applicable, including for the TEC Core products a-posteriori and estimated parameters and near real-time alarms to indicate the level of degradation of ionospheric correction models with respect to the actual state of the ionosphere. This latter assessment shall be established by considering the update rate for the different service users among the following (defined in CRD by SWE-CRD-TIO-1650, SWE-CRD-TIO-1651 and SWE-CRD-TIO-1652): • Users of GNSS Single frequency services with average accuracy, no integrity (e.g. typical GNSS mass market user) • Users of GNSS Single frequency services with average accuracy, using integrity (e.g. EGNOS user) • Users of multi-frequency GNSS systems with very high accuracy (e.g. GNSS geodetic users, RTK).			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1634 SWE-CRD-TIO-1637 SWE-CRD-TIO-2652		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11149			
Service 5-3 shall use as inputs the data products (archived/a posteriori reconstruction, and nowcast) concerning TEC needed for the delivery of the archived data/products and nowcast to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.3.1. Data Policy Enforcement

SWE-SRD-11152			
Service 5-3 shall be a service for registered users only, delivering its outputs on request for the reconstruction/nowcast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.3.2. Handle service requests

SWE-SRD-11154			
The following set of user criteria shall be requested by service 5-3 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be recovered from archives / reconstructed / nowcasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11155			
Service 5-3 shall allow its users to specify freely the location and time frame for their reconstruction/nowcast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11160			
Service 5-3 shall inform its users informed of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.3.3. Deliver products/tools/reports

SWE-SRD-11156			
Service 5-3 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows: • Considered geographical area and altitude domain • Time span • Publication date • Flag indicating if information from third parties is included			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11157			

Service 5-3 shall request the user to identify which parameter to be recovered from archive, reconstructed a posteriori or nowcasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Recovery from archive, a posteriori reconstruction and nowcast of TEC core products including TEC maps and 3D electron density grids, complying with the Products Specification for product code IT-001-N, IT-001-P, IT-002-N, IT-002-P (includes too Height of maximum electron density in F2 layer)
• The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user,
• A description of the model used,
• More generally, nowcasted/reconstructed parameters as per user's request within the list below that encompasses the assessed ionosphere properties but too some of the inputs to the ionosphere models that the user may be interested in:
  ○ Ionosphere:
  ▪ Riometer data / Ionosonde measurements [product codes IT-005-N , IT-005-P]
  ▪ URSI ionospheric parameter values [product codes IT-006-N, IT-006-P]
  ▪ Ionospheric scintillation, location and intensity [product codes IT-009-N, IT-009-P]
  ○ Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-P]
  ○ Vector measurements of local geomagnetic field [product codes AG-005-N, AG-006-N, AG-005-P, AG-006-P]
  ○ Solar data:
  ▪ SSN [product codes SU-007-N, SU-007-P]
  ▪ Solar index F10.7 [product codes SU-008-N, SU-008-P]
  ▪ X-ray flares [product codes SU-001-N, SU-001-P]
  ▪ Solar radiometric fluxes [product codes SU-027-N, SU-027-P, SU-028-N, SU-028-P, SU-029-N, SU-029-P]			

▪ Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F] ▪ CME propagation [products code SU-036-F] ○ Solar wind data: ▪ Solar wind bulk velocity [product codes L1-009-M, L1-009-N, L1-009-P, L1-009-F], ▪ Solar wind bulk velocity at L5 [product codes IP-003-M, IP-003-N, IP-003-P, IP-003-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644 SWE-CRD-TIO-1645 SWE-CRD-TIO-1646 SWE-CRD-TIO-1647 SWE-CRD-TIO-1648 SWE-CRD-TIO-3033		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12304			
Service 5-3 shall provide the alerts to the user by means of web-services with a refresh rate of one minute. Alerts shall be provided also by email and/or sms on request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 5-3 is not required to deliver tools.

3.1.6.4. Service 5-4: Communication and Navigation - Near real-time ionospheric scintillation maps

SWE-SRD-12570			
The Space Weather System shall provide a Service 5-4: Communication and navigation - Near real-time ionospheric scintillation maps.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11246			
Service 5-4 shall provide near real-time estimate of the scintillation maps, including near real time and forecast of ionospheric scintillations Index (S4) and sigma phase error (Sphi) for frequencies from UHF to C band (30 MHz to 5 GHz), and this for the following service users: • Users of GNSS Single frequency services with average accuracy, no integrity (e.g. typical GNSS mass market user) • Users of GNSS Single frequency services with average accuracy, using integrity (e.g. EGNOS user) • Users of multi-frequency GNSS systems with very high accuracy (e.g. GNSS geodetic users, RTK)			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1635		
Related Requirements:		**Verification Method:**	

SWE-SRD-11346			
Service 5-4 shall use as inputs the data products (nowcast and forecast) needed for the delivery of the nowcasts and forecasts to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.4.1. Handle service requests

SWE-SRD-11248			
The following set of user criteria shall be requested by service 5-4 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be provided as nowcast /forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11347			
Service 5-4 shall allow its users to specify freely the location and time frame for their nowcast/forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11348			
Service 5-4 shall inform its users informed of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.4.2. Deliver products/tools/reports

SWE-SRD-11250			
Service 5-4 shall request the user to identify which parameter to be nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Nowcast and forecast of scintillation maps including the following scintillation indices and parameters: S4, sigma_phi, fading depth, fade duration, time between fades, in compliance with the Products Specification for product codes IT-009-N, IT-009-F, • The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user, • A description of the model used, • More generally, nowcasted/reconstructed parameters as per user's request within the list below that encompasses the assessed ionosphere properties but too some of the inputs to the ionosphere models that the user may be interested in: o Ionosphere: ▪ Riometer data / Ionosonde measurements [product codes IT-005-N , IT-005-F] ▪ URSI ionospheric parameter values [product codes IT-006-N, IT-006-F] ▪ TEC maps and 3D electron density grids, [product codes IT-001-N, IT-001-F, IT-002-N, IT-002-F] (includes too Height of maximum electron density in F2 layer) o Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F] o Vector measurements of local geomagnetic field [product codes AG-005-N, AG-006-N, AG-005-F, AG-006-F] o Solar Data: ▪ SSN [product codes SU-007-N, SU-007-F] ▪ Solar index F10.7 [product codes SU-008-N, SU-008-F] ▪ X-ray flares [product codes SU-001-N, SU-001-F] ▪ Solar radiometric fluxes [product codes SU-027-N, SU-027-F, SU-028-N, SU-028-F, SU-029-N, SU-029-F] ▪ Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F] ▪ CME propagation [products code SU-036-F] o Solar wind data: ▪ Solar wind bulk velocity [product codes L1-009-M, L1-009-N, L1-009-P, L1-009-F], ▪ Solar wind bulk velocity at L5 [product codes IP-003-M, IP-003-N, IP-003-P, IP-003-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644		

	SWE-CRD-TIO-1645 SWE-CRD-TIO-1646 SWE-CRD-TIO-1647 SWE-CRD-TIO-1648		
Related Requirements:		**Verification Method:**	Design Review

Service 5-4 is not required to deliver tools.

Service 5-4 is not required to deliver user's specific reports.

3.1.6.5. Service 5-5: Communication and Navigation - Monitoring and forecast of ionospheric disturbances

SWE-SRD-12571			
The Space Weather System shall provide a Service 5-5: Communication and navigation - Monitoring and forecast of ionospheric disturbances.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11255			
Service 5-5 shall provide an estimate of the occurrence risk of ionospheric disturbances, including: • monitoring and detection of ionospheric phenomena causing local and regional disturbances of electron density in the European region • 24-hour forecast of ionospheric phenomena causing local and regional disturbances of electron density in the European region • detection of geomagnetic storms and local geomagnetic events • 24-hour forecast of the ionospheric scintillation Index (S4) and sigma phase error (Sphi) for frequencies from UHF to C band (30 MHz to 5 GHz) • 24-hour forecast of geomagnetic storms and local geomagnetic events • monitoring of ionospheric parameters for sub-ionospheric radio transmission • 24-hour forecast of ionospheric parameters for sub-ionospheric radio transmission • nowcast of expected impact on land HF communications due to solar flares and/or energetic particles events • forecast of expected impact on land HF communications due to solar flares and/or energetic particles events • nowcast and forecast of 3D electron density grids. Ionospheric phenomena shall explicitly include: trough, Travelling Ionospheric Disturbances (TIDs), patches, depletions and D-region absorption.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-TIO-1636 SWE-CRD-TIO-1637 SWE-CRD-TIO-2652 SWE-CRD-TIO-3027 SWE-CRD-TIO-3029 SWE-CRD-TIO-3030 SWE-CRD-TIO-3031		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11350			
Service 5-5 shall use as inputs the data products (nowcast and forecast) needed for the delivery of the nowcasts and forecasts to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.5.1. Data Policy Enforcement

SWE-SRD-11260			
Service 5-5 shall be a service for registered users only, delivering its outputs on request for the nowcast/forecast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.5.2. Handle service requests

SWE-SRD-11262			
The following set of user criteria shall be requested by service 5-5 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be provided as nowcast /forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11263			
Service 5-5 shall allow its users to specify freely the location and time frame for their nowcast/forecast requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11252			
Service 5-5 shall inform its users informed of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.6.5.3. Deliver products/tools/reports

SWE-SRD-11265			

Service 5-5 shall request the user to identify which parameter to be nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user:

- Monitoring and detection of:
  - Trough,
  - Travelling Ionospheric Disturbances (TIDs),
  - Patches,
  - Depletions
  - D-region absorption
  - complying with the Products Specification in compliance with the Products Specification for product codes IT-011-N, IT-011-F.
- The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user,
- More generally, nowcasted/reconstructed parameters as per user's request within the list below that encompasses the assessed ionosphere properties but too some of the inputs to the ionosphere models that the user may be interested in:
  - Ionosphere:
    - Riometer data / Ionosonde measurements [product codes IT-005-N , IT-005-F]
    - URSI ionospheric parameter values [product codes IT-006-N, IT-006-F]
    - Ionospheric scintillation, location and intensity [product codes IT-009-N, IT-009-F]
    - TEC maps and 3D electron density grids, [product codes IT-001-N, IT-001-F, IT-002-N, IT-002-F] (includes too Height of maximum electron density in F2 layer)
  - Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F]
  - Vector measurements of local geomagnetic field [product codes AG-005-N, AG-006-N, AG-005-F, AG-006-F]
  - Solar Data:
    - SSN [product codes SU-007-N, SU-007-F]
    - Solar index F10.7 [product codes SU-008-N, SU-008-F]
    - X-ray flares [product codes SU-001-N, SU-001-F]
    - Solar radiometric fluxes [product codes SU-027-N, SU-027-F, SU-028-N, SU-028-F, SU-029-N, SU-029-F]
    - Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F]
    - CME propagation [products code SU-036-F]
  - Solar wind data:
    - Solar wind bulk velocity [product codes L1-009-M, L1-009-N, L1-009-P, L1-009-F],
    - Solar wind bulk velocity at L5 [product codes IP-003-M, IP-003-N, IP-003-P, IP-003-F].

Justification:	

Comments:			
Source Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644 SWE-CRD-TIO-1645 SWE-CRD-TIO-1646 SWE-CRD-TIO-1647 SWE-CRD-TIO-1648		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11358			
Service 5-5 shall provide the alerts to the user by means of web-services with a refresh rate of one minute. Alerts shall also be provided by email and/or sms on request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 5-5 is not required to deliver tools.

3.1.6.6. Performance Requirements

SWE-SRD-9169			
For Users of GNSS Single frequency services with average accuracy, no integrity (e.g. typical GNSS mass market user), the data shall be obtained globally with a 5x2.5 degrees longitude-latitude 2D grid with an update not larger than 15 minutes.			
Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.		
Comments:	Adaptation of grid resolution in case of data gaps (e.g. for scintillation monitoring).		
Source Requirements:	SWE-CRD-TIO-1650		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9170			
For Users of: • GNSS Single frequency services with average accuracy, using integrity (e.g. EGNOS user), • Users of multi-frequency GNSS systems with average multifrequency accuracy, no integrity (commercial services, PRS),			

- Users of multi-frequency GNSS systems with average accuracy, integrity (aeronautical multifrequency),
- Users of multi-frequency GNSS systems with very high accuracy (e.g. GNSS geodetic users, RTK), and
- Users of satellite data communications with high availability / continuity (e.g. Search-and-Rescue, Air Traffic Control/Management via Satellite, high availability/continuity data networks such as Galileo Ground Segment Data Network) and for other space-based services/products users affected by the ionosphere (UHF - C-band radars, GNSS-R altimetry, UHF/low microwave radioastronomy and deep space communications),

Data shall be obtained globally with a 1x1 degrees lon-lat 2D grid with an update not larger than 5 minutes.

Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.		
Comments:			
Source Requirements:	SWE-CRD-TIO-1651		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9171			
3D grid data shall be obtained for specific regions with a 1x1 degree spatial resolution and vertical resolution of ~100 km with an update not larger than 5 minutes.			
Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.		
Comments:			
Source Requirements:	SWE-CRD-TIO-1652		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9173			
For Height of maximum electron density in F2 layer, URSI ionospheric parameter values and Vector measurements of local geomagnetic field, the data shall be available with an update not larger than 1 hour.			
Justification:	Takes into account spatial scale of disturbances affecting the user.		
Comments:			
Source Requirements:	SWE-CRD-TIO-1654		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20247			
The Space Weather System shall translate information from the physics domain (e.g. scintillation maps) to the position domain that is relevant for the end user.			
Justification:	Users typically assess uncertainty in terms of position.		
Comments:			
Source Requirements:	SWE-CRD-TIO-3024		
Related Requirements:		**Verification Method:**	

SWE-SRD-20248			
Provision of precise ionospheric information along with uncertainties			
Justification:	Users including e.g. EGNOS in SWE-CRD-TIO-USR-02 may need precise maps provided along with associated uncertainties to check whether the broadcast ionosphere is giving misleading information. Furthermore, for navigation techniques such as PPP-RTK or Fast PPP (SWE-CRD-TIO-USR-05) not only the value of the ionosphere is important but the uncertainty in it. This is because the ionosphere is used in multi-frequency systems for convergence of the position.		
Comments:			
Source Requirements:	SWE-CRD-GEN-3267		
Related Requirements:		**Verification Method:**	

3.1.7. Domain 6 services - Space Traffic coordination

3.1.7.1. Service 6-1: Space Traffic coordination – Atmospheric estimates for drag calculation

SWE-SRD-12572			
The Space Weather System shall provide a Service 6-1: Space Traffic Coordination – Atmospheric estimates for drag calculation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11281			
Service 6-1 shall provide an estimate of the atmospheric density including: • relevant environmental data for the user to compute drag of spacecraft • atmospheric density estimate for at least one year • atmospheric density forecast • thermospheric density estimates to compute drag of spacecraft at altitudes below which drag exceeds 1% of the overall forces acting on the spacecraft.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3015 SWE-CRD-STC-3095 SWE-CRD-STC-3099 SWE-CRD-STC-3096		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11359			
Service 6-1 shall use as inputs the data products (archived/a posteriori reconstruction, and forecast) concerning atmospheric density needed for the delivery of the archived data/products and forecast to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.1.1. Handle service requests

SWE-SRD-11360			
The following set of user criteria shall be requested by service 6-1 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to be recovered from archive / reconstructed / forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11361			
Service 6-1 shall allow its users to specify freely the location and time frame for their requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11366			
Service 6-1 shall inform its users informed of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.1.2. Deliver products/tools/reports

SWE-SRD-11363			
Service 6-1 shall request the user to identify which parameter to be to be recovered from archives or reconstructed or forecasted within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Recovery from archives, a posteriori reconstruction and forecast of atmospheric density complying with the Products Specification for product code AG-007-P, AG-007-F • The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user, • A description of the model used, • More generally, parameters to be recovered from archives, reconstructed or forecasted as per user's request within the list below that encompasses the assessed atmosphere properties but too some of the inputs to the drag calculation models that the user may be interested in: o Indices: geomagnetic (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P, MR-002-F, MR-003-F, MR-004-F], solar (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P, SU-006-F, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P, SU-013-F, L1-008-F], o Ionospheric electron density as a function of altitude: TEC maps and 3D electron density grids, [product codes IT-001-P, IT-001-F, IT-002-P, IT-002-F] (includes also Height of maximum electron density in F2 layer).			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3104 SWE-CRD-STC-3105 SWE-CRD-STC-3106		
Related Requirements:		**Verification Method:**	Design Review

Service 6-1 is not required to deliver tools.
Service 6-1 is not required to deliver user's specific reports.

3.1.7.2. Service 6-2: Space Traffic coordination – Archive of geomagnetic and solar indices for drag calculation

SWE-SRD-12573			
The Space Weather System shall provide a Service 6-2: Space Traffic Coordination – Archive of geomagnetic and solar indices for drag calculation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11286			
Service 6-2 shall provide the user with past values of data relevant to drag calculation, including: • an archive of geomagnetic indices for at least one year • an archive of solar indices for at least one year			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3095 SWE-CRD-STC-3101 SWE-CRD-STC-3103		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11370			
Service 6-2 shall use as inputs the data products needed for the delivery of the archived index data to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.2.1. Handle service requests

SWE-SRD-11373			
The following set of user criteria shall be requested by service 6-2 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to be recovered from archive / reconstructed			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11374			
Service 6-2 shall allow its users to specify freely the location and time frame for their requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.2.2. Deliver products/tools/reports

SWE-SRD-11376			
Service 6-2 shall request the user to identify which parameter will be recovered from archives within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • geomagnetic indices (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P], • solar indices (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-P, SU-008-M, SU-008-P, SU-009-P, SU-010-P, SU-011-P, SU-012-P], • and other indices (IG12, IMF) [product codes SU-013-P, L1-008-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3104 SWE-CRD-STC-3105		
Related Requirements:		**Verification Method:**	Design Review

Service 6-2 is not required to deliver tools.

Service 6-2 is not required to deliver user's specific reports.

3.1.7.3. Service 6-3: Space Traffic coordination – Nowcast and forecast of geomagnetic and solar indices for drag calculation

SWE-SRD-12574			
The Space Weather System shall provide a Service 6-3: Space Traffic Coordination – Forecast of geomagnetic and solar indices for drag calculation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11291			
Service 6-3 shall provide nowcasts and forecasts for drag calculation, including: • either a long-term (100-200 year) forecast of solar and geomagnetic indices or a long-term atmospheric density forecast for the same period, with the forecast updated annually • forecast values of geomagnetic activity indices used in atmosphere models (e.g., Ap, Kp, Dst and other indices depending on the models used by the user) with associated confidence level. • forecast values of solar activity indices used in atmosphere models (R, F10.7, F30, S10, E10, M10, Y10 and other indices depending on the models used by the user)			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3014 SWE-CRD-STC-3100 SWE-CRD-STC-3102		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11407			
Service 6-3 shall use as inputs the data products (forecast) needed for the delivery of the data to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.3.1. Handle service requests

SWE-SRD-11381			
The following set of user criteria shall be requested by service 6-3 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to forecasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11380			
Service 6-3 shall allow its users to specify freely the location and time frame for their requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11382			
Service 6-3 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.3.2. Deliver products/tools/reports

SWE-SRD-11384			
Service 6-3 shall request the user to identify which parameter to be forecasted within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • geomagnetic indices (Kp, Ap, Dst) [product codes MR-002-F, MR-003-F, MR-004-F], • solar indices (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-F, SU-008-M, SU-008-F, SU-009-F, SU-010-F, SU-011-F, SU-012-F], • and other indices (IG12, IMF) [product codes SU-013-F, L1-008-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3104 SWE-CRD-STC-3105		
Related Requirements:		**Verification Method:**	Design Review

Service 6-3 is not required to deliver tools.
Service 6-3 is not required to deliver user's specific reports.

3.1.7.4. Service 6-4: Space Traffic coordination – Nowcast of ionospheric group delay

SWE-SRD-12575			
The Space Weather System shall provide a Service 6-4: Space Traffic Coordination – Nowcast of ionospheric group delay.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11296			
Service 6-4 shall provide nowcast of ionospheric group delay to estimate effects on radar signal including: • relevant environmental data to estimate ionospheric refraction of radio waves • relevant environmental data to estimate ionospheric group delay			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3097 SWE-CRD-STC-3098		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11411			
Service 6-4 shall use as inputs the data products (nowcast) needed for the delivery of the data to the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.4.1. Handle service requests

SWE-SRD-11389			
The following set of user criteria shall be requested by service 6-4 prior to the generation of the outputs of the service: • Location / area • Altitude domain • Time span • Parameters to nowcast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11390			
Service 6-4 shall allow its users to specify freely the location and time frame for their requests, within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11388			
Service 6-4 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.7.4.2. Deliver products/tools/reports

SWE-SRD-11392			
Service 6-4 shall request the user to identify which parameter to be nowcasted within the list of data products below the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Nowcast of ionospheric group delay complying with the Products Specification for product codes IT-001-N, IT-002-N • The assumptions and inputs obtained from the data products used for the elaboration of the prediction delivered to the user, • A description of the model used, • More generally, nowcast parameters as per user's request within the list below that encompasses some of the inputs to the ionospheric group delay calculation models that the user may be interested in: o geomagnetic indices (Kp, Ap, Dst) [product codes MR-002-N, MR-003-N, MR-004-N], o solar indices (R, F10.7, S10, E10, M10, Y10) [product codes SU-006-N, SU-008-M, SU-008-N, SU-009-N, SU-010-N, SU-011-N, SU-012-N], o and other indices (IG12, IMF) [product codes SU-013-N, L1-008-N].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-STC-3104 SWE-CRD-STC-3105 SWE-CRD-STC-3106		
Related Requirements:		**Verification Method:**	Design Review

Service 6-4 is not required to deliver tools.
Service 6-4 is not required to deliver user's specific reports.

3.1.7.5. Performance Requirements

SWE-SRD-9174			
For service domain 6, the Space Weather System shall provide for surveillance and tracking centre(s), stations and service users forecast of all specified data with daily updates.			
Justification:	Should be greater or equal to update time of Space Weather System orbit calculation.		
Comments:	This is meant for all specified data needed by surveillance and tracking centres, station and service users. The forecasts shall be made for hours, days, weeks and months ahead.		
Source Requirements:	SWE-CRD-STC-3107		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9175			
For service domain 6, the Space Weather System shall provide following updates of the forecast specifically meant for spacecraft operators: • a daily update of a forecast with a time period of 27 days, • and a monthly update of forecast with a time period of 11 years.			
Justification:	Should be greater or equal to update time of Space Weather System orbit calculation.		
Comments:			
Source Requirements:	SWE-CRD-STC-3108		
Related Requirements:		**Verification Method:**	Design Review Test

3.1.8. Domain 7 services – Power system operation

3.1.8.1. Service 7-1: Power system operation – Service to power system operators

SWE-SRD-12576			
The Space Weather System shall provide a Service 7-1: Service to power system operation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11301	
Service 7-1 shall provide nowcast and forecast of GIC in power systems based on local magnetometer networks and solar wind data (in case of forecasts), including: • a tailored service for the analysis and forecasting of GICs throughout the power system • nowcast, forecast and alerts of interplanetary, geomagnetic and geoelectric data and disturbances • a post-event analysis toolkit	
Justification:	a tailored service for the analysis and forecasting of GICs throughout the power system nowcast, forecast and alerts of interplanetary, geomagnetic and geoelectric data and disturbances a post-event analysis toolkit
Comments:	• A tailored service for generating Network maps showing GICs throughout the power system • A tailored service for specific users providing a table of modelled GIC values for the Users network in the last minute and peak GIC in the last 60 mins • Nowcast, forecast and alerts of dB/dt at specific user-defined locations • Global 27-day forecast of geomagnetic activity • Local forecast of geomagnetic activity from 15 min ahead up to 2-3 days ahead. • Nowcast and forecast network maps of the geoelectric field variations in the vicinity of a user's ground infrastructure • Forecast network maps of GICs in the vicinity of a user's ground infrastructure, and a GIC risk index • Forecasts of transient and recurrent IMF Bz features, with 5-day lead time A post-event analysis toolkit shall also be provided.
Source Requirements:	SWE-CRD-POW-3057 SWE-CRD-POW-3058 SWE-CRD-POW-3059

	SWE-CRD-POW-3060 SWE-CRD-POW-3061 SWE-CRD-POW-3066 SWE-CRD-POW-3067 SWE-CRD-POW-3068 SWE-CRD-POW-3069 SWE-CRD-POW-3071 SWE-CRD-POW-3072 SWE-CRD-POW-3073 SWE-CRD-POW-3112		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11415			
Service 7-1 shall use as inputs the data products needed for the delivery of the data required by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.8.1.1. Data Policy Enforcement

SWE-SRD-11395			
Service 7-1 shall be a service for registered users only, delivering its outputs on request for the archive/reconstruction/nowcast/forecast services and the tools, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.8.1.2. Handle service requests

SWE-SRD-11397			
The following set of user criteria shall be requested by service 7-1 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to be recovered from archive / reconstructed / nowcasted / forecasted • Information on user's system (e.g. network map for tailored service) • Magnetotelluric data for the vicinity of a user's system and/or ground infrastructure • Ground conductivity model(s)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11398			
Service 7-1 shall allow its users to specify freely the location and time frame for their request within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11396			
Service 7-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11807			
Service 7-1 shall inform the user of any limitations to the service that may occur if they are unable to provide system specific information for service tailoring purposes.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.8.1.3. Deliver products/tools/reports

SWE-SRD-11400			
Service 7-1 shall request the user to identify which parameters to be recovered from archive, reconstructed, nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Auroral visible and UV imaging (archives and nowcast) [product codes AG-001-P, AG-001-M, AG-001-N, AG-002-P, AG-002-M, AG-002-N,], • Geomagnetic field disturbances (including from Network of magnetometer measurements in vicinity of customer, including dB/dt) [product codes AG-005-P, AG-005-M, AG-005-N, AG-005-F], • Local geoelectric field on ground [product codes AG-006-P, AG-006-N, AG-006-F], • Solar Wind velocity, density and magnetic field at L1 [product codes L1-008-P, L1-009-P, L1-010-P, L1-008-M, L1-009-M, L1-010-M, L1-008-N, L1-009-N, L1-010-N, L1-008-F, L1-009-F, L1-010-F], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P, IP-003-M, IP-004-M, IP-006-M, IP-003-N, IP-004-N, IP-006-N, IP-003-F, IP-004-F, IP-006-F], • Solar disk, coronal (coronagraph) and heliospheric imaging [including product codes SU-015-P, SU-017-P, SU-020-P, SU-022-P, SU-025-P, SU-32-P, SU-015-M, SU-017-M, SU-020-M, SU-022-M, SU-025-M, SU-32-M, SU-015-N, SU-017-N, SU-020-N, SU-022-N, SU-025-N, SU-32-N, SU-015-F, SU-017-F, SU-020-F, SU-022-F, SU-025-F, SU-32-F], • Solar disk, coronagraphic and heliospheric imaging from L5 [including product codes SU-040-P, SU-041-P, SU-045-P, SU-050-P, SU-040-M, SU-041-M, SU-045-M, SU-050-M, SU-040-N, SU-041-N, SU-045-N, SU-050-N, SU-040-F, SU-041-F, SU-045-F, SU-050-F], • Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F], • Geomagnetic indices: (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P, MR-002-N, MR-003-N, MR-004-N, MR-002-F, MR-003-F, MR-004-F], • Geomagnetic indices: (AE, AL, AU, PC, AZ) [product codes MR-019-P, MR-020-P, MR-023-P, MR-019-N, MR-020-N, MR-023-N, MR-019-F, MR-020-F, MR-023-F], • Magnetotelluric data [AG-010-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-POW-3062 SWE-CRD-POW-3064 SWE-CRD-POW-3113 SWE-CRD-POW-3114 SWE-CRD-POW-3115 SWE-CRD-POW-3116 SWE-CRD-POW-3118 SWE-CRD-POW-3249 SWE-CRD-POW-3261		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11401			
Service 7-1 shall deliver tools to power grid operators for post-event analysis: those tools shall provide the capability to show geomagnetically induced currents on a network map throughout the power system and generate tables of modelled GIC values for the users' network.			
Justification:			
Comments:	The tools may be available for download. Alternatively, these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11420			
Service 7-1 shall, upon request from a user and with the thresholds defined by the user, provide a forecast of geomagnetic activity for 15 minutes to 27 days ahead.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11421			
Service 7-1 shall provide the alerts to the user by mean of web-services with a refresh rate less than 15mins. Alerts shall also be provided by email and/or sms on request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.8.2. Performance Requirements

SWE-SRD-9183			
GIC nowcasts shall be provided in as close to near real-time as possible.			
Justification:	Operators require maximum time to react following detection of GIC exceeding threshold for safe operation.		
Comments:			
Source Requirements:	SWE-CRD-POW-3119		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20249			
Forecasts of transient and recurrent IMF Bz features should be provided with a target accuracy of +/- 6 hours.			
Justification:	Advanced warning of conditions likely to lead to enhanced GIC.		
Comments:			
Source Requirements:	SWE-CRD-POW-3070		
Related Requirements:		**Verification Method:**	

3.1.9. Domain 8 services – Pipeline operation

3.1.9.1. Service 8-1: Pipeline operation – Service to pipeline operator

SWE-SRD-12577			
The Space Weather System shall provide a Service 8-1 Service to Pipeline operation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11306			
Service 8-1 shall provide nowcast and forecast of Geoelectric field in vicinity of pipelines based on local magnetometer networks and solar wind data, and: • a tailored service for the analysis and forecasting of GICs throughout the system, including pipeline- and network-specific details • nowcast, forecast and alerts of interplanetary, geomagnetic and geoelectric data and disturbances • a post-event analysis toolkit			
Justification:			
Comments:	• a tailored service for specific users providing a table of modelled GIC values for the users network in the last minute and peak GIC in the last 60 mins • information on current densities and corrosion rates in users pipelines • a tailored service for specific users providing Pipe-to-soil potential difference (PSP) variations in the users pipe network • global monitoring of geomagnetic activity • forecast, nowcast and alerts (including thresholds) of dB/dt at specific user-defined locations. • global forecast of geomagnetic activity from 15 min ahead up to 27 days ahead • a tailored service for specific users providing time-dependent maps of geoelectric field variations for the users' ground infrastructure • data and tools to support pipeline operators in post-event analysis		
Source Requirements:	SWE-CRD-PPL-3000 SWE-CRD-PPL-3001 SWE-CRD-PPL-3002 SWE-CRD-PPL-3003 SWE-CRD-PPL-3004 SWE-CRD-PPL-3005		

	SWE-CRD-PPL-3006 SWE-CRD-PPL-3135 SWE-CRD-PPL-3136 SWE-CRD-PPL-3137		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11417			
Service 8-1 shall use as inputs the data products needed for the delivery of the data required by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.9.1.1. Data Policy Enforcement

SWE-SRD-11426			
Service 8-1 shall be a service for registered users only, delivering its outputs on request for the nowcast/forecast services and the tools, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.9.1.2. Handle service request

SWE-SRD-11428			
The following set of user criteria shall be requested by service 8-1 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to be nowcast / forecast • Specific technical characteristics of pipeline			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11429			
Service 8-1 shall allow its users to specify freely the location and time frame for their request within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11430			
Service 8-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11808			
Service 8-1 shall inform the user of any limitations to the service that may occur if they are unable to provide system specific information for service tailoring purposes.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.9.1.3. Deliver products/tools/reports

SWE-SRD-11432			
Service 8-1 shall request the user to identify which parameters to nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Geomagnetic Field disturbances (including from Network of magnetometer measurements in vicinity of customer, including dB/dt) [product codes AG-005-M, AG-005-N, AG-005-F], • Local geoelectric field on ground [product codes AG-006-N, AG-006-F], • Solar Wind velocity, density and magnetic field at L1 [product codes L1-008-N, L1-009-N, L1-010-N, L1-008-F, L1-009-F, L1-010-F], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-N, IP-004-N, IP-006-N, IP-003-F, IP-004-F, IP-006-F], • Solar disk, coronal (coronagraph) and heliospheric imaging [including product codes SU-015-N, SU-017-N, SU-020-N, SU-022-N, SU-025-N, SU-32-N, SU-015-F, SU-017-F, SU-020-F, SU-022-F, SU-025-F, SU-32-F], • Solar disk, coronagraphic and heliospheric imaging from L5 [including product codes SU-040-N, SU-041-N, SU-045-N, SU-050-N, SU-040-F, SU-041-F, SU-045-F, SU-050-F], • Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F], • Geomagnetic indices: (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P, MR-002-N, MR-003-N, MR-004-N, MR-002-F, MR-003-F, MR-004-F], • Geomagnetic indices: (AE, AL, AU, PC, AZ) [product codes MR-019-P, MR-020-P, MR-023-P, MR-019-N, MR-020-N, MR-023-N, MR-019-F, MR-020-F, MR-023-F], • Solar X-ray flux [product codes SU-027-P, SU-027-M, SU-027-N, SU-027-F], • Magnetotelluric data [AG-010-P].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-PPL-3007 SWE-CRD-PPL-3063 SWE-CRD-PPL-3065 SWE-CRD-PPL-3138 SWE-CRD-PPL-3139 SWE-CRD-PPL-3140 SWE-CRD-PPL-3141 SWE-CRD-PPL-3142 SWE-CRD-PPL-3143 SWE-CRD-PPL-3262		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11437			
Service 8-1 shall deliver tools to pipeline operators for post-event analysis: those tools shall compute the Pipe-to-soil potential difference (PSP) variations in the users pipe network, and shall generate the tables of modelled PSP values for the network.			
Justification:			
Comments:	The tools may be available for download. Alternatively, these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11438			
Service 8-1 shall, upon request from a user and with the thresholds defined by the user, provide a local and global forecast of geomagnetic activity from 15min ahead to 27 days ahead.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11439			
Service 8-1 shall provide the alerts to the user by means of web-services with a refresh rate less than 15minutes. Alerts shall also be provided by email and/or sms on request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11440			
Service 8-1 shall offer a tailored service for specific users providing time-dependent maps of geoelectric field variations for the users´ ground infrastructure, in compliance with the Products Specification requirements applicable to product codes AG-006-P, AG-006-N, AG-006-F.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.9.2. Performance Requirements

SWE-SRD-20250			
GIC nowcasts shall be provided in as close to near real-time as possible.			
Justification:	Operators require maximum time to react following detection of GIC exceeding threshold for safe operation.		
Comments:			
Source Requirements:	SWE-CRD-PPL-3114		
Related Requirements:		**Verification Method:**	

3.1.10. Domain 9 services – Aviation

3.1.10.1. Service 9-1: Aviation – Service to aviation operation

SWE-SRD-12578			
The Space Weather System shall provide a Service 9-1: Service to Aviation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11311	
Service 9-1 shall provide data relating to increased radiation levels at aircraft altitudes and degraded communications, in particular for high-latitude routes, including: • a tailored service for radiation impacts on crew, passengers, avionics and communications • a tailored service for interplanetary and ionospheric impacts on communications and navigation systems • nowcast, forecast and alerts of interplanetary, geomagnetic and geoelectric data and disturbances • post-event analysis data and tools	
Justification:	
Comments:	• nowcast and forecast of radiation storms with energies affecting crew and passengers (forecasts 6, 12, 18, 24 hours ahead) • nowcast and forecast of expected impact for HF communications (forecasts 6, 12, 18, 24 hours ahead) • nowcast and forecast of expected impact for satellite communications (forecasts 6, 12, 18, 24 hours ahead) • nowcast and forecast of expected impact for on GNSS (forecasts 6, 12, 18, 24 hours ahead) • graphical forecast including intensity, onset, duration and boundary of degraded HF and SATCOM communications for polar routes (6, 12, 18, 24 hours ahead) • post event information on radiation levels on a series of pre-defined routes used by commercial airlines (<1 week delay if significant activity). • maps of probability of losing communication and maps of degree of navigation signal degradation • monitoring and detection of ionospheric phenomena causing local disturbances of electron density. These shall explicitly include: trough, Travelling Ionospheric Disturbances (TIDs), patches, depletions and D-region absorption and post-storm depression

	• near real-time solar radio measurements and notifications on frequencies that could affect aviation operations 1-2GHz • estimation of the potential impact of solar radio emissions on aviation radar • prediction of the radiation dose during the GLE, in the extent of hours • cosmic ray dose forecasts of up to one year for a given airline flight defined by the user. • short term (<30mins) warnings of radiation storms with energies affecting crew and passengers • statistical information on radiation environment at aircraft altitude for avionics • radiation and ionospheric data for post-event analyses • global near real-time and forecast TEC maps on medium and large scales.		
Source Requirements:	SWE-CRD-AVI-3039 SWE-CRD-AVI-3040 SWE-CRD-AVI-3041 SWE-CRD-AVI-3042 SWE-CRD-AVI-3043 SWE-CRD-AVI-3044 SWE-CRD-AVI-3045 SWE-CRD-AVI-3046 SWE-CRD-AVI-3049 SWE-CRD-AVI-3050 SWE-CRD-AVI-3051 SWE-CRD-AVI-3053 SWE-CRD-AVI-3054 SWE-CRD-AVI-3055 SWE-CRD-AVI-3056 SWE-CRD-AVI-3120 SWE-CRD-AVI-3121 SWE-CRD-AVI-3122 SWE-CRD-AVI-3123 SWE-CRD-AVI-3244 SWE-CRD-AVI-3245		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11442			
Service 9-1 shall use as inputs the data products needed for the delivery of the data required by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.10.1.1. Data Policy Enforcement

SWE-SRD-11418			
Service 9-1 shall be a service for registered users only, delivering its outputs on request for the archive/reconstruction/nowcast/forecast services, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.10.1.2. Handle service requests

SWE-SRD-11427			
The following set of user criteria shall be requested by service 9-1 prior to the generation of the outputs of the service: • Location / area / route • Time span • Parameters to be recovered from archive / reconstructed / nowcasted / forecasted			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11419			
Service 9-1 shall allow its users to specify freely the location and time frame for their request within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11422			
Service 9-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.10.1.3. Deliver products/tools/reports

SWE-SRD-11444			

Service 9-1 shall request the user to identify which parameters to be recovered from archive, reconstructed, nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Solar data:
  ○ X-ray flux [product codes SU-027-P, SU-027-M, SU-027-N, SU-027-F]
  ○ SSN [product codes SU-007-N, SU-007-F]
  ○ Solar index F10.7 [product codes SU-008-N, SU-008-F]
  ○ Radio burst detection and characterisation [product codes SU-035-M, SU-035-N, SU-035-P, SU-035-F]
  ○ Solar disk and coronal imaging (coronagraph) and heliospheric imaging [including product codes SU-015-N, SU-017-N, SU-020-N, SU-022-N, SU-025-N, SU-32-N, SU-015-F, SU-017-F, SU-020-F, SU-022-F, SU- SU-025-F, SU-32-F],
  ○ Solar disk, coronagraphic and heliospheric imaging from L5 [including product codes SU-040-N, SU-041-N, SU-045-N, SU-050-N, SU-040-F, SU-041-F, SU-045-F, SU-050-F],
  ○ Near real-time and archived measurements of atmospheric neutrons [product codes AG-008-P, AG-008-M]
  ○ Near real-time and archive of measurements of interplanetary 1 MeV to >100 MeV protons [product codes L1-001-P, L1-003-P, L1-001-M, L1-003-M]
  ○ Solar Wind velocity, density and magnetic field at L1 [product codes L1-008-N, L1-009-N, L1-010-N, L1-008-F, L1-009-F, L1-010-F],
  ○ Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-N, IP-004-N, IP-006-N, IP-003-F, IP-004-F, IP-006-F],
  ○ Ionospheric data:
  ▪ Riometer data / Ionosonde measurements [product codes IT-005-N , IT-005-F]
  ▪ URSI ionospheric parameter values [product codes IT-006-N, IT-006-F]
  ▪ Ionospheric scintillation, location and intensity [product codes IT-009-N, IT-009-F]
  ▪ TEC maps and 3D electron density grids on medium and large scales, [product codes IT-001-N, IT-001-F, IT-002-N, IT-002-F] (includes too Height of maximum electron density in F2 layer)			

○ Dose at aircraft altitudes [product codes SC-009-P, SC-009-N].			
Justification:			
Comments:	Anisotropy data generally, but particularly during GLEs, is required for accurate dose estimation		
Source Requirements:	SWE-CRD-AVI-3048 SWE-CRD-AVI-3052 SWE-CRD-AVI-3124 SWE-CRD-AVI-3125 SWE-CRD-AVI-3126 SWE-CRD-AVI-3127 SWE-CRD-AVI-3128 SWE-CRD-AVI-3129 SWE-CRD-AVI-3131 SWE-CRD-AVI-3132 SWE-CRD-AVI-3150 SWE-CRD-AVI-3151 SWE-CRD-AVI-3152 SWE-CRD-AVI-3163 SWE-CRD-AVI-3168 SWE-CRD-AVI-3268		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11454			
Service 9-1 shall offer a tailored service for its users by providing according to their route: • cosmic ray dose forecasts of up to one year for a given airline flight defined by the user • forecast of radiation storms with energies affecting crew and passengers (6, 12, 18, 24 hours ahead) • short term (<30mins) warnings of radiation storms with energies affecting crew and passengers (radiation end-of-quiet and all quiet alerts) • post event information on radiation levels (atmospheric neutrons) on a series of pre-defined routes used by commercial airlines (<1 week delay if significant activity) • statistical information on radiation environment at aircraft altitude for avionics.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11809			
Service 9-1 shall offer a tailored service for its users by providing according to their route: • graphical forecast including intensity, onset, duration and boundary of degraded HF and SATCOM communications for polar routes (6, 12, 18, 24 hours ahead).			
Justification:	Assists with route selection and management, emergency response.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.10.2. Performance Requirements

SWE-SRD-9180			
Data relating to airline critical communications shall be obtained for specific regions with an update not larger than 30 minutes.			
Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.		
Comments:			
Source Requirements:	SWE-CRD-AVI-3133		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9181			
Data relating to precise location determination shall be obtained for specific regions with narrow 3D volumetric grid with an update not larger than 30 minutes.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-AVI-3134		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20251			
Updated information on space weather phenomena shall be issued as necessary but at least every six hours until such time as the space weather phenomena is no longer detected and/or is no longer expected to have an impact.			
Justification:	Notification during disturbed conditions is essential for the user.		
Comments:			
Source Requirements:	SWE-CRD-AVI-3047		
Related Requirements:		**Verification Method:**	

SWE-SRD-20252			
Altitude range for radiation nowcast and forecast products shall extend to 100km altitude.			
Justification:	Extended altitude range takes into account radiation dose dur to GCR for sub-orbital space tourism.		
Comments:			
Source Requirements:	SWE-CRD-AVI-3269		
Related Requirements:		**Verification Method:**	

3.1.11. Domain 10 services – Resource exploration and exploitation

3.1.11.1. Service 10-1: Resource exploration and exploitation – Service to resource exploitation and exploitation operation

SWE-SRD-12579			
The Space Weather System shall provide a Service 10-1: Service to Resource exploration and exploitation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11316	
Service 10-1 shall provide forecast and nowcast of disturbed magnetic conditions in the vicinity of high latitude magnetometer stations, coupled with precise information on position, and including: • a tailored local geomagnetic activity service supporting aeromagnetic surveying and directional drilling • nowcast, forecast and alerts of ionospheric and geomagnetic data and disturbances • a post-event analysis toolkit	
Justification:	
Comments:	Service shall be tailored to resource exploitation system operators include geomagnetic prospecting and surveying companies or organisations require near real-time data on geomagnetic disturbances together with precise positioning location from GNSS services. • nowcast and forecast (0-8hr, 24-48hr) of local geomagnetic activity for aeromagnetic surveys • nowcast and forecast (0-8hr, 24-48hr) of local geomagnetic activity for directional drilling at customer-specified locations with amplitude greater than 1-10 nT • "All-quiet conditions" geomagnetic forecast with an 8-hour lead time • nowcast and forecast of global ionospheric scintillation maps, and alerts and data • global near real-time and forecast TEC maps on medium and large scales • data and tools to support drilling operators in post-event analysis
Source Requirements:	SWE-CRD-RES-3074 SWE-CRD-RES-3075 SWE-CRD-RES-3077 SWE-CRD-RES-3078

	SWE-CRD-RES-3079 SWE-CRD-RES-3168 SWE-CRD-RES-3169 SWE-CRD-RES-3170 SWE-CRD-RES-3171 SWE-CRD-RES-3172 SWE-CRD-RES-3173		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11447			
Service 10-1 shall use as inputs the data products needed for the delivery of the data required by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.11.1.1. Data Policy Enforcement

SWE-SRD-11456			
Service 10-1 shall be a service for registered users only, delivering its outputs on request for the nowcast/forecast services and the tools, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.11.1.2. Handle service requests

SWE-SRD-11458			
The following set of user criteria shall be requested by service 10-1 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to be nowcast / forecast / reconstructed			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11459			
Service 10-1 shall allow its users to specify freely the location and time frame for their request within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11457			
Service 10-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.11.1.3. Deliver products/tools/reports

SWE-SRD-11461			
Service 10-1 shall request the user to identify which parameters to nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user: • Geomagnetic field disturbances (including from Network of magnetometer measurements in vicinity of customer, including dB/dt) [product codes AG-005-M, AG-005-N, AG-005-F], • Local geoelectric field on ground [product codes AG-006-N, AG-006-F], • Solar Wind velocity, density and magnetic field at L1 [product codes L1-008-N, L1-009-N, L1-010-N, L1-008-F, L1-009-F, L1-010-F], • Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-N, IP-004-N, IP-006-N, IP-003-F, IP-004-F, IP-006-F], • Solar data: o X-ray flux [product codes SU-027-P, SU-027-M, SU-027-N, SU-027-F] o Solar disk and coronal (coronagraph) and heliospheric imaging [including product codes SU-015-N, SU-017-N, SU-020-N, SU-022-N, SU-025-N, SU-32-N, SU-015-F, SU-017-F, SU-020-F, SU-022-F, SU- SU-025-F, SU-32-F], o Solar disk, coronagraphic and heliospheric imaging from L5 [including product codes SU-040-N, SU-041-N, SU-045-N, SU-050-N, SU-040-F, SU-041-F, SU-045-F, SU-050-F], • Ionosphere: o Ionospheric scintillation, location and intensity [product codes IT-009-N, IT-009-F] o TEC maps and 3D electron density grids, [product codes IT-001-N, IT-001-F, IT-002-N, IT-002-F] (includes too Height of maximum electron density in F2 layer)			

• Local magnetospheric magnetic field for aeromagnetic surveys at customer-specified locations with amplitude greater than 1-10 nT (including from Network of magnetometer measurements in vicinity of customer, including dB/dt) [product codes AG-005-P, AG-005-M, AG-005-N, AG-005-F], • Local geoelectric field for aeromagnetic surveys at customer-specified locations with amplitude greater than 1-10 nT [product codes AG-006-P, AG-006-N, AG-006-F], • Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F], • Geomagnetic indices: (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P, MR-002-N, MR-003-N, MR-004-N, MR-002-F, MR-003-F, MR-004-F], • Geomagnetic indices: (AE, AL, AU, PC, AZ) [product codes MR-019-P, MR-020-P, MR-023-P, MR-019-N, MR-020-N, MR-023-N, MR-019-F, MR-020-F, MR-023-F], • Auroral Particle Precipitation [product codes MR-018-P, MR-018-N, MR-018-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-RES-3076 SWE-CRD-RES-3174 SWE-CRD-RES-3175 SWE-CRD-RES-3176 SWE-CRD-RES-3177 SWE-CRD-RES-3178 SWE-CRD-RES-3179 SWE-CRD-RES-3180 SWE-CRD-RES-3181 SWE-CRD-RES-3253 SWE-CRD-RES-3264		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11463			
Service 10-1 shall deliver tools to drilling operators: those tools shall compute the consequences of the local fluctuations of the geomagnetic field on the accuracy of the drilling.			
Justification:			
Comments:	The tools may be available for download. Alternatively, these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11468			
Service 10-1 shall offer a tailored service for specific users providing nowcast and forecast (0-6hr, 24-48hr) of local geomagnetic activity for directional drilling at customer-specified locations with amplitude greater than 1-10 nT, in compliance with the Products Specification requirements applicable to product codes AG-005-N, AG-005-F, AG-006-N, AG-006-F.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.11.2. Performance Requirements

SWE-SRD-20253			
Data relating to precise location determination shall be obtained for specific regions with narrow 3D volumetric grid with an update not larger than 30 minutes.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-RES-3182		
Related Requirements:		**Verification Method:**	Design Review Test

3.1.12. Domain 11 services – Aurora observation and forecast

3.1.12.1. Service 11-1: Aurora observation and forecast – Service to aurora observation and forecast operation

SWE-SRD-12580			
The SWE system shall provide a Service 11-1: Service to Aurora observation and forecast.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11321			
Service 11-1 shall provide a regional auroral forecast coupled with meteorological forecast (cloud cover) geared towards tourism sector, including: • a forecast of the probability of visible auroras (>18hours, >12 hours, >6 hours, >3 hours) • auroral activity nowcast • daily bulletin to describe Space Weather conditions for the next 18 hours			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-AUR-3008 SWE-CRD-AUR-3009 SWE-CRD-AUR-3271		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11472			
Service11-1 shall use as inputs the data products needed for the delivery of the data required by the user.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20039			
Service 11-1 shall be a service for registered users only, delivering its outputs on request for the nowcast/forecast services and the tools, and automatically for the alerts.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.12.1.1. Handle service requests

SWE-SRD-11473			
The following set of user criteria shall be requested by service 11-1 prior to the generation of the outputs of the service: • Location / area • Time span • Parameters to be recovered from archive / reconstructed / nowcast / forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11474			
Service 11-1 shall allow its users to specify freely the location and time frame for their request within the maximum ranges covered by the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11475			
Service 11-1 shall inform its users of the limitations of accuracy and reliability that may result from a specific request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11476			
Service11-1 shall recall in its outputs delivered to the user the input elements that the user has provided and reword/complement them with metadata as follows: • Considered geographical area and altitude domain • Time span • Publication date • Flag indicating if information from third parties is included			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.12.1.2. Deliver products/tools/reports

SWE-SRD-11810			

Service 11-1 shall request the user to identify which parameters to be recovered from archive, reconstructed, nowcasted or forecasted, within the list of data products below, the user wants to be delivered, request them from the Space Weather System database and provide them to the user:
• Auroral visible and UV imaging (archives and nowcast) [product codes AG-001-P, AG-001-M, AG-001-N, AG-002-P, AG-002-M, AG-002-N,],
• Probability of visible auroras (forecast) [product code AG-001-F],
• Geomagnetic Field Disturbances (including from Network of magnetometer measurements in vicinity of customer, including dB/dt) [product codes AG-005-P, AG-005-M, AG-005-N, AG-005-F],
• Solar Wind velocity, density and magnetic field at L1 [product codes L1-008-P, L1-009-P, L1-010-P, L1-008-M, L1-009-M, L1-010-M, L1-008-N, L1-009-N, L1-010-N, L1-008-F, L1-009-F, L1-010-F],
• Solar Wind velocity, density and magnetic field at L5 [product codes IP-003-P, IP-004-P, IP-006-P, IP-003-M, IP-004-M, IP-006-M, IP-003-N, IP-004-N, IP-006-N, IP-003-F, IP-004-F, IP-006-F],
• Solar data:
  ○ Solar disk, coronal(coronagraph) and heliospheric imaging [including product codes SU-015-P, SU-017-P, SU-020-P, SU-022-P, SU-025-P, SU-32-P, SU-015-M, SU-017-M, SU-020-M, SU-022-M, SU-025-M, SU-32-M, SU-015-N, SU-017-N, SU-020-N, SU-022-N, SU-025-N, SU-32-N, SU-015-F, SU-017-F, SU-020-F, SU-022-F, SU-025-F, SU-32-F],
  ○ Solar disk, coronagraphic and heliospheric imaging from L5 [including product codes SU-040-N, SU-041-N, SU-045-N, SU-050-N, SU-040-F, SU-041-F, SU-045-F, SU-050-F],
  ○ X-ray flux [product codes SU-027-P, SU-027-M, SU-027-N, SU-027-F],
• Geomagnetic storm indices: global, auroral, mid-latitude and ring current [product codes MR-001-N, MR-001-F],			

• Geomagnetic indices: (Kp, Ap, Dst) [product codes MR-002-P, MR-003-P, MR-004-P, MR-002-N, MR-003-N, MR-004-N, MR-002-F, MR-003-F, MR-004-F], • Geomagnetic indices: (AE, AL, AU, PC, AZ) [product codes MR-019-P, MR-020-P, MR-023-P, MR-019-N, MR-020-N, MR-023-N, MR-019-F, MR-020-F, MR-023-F], • Auroral Particle Precipitation and Auroral Kilometric Radiation [product codes MR-018-P, MR-022-P, MR-018-N, MR-022-N, MR-018-F].			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-AUR-3010 SWE-CRD-AUR-3183 SWE-CRD-AUR-3184 SWE-CRD-AUR-3185 SWE-CRD-AUR-3186 SWE-CRD-AUR-3187 SWE-CRD-AUR-3188 SWE-CRD-AUR-3265		
Related Requirements:		**Verification Method:**	Design Review

Service 11-1 is not required to deliver tools.

Service 11-1 is not required to deliver user's specific reports.

3.1.12.2. Performance Requirements

No additional requirements are identified at this stage.

3.1.13. Domain 12 services - General data and modelling services

3.1.13.1. Service 12-1: General data and modelling service – Space weather data repository

SWE-SRD-12581			
The SWE system shall provide a Service 12-1: General data and modelling service – Space Weather data repository.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.1.1. Handle service requests

SWE-SRD-11485			
The following set of user criteria shall be requested by service 12-1 prior to access the data and be modulated depending upon on each dataset: • Time • Source/sensor • Location • Domain • Metadata (parameter dependent) • Parameter to be retrieved			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11486			
Service 12-1 shall allow its users to retrieve data through a web interface.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11484			
Service 12-1 shall allow its users to access data through automated tools/interfaces.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.1.2. Deliver products/tools/reports

SWE-SRD-11490			
Service 12-1 shall request the user to identify which parameters to be recovered from archive the user wants to be delivered, request them from the Space Weather System database and provide the relevant information/metadata to the user for each dataset.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11491			
The data managed by Service 12-1 shall cover all domains and encompass all the products specified by the Products Specification.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11478			
Service 12-1 shall make the list of data tables and columns available.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11492			
Service 12-1 shall make the list of data tables and columns available according to a standard format.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12305			
Service 12-1 shall provide tools to access data			
Justification:			
Comments:	The tools may be available for download. Alternatively these may be delivered via a web interface depending on user needs/preference.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 12-1 is not required to deliver user's specific reports.

3.1.13.2. Service 12-2: General data and modelling service – Latest data guaranteed service

SWE-SRD-12582			
The SWE system shall provide a Service 12-2: General data and modelling service – Latest data guaranteed service.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11331			
Service 12-2 shall provide an agreed set of data required as input to tailored and non-tailored customer service available on a registration basis.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-1672 SWE-CRD-GEN-2659 SWE-CRD-GEN-2657 SWE-CRD-GEN-2655		
Related Requirements:		**Verification Method:**	Design Review

3.1.13.2.1. Handle service requests

SWE-SRD-11497			
The following set of user criteria shall be requested by service 12-2 prior to access the data: • Dataset • Time Period			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11498			
Service 12-2 shall allow its users to select the dataset of interest to them.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11499			
Service 12-2 shall allow its users to select the frequency with which the data is provided, either as regular intervals (e.g. daily) or as soon as it is available.			
Justification:			
Comments:	This will create two types of API: regular and streaming - these two may need to be different requirements		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11500			
Service 12-2 shall allow its users to select how far back the data shall be provided either since last provision or within a specific timeframe (e.g. last day).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.2.2. Deliver products/tools/reports

SWE-SRD-11502			
Service 12-2 8-2 shall request the user to identify which latest data they want to be delivered, request them from the Space Weather System database and provide: • the latest data itself as per user's request concerning any space weather data in the CRD • the corresponding metadata for each dataset • the corresponding metadata for each data source			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 12-2 is not required to deliver tools.

Service 12-2 is not required to deliver user's specific reports.

3.1.13.3. Service 12-3: General data and modelling service – Space weather nowcast and forecast products

SWE-SRD-12583			
The Space Weather System shall provide a Service 12-3: General data and modelling service – Space Weather nowcast and forecast products.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11336			
Service 12-3 shall provide nowcast and forecast of space weather parameters, including: • Nowcast products based on data and modelling, • Forecast products based on data and modelling, • Daily Forecast (1 day, 2 days, weekly outlook), • Daily activity report (plus last 24 hours), • weekly or monthly report, • "All-quiet conditions" indications, • long term solar cycle forecast, • a general set of alarms for nowcasts defined by Service Domain, with the start and termination thresholds configurable as per user domain and as per space environment parameters. This will include "all quiet" and "end of quiet" alarms.			
Justification:			
Comments:			

Source Requirements:	SWE-CRD-GEN-1673 SWE-CRD-GEN-2665 SWE-CRD-GEN-2666 SWE-CRD-GEN-1674 SWE-CRD-GEN-2670 SWE-CRD-GEN-2671 SWE-CRD-GEN-2672 SWE-CRD-GEN-1675 SWE-CRD-GEN-1676 SWE-CRD-GEN-1679 SWE-CRD-GEN-2653 SWE-CRD-GEN-1680 SWE-CRD-GEN-2642 SWE-CRD-GEN-1686		
Related Requirements:		**Verification Method:**	Design Review

3.1.13.3.1. Data Policy Enforcement

SWE-SRD-11507			
Service 12-3 shall be accessible as a broadcast for the list of data products for which free broadcast is authorized by the Data Policy, and for the other data a service for registered users only.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.3.2. Handle service requests

SWE-SRD-11511			
The following set of user criteria shall be requested by service 12-3 prior to access a dataset: • required data products • required update rate • expected time lag in respect to “now” specified • specific information related to the service			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11512			
The following set of user criteria shall be requested by service 12-3 as part of a specific report request: • Expected report type • Datasets to be included • Trigger for release or frequency			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.3.3. Deliver products/tools/reports

SWE-SRD-11516			
Service 12-3 shall provide a nowcast of a variable list of data products, upon User's request but within the list of all Space Weather data in the Products Specification.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11517			
Service 12-3 shall provide its data outputs as datasets with date, source and other relevant information and metadata.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11518			
Service 12-3 shall provide its data outputs by grouping the nowcast parameters with at least the following categories: • solar activity, • solar wind key parameters (density, magnetic field), • geomagnetic activity • radiation environment at GEO, MEO, LEO, • ionospheric propagation conditions, • neutral density, • indices.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11513			
Service 12-3 shall inform its users on the source of the dataset and receive information on the used models.			
Justification:			
Comments:	The model version should be stated		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11514			
Service 12-3 shall provide its users access to quality metrics for the forecasts/nowcast models.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11534			
Service 12-3 shall provide its reports by detailing a given set of data and forecasts, with at least the following reports produced: • daily forecast (1 day, 2 days, weekly outlook) • daily activity report (plus last 24 hours) • weekly or monthly report • "All quiet conditions" • "End of All quiet conditions" • long term solar cycle forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11535			
Service 12-3 shall generate its user's specific reports at predefined intervals and made available through various channels: • Published via web portal • Distributed to registered users • Made accessible on the Space Weather System repository			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 12-3 is not required to deliver tools.

3.1.13.4. Service 12-4: General data and modelling service – Event based alarms

SWE-SRD-12584			
The Space Weather System shall provide a Service 12-4: General data and modelling service – Event based alarms.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11341			
Service 12-4 shall provide alarms on: • an as-needed basis for specific datasets and events, • based on relevant data and where feasible rapid model outputs indicating likely consequences (e.g. time of interplanetary shock reaching Earth), • on the datasets defined and used by the following services: • Latest Data Service (service #8-2) • Nowcast and Forecast Products Service (service #8-3).			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-1672 SWE-CRD-GEN-2658 SWE-CRD-GEN-2656 SWE-CRD-GEN-2655 SWE-CRD-GEN-2654 SWE-CRD-GEN-1673 SWE-CRD-GEN-2667 SWE-CRD-GEN-2668 SWE-CRD-GEN-2669 SWE-CRD-GEN-2643		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11537			
Service 12-4 shall include two components: • An agreed set of default alarms defined for the Space Weather System and made available to all users or visitors of the system. The alarm thresholds are defined by the Space Weather System and are common at least for each domain. These Alarms will be provided to the users registered for the default Space Weather System alarm service and published via web portal. Additionally, the current status of these alarms will also be available in the data repository. • A subscription service will allow for tailored automated alarms on a particular parameter/dataset. Each user will be able to configure the alarm thresholds for specific datasets of interest to them.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.4.1. Handle service requests

SWE-SRD-11519			
The following set of user criteria shall be requested by the subscription service 12-4 during an alert request: • Dataset or Event • Threshold for alarm (start and termination if applicable) • Threshold crossing direction (i.e. is the alarm triggered when the threshold is crossed from a lower to a higher value or the other way round?) • Retrieval/reception method (e.g. Email, display in user area)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.4.2. Deliver products/tools/reports

Service 12-4 is not required to deliver tools.

SWE-SRD-12306			
Service 12-4 shall deliver alarms as data products.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11523			
Service 12-4 shall allow the user to define their own event based alarms for latest values and nowcasts (registered users only).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11524			
Service 12-4 shall provide the alarms to the users that have been requested.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11525			
Service 12-4 shall inform its users of the source of the dataset producing the alarm.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11526			
Service 12-4 shall provide its users with information on the quality/reliability of the alarm (e.g. for a forecast or nowcast).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.5. Service 12-5: General data and modelling service – Virtual space weather modelling system

SWE-SRD-12585			
The Space Weather System shall provide a Service 12-5: General data and modelling service – Virtual space weather modelling system.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11555			
Service 12-5 shall: • provide model integration and validation as part of a coordinated framework • allow coupling of modelling assets and data in order to simulate propagation of space weather phenomena from the Sun to the Earth. Both users and developers shall benefit from this service as incorporation of models into a coherent framework will stimulate further targeted model development • provide an interface allowing graphical visualisation of combined results of model simulation outputs and subsets thereof, as the scales and complexity of the models involved in an end-to-end simulation make it difficult to grasp from tabulated data the scope of the simulation outcomes • provide easy to use visualisation tools • provide tools for validating the respective model-based measurements and other means.			
Justification:			
Comments:	As a baseline 2-D maps and time animation will be provided, with the goal to provide 3-D visualisation where possible		
Source Requirements:	SWE-CRD-GEN-1682 SWE-CRD-GEN-2645 SWE-CRD-GEN-2646 SWE-CRD-GEN-2647 SWE-CRD-GEN-1683 SWE-CRD-GEN-1685		
Related Requirements:	SWE-SRD-12004 SWE-SRD-12005 SWE-SRD-12006 SWE-SRD-12007 SWE-SRD-12008 SWE-SRD-12009 SWE-SRD-12010	**Verification Method:**	Design Review

SWE-SRD-20040			
Service 12-5 shall allow the models available within the system: • to be utilised for end-to-end modelling, underpinning event arrival and impact forecasting. • to be used both in combination through a single interface as part of the system, and also individually as required, to underpin user driven services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.1.13.5.1. Handle service requests

SWE-SRD-11559			
The following set of user criteria shall be requested to the user by service 12-5: • Model run ID • Model or region of interest • Visualisation criteria: appropriate visualisation method according to the specific product.			
Justification:			
Comments:	Data retrieval to be supported via e.g. HMI or API		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.5.2. Deliver products/tools/reports

Service 12-5 is not required to deliver data products.

SWE-SRD-11561			
Service 12-5 shall request the user to identify which model outputs the user wants to be delivered, request them from the Space Weather System database and provide them to the user.			
Justification:			
Comments:	Those shall be offered to the user as series of relevant models grouped by categories e.g. domains, regions.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11562			
Service 12-5 shall provide access to a suite of tools to support online validation.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11565			
Service 12-5 shall provide the model outputs to the users by means of APIs, web-services and mechanisms for file transfer.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 12-5 is not required to deliver user's specific reports.

3.1.13.5.3. Subscribe/Unsubscribe to service

SWE-SRD-11564			
Service 12-5 shall offer the possibility for users (if authorized by the Data Policy) to obtain results from the Virtual space weather modelling system by at least the following methods: • individual run on demand • regular runs of a "best case" end to end simulation on a regular pre-defined schedule (schedule set centrally) • subscription-based approach where the user can request regular run of a given model/set of models, scheduled to feed into further downstream processing			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.5.4. Upload models from developers

SWE-SRD-11597			
Service 12-5 shall be extensible and shall be capable of integrating 3rd party model developments, subject to QC and validation campaigns.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.6. Service 12-6: General data and modelling service – Space weather training and support material

SWE-SRD-12587			
The Space Weather System shall provide a Service 12-6: General data and modelling service – space weather training and support material.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11579			
Service 12-6 shall provide access to web-based content and educational material, (including tutorials) covering aspects of space weather geared towards users and customers, including information on the types of products available and associated caveats.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-1681		
Related Requirements:		**Verification Method:**	Design Review

3.1.13.6.1. Data Policy Enforcement

SWE-SRD-11581			
Service 12-6 shall be accessible to all users as a “broadcast” service, available on the web (e.g. through the Space Weather System portals) as information websites.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.6.2. Handle service requests

SWE-SRD-11583			
Service 12-6 shall also offer the user access to an information package on request. The user shall be asked to indicate the type of data/information required.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11811			
Service 12-6 shall offer interactive web-based space weather tutorials.			
Justification:			
Comments:	Limited registration needed for usage statistics.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11584			
The support websites of service 12-6 shall not only be static but shall also provide up-to-date information on the space weather conditions retrieved from other services (mainly the Space Weather System repository).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11580			
The educational material presented by service 12-6 shall be written for students and professionals with limited space weather background.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11582			
Service 12-6 shall offer the user the capacity to find background information on space weather physics, effects and applications.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11604			
Service 12-6 shall offer the user the capacity to search for specific topics.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11605			
Service 12-6 shall offer the user the capacity to find information in direct relation to the Space Weather System services (e.g. when describing flares, links should be provided to actual images and reports from the Space Weather System repository).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.6.3. Deliver products/tools/reports

SWE-SRD-11587			
Service 12-6 shall provide the user with space weather support material contents, in a visual and user-friendly way: • web content explaining online the physical terms, acronyms and scales • information package.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

Service 12-6 is not required to deliver tools.

Service 12-6 is not required to deliver user's specific reports.

3.1.13.6.4. Subscribe/Unsubscribe to service

SWE-SRD-11591			
Service 12-6 shall be offered without subscription.			
Justification:			
Comments:	Limited registration needed for usage statistics		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.1.13.7. Performance Requirements

SWE-SRD-11326			
Service 12-1shall provide a repository of all available Space Weather data of relevance for European Space Weather System users and service providers, consisting in a long term database repository for space weather data from all relevant domains that shall: • include sensor data and derived products including model runs and event catalogue, • be compatible and cross-referenceable with VO activities (e.g. VSO, Virbo), • support generation of new indices and further understanding of long term trends, supporting development of improved models and forecast tools.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-1678 SWE-CRD-GEN-2673 SWE-CRD-GEN-2674 SWE-CRD-GEN-2675 SWE-CRD-GEN-2676 SWE-CRD-GEN-2677 SWE-CRD-GEN-2678 SWE-CRD-GEN-2679 SWE-CRD-GEN-2680 SWE-CRD-GEN-1685		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11613			
Forecasts validity shall depend on the parameter and models applied and shall be as detailed in the Product Specification per parameter.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.2. Overall System Requirements

3.2.1. General and Governance Requirements

SWE-SRD-9110			
The Space Weather System shall make the Space Weather products (including data, models and tools) available for the services of its mandate, either by generating them itself in its centres or by federating cooperating centres that produce those products (including data, models and tools).			
Justification:	Functional analysis of the Space Weather System		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20001			
The Space Weather System shall incorporate and support the further development of Existing European assets, ensuring they satisfy the necessary requirements in terms of performance, data policy and availability.			
Justification:	Extensive assets and expertise exist within the ESA Member States. The aim of the programme is to build on and strengthen existing capabilities, with targeted development to fill key gaps. Duplication should be avoided wherever possible.		
Comments:			
Source Requirements:	SYS-CRD-SYS-3202		
Related Requirements:		**Verification Method:**	

SWE-SRD-11964			
The system shall monitor and provide the status of own subsystems and assets, including status of external entities, communication links and contributing sensors/centres.			
Justification:	Status of system and devices need to be known.		
Comments:	The system status shall be reported to the governing authority. System status in the context of this requirement mainly refers to availability.		
Source Requirements:	SYS-CRD-QUA-3227		
Related Requirements:	SWE-SRD-20002	**Verification Method:**	Design Review Test

SWE-SRD-11952			
The system shall be capable of generating the following types of metrics: • service metrics • data processing metrics • data acquisition metrics			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11954			
The system shall define the data processing and data acquisition metrics based on at least the following parameters in all the internal interfaces: • Data throughput • Sensor performances • Amount of stored data More TBD			
Justification:	In order to monitor the quality of the data processing and data acquisition functions by the operator.		
Comments:	This requirement needs to be further analysed at sub-system and implementation level for each function and interface considered. A trade-off of the cost/benefit function needs to be performed.		
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11955			
The metrics produced by the system shall quantify the quality of the system data types considering, at least: • the reliability of the data • the availability of the data • the accuracy, latency (and other performances) of the data and data sources, and data products and services			
Justification:	In order to allow efficient monitoring of the system.		
Comments:	The quality will be measured by measuring the reliability, availability, accuracy and performances of the data and data sources.		
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11956			
The system shall allow the operators to define service metrics computed applying logical and/or mathematical functions of metrics.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11957			
The system shall allow the generation of reports based on the system metrics.			
Justification:	In order to allow to perform metrics trend analyses. Since the service and the data processing and acquisition functions will be continuously available, the general quality, the performances and the specific data produced should be presented to the user in a regular way, particularly when concerning to operational data.		
Comments:			
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11958			
The system shall allow monitoring the system metrics and generating alarms based on selectable criteria and thresholds.			
Justification:	There will be some values in metrics which directly drive to generate alarms. These cases need to be configurable. Since the service and the data processing and acquisition functions will be continuously available, the general quality, the performances and the specific data produced should be presented to the user in a regular way, particularly when concerning to operational data.		
Comments:			
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11959			
The system shall store the computed metrics and allow to: • retrieve any past computed metric • generate statistics and evolution in time of the computed metrics			
Justification:	In order to allow the operator to monitor the state of the system and to analyse tendencies.		
Comments:			
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20006			
The Space Weather System shall maintain usage statistics.			
Justification:	Required in order to monitor service usage at system, service and component level.		
Comments:			
Source Requirements:	SYS-CRD-QUA-3220		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11860			
The system shall have an issue tracking system allowing its administrators, operators and end-users to raise problem reports concerning anomalies in the system behaviour, services and products.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11861			
The system shall log and archive all maintenance activities including procedures and resources used.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11863			
The system shall be able to produce metrics reports covering the maintenance activities including at least: • Number of problem reports raised per time period • Number of problems resolved per time period • Effort spent investigating and resolving problems • Perfective maintenance activities performed per time period • Planned perfective and corrective maintenance activities in the upcoming time period • etc.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11862			
The system shall have the capability to plan the maintenance activities taking the operational needs and availability requirements of the system into account.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12883			
The system shall support investigation of Data Policy incidents.			
Justification:	In order to make sure that Data Policy incidents can be investigated.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11966			
The system shall be capable of enforcing the governance (including priorities) and data policy directives.			
Justification:	This is to ensure that the system operates always within the rules & regulations laid down in the data governance directives.		
Comments:			
Source Requirements:	COM-SRD-1589		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11977			
From the legal and technical perspective, the design of the Space Weather System shall allow for the transfer of the system operation and maintenance to third parties. In this case, the constraints driven by Intellectual Property Rights of participating data and service providers shall be respected.			
Justification:	In order to ensure the possibility of flexible system handover.		
Comments:	An example would be commercial use since some of the data providers are public institutes whose charter limits the potential exploitation of their data for commercial purposes.		
Source Requirements:	COM-SRD-3618 SYS-CRD-DAT-3241		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-9126			
The Space Weather System shall have a subsystem in charge of managing the data policy in a coordinated way with the Space Weather contributing centres and sensors.			
Justification:	Functional analysis of the Space Weather System		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10309			
For the data sources that provide calculated values (whether indices, derived parameters, extrapolations of basic parameters or any result from a calculation process), the Space Weather System shall provide accurate description of the model and parameters used for their generation as well as which exact information is provided by each parameter and its domain of applicability.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12158			
All processing elements of the system shall be located within the territory of the ESA and European member states including their non-continental extensions. System sensors may be located in non-European states if required.			
Justification:	In order to ensure European control over the system and support for European industry.		
Comments:			
Source Requirements:	COM-SRD-2770		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12159			
The system shall allow to enter as configuration the governance established by the designated Governing Authority, expressed by the directives.			
Justification:	In order to ensure that the system is compliant with the governance directives.		
Comments:	At present time, governance is not defined in detail, but this requirement allows the system to cope with this uncertainty. The system requirements in this area will be refined as the governance specification becomes available.		
Source Requirements:	COM-SRD-3775		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12160			
The system shall allow to enter as configuration the data policy established by the designated Governing Authority, expressed by the data policy directives.			
Justification:	In order to ensure that the system is compliant with the data policy directives.		
Comments:	At present time, data policy is not defined in detail, but this requirement allows the system to cope with this uncertainty. The system requirements in this area will be refined as the data policy specification becomes available.		
Source Requirements:	COM-SRD-3776		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-9201			
The system performance requirements shall be validated by test using first simulations, then real evaluation of the data exchanges.			
Justification:	Simulations to be used during the development phase, real test during the implementation and operation phases.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12187			
The overall objective of verification shall be to demonstrate, through a dedicated process, that the system meets the specified requirements.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3763		
Related Requirements:		**Verification Method:**	

SWE-SRD-12188			
The verification process activities shall consist of planning, execution, reporting, control and closeout and its implementation activities shall be documented by means of a specific set of verification documents as defined by ECSS standard.			
Justification:			
Comments:	The Verification Plan and the AIT Plan can be combined in one single AIV Plan (i.e. in this case VP and AIT plans do not exist anymore as single entities).		
Source Requirements:	COM-SRD-3764		
Related Requirements:		**Verification Method:**	

SWE-SRD-12189			
The system shall be subjected to AIV activities at increasing level of detail. At least the following level shall be considered: • System level • Sensor network level • Data centre level • Service centre level • Sub-system level			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3765		
Related Requirements:		**Verification Method:**	

SWE-SRD-12190			
The system requirements traceability shall be verified by checking at least the following fields: • Requirement identifier, • Requirement text • Levels of verification, • Methods of verification • Link to the relevant section of the verification plan and verification report • Status of Compliance (yes, no, partial), • o Close-out status (open / closed).			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3767		
Related Requirements:		**Verification Method:**	

SWE-SRD-12192			
For each data type, the Space Weather System shall maintain self-consistent metadata describing the data.			
Justification:			
Comments:	The system may adopt one established, existing metadata model, or several models in parallel, as necessary. Self-consistency requires that the assumptions used to develop, or use, a model must not conflict with their own conclusions; this applies to both the actual model, and any adaptation or extension.		
Source Requirements:	COM-SRD-3595		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9111			
The Space Weather System shall establish and manage a consistent list of the data products needed by its services, and specify them in a way that enables the compliance with the performance requirements of the services, by specifying to the different centres in charge of those data products the nature, physical range, spatial range, spatial resolution, time range, time resolution and cadence, accuracy and reliability.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9112			
The Space Weather System shall establish and manage a consistent list of the models needed by its services, and specify them in a way that enables the compliance with the performance requirements of the services.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9113			
The Space Weather System shall establish and manage a consistent list of the tools needed by its services, and specify them in a way that enables the compliance with the performance requirements of the services.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9114			
The Space Weather System shall establish and manage an applicability matrix of the products (data, models and tools) to its different services, infer the induced interface requirements between the products providers and the services providers, and enforce those interface requirements.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11953			
The system shall define an appropriate set of service metrics based on at least the following parameters: • Number of user requests per time period • Number of product deliveries per time period • Service availability • Number of timeliness violations per time period • Service interrupts • Amount of data delivered • Number of subscriptions • Number of registered users • Number of denied access requests • Number of failed authentication attempts More TBD			
Justification:	In order to monitor the quality of the service provided to the end-user by the system.		
Comments:	KPIs will be derived on the basis of the service metrics.		
Source Requirements:	SYS-CRD-QUA-3219		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20003			
A set of appropriate KPIs shall be established based on monitoring metrics in order to demonstrate at least (1) end user/customer engagement (2) end user/customer satisfaction (3) service maturity (4) service quality.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-QUA-3222		
Related Requirements:		**Verification Method:**	

SWE-SRD-20004			
Assessment of accuracy for each provided space weather data and data products shall be provided by the Space Weather System.			
Justification:	Required to determine domain of applicability		
Comments:	For newly included data and products an estimate of the expected accuracy based on previous validation work may be presented. This may also include cross-validation with other similar products provided by the system. Continuous validation against an agreed reference utilising agreed metrics shall be encouraged wherever possible.		
Source Requirements:	SYS-CRD-QUA-3225		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20005			
The Space Weather System shall make its estimation of the accuracy of the provided services and data and make it available to the users.			
Justification:	Required to increase the level of confidence of the users in the system and assess the quality of data for specific uses.		
Comments:			
Source Requirements:	SYS-CRD-QUA-3226		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9127			
The Space Weather System shall identify Space Weather risks and threats and report it to identified user groups according to data policy.			
Justification:	Functional analysis of the Space Weather System		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12098			
The data policy enforcement shall be audited and approved by the governing authority before the system services are entering into operation.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3974		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11961			
The system shall continuously monitor the compliance to the directives imposed by the Governing Authority and shall issue reports and warnings when required.			
Justification:	This is to make sure that directives are adhered to at all time by the system and that violations are reported as reports and/or warnings.		
Comments:			
Source Requirements:	COM-SRD-265		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12234			
The system shall provide all metric reports regarding the performance of the system to the Governing Authority upon request as well as periodically.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-265		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11962			
The system shall archive the reports for the system lifetime.			
Justification:	This is to ensure that a full system audit of all reports is possible for any point in time.		
Comments:			
Source Requirements:	COM-SRD-1583		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12066			
The system shall be capable to provide reports to the designated Governing Authority at the latest 8 hours after request.			
Justification:	In order to satisfy performance requirements, ensure efficient operation of the system.		
Comments:	The time constraint may still be subject to change.		
Source Requirements:	COM-SRD-1600		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12167			
The designated Governing Authority shall ensure that data policy rules apply to the development and operational phases of the system.			
Justification:			
Comments:	From end-user perspective, minimise the constrains on accessing a service and obtaining a product.		
Source Requirements:	COM-SRD-3970		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12169			
The system shall have the required documentation to maintain and operate it.			
Justification:	In order to ensure easy operations and maintenance using available documentation.		
Comments:			
Source Requirements:	COM-SRD-3604		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-9197			
The Space Weather System shall federate capabilities of already existing systems, include functionalities currently executed by other teams and other agencies (in particular national agencies) and develop new functionalities currently not existing.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-DAT-3235		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-9198			
The federation of assets shall be manageable in a flexible and dynamic way all along the development, implementation and maintenance phases of Space Weather System.			
Justification:	The list of assets cannot and should not be frozen during these phases.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20281			
The R2O2R System shall facilitate the demonstration and testing of new capabilities with end users in the loop. This complements the operational Space Weather System.			
Justification:	The R2O2R system is intended to foster collaboration between researchers, developers, forecasters, system operators and end users in order to facilitate the overall R2O2R process and ensure smooth and efficient transition of new capabilities into improved service capabilities. It shall be representative of the operational Space Weather System and shall support the validation and demonstration of advanced product concepts and technology capabilities targeting improved services.		
Comments:	Both service users and developers shall have access to the outputs of the R2O2R system. One or more dedicated user test campaigns may be organised for new capabilities being integrated into this environment. Online validation shall further demonstrate the performance of new capabilities under a range of space weather conditions. The R2O2R system may include centralised and distributed elements in order to facilitate a wide range of capability testing and demonstration.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.2.2. Functional Requirements

SWE-SRD-12882			
The Space Weather System shall be sufficiently configurable to accept changes to the Data Policy Directives applicable to the system without requiring modification of the applications			
Justification:	The Space Weather System targets continuity of service.		
Comments:	When the limit of the application configurability foreseen by its design will be reached, a change to the s/w applications versus a change of the requirement shall be considered (trade-off). Application is referring to software components. The term "Directives" is defined in [AD-06].		
Source Requirements:			
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9128			
The Space Weather System shall provide alarms based on events (e.g. flare alert (without spatial info), flare alert (with spatial info), Halo CME alert, CME warning, coronal hole alert, CIR alert, geomagnetic storm onset alert, geomagnetic warning etc) for an agreed set of defaults. The accompanying alarm message shall incorporate relevant data and, whenever feasible, likely consequences (e.g. time of interplanetary shock reaching Earth).			
Justification:	Alarms on an as-needed basis (e.g. flare, CME, SPE, magnetic storm onset). Incorporate relevant data and where feasible rapid model run outputs indicating likely consequences (e.g. time of interplanetary shock reaching Earth). Agreed set of default alarms. Subscription service will allow for tailored automated alarms on a particular parameter/dataset.		
Comments:			
Source Requirements:	SYS-CRD-FUN-3189 SYS-CRD-FUN-3190		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12268			
The Space Weather System shall have a "latest data" real-time data provision functionality allowing products with stringent timeliness and latency requirements to be provided to the users.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12269			
The production of data products shall be configurable in terms of the product performance and quality parameters.			
Justification:	Provision for specific agreements with individual users where requested on a case-by-case basis as part of the Guaranteed data service for third-party/added-value service providers		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12240			
The system shall be able to receive and process data provided by Third Party Providers.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11934			
The Space Weather System shall be able to monitor the availability and request specific data from cooperating centres and their services as defined by associated SLAs and ICDs.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11825			
The Space Weather System shall be able to monitor the status and availability of all Space Weather System or federated Space Weather sensors			
Justification:	Maintain information about the sensor system status		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11826			
The Space Weather System shall be able to make and maintain a schedule for the planned maintenance of the Space Weather System and federated Space Weather sensors to ensure continuous availability of the Space Weather sensor data for the Space Weather System.			
Justification:	Planned sensor outages should not impact the system performance or at least the impact is minimised.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11827			
The Space Weather System shall be able to simulate the impact of one or more missing Space Weather System or federated Space Weather sensors on the observation system and observation coverage.			
Justification:	This allows assessing the impact of a sensor outage especially because availability of the federated sensors may not be under Space Weather System control.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11829			
The Space Weather System shall be able to simulate the impact of replacing one or more Space Weather System or federated Space Weather sensors with alternative sensors.			
Justification:	This allows advance planning for the loss or replacement of a sensor.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11946			
The system shall provide the necessary functions for translating the data provided by cooperating sensors into a format which is compatible with the internal processing functions.			
Justification:	In order to ensure that data coming from cooperating sensors can be processed by the system.		
Comments:			
Source Requirements:	COM-SRD-3606		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10319			
When the sensor provides data that are not calibrated and/or not instantiated, the Space Weather System shall process the data from the sensor so as to advance the data, by calibrating and/or complementing with metadata such as location and time of the measurement, asset sensor ID, processing software version etc.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9188			
The Space Weather System shall support simulations of Space Weather phenomena faster than real-time to provide forecasts subject to data availability. Forecasts will be updated nearer the event/disturbance arrival time based on new data such as that detected in-situ at L1.			
Justification:	Running physical models of the solar-interplanetary-magnetospheric-ionospheric environment is required for forecasting and future architecture optimisation.		
Comments:			
Source Requirements:	SWE-CRD-GEN-1741		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10121			
The Space Weather System shall process the 'Request for system activity data'.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10123			
The Space Weather System shall reply to the 'Request for system activity data' by collecting information, assembling it and replying with a 'System activity data'.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10124			
The Space Weather System shall provide a 'System activity data' as requested by the 'Request for system activity data': either periodically and/or on request.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12088			
The monitoring information to be generated by the system components shall be configurable.			
Justification:	The operator should be able to configure the monitoring information.		
Comments:			
Source Requirements:	COM-SRD-1584		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12092			
The system shall be capable of generating visual and audio alarms to the operator in case an alarm is generated within the Space Weather System. The criticality level of the alarms and alarm categories shall be configurable by the user.			
Justification:	Operators need to be warned of alarms.		
Comments:	It should also be possible to disable alarms if deemed necessary.		
Source Requirements:	COM-SRD-276		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12096			
The system shall allow to the operator to request the modification of the configuration of any element of the system.			
Justification:	In order to ensure the flexibility of the system in terms of configuration.		
Comments:			
Source Requirements:	COM-SRD-65		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12131			
Each subsystem and asset of the system shall provide test ports and tools allowing monitoring of parameters at any moment, without affecting nominal operations.			
Justification:	This is necessary for AIV and troubleshooting activities.		
Comments:			
Source Requirements:	COM-SRD-74		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-20261			
The system shall allow replaying processes associated with all services using archived data and recorded data exchange.			
Justification:	To support troubleshooting and handling of user requests and claims.		
Comments:			
Source Requirements:	SYS-CRD-FUN-3197		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12164			
The system shall allow to trace and log any change to the data policy.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3967		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12177			
All products which are results of processing information shall have a time stamp with the system time, and the content shall be referred to the system time.			
Justification:			
Comments:	The system time is specified in SWE-SRD-12089 to be UTC.		
Source Requirements:	COM-SRD-29 SYS-CRD-SYS-3204		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.3. Performance Requirements

SWE-SRD-10310			
The Space Weather System shall make its estimation of the accuracy of the provided data and data products and make it available to the users.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-QUA-3225 SYS-CRD-QUA-3226		
Related Requirements:		**Verification Method:**	

SWE-SRD-10311			
Uncertainties in the presented data shall be quantified in the form of quality metrics.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12243			
The system shall decide, according to Data Policy rules, if either the Third Party Data received or the equivalent set of data computed independently by the system shall be used in subsequent analyses.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12244			
When Third Party Data is available, the system shall offer the possibility to use this data in any analysis performed by the system.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12245			
The system shall provide automatic feedback regarding the compliance with the required formats.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11921			
The Space Weather System shall provide means for the verification of the observation plans ensuring: • no resource conflicts • availability of sensors (taking maintenance, calibration and other observation activities into account) • that the observations can be carried out taking visibility/pointing constrains into account • availability of data processing resources • performance (timeliness and accuracy) of the measurements			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12252			
The Space Weather System shall provide means for the verification of the generated commands to monitor and control the SWE sensor network.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12251			
The Space Weather System shall provide means for the verification of the generated commands to monitor and control the SWE sensor network.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12248			
The Space Weather System shall provide means for the monitoring of the status, configuration, and availability of the Space Weather System Sensors.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11944			
The system shall be able to handle (receive, process and send) sensor data from internal and collaborating sensors.			
Justification:	In order to receive data from sensors (internal and collaborating), process received data, and be capable of forwarding this data.		
Comments:			
Source Requirements:	COM-SRD-3587		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11945			
The system shall be capable of processing different data streams from sensors: processing the data both from the internal sensors and from cooperating sensors.			
Justification:	In order to be able to handle and process all incoming sensor information to generate products.		
Comments:			
Source Requirements:	COM-SRD-3588		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12086			
The system shall have a reduced direct human intervention in the data processing for the sake of rapidity of execution, reliability and repeatability of the results.			
Justification:	Large quantity of data to be processed daily.		
Comments:	Human supervision of the output is always foreseen: human intervention is needed only when error messages are prompted and/or unrealistic results are obtained.		
Source Requirements:	COM-SRD-3605		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12132			
Each subsystem and asset of the system shall log all information that allow to identify the source of errors.			
Justification:	This is necessary for AIV and troubleshooting activities.		
Comments:			
Source Requirements:	COM-SRD-76		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12134			
The subsystems and assets of the system shall be maintainable throughout the lifetime of the service that they are providing.			
Justification:	This is necessary to meet the requirement of having an overall Space Weather System that can be maintained during its service lifetime.		
Comments:			
Source Requirements:	COM-SRD-78 SYS-CRD-SYS-3201		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12138			
The system shall be able to cope with changes in data formats of external user products.			
Justification:	The ability to cope with new customer data formats is needed for meeting the specified lifetime of the system.		
Comments:			
Source Requirements:	COM-SRD-1271		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12179			
The system shall be able to perform conversions between the system reference coordinate systems and the different coordinate systems used by interfaced external systems.			
Justification:	Interoperability needs to be ensured.		
Comments:			
Source Requirements:	COM-SRD-31 SYS-CRD-SYS-3205		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12199			
The system shall allow to manage the data policy as an arborescence of sub-data policies.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3937		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12200			
The system shall allow to specify a period of time for the applicability of a classification level associated to a data item (respectively data item attribute).			
Justification:			
Comments:	The period of time should be defined as a closed time interval in the form [start date and time, end-date and time] in which either time and date shall be optional. Omitted start date and time means immediate effect of the associated classification level as when the data policy becomes applicable; omitted end date and time means endless applicability of the associated classification level.		
Source Requirements:	COM-SRD-3938		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12062			
The bulk data reprocessing shall not prevent the system to carry out with the normal operations and fulfil the performance requirements of the system.			
Justification:	In order to ensure the flexibility of the bulk data reprocessing.		
Comments:			
Source Requirements:	COM-SRD-3788		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12063			
The bulk data reprocessing shall be able to switch from one version to another of any element of the system in less than two hours.			
Justification:	In order to ensure the flexibility of the bulk data reprocessing.		
Comments:	This assumes that the element is already installed and configured.		
Source Requirements:	COM-SRD-3692		
Related Requirements:		**Verification Method:**	Test

3.2.4. Interface Requirements

SWE-SRD-12110			
Each HMI shall allow quick access to reference, help, and training materials.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3825		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12111			
Each HMI shall incorporate role-based access to information and functionality (e.g. for example, the administrator role could change the configuration and see the status of a system via the HMI whereas the operator role could only see the status of a system).			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3826		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20255			
The Space Weather System shall have the capability of interfacing with external systems, such as contributing sensors or data centres, for the purpose of exchanging data.			
Justification:	The Space Weather system is expected to interface with external data providers such as NASA, NOAA and other international organisations/agencies for the purposes of data exchange.		
Comments:	The necessary interface control documents shall be agreed with the relevant parties.		
Source Requirements:	SYS-CRD-SYS-3208		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20256			
Interfaces between different components of the Space Weather System and between the Space Weather System and external entities shall be harmonised to maximise commonalities.			
Justification:	For maintenance, data analysis and future evolution purposes it is important that interfaces are as homogeneous as possible. Where possible, same fields will be available (even if they are empty for some specific interfaces) in the same place within the message and same protocols will be used.		
Comments:	It is not intended to change interfaces already defined/existing (e.g. for external entities or sensors already operational), the objective is to optimise new interfaces to be defined.		
Source Requirements:	SYS-CRD-SYS-3209		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12071			
Each internal or external interface in the system where there is a one-to-many flow shall include mechanisms that allow the priority of service element generation and dissemination to be defined, configured, and implemented.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3751 SYS-CRD-SYS-3213		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12074			
For each internal or external interface in the system, the implementation shall allow the operators to reconfigure the priority handling without interrupting normal operations.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3754 SYS-CRD-SYS-3214		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12075			
For each internal or external interface in the system, the implementation shall allow the active configuration of the priority handling to be readily visualised by the operations teams.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3755 SYS-CRD-SYS-3215		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-10135			
The Space Weather System shall receive SWE information from ground or space based sensors and their associated systems either via a web interface for user or a web interface for application.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12143			
The system shall adopt/define data interface standards to facilitate interoperability.			
Justification:			
Comments:	Any adoptions/deviations/extensions of data interface standards shall also be proposed to the relevant standardisation organisations, in order to maintain interoperability across the boundaries of the ESA Space Weather System. In case new data interface types are identified where no standard exist yet, these shall also be proposed as new standards.		
Source Requirements:	COM-SRD-3603		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12108			
Each element of the system shall include one or more HMIs which present process data to a human operator and through which the human operator fully controls and monitors the process.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3823		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12109			
Each HMI shall present information to the human operator graphically in the form of a mimic diagram such that the operator can see a schematic representation of the process being controlled and monitored.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3824		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20260			
The user shall be able to access both operational services and new capabilities in testing/demonstration.			
Justification:	In order to provide feedback on their usability, and to support continued service improvement and R2O2R activities.		
Comments:			
Source Requirements:	SYS-CRD-FUN-3259		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.5. Design and Implementation Requirements

3.2.5.1. General

SWE-SRD-20002			
The Space Weather System shall implement and maintain configuration control.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9109			
The storage function shall be ensured at System level by the relevant services of Domain "General Data Services", and at data centres level by the entities in charge of the considered products.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20257			
The Space Weather System shall clearly document the priority handling mechanisms that are implemented.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3191		
Related Requirements:		**Verification Method:**	Inspection Test

SWE-SRD-20258			
The Space Weather System shall clearly document the procedures to alter the configuration of the priority handling.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3192		
Related Requirements:		**Verification Method:**	Inspection Test

SWE-SRD-12089			
The Space Weather System shall refer on all operational and local displays to UTC as single common system time.			
Justification:			
Comments:	It is recommended to specify UTC.		
Source Requirements:	COM-SRD-30 SYS-CRD-SYS-3204		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12090			
The system shall provide periodic reports to the operators on the integrity of its services and its data and products.			
Justification:			
Comments:	For this requirement, integrity is related to the overall integrity of the system at a given time.		
Source Requirements:	COM-SRD-3622		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12091			
The system shall generate the reports on operator's demand and periodically.			
Justification:	In order to ensure availability of reports.		
Comments:			
Source Requirements:	COM-SRD-1582		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12130			
All the elements of the system shall be designed in a modular way such that it is possible to repair, replace, or upgrade them without affecting the full system.			
Justification:	Modularity helps ensure maintenance will not affect the full element.		
Comments:			
Source Requirements:	COM-SRD-73		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12136			
Adding new functions, services, sensors and external systems shall be managed globally with system parameters reconfiguring the system in order to accept in an easy way the new element.			
Justification:	This requirement is needed in order to ensure the overall Space Weather System can be maintained through its service lifetime.		
Comments:			
Source Requirements:	COM-SRD-1269		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12142			
The system shall adopt/define standards to manipulate the sensors systems data and in particular use a single reference and time frame to facilitate the exchange of data within the own system.			
Justification:	In order to ensure synchronisation of the data received from different sensors.		
Comments:			
Source Requirements:	COM-SRD-3602		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12152			
The system design shall follow an incremental development approach.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-24		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12154			
The system shall have a well-defined interface layer that allows to extend the interfaces of the system to interact with additional Third Party Providers minimising the impact on the system.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-1268		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12156			
Throughout its operational lifetime, each element of the system shall assure that its functions and services are compatible with both the current and all previous applicable input and output data formats.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3629		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12161			
The system shall provide their own independent calibration systems or shall establish a coordination mechanism with external calibration systems.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3623		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12165			
The developing entity shall design the system such that it complies with the data policy directives.			
Justification:	In order to ensure compliance with data policy directives already in the design phase.		
Comments:			
Source Requirements:	COM-SRD-3968		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12166			
The implementation of the data policy shall minimise the operational overhead on the system.			
Justification:	In order to ensure efficient implementation of data policy.		
Comments:	This is to be seen as from the end-user perspective.		
Source Requirements:	COM-SRD-3969		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12168			
The system shall be designed to ensure the traceability of the mechanisms that implement and enforce the data policy.			
Justification:	In order to ensure that data policy implementations can be traced.		
Comments:	At any point in time, we should know what are the mechanism enforced in the system and where. How is the data policy designed into the system.		
Source Requirements:	COM-SRD-3971		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12180			
The reference coordinate system for locations on earth for the system shall be ITRF with WGS84 as a reference for altitude.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-262 SYS-CRD-SYS-3205		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20263			
The system shall use units in line with international standards and common practice in the relevant user communities			
Justification:	In order to ensure consistency between the Space Weather system and other systems in terms of SI units and other units when interfacing with users systems requires this.		
Comments:			
Source Requirements:	SYS-CRD-SYS-3206		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-20264			
The values of fundamental constants (e.g. the speed of light) shall be defined and used systematically and consistently throughout the Space Weather System.			
Justification:	In order to ensure consistency between different subsystems using the same fundamental constants		
Comments:			
Source Requirements:	SYS-CRD-SYS-3207		
Related Requirements:		**Verification Method:**	Design Review

3.2.5.2. Environments

SWE-SRD-11981			
The Space Weather System shall have following environment types: • production environment for operations, • staging environment for training and operational validation of new elements and processes, • testing environment and, • development environment(s).			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3782		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-11982			
The environments of the Space Weather System, specified in SWE-SRD-11981, shall be operable independently from each other.			
Justification:	In order to honour common network separation practise.		
Comments:	Operation of one environment shall not affect the operation of a different one.		
Source Requirements:	SYS-CRD-SYS-3210		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-11991			
The different ICT environments shall be capable of providing functional units that can be integrated and/or deployed at different geographical premises.			
Justification:	To support the distributed nature of the Space Weather System.		
Comments:			
Source Requirements:	COM-SRD-3640		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-11992			
The system shall allow data interchange between the different independent ICT environments.			
Justification:	In order to ensure the possibility the transfer data between the different ICT environments.		
Comments:	This should cover different types of data transfer: real-time, deferred-time, etc.		
Source Requirements:	COM-SRD-3719		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-11983			
The production environment of the Space Weather System shall host the operations of the Space Weather System.			
Justification:	In order to have one environment only for handling the system operations.		
Comments:			
Source Requirements:	COM-SRD-3635		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-21001			
The production environment of the Space Weather System shall allow updating of existing elements or adding new elements with an acceptable service interruption.			
Justification:			
Comments:	Acceptable service interruption is specified in availability requirement section.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21002			
The production environment of the Space Weather System shall have permanent access to real-time data from the Data Acquisition Segment.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11989			
The staging environment of the Space Weather System shall provide capabilities that are fully representative of the operational environment.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3637		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12004			
The staging environment(s) of the Space Weather System shall provide an operational validation capability to allow the qualification of a new version of a given component by operating it in parallel to the production environment. This shall also apply to federated services and products.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:	Qualification is achieved by running the existing and the new version of the component in parallel until successful validation of the results produced by the new component in comparison to the existing one.		
Source Requirements:	COM-SRD-3789		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-21003			
The staging environment(s) of the Space Weather System shall have the capability to have access to the Acquisition Segment and is real-time data.			
Justification:			
Comments:	This is needed for the operational validation capability.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21004			
The staging environment(s) of the Space Weather System shall have the capability to use simulated data sets, which are representative for the real-time data of the Acquisition Segment, for the purpose of operational training.			
Justification:			
Comments:	This is needed for operational training and the conduction of operational simulation in a representative staging environment.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11988			
The staging environment(s) of the Space Weather System shall accept test data with the same inputs as the operational environment without unnecessary use of classified data.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3636		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12005			
The operational validation capability shall allow supporting multiple versions of any element of the system.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:			
Source Requirements:	COM-SRD-3675		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-21005			
The operational validation capability shall not have any impact on the operations and service availability.			
Justification:			
Comments:	The operational validation and qualification of new elements and processes need to be isolated from the actual operations. This can be achieved by the implementation of a staging environment with access to the live data.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12006			
For the operational validation capability, the staging environment(s) of the Space Weather System shall allow the installation of new versions of any element in less than 8 hours.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:			
Source Requirements:	COM-SRD-3676		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12007			
For the operational validation capability, the staging environment of the Space Weather System shall be able to switch from one version to another of any element of the system, in less than 2 hours.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:			
Source Requirements:	COM-SRD-3677		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12008			
The staging environment(s) of the Space Weather System shall have access to sufficient data sources to allow it to run in parallel to the production environment during the period of qualification.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:			
Source Requirements:	COM-SRD-3678		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12009			
The operational validation capability shall have all the access necessary to the outputs of the operational system to allow a cross-comparison to be performed.			
Justification:	In order to allow smooth integration of new versions of operational components.		
Comments:			
Source Requirements:	COM-SRD-3679		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12010			
The operational validation capability shall have all the tools necessary to efficiently cross-compare the results of the qualification campaign with those previously produced by the operational environment.			
Justification:	In order to ensure validation of operational output.		
Comments:			
Source Requirements:	COM-SRD-3680		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12051			
The Space Weather System shall allow the simulation of operational activities in a staging environment with sufficient access to data sources for this purpose over an extended period of time.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3716 SYS-CRD-FUN-3196		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12052			
The staging environment of the Space Weather System shall allow training sessions on different aspects of the system to be performed in parallel.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3717 SYS-CRD-FUN-3196		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-11985			
The testing environment of the Space Weather System shall be representative of the operational environment.			
Justification:	In order to make sure that the AIV activities are working close to the operational environment.		
Comments:			
Source Requirements:	COM-SRD-3783		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-11984			
The testing environment of the Space Weather System shall allow to perform Acceptance, Validation and Integration activities as defined by the ECSS standards.			
Justification:	In order to have one environment only for handling the system Acceptance, Validation and Integration activities.		
Comments:			
Source Requirements:	COM-SRD-3634		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12032			
The testing environment of the Space Weather System shall enable the testing and validation of elements of the system prior to their deployment in the production environment of the operational Space Weather System.			
Justification:	In order to be able to validate new system elements before being deployed operational.		
Comments:			
Source Requirements:	COM-SRD-3657		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-21006			
The testing environment of the Space Weather System shall have the capability to use simulated data sets, which are which are representative for the real-time data of the Acquisition Segment, for the purpose of testing and acceptance of new elements.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12035			
The testing environment of the Space Weather System shall have access to sufficient data sources to allow it to simulate the activity of the production environment over an extended period of time.			
Justification:	In order to test and validate new system elements in a representative environment.		
Comments:			
Source Requirements:	COM-SRD-3661		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-11990			
The testing environment of the Space Weather System shall allow testing a single component by interfacing with other components of the system being either simulated or real.			
Justification:	This will allow to perform the integration of the different components of the system as well as to perform end-to-end system tests.		
Comments:			
Source Requirements:	COM-SRD-3639		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12033			
The testing environment of the Space Weather System shall be capable of supporting multiple versions of any element of the system.			
Justification:	In order to provide for efficient testing on multiple versions of a system element.		
Comments:			
Source Requirements:	COM-SRD-3658		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12034			
The testing environment of the Space Weather System shall allow the installation and configuration of new versions of any element, to be tested and accepted, in less than 8 hours.			
Justification:	In order to ensure time efficient testing and validation of new system elements.		
Comments:			
Source Requirements:	COM-SRD-3659		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12061			
The testing environment of the Space Weather System shall be able to switch from one version to another of any element of the system in less than eight hours.			
Justification:	In order to ensure the flexibility of the AIV environment.		
Comments:			
Source Requirements:	COM-SRD-3660		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12036			
The testing environment of the Space Weather System shall have all the tools necessary to efficiently analyse the results and perform a comprehensive assessment.			
Justification:	In order to complete the assessment of new system elements before being introduced into the operational environment.		
Comments:			
Source Requirements:	COM-SRD-3662		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-11986			
The system development environment(s) of the Space Weather System shall allow the development and maintenance of the system.			
Justification:	In order to be able to validate, integrate and accept new system components in the AIV environment and deploy them in the operational environment.		
Comments:	The objective is to have a development and AIV environments representatives of the operational environments.		
Source Requirements:	COM-SRD-3784		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12043			
The development environment(s) of the Space Weather System shall enable investigation and analysis of problems identified in the production environment.			
Justification:	In order to be able to investigate problems without interfering with the performance of the operational system.		
Comments:			
Source Requirements:	COM-SRD-3668		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12044			
The development environment(s) of the Space Weather System shall allow replaying all system processes using archived data and recorded data exchange and for a configurable period of time.			
Justification:			
Comments:			
Source Requirements:	SYS-CRD-FUN-3197		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12045			
The development environment(s) of the Space Weather System shall be capable of supporting all previous and still relevant versions of any element of the system.			
Justification:	In order to ensure the capability to develop patches or updates also for previous versions of the system and primarily of course for the current relevant version of the system.		
Comments:			
Source Requirements:	COM-SRD-3669		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12148			
The development environment(s) of the Space Weather System shall allow a new version of any component of the system to be installed and configured in less than eight hours.			
Justification:	In order to ensure efficient and timely installation of a new version of any component.		
Comments:			
Source Requirements:	COM-SRD-3670		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12060			
The development environment(s) of the Space Weather System shall be able to switch from one version to another of any element of the system in less than eight hours.			
Justification:	In order to ensure the flexibility of the development environment.		
Comments:			
Source Requirements:	COM-SRD-3671		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12057			
The ICT environment shall include simulators that allow any part of the operational system to be simulated. These include, but are not limited to, simulators for the following: • Network of ground-based sensors • Network of Space-based sensors • Data processing chain • Interface to Third Party Providers • Interface to the designated Governing Authority			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3734		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12058			
System testing requires specific tests tool that shall be provided within the frame of the Space Weather System: • Sensor simulators shall allow to execute on-board software and simulate the behaviour of the sensors. • In their flight environment. It shall be interfaced with the command and control centre. • Sensor/satellite suitcase shall be representative of the sensors (satellites) TM/TC subsystem and allow to execute compatibility tests with the ground stations. • Mission simulators shall be representative of the mission planning process and shall be able to execute resource sharing tests between the shareholders of programming rights.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3750		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12054			
The simulators shall support the development of the system, including the AIV activities.			
Justification:			
Comments:	This implies that the simulators can be installed and configured as part of the development and AIV environments.		
Source Requirements:	SYS-CRD-SYS-3210		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12184			
The network infrastructure shall provide sufficient information to allow the traffic flow throughout the network to be fully administered and monitored in a centralised way.			
Justification:	In order to be able to efficiently administer and monitor the system traffic flow.		
Comments:			
Source Requirements:	COM-SRD-1621		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12185			
The design of the network infrastructure shall physically separate systems onto independent networks according to the criticality and security classification of the data moving on that network.			
Justification:	In order to implement multiple levels of security at network level.		
Comments:			
Source Requirements:	COM-SRD-3827		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.5.3. Data

SWE-SRD-11998			
The bulk data reprocessing function shall allow using different versions of any element of the system.			
Justification:	In order to ensure flexible operations.		
Comments:	By element is meant any SW/HW configuration item of the system.		
Source Requirements:	COM-SRD-3690		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11999			
The bulk data reprocessing function shall allow a new version of any element of the system to be installed and configured in less than one working day.			
Justification:	In order to cope with performance requirements.		
Comments:			
Source Requirements:	COM-SRD-3691		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12241			
Any information provided by a third party provider shall be flagged as external data and the information of the source shall be kept attached.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11804			
The refresh rate for alerts should be higher than any of the input sources' data rates.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCH-2681		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9187			
Space and ground segments shall include calibration information for provided data.			
Justification:	Good calibration of data is required with a view to standardisation.		
Comments:			
Source Requirements:	SWE-CRD-GEN-1739		
Related Requirements:		**Verification Method:**	Design Review Analysis Inspection

SWE-SRD-12163			
The Space Weather System shall be designed to ensure the traceability, the control, and the validation of all data introduced into the system.			
Justification:	In order to be able to validate which service products have been produced using which data sources (i.e. internal data sources or third-party data provider sources).		
Comments:			
Source Requirements:	COM-SRD-3966		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-20266			
The Space Weather System shall allow to browse and filter all archived data throughout the lifetime of the system. The filtering functions shall be customisable by the end-users.			
Justification:	Required in order to retrieve datasets.		
Comments:	The expected lifetime of the system is specified in SWE-SRD-12182.		
Source Requirements:	SYS-CRD-FUN-3194		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12171			
Whenever databases are implemented in the system, mechanisms and interfaces to automate the addition of new elements to the database shall be provided.			
Justification:	In order to ensure the possibility to expand databases with new elements if required.		
Comments:			
Source Requirements:	COM-SRD-3608		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9140			
The Space Weather System shall allow to retrieve the data, which is already stored in the system, with a lower sampling rate at which the primary data is available			
Justification:	The users will be able to specify their requests according to their data needs vs their timeliness requirements.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1581		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.5.4. Applicable Standards, Regulations and Certifications

SWE-SRD-12326			
The system shall be designed, developed, and operated in compliance with [AD-03].			
Justification:	In order to be compliant with European Standards on Space Systems Development		
Comments:	Where required, tailoring of ECSS standards such as [AD-07] and [AD-08] shall be applied. Additionally, the ISO 9001 standard shall be applicable and follow in the design and development of the Space Weather System.		
Source Requirements:	COM-SRD-3670 SYS-CRD-QUA-3229		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12081			
The system shall be designed to minimize energy consumption.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-1281		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12083			
Any system asset, including data centres and sensors, shall be compliant with the worst case environmental conditions applicable to the site where they are to be installed.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3627		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12122			
All electrical devices that are part of the system shall be certified.			
Justification:			
Comments:	As applicable, the labels “CE” or "UKCA" should be used.		
Source Requirements:	COM-SRD-36 SYS-CRD-HAS-3232		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12123			
The system shall ensure that all physical assets are certified.			
Justification:			
Comments:	As applicable, the labels “CE” or "UKCA" should be used.		
Source Requirements:	COM-SRD-37 SYS-CRD-HAS-3232		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12124			
The design, the development and operation of the System as well as each of its components shall follow the health and safety standards applicable to their centres (ESA or local/national regulations) as well as the EU standards and laws, whichever is more stringent.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-38 SYS-CRD-HAS-3231 SYS-CRD-HAS-3234		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12126			
All radiating components and their shelters, housings and sites shall follow the applicable national and EU laws and regulations whichever are more stringent.			
Justification:			
Comments:	Physical assets are assets that are actually manufactured. This excludes assets such as software systems, expertise, or people.		
Source Requirements:	COM-SRD-40 SYS-CRD-HAS-3233		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-12116			
The ECSS suite of standards shall apply during the whole system lifecycle.			
Justification:	As requested by the customer requirements document.		
Comments:			
Source Requirements:	COM-SRD-3780		
Related Requirements:		**Verification Method:**	Inspection

SWE-SRD-12117			
All new ground segment operational software implemented for the system shall be developed in accordance with the ECSS-E-40 and ECSS-Q-80 standards as tailored in [AD 54], [AD 55].			
Justification:	The ECSS SW Tailoring for Ground Segment Systems have been approved for all Ground Segment software. Using this set of tailoring guidelines will reduce the documentation need for e.g. SW development in studies or prototypes.		
Comments:	When existing software has been developed according to a specific standard, its maintenance and customisation follows the same standard (PSS-05). This applies to old infrastructure Space Weather System software items.		
Source Requirements:	COM-SRD-3773		
Related Requirements:		**Verification Method:**	Inspection

SWE-SRD-12125			
The system development and its operations shall comply with the health and safety regulations and standards that are applicable to its centres (e.g. ESA, EU, National, precedence rules).			
Justification:			
Comments:			
Source Requirements:	COM-SRD-39 SYS-CRD-HAS-3231 SYS-CRD-HAS-3234		
Related Requirements:		**Verification Method:**	Analysis Inspection

3.2.6. Availability and Reliability Requirements

3.2.6.1. Service Criticality

This section describes the different failure effect severity categories for dependability applicable to the system. The following definitions are of applicability:

- Mission Critical Service: Service whose unavailability and/or downtime may result in not meeting the system objectives.
- Non-Critical Service: Service whose unavailability or downtime will not impact the segment's mission goals.

The terms downtime used above is defined as the period of time when the system/service is unavailable as a result of failure, malfunction, corrective maintenance, preventive maintenance, and/or logistic/administrative delays.

	Catastrophic (Level 1)	**Critical (Level 2)**	**Major (Level 3)**	**Minor/Negligible (Level 4)**
Mission Critical Services	Failure propagation (for analyses lower than SWE system level)	Loss of service	Major service degradation	Minor service degradation
Non-Critical Services	N/A	Failure propagation (for analyses lower than SWE system level)	Loss of service	Major service degradation

Table 2: Failure effect severity categories for dependability

SWE-SRD-12706			
No single failure of any element of the Space Weather System or single operator error shall have critical or catastrophic dependability consequences.			
Justification:	As requested by the customer requirements document.		
Comments:			
Source Requirements:	COM-SRD-3780		
Related Requirements:		**Verification Method:**	Inspection Analysis

SWE-SRD-12862			
Service criticality shall be defined in accordance with the following table.			
Justification:	As requested by the customer requirements document.		
Comments:			
Source Requirements:	COM-SRD-3780		
Related Requirements:		**Verification Method:**	Inspection

Service Name	Criticality	Notes
Environment Specification: Data Archive	Non-critical	
Post Event Analysis	Non-critical	
Space Weather in the Solar System (S/C Design)	Non-critical	
In Orbit Environment and Effects Monitoring	Mission critical	
Post Event Analysis	Mission critical	
In-orbit Environment and Effects Forecast	Mission critical	
Mission Risk Analysis	Non-critical	
Space Weather in the Solar System (S/C Operation)	Non-critical	
In-flight Crew Radiation Exposure	Mission critical	
Cumulative Crew Radiation Exposure	Non-critical	
Increased Crew Radiation Exposure Risk	Non-critical	
Radiation Environment Monitoring	Mission critical	Service is mission critical during launch campaigns.
Estimate of Radiation Effects in Sensitive Electronics	Non-critical	
Forecast of Radiation Storms	Mission critical	Service is mission critical during launch campaigns.
Risk Estimate of Service Disruption Caused by Ionospheric Scintillations	Mission critical	Service is mission critical during launch campaigns.
Near-Real Time TEC Maps	Mission critical	
Forecast TEC Maps	Mission critical	
Quality Assessment of Ionospheric Correction	Mission critical	
Near-Real Time Ionospheric Scintillation Maps	Mission critical	
Monitoring and Forecast of Ionospheric Disturbances	Mission critical	
Atmospheric Estimates for Drag Calculation	Mission critical	Service is mission critical during atmospheric re-entries, not for normal orbit propagation.
Archive of Geomagnetic and Solar Indices for Drag Calculation	Non-critical	
Forecast of Geomagnetic and Solar Indices for Drag Calculation	Mission critical	Service is mission critical during atmospheric re-entries, not for normal orbit propagation.
Nowcast of Ionospheric Group Delay	Non-critical	Service is mission critical during atmospheric re-entries, not for normal orbit propagation.
Power Operation	Mission critical	
Pipeline Operation	Non-critical	
Aviation	Mission critical	
Resource Exploration and Exploitation	Mission critical	
Aurora Observation and Forecast	Mission critical	The service for the Auroral tourism sector is critical during the tourism season roughly September - April.
Space Weather Data Repository	Non-critical	
Latest Data Guaranteed Service	Mission critical	
Space Weather Nowcast and Forecast Products	Mission critical	
Event Based Alarms	Mission critical	
Virtual Space Weather Modelling System	Non-critical	
Space Weather Training and Support Material	Non-critical	

Table 3: Service criticality for all SWE Services

3.2.6.2. Service Availability and Reliability

SWE-SRD-21007			
With the exception of scheduled maintenance, the general maximum contiguous downtime of all operational services in the service domains 1-12 shall be, if not specified in further requirement, less than 24 hours.			
Justification:			
Comments:	The target is 24/7 operation. The baseline regarding the availability of pre-operational services of the R2O2R system are office hours.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21008			
The general operational availability for all service domains, domain 1-12, shall be, if not further specified in further requirement, better than 99% per year.			
Justification:			
Comments:	The target is 24/7 operation. This is only applicable for operational services and not the R2O2R system.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21009			
The general availability for all service domains in the R2O2R systems shall be, if not further specified in further requirement, better than 95% per year.			
Justification:			
Comments:	The baseline regarding the availability of pre-operational services are office hours.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11843			
The Space Weather System shall indicate interruptions, e.g. specific data streams, of any operational services, applicable to all service domains.			
Justification:	The user will need to be informed of a known decrease in accuracy of the service they are using.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1575		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9160			
Two days prior a launch, the maximum contiguous downtime of service domain 4 shall be less than 30 minutes.			
Justification:	2 days is the critical period for decision of launching or not pending on space weather condition. A maximum downtime of 30 minutes is compatible with the refreshing rate requirement.		
Comments:	This requirement applies only for relevant launch campaigns In general, the availability requirements for Service 4 are only applicable for launch campaigns. At other times, availability requirements for the SCO domain are considered to be the reference for this domain noting that all SCO domain data and products shall also be available to the LAU domain.		
Source Requirements:	SWE-CRD-LAU-1627, SWE-CRD-LAU-1622		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12868			
Two days, respective 48hours, prior launch the operational availability of service domain 4 shall be better than 98.96% for this period.			
Justification:	2 days is the critical period for decision of launching or not pending on space weather condition. A maximum downtime of 30 minutes is compatible with the refreshing rate requirement.		
Comments:	In general, the availability requirements for Service 4 are only applicable for launch campaigns.		
Source Requirements:	SWE-CRD-LAU-1627		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-20245			
From two weeks prior launch, Service 4 shall be continuously available.			
Justification:			
Comments:	In general, the availability requirements for Service 4 are only applicable for launch campaigns. Outside these periods, availability requirements relevant for the SCO domain shall apply.		
Source Requirements:	SWE-CRD-LAU-1627 SWE-CRD-LAU-2683		
Related Requirements:		**Verification Method:**	

SWE-SRD-9167			
The maximum contiguous downtime of service 5 shall be less than 5 minutes with the exception of scheduled maintenance.			
Justification:	The maximum service downtime depends on the users but is driven by the most demanding users.		
Comments:	With a service interruption being defined as the temporary suspension of the capacity to nowcast or forecast the data to the user.		
Source Requirements:	SWE-CRD-TIO-1649		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9186			
The Space Weather System shall take measures to ensure that the services can continue to function in all space weather conditions.			
Justification:	In particular, space weather sensors should be designed so they continue to provide useful information during solar energetic particle events, and under disturbed ionospheric conditions.		
Comments:			
Source Requirements:	SWE-CRD-GEN-1738		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.6.3. System Availability and Reliability

SWE-SRD-12129			
The Space Weather System shall allow that any element of the system can be repaired, replaced or upgraded without any interruption of the service provision.			
Justification:	Maintenance or upgrade activities must not impact on normal operation.		
Comments:			
Source Requirements:	COM-SRD-72 SYS-CRD-FUN-3195		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12140			
The Space Weather System shall allow to open / close the access to external systems (e.g. sensors, external systems) without affecting the operational use of the available parts.			
Justification:	The ability to open/close access to external system without affecting operational use is driven by the need to minimise offline time as well as system maintainability.		
Comments:			
Source Requirements:	COM-SRD-1273		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12137			
The Space Weather System shall allow to upgrade the hardware and to update the software of any operational element while still meeting all Space Weather System service availability requirements.			
Justification:	The maintenance of the system should not impact the provision of the services specified in the present document.		
Comments:			
Source Requirements:	COM-SRD-1270 SYS-CRD-FUN-3195		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12064			
The Space Weather System shall be able to provide the services in the temporary absence of external synchronisation reference without degradation of performances.			
Justification:	The system availability must not depend on presence of external service.		
Comments:	The system must be able to maintain time synchronization accuracy for a TBD time period without external reference (free run). Any deviation to this requirement shall be duly justified.		
Source Requirements:	COM-SRD-70		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9562			
The operational availability of the Space Weather System and its elements shall be such that all Space Weather System service availability requirements are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12863			
The maximum contiguous downtime of the Space Weather System and its elements shall be such that all required maximum contiguous downtimes of Space Weather System services are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12144			
The unavailability of any element of the system shall not lead to the unavailability of any other element of the system.			
Justification:	In order to ensure that a failure of one part of the system will not lead to a failure of the complete system.		
Comments:			
Source Requirements:	COM-SRD-1284		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12182			
The Space Weather System functionalities shall be available over the system lifetime supposed to be 50 years.			
Justification:	This is a design assumption to allow dimensioning the system.		
Comments:	The lifetime starts with the first Space Weather System service being operational. Other parts of the Space Weather System may still be under development at this point. The lifetime may still change as result of the architectural design activity.		
Source Requirements:	COM-SRD-1283 SYS-CRD-FUN-3193 SYS-CRD-SYS-3203		
Related Requirements:		**Verification Method:**	Design Review Analysis

3.2.6.4. Data Availability and Reliability

SWE-SRD-9136			
All Space Weather System data shall be available to the end user in near-real time			
Justification:	To allow -real-time assessment of space weather threats on spacecraft in routine mode.		
Comments:	Near-real time is defined in terms of the specified latency of all of the -N Nowcast products in the Product Specification Document [AD-09].		
Source Requirements:	SWE-CRD-SCO-1577		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-9141			
Any request to retrieve data already stored in the system shall have a maximum response time delay of 10 minutes. This applies only to data that do not require computation after the request.			
Justification:	Performance is a critical requirement for the usefulness of the system.		
Comments:	Requests for small quantities of data should be retrievable faster than the baseline 10 minutes.		
Source Requirements:	SWE-CRD-SCO-1582		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12231			
The system shall make available any requested data from the archive within 48 hours (TBC) after the request.			
Justification:			
Comments:	The time constraint may still be subject to change.		
Source Requirements:	COM-SRD-1601		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9132			
Environmental data shall be available for the statistical service products at most 1 week after acquisition from sensors.			
Justification:	Latency time driven by the service for spacecraft anomaly analysis.		
Comments:			
Source Requirements:	SWE-CRD-SCD-1528		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-9133			
Environmental data shall be available for the local spacecraft environment products, in near real-time and at most 1 day after retrieval on ground.			
Justification:	This is to respond to urgent analysis request for critical spacecraft failures.		
Comments:	Expanded from SWE-CRD-SCO-1531 requirement description.		
Source Requirements:	SWE-CRD-SCD-1529		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-9148			
As a minimum, the Space Weather System data, covering the time spent from the start of the mission to present, shall be available.			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-SCO-2638		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11841			
The Space Weather System shall, after offline periods of a service or service domain, recover the missing data.			
Justification:	Complete datasets are required for e.g. post-event analysis and statistical model generation.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1575		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-11948			
In case the system is using data from external sources that cannot be checked independently (e.g. operational orbit data for planned manoeuvres), it shall flag this data and any by-product as data for which the system cannot be liable for.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3626		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-11950			
Each product made available by the system shall provide an indication of the reliability and information on the source of the data on which the product is based.			
Justification:	Needed for assessment of quality of services and products		
Comments:	If possible, metadata shall follow standard recommendations, e.g. IERS for Earth Orientation Parameters.		
Source Requirements:	COM-SRD-56 SYS-CRD-QUA-3228		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20265			
All observational and intermediate data and all resulting products shall be stored and made available on request for the lifetime of the system as defined in SWE-SRD-12182. This shall comprise sensor raw data, intermediate data, and transmitted service products.			
Justification:	It may be required to reanalyse data for calibration or training purposes. Data shall also be made available for scientific use.		
Comments:			
Source Requirements:	SYS-CRD-FUN-3193		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-11846			
The Space Weather System shall make available its data and products continuously on a 24/7 basis, as near as possible.			
Justification:	The level of guarantee may take into account the limitations of the data source and, where applicable, the requirements of the 3rd party service provider.		
Comments:	Any unexpected outages have to be dealt with in an agreed time period.		
Source Requirements:	SWE-CRD-GEN-1736		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-9138			
The Space Weather System shall make available the outputs of forecast models available to their end-users as soon as they are produced.			
Justification:	The usability and usefulness of the forecasted data depend on the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1579		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.7. Security and Data Policy Requirements

Note: All requirements in this section are currently under review and their current applicability should be checked with the ESA Space Weather Office prior to utilisation.

3.2.7.1. Security

3.2.7.1.1. Security Policy

SWE-SRD-12193			
The Space Weather System shall configure and apply the "Data policy directives" for security as part of the security policy.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3927		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12194			
The security policy shall be a sub-set of the data policy.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3928		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12195			
The security policy shall be defined taking into account: a. ESA Security Regulation; b. Programme Security Instructions document; c. 3rd party data policy constrains; d. TBD.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3929		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12196			
The security policy shall be enforced by means of: a. System Security Requirement Statements (SSRS); b. Security Procedures (SecOps).			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3930		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12197			
The Space Weather System security policy shall address at least the following aspects: a. Physical and infrastructure Security b. Data security c. Security of users, data providers and external entities d. Space Weather System Service security e. Definition of responsibilities for data handling and data security f. Security Management g. Definition of security governance structures h. Definition of required security management documentation (e.g. CSRS/SSRS/SecOps.) i. Personnel Security Management			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3931		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12198			
The security policy shall foresee all data and documentation attributed Protection Level 1 (ESA Unclassified - for ESA official use only)			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3932		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12203			
The governing authority shall be responsible to define and approve the user needs of the system.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3941		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.7.1.2. SWE Specific

SWE-SRD-12515			
The Space Weather System shall be able to handle data classified as ESA Unclassified, unless otherwise specified in the present document.			
Justification:	In order to honour data distribution restrictions imposed by data providers and/or users.		
Comments:	It is expected that most of the data handled by the Space Weather System is ESA Unclassified. Special markings of ESA Unclassified such as "Privileged" may apply to protect commercial or scientific interests of data providers and/or users.		
Source Requirements:	COM-SRD-3752		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-20254			
The Space Weather System shall implement cybersecurity controls in line with the results of a threat and risk assessment and the corresponding risk treatment decisions.			
Justification:	In line with the ESA security framework, the Space Weather System will be subject to a regular cybersecurity threat and risk assessment. Any risks identified through this process will require a risk treatment decision by the appropriate space weather system stakeholders. Any such decision resulting in risk mitigation will result in requirements for cybersecurity controls to be implemented by the Space Weather System.		
Comments:			
Source Requirements:	SYS-CRD-SEC-3230		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.7.1.3. Cryptographic

SEC-SRD-3817			
All cryptographic algorithms used as part of the Space Weather System for protecting sensitive information and information classified ESA Restricted shall be compliant with [AD-SEC-04] and the applicable security policy.			
Justification:	It needs to be ensured that no insecure crypto algorithms are used as part of the Space Weather System.		
Comments:	It should be noted that the actual implementation of the cryptographic algorithms could be flawed if not done properly, even if this requirement is fulfilled.		
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-22 SEC-CRD-23 SEC-CRD-24 SEC-CRD-25 SEC-CRD-26 SEC-CRD-3573 SEC-CRD-3578 SEC-CRD-3598		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3818			
All cryptographic keying material to be used within the Space Weather System shall have an appropriate bit length that is directly dependent on its lifetime and use.			
Justification:	It needs to be ensured that the cryptographic keys used within the Space Weather System are of appropriate length to be resistant to cryptanalysis or brute force attacks.		
Comments:	The actual length should be established as part of a risk assessment.		
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3873			
All cryptographic keying material to be used within the Space Weather System shall have a lifetime that is appropriate for its application.			
Justification:	It needs to be ensured that the cryptographic keys used within the Space Weather System are not used for too long a time. Otherwise, the risk resulting from cryptanalysis and/or brute force attacks increases.		
Comments:	The actual lifetime of the cryptographic keys should be established as part of a risk assessment.		
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3829			
the Space Weather System shall implement and operate a key management system capable of managing all cryptographic keys required for the operation of the Space Weather System.			
Justification:	Cryptographic keys are required throughout the Space Weather System for all kind of cryptographic operations.		
Comments:			
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3883			
The security level for the key distribution shall be according to the applicable security policy and sensitivity/ classification level of the data to be protected with the keys to be distributed.			
Justification:	Cryptographic keys are required throughout the Space Weather System for all kind of cryptographic operations.		
Comments:			
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3828			
The Space Weather System shall be capable to securely generate cryptographic keys.			
Justification:	True randomness of keys is required to avoid brute force and key guessing attacks.		
Comments:	A secure real random number generator (RNG) is required for this purpose. In most cases, this is a certified hardware device.		
Source Requirements:	SEC-CRD-11 SEC-CRD-21 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.4. Identification and Authentication

SEC-SRD-3716			
The Space Weather System shall have an identity management and authentication system (IAS) that is capable to manage user identities and authenticate Space Weather System users.			
Justification:	The capability to authenticate users is a prerequisite for any access control or accounting that is to be implemented by the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-18 SEC-CRD-26 SEC-CRD-40 SEC-CRD-46		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3718			
The Space Weather System IAS shall support multiple levels of secure authentication. It shall support at least: • Password-based authentication • Certificate-based authentication • Authentication using hardware tokens			
Justification:	Space Weather System will offer services of different sensitivity and classification levels. The security of the authentication system needs to be increased for services of higher sensitivity levels.		
Comments:	This initial list is to be considered non-exhaustive and may be further refined in the course of the Space Weather System architectural design. The Space Weather System data policy will, for each service, define the minimal authentication level required. Authentication of registered users as a prerequisite to access classified information requires special authentication techniques beyond this requirement.		
Source Requirements:	SEC-CRD-27		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3720			
The Space Weather System IAS shall be able to support multiple authentication levels per registered user.			
Justification:	A registered user may have access to Space Weather System services of different sensitivity levels. He should not be required to use a high security authentication when accessing low sensitivity services only.		
Comments:			
Source Requirements:	SEC-CRD-27		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3614			
The Space Weather System IAS shall not allow access to any part of the Space Weather System for registered users without successful authentication unless explicitly specified in the applicable data policy.			
Justification:	Authentication is a prerequisite for access control and thus subsequently for accessing any Space Weather System or consuming any Space Weather System service.		
Comments:	By not allowing any access to the Space Weather System without prior authentication, the Space Weather System is better shielded against denial-of-service attacks. Furthermore, all access to any system resource can be traced if the registered user is authenticated.		
Source Requirements:	SEC-CRD-40		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3616			
The Space Weather System IAS authentication procedure shall validate the authentication information only on completion of all input data. If an error condition arises, the Space Weather System IAS shall not indicate which part of the data is correct or incorrect.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-40		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3617			
The Space Weather System IAS shall limit the number of unsuccessful authentication attempts per registered user.			
Justification:	This is a countermeasure to prevent denial-of-service, or other brute force attacks, such as password guessing.		
Comments:	The exact specification of the procedures for handling unsuccessful log-on attempts will be defined at a later stage.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3627			
The Space Weather System IAS shall terminate inactive sessions of registered users after a specified period of inactivity.			
Justification:	This prevents malicious use of sessions that have been inactive for some time and the genuine user is not using it anymore.		
Comments:	The maximum period of inactivity shall be established following the risk assessment and shall be laid down in the applicable SecOps.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3628			
If an IAS account of a registered user is not used during a defined period, the account shall be automatically locked.			
Justification:	This shall prevent access to the Space Weather System services by registered or no longer registered users whose credentials have been revoked.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3623			
Upon registration, or upon change of authentication credentials that allow access to sensitive information as specified in the applicable security policy, the Space Weather System AS system shall provide the credentials to registered users in a secure way.			
Justification:	Authentication credentials such as passwords, certificate private keys, and hardware tokens need to be protected when being distributed to the users.		
Comments:	The use of third parties or unprotected (clear text) electronic mail messages for distribution of authentication credentials shall be avoided. Temporary passwords shall be unique to an individual and shall not be guessable.		
Source Requirements:	SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3850			
Upon registration, or upon change of authentication credentials that allow access to information classified ESA Confidential or higher, the Space Weather System IAS system shall be capable of providing the credentials to registered users in compliance with the applicable security policy.			
Justification:	High-Security Authentication credentials that are a prerequisite for access to classified information shall be protected as foreseen in the ESA Security Directives and the Space Weather System PSI when being distributed to the registered users.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26 SEC-CRD-3598 SEC-CRD-3612		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3620			
The Space Weather System IAS shall never transmit passwords in clear text over an unprotected communication channel.			
Justification:	This prevents password eavesdropping.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3621			
The Space Weather System IAS shall never store passwords in an unprotected form in an insecure environment.			
Justification:	If an attacker successfully hacks into an Space Weather System, it is not possible for them to retrieve passwords if they are stored in a secure environment.		
Comments:	An insecure environment is each environment that fails to preserve the confidentiality or integrity of the data stored in it. For example, an unencrypted hard drive is an insecure environment.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3849			
The Space Weather System shall only store cryptographic hashes of passwords.			
Justification:	This increases the security level, since theft of the stored credentials will not disclose the real passwords, only the hashes.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3626			
The Space Weather System IAS shall force registered users to change passwords on a periodic basis.			
Justification:			
Comments:	The exact period will be established following an information risk assessment and will be laid down in the applicable SecOps.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3808			
The Space Weather System IAS shall not allow registered users to select weak passwords.			
Justification:	Weak passwords may be subject to brute force attacks.		
Comments:	Secure password guidelines should be implemented into the password policies, which are part of the applicable SecOps.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3803			
The Space Weather System IAS shall be supported by a Public-Key Infrastructure (PKI).			
Justification:	A PKI is required for the generation and maintenance of digital certificates.		
Comments:	Depending on the governance of the Space Weather System, an external PKI could be used to issue and maintain Space Weather System certificates, or a Space Weather System internal PKI may have to be developed and deployed. This will be decided in a future development phase.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3630			
For certificate-based authentication, the Space Weather System IAS shall only use certificates that are managed by a trusted certificate authority.			
Justification:	The certificate for the authentication needs to originate from a secure source.		
Comments:	The list of trusted certificate authorities will be defined at a later stage.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3631			
The Space Weather System IAS shall not allow authentication using invalid i.e. revoked, unsigned, or expired certificates.			
Justification:	Invalid certificates shall not be accepted for authentication.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3846			
The Space Weather System IAS shall maintain a certificate revocation list (CRL) which is being cross-checked online each time a certificate is used for authentication.			
Justification:	The authentication service needs to know whether a certificate is still valid before authentication can proceed.		
Comments:	This could be achieved for example by means of the OCSP protocol.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3811			
The Space Weather System IAS shall allow revocation of certificates at any time.			
Justification:	If a registered user is no longer authorised to access the Space Weather System, all their currently valid certificates need to be revoked.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3723			
The Space Weather System IAS support allow authentication using compliant hardware tokens. They shall be: • FIPS 140-2 compliant for access to sensitive, but unclassified information • Certified according to [AD-SEC-05] for access to classified information			
Justification:	Certified hardware solutions are required for high security authentication.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3719			
The Space Weather System IAS shall be able to group registered users into logical configurable groups and maintain these groups in the identity repository.			
Justification:			
Comments:	This is a prerequisite for role-based access control.		
Source Requirements:	SEC-CRD-40		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3807			
The Space Weather System IAS shall at least manage the following logical groups of registered users: • Space Weather System Operators • Space Weather System End Users • Space Weather System Administrators • Space Weather System Security Officers			
Justification:	Four main groups of registered users can already be identified and the Space Weather System IAS must be able to handle them.		
Comments:	The listed groups of registered users are currently foreseen. Other groups may be added during the future definition of the Space Weather System.		
Source Requirements:	SEC-CRD-27 SEC-CRD-3573		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3721			
The Space Weather System IAS shall be able to store user identity information in the identity repository. The exact information to be stored as part of a user's identity information shall be configurable for each authentication level.			
Justification:	More secure authentication systems require more identity information to be present in order to guarantee secure authentication.		
Comments:	The exact information to be stored for each authentication level will be defined at a later stage.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3725			
The Space Weather System IAS shall securely store the identity information of the registered users.			
Justification:	This is required to protect the privacy of the registered users.		
Comments:			
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3821			
The Space Weather System IAS shall provide a registration authority for the registration of new users.			
Justification:	Registration of users is a pre-requisite for authentication & access control.		
Comments:	All operators, administrators, and security officers must be registered. End users may be able to access some Space Weather System services without prior registration.		
Source Requirements:	SEC-CRD-25 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3820			
The Space Weather System shall allow read access to the identity information of a registered user only for the affected user and the Space Weather System Administrator.			
Justification:	This is required to protect the privacy of the Space Weather System users.		
Comments:			
Source Requirements:	SEC-CRD-12 SEC-CRD-13 SEC-CRD-14 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3819			
the Space Weather System shall allow read & write access to identity information of registered users only for the registration authority and the security officer responsible for the Space Weather System IAS.			
Justification:	This is required to protect the privacy of the Space Weather System users.		
Comments:			
Source Requirements:	SEC-CRD-12 SEC-CRD-13 SEC-CRD-14 SEC-CRD-26		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.5. Access Control

SEC-SRD-3726			
The Space Weather System shall only perform access control for registered users that have been successfully authenticated by the Space Weather System IAS and whose authentication session is still active in compliance with the applicable security policy.			
Justification:	The access control procedure requires the identity of the registered user as an input parameter.		
Comments:	This implies that access control is only being performed once a registered user has been authenticated.		
Source Requirements:	SEC-CRD-18 SEC-CRD-40 SEC-CRD-46		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3729			
The Space Weather System shall immediately revoke access rights of registered users whose authentication session has been terminated or expired.			
Justification:	Without valid authentication, a user shall not have access to any Space Weather System or service that has access control restrictions applied.		
Comments:			
Source Requirements:	SEC-CRD-18 SEC-CRD-40		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3727			
The access control system shall be based on Role-Based Access Control (RBAC). The roles shall be specified by the Space Weather System IAS.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-37		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3728			
The Space Weather System access control system shall store rules, rights and roles for each registered user and group in the access control repository.			
Justification:			
Comments:	The access control repository may be co-located with the IAS repository but this is not mandatory.		
Source Requirements:	SEC-CRD-37		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3606			
The Space Weather System access control system shall only provide registered users with access to the services that they are authorised to consume as specified by the applicable data policy in compliance with the applicable security policy.			
Justification:	Only authorised users shall be able access services. The access control regulations are to be laid down in the applicable data policy and SecOps.		
Comments:			
Source Requirements:	SEC-CRD-18 SEC-CRD-40 SEC-CRD-3572		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3854			
the Space Weather System shall be capable of enforcing access control to all resources within the Space Weather System in compliance with the applicable security policy.			
Justification:	All resources within the Space Weather System must be protected with access control mechanisms.		
Comments:	A resource could be a data type and/or a physical asset.		
Source Requirements:	SEC-CRD-18 SEC-CRD-40 SEC-CRD-3572		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3688			
The Space Weather System security officer roles shall be defined so that no single user or user group may have a sole responsibility over the security of the Space Weather System in compliance with the applicable security policy.			
Justification:	This is to ensure that the users or user groups cannot misuse their privilege without being accountable for their actions.		
Comments:			
Source Requirements:	SEC-CRD-3572		
Related Requirements:		**Verification Method:**	Test Analysis

3.2.7.1.6. Accounting and Logging

SEC-SRD-3646			
Audit logs recording registered user activities, exceptions, and information security events shall be produced by the Space Weather System and kept stored for a configurable period of time.			
Justification:	This is to assist in future investigations and access control monitoring. The time period for the storage will be established following a risk assessment and will be documented in the SecOps.		
Comments:			
Source Requirements:	COM-CRD-GEN-2276 SEC-CRD-3574		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3647			
Any service product being prepared by the Space Weather System shall be uniquely attributable to the registered user who requested that service.			
Justification:	For proper security logging, it is necessary to know which user requested which service.		
Comments:			
Source Requirements:	COM-CRD-GEN-2277 SEC-CRD-3574		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3648			
At least, the Space Weather System shall always record the following events on the auditing log: • system and service (re)starts and faults; • user authentication processes and log-off; • creation, deletion or alteration of authentication credentials; • unsuccessful attempts to access resources; • alteration of system date/time; • all security actions, including creation, deletion or alteration of access rights; • the transmission/receipt of information between users and the Space Weather System; • abnormal usage behaviour;			
Justification:	This requirement specifies the usual events that are recorded by any logging system.		
Comments:	More logging events may be specified in the future development of the Space Weather System.		
Source Requirements:	SEC-CRD-3574		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3650			
The Space Weather System shall create user activity audit logs that shall include, when relevant: • user identity; • dates, times, and details of key events, e.g. authentication and log-off; • records of successful and rejected system access attempts; • records of successful and rejected data and other resource access attempts; • use of privileges; • alarms raised by the access control system;			
Justification:	This requirement specifies the usual activity events that are recorded by any logging system for any registered user.		
Comments:	More user activity logging events may be specified in the future development of the Space Weather System.		
Source Requirements:	SEC-CRD-3574		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3651			
The Space Weather System shall protect the confidentiality and integrity of the audit logs.			
Justification:	Only security officers shall be able to access these logs. However, they shall not be able to modify them.		
Comments:	The audit logs produced by the ESA Space Weather System may contain intrusive and confidential personal data which could compromise the privacy of the Space Weather System users if disclosed.		
Source Requirements:	SEC-CRD-13 SEC-CRD-14		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3652			
Only security officers shall be able to delete any Accounting Log records. Where possible, the security officers shall not have permission to erase or de-activate logs of their own activities.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3653			
The accounting information shall only be removed from any system upon completion of a successful recording into a definitive file on a computer storage media.			
Justification:	It must be ensured that no audit information is lost. It may be required at a future time for tracing a security incident.		
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3654			
If accounting information cannot be recorded, the Space Weather System shall automatically raise an alarm to a security officer.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3700			
The Space Weather System shall keep records of all suspected or actual faults, and all preventive and corrective maintenance.			
Justification:	This will help to trace sabotage events and support audits.		
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3907			
The allocation and use of privileges shall be restricted and controlled.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.7. Auditing

SEC-SRD-3655			
The Space Weather System shall ensure that the entries in the Space Weather System IAS repository and the access control repository shall be regularly reviewed and entries updated or revoked when necessary.			
Justification:	It must be ensured that registered users who are no longer active or whose account has been revoked shall be removed from the IAS and access control system repositories.		
Comments:	The procedure and policy for reviewing the IAS entries will be documented in the applicable Security Operations Procedure document (SecOps), as specified in [AD-SEC-02].		
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3657			
The clocks of all relevant information processing systems within the Space Weather System shall be synchronized with an atomic clock server with an allowed jitter of one second.			
Justification:	Time synchronisation is a prerequisite for precise audit logs.		
Comments:	High jitter value is acceptable since it is still sufficient for audit purposes.		
Source Requirements:	SEC-CRD-31 SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3822			
The Space Weather System shall perform regular audits of the need-to-know of registered users with regard to the services to which each user is currently subscribed.			
Justification:	The procedure for this requirement will be specified in the Secure Operating Procedures as required in [AD-SEC-02].		
Comments:			
Source Requirements:	SEC-CRD-31 SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3847			
The Space Weather System shall ensure regular audits of all audit logs that are created by the Space Weather System.			
Justification:	This is a prerequisite for precise audit logs.		
Comments:			
Source Requirements:	SEC-CRD-31 SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3882			
The Space Weather System shall enforce periodic information risk assessment exercises.			
Justification:	In order to assess new and retained risks, to analyse developments and potentially incorporate lessons learnt.		
Comments:	This is required as well should there be the need for an ISO 27001 certification of the Space Weather System.		
Source Requirements:	SEC-CRD-21 SEC-CRD-22		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3838			
The Space Weather System shall ensure regular inspection of all security administration procedures and controls, including: • Configuration control • Maintenance and configuration of equipment and systems • Withdrawal from service and disposal of equipment • Security education and awareness • Security incident handling and reporting			
Justification:			
Comments:	Regular audits and inspections of all procedures and control put in place to ensure Space Weather System security are vital.		
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.8. Information and marking handling

SEC-SRD-3659			
Output from systems containing information that is sensitive or classified shall carry an appropriate classification label as specified in [AD-SEC-02].			
Justification:			
Comments:	Items for consideration include printed reports, screen displays, recorded media (e.g. tapes, disks, CDs), electronic messages, and file transfers.		
Source Requirements:	SEC-CRD-25 SEC-CRD-3576		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3660			
The change of classification or need-to-know label shall be possible following specified rules laid down in the applicable security policy.			
Justification:			
Comments:	The applicable security policy will be defined in a later stage of the Space Weather System programme.		
Source Requirements:	SEC-CRD-20 SEC-CRD-25 SEC-CRD-33 SEC-CRD-65 SEC-CRD-3576		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3661			
The originator/creator of classified information shall ensure that the Information Label is present and to give the correct originator/creator, classification and diffusion as specified in [AD-SEC-02].			
Justification:			
Comments:	The applicable data policy will be defined in a later stage of the Space Weather System programme.		
Source Requirements:	SEC-CRD-25 SEC-CRD-33 SEC-CRD-3576		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3867			
All data used within the Space Weather System shall contain a meta-data tag indicating the data's sensitivity level and required need-to-know label.			
Justification:			
Comments:	The applicable data policy will be defined in a later stage of the Space Weather System programme.		
Source Requirements:	SEC-CRD-25 SEC-CRD-33 SEC-CRD-3576		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3868			
The Space Weather System shall implement effective information flow control that prevents leakage of sensitive information into unsensitive information and/or service products.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-35 SEC-CRD-3576		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3870			
The Space Weather System shall implement effective information flow control that prevents leakage of sensitive information to external information systems or between Space Weather System elements.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-36 SEC-CRD-3578 SEC-CRD-3598 SEC-CRD-3612		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.9. Data Integrity

SEC-SRD-3670			
All input to and output of all Space Weather System services shall be validated for correctness, harmlessness and meaningfulness before processing and/or distribution.			
Justification:	This ensures that no falsified, harmful, or meaningless information is produced by the Space Weather System services and delivered to the users.		
Comments:			
Source Requirements:	SEC-CRD-21 SEC-CRD-22 SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3732			
All input from Third-Party data providers shall be validated for correctness, harmlessness and meaningfulness before processing and/or distribution.			
Justification:	This ensures that no falsified, harmful, or meaningless information is injected into the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3845			
All internal input to and internal output from the Space Weather System shall be validated for correctness and meaningful semantics and its integrity shall be ensured.			
Justification:	This ensures that no falsified or meaningless information is injected into the Space Weather System components.		
Comments:	Both input and output data to/from applications also includes data to/from acquisition and processing as well as validation checks incorporated in the processing applications.		
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3677			
The services provided by third parties (external systems) shall be regularly monitored and reviewed, and audits should be carried out regularly. In particular, it shall be reviewed whether security terms and conditions of the agreements are being adhered to, and that information security incidents and problems are managed properly.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-31 SEC-CRD-33		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3678			
The Space Weather System shall provide tools to ensure the detection of integrity violations on information and data that is imported into the Space Weather System.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3733			
The Space Weather System shall be capable of detecting integrity violations on Space Weather System service products during transfer in compliance with the applicable security policy.			
Justification:	All recipients of Space Weather System service products shall be able to verify the integrity of the received data.		
Comments:	This can be ensured e.g. by cryptographic hashes.		
Source Requirements:	SEC-CRD-3578 SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3734			
The Space Weather System shall be capable of detecting integrity violations on service requests during transfer in compliance with the applicable security policy.			
Justification:	All Space Weather System services that receive Space Weather System service requests shall be able to verify the integrity of the received data.		
Comments:	This can be ensured e.g. by cryptographic hashes.		
Source Requirements:	SEC-CRD-16 SEC-CRD-3578 SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3739			
The Space Weather System shall be capable of detecting integrity violations on Space Weather System authentication session communication in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and the registered users during the authentication process and the maintenance of the authentication session needs to be integrity protected.		
Comments:	This prevents "hijacking" of authentication sessions.		
Source Requirements:	SEC-CRD-3578 SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3793			
The Space Weather System shall provide anti-replay protection for Space Weather System authentication session communication in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and the registered users during the authentication process and the maintenance of the authentication session needs to be protected against replay attacks.		
Comments:	This prevents replaying of authentication sessions.		
Source Requirements:	SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3794			
The Space Weather System shall be capable of providing anti-replay protection for any data transfer sessions if required in compliance with the applicable security policy.			
Justification:			
Comments:	In some cases, anti-replay protection is required for certain types of Space Weather System data transfers, e.g. service requests.		
Source Requirements:	SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3856			
The Space Weather System shall be capable of detecting integrity violations on all Space Weather System data/meta-data that is communicated in compliance with the applicable security policy.			
Justification:	Integrity protection for all communication within the Space Weather System is critical.		
Comments:			
Source Requirements:	SEC-CRD-16 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3857			
The Space Weather System shall be capable of detecting integrity violations for all data/meta-data that is exchanged between the Space Weather System and third party data providers in compliance with the applicable security policy.			
Justification:	Integrity protection for all communication between the Space Weather System and third party data providers is critical.		
Comments:			
Source Requirements:	SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3796			
The Space Weather System shall be capable of detecting integrity violations for stored data, including in particular raw data.			
Justification:	The integrity of raw data needs to be protected since this data forms the input to further processing and service product generation.		
Comments:	It has to be noted that the raw data storage can reach a substantial size in the range of terabytes. An efficient integrity protection mechanism is thus required.		
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.10. Data Authentication

SEC-SRD-3742			
The authenticity of Space Weather System service products shall be ensured during transfer in compliance with the applicable security policy.			
Justification:	All users and other Space Weather System services that receive Space Weather System service products shall be able to verify the authenticity of the received data.		
Comments:	All end users that receive Space Weather System service products shall be able to verify the origin of the received data. This can be ensured e.g. by cryptographic hashes.		
Source Requirements:	SEC-CRD-23 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3743			
The authenticity of service requests that are received by the Space Weather System shall be ensured during transfer in compliance with the applicable security policy.			
Justification:	All Space Weather System services that receive Space Weather System service requests shall be able to verify the authenticity of the received data.		
Comments:			
Source Requirements:	SEC-CRD-16 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3744			
The Space Weather System shall protect the authenticity of Space Weather System authentication session communication in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and the registered user during the authentication process and the maintenance of the authentication session needs to be authenticity protected.		
Comments:	This prevents "hijacking" of authentication sessions.		
Source Requirements:	SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3855			
The authenticity of all Space Weather System data/meta-data that is communicated shall be ensured during transfer in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and the registered user and within the Space Weather System needs to be authenticated.		
Comments:			
Source Requirements:	SEC-CRD-23 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3858			
The Space Weather System shall be capable of authenticating for all data/meta-data that is exchanged between the Space Weather System and third party data providers in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and third-party data providers shall be protected.		
Comments:			
Source Requirements:	SEC-CRD-16 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3884			
The Space Weather System shall be capable to ensure the authentication and authorisation of third party data providers.			
Justification:	All communication between third-party data providers and the Space Weather System and shall be authenticated and authorised.		
Comments:			
Source Requirements:	SEC-CRD-16 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3749			
If specified by the service, the Space Weather System shall be capable to ensure non-repudiation of service requests received from the end user in compliance with the applicable security policy.			
Justification:	This ensures that users are liable for the service requests they make to the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3834			
If specified by the service, the Space Weather System shall be capable to implement accounting in compliance with the applicable security policy.			
Justification:	This ensures that users are liable for the service requests they make to the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-24 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3750			
The Space Weather System shall be capable of time-stamping data such as service products, service requests, and data received from external sources in compliance with the applicable security policy.			
Justification:	Time-stamping is required in case timeliness of data is an issue and e.g. part of a service agreement.		
Comments:			
Source Requirements:	SEC-CRD-24 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3860			
The Space Weather System shall be capable of ensuring non-repudiation of data/meta-data that is exchanged between the Space Weather System and users as well as third-party data providers in compliance with the applicable security policy.			
Justification:	This is required in case of a service agreement that includes legal agreements or a service agreement that includes legal agreements and important for communication between the Space Weather System and third-party data providers.		
Comments:	This is particularly relevant for service products delivered to the users.		
Source Requirements:	SEC-CRD-24 SEC-CRD-3578		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SWE-SRD-12225			
The system shall implement a capability to enforce non-repudiation for data that is received from third-party data providers and end-users.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3963		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.7.1.11. Data Confidentiality

SEC-SRD-3763			
The Space Weather System shall be able to ensure the confidentiality of data/ meta-data and service products derived from specific input data according to the publication date or distribution restrictions of that input data or until explicit authorisation from the data provider who provided the input.			
Justification:	Service providers may supply input data only under certain conditions such as: • Limited distribution (need-to-know) • No publication prior a certain publishing date		
Comments:			
Source Requirements:	SEC-CRD-11 SEC-CRD-15 SEC-CRD-3603		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3756			
The Space Weather System shall be capable of ensuring the confidentiality of user-tailored service products in compliance with the applicable security policy.			
Justification:	Space Weather System service products are often tailored specifically to the registered user who requested the service product. Thus disclosure of these service products would violate the privacy and the interests of the user.		
Comments:			
Source Requirements:	SEC-CRD-11		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3757			
The Space Weather System shall be capable of ensuring the confidentiality of data/meta-data that is communicated by the Space Weather System in compliance with the applicable security policy.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-12 SEC-CRD-16		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3758			
The Space Weather System shall be capable of protecting the confidentiality of Space Weather System authentication session communication in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and the registered user during the authentication process and the maintenance of the authentication session needs to be confidentiality protected.		
Comments:	This prevents "hijacking" of authentication sessions.		
Source Requirements:	SEC-CRD-11		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3859			
The Space Weather System shall be capable of ensuring confidentiality for all data/meta-data that is exchanged between the Space Weather System and third party data providers in compliance with the applicable security policy.			
Justification:	All communication between the Space Weather System and third-party data providers shall be protected.		
Comments:			
Source Requirements:	SEC-CRD-11 SEC-CRD-16		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3760			
The Space Weather System shall restrict access to the usage statistics to authorised users.			
Justification:	This protects the anonymity of registered users.		
Comments:			
Source Requirements:	SEC-CRD-13		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3761			
The Space Weather System shall be capable of preserving the anonymity of registered users and user service requests.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-14 SEC-CRD-19		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3762			
The Space Weather System shall be capable of preserving the anonymity of data providers.			
Justification:			
Comments:	This means that the Space Weather System must be capable of ensuring that a data provider's identity cannot be uncovered from the data set originating from the provider, after initial processing. This may also cover providing confidentiality only for part of the data provider information e.g. key performance indicators.		
Source Requirements:	SEC-CRD-17 SEC-CRD-45		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.12. Networks and Data Transfer

SEC-SRD-3684			
The Space Weather System shall ensure that the confidentiality and integrity of data passing between different elements of the Space Weather System over public networks or over wireless networks is ensured.			
Justification:	The Space Weather System is a distributed one. Communication between two Space Weather System centres via public networks need to be protected. This requirement constitutes a minimum of data protection.		
Comments:	This can be achieved by using e.g. VPN solutions. It should be put in place in compliance to IPV6/IPSec in addition to any application layer security solutions that may be implemented at service level.		
Source Requirements:	SEC-CRD-11 SEC-CRD-16 SEC-CRD-22		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3823			
The Space Weather System shall produce and implement secure network policies and associated procedures.			
Justification:	The Space Weather System is composed of a number of interconnected networks of potentially different sensitivity. It is crucial that appropriate network policies are in place to control the communication between these networks.		
Comments:	The ESA Security Regulations [AD-SEC-02] provide a basic network policy setup.		
Source Requirements:	SEC-CRD-3563 SEC-CRD-3629		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3824			
The Space Weather System shall maintain the secure network policies and procedures throughout the lifetime of the Space Weather System.			
Justification:	The network policies are living documentation. They need to be adapted to possible new needs of the Space Weather System and its users as well as to changing environments.		
Comments:	A network security board should be in charge of the network policy management.		
Source Requirements:	SEC-CRD-3563 SEC-CRD-3629		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.13. Business Continuity

SEC-SRD-3679			
The Space Weather System shall establish and maintain a managed process for business continuity that addresses the information security requirements.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3562 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3680			
The Space Weather System shall establish plans to maintain or restore operations and ensure availability of information at the required level and in the required time scales following interruption to, or failure of, critical business processes.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3681			
The Space Weather System business continuity plans shall be tested and updated regularly to ensure that they are up to date and effective.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3579		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3682			
The Space Weather System shall ensure that back-up copies of all security relevant information and software shall be taken and tested regularly in accordance with the agreed security policy.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3833			
The Space Weather System shall ensure that a security agreement in put into place and maintained for each external entity (data source) that provides sensitive data as input to the Space Weather System.			
Justification:	A security service agreement needs to be in place before any sensitive information can be accepted by the Space Weather System from external entities. This may also be part of the data policy.		
Comments:	[AD-SEC-02] and the applicable security policy describe the classification levels of the data that is handled by the Space Weather System. As per definition, sensitive data is always classified ESA Unclassified.		
Source Requirements:	SEC-CRD-3562		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3848			
The Space Weather System shall put mechanisms in place to reduce the consequences of denial of service (DOS) attacks to an acceptable risk level.			
Justification:	The acceptable risk level will be determined in the context of an information risk assessment.		
Comments:	DOS attacks are the most common attacks on IT systems in open networks and the Space Weather System must be properly protected against those.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

3.2.7.1.14. Administration of Security

SEC-SRD-3693			
The Space Weather System shall apply configuration control to each Space Weather System component throughout its lifecycle.			
Justification:			
Comments:	Configuration includes software, hardware, firmware and all system documentation.		
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3694			
All changes to any part of the Space Weather System shall be proposed, approved, implemented, and recorded in accordance with the applicable System Security Requirements Specification (SSRS) or/and the Security Accreditation Strategy depending on the impact of the configuration change.			
Justification:			
Comments:	The security accreditation strategy is defined in the applicable security policy.		
Source Requirements:	SEC-CRD-3575 SEC-CRD-3598 SEC-CRD-3612		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3697			
It shall be ensured that appropriate security controls are implemented when Space Weather System equipment is scheduled for maintenance, taking into account whether this maintenance is performed by personnel on site or external to the organization.			
Justification:			
Comments:			
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3691			
The Space Weather System shall establish Security operating procedures (SecOps).			
Justification:			
Comments:	The contents and structure of the SecOps is defined in [AD-SEC-02].		
Source Requirements:	SEC-CRD-3575		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3671			
The Space Weather System shall implement proper detection, prevention, and recovery controls to reduce the risk to Space Weather System software systems resulting from malware to an acceptable level.			
Justification:	Protection of software systems from malware is common practise for every operational software environment.		
Comments:	The acceptable level shall be defined through a risk assessment. A secure software engineering framework will help to identify proper controls. The list of controls to be implemented shall be taken from well-known sources.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3579 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3672			
Infrastructure baseline applications used within the Space Weather System shall be configured using applicable security best practices such as ESACERT CIS-CAT toolset			
Justification:	Secure configuration of baseline infrastructure such as operating systems is required to ensure the overall security of the Space Weather System.		
Comments:	The precise specification of best practises to be used depends on the infrastructure baseline applications that will be used for the Space Weather System. Thus, it will be defined during the architectural design phase.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3699			
Only authorized maintenance personnel shall carry out repairs and service Space Weather System equipment.			
Justification:	This ensures that no unauthorized personnel is allowed access to Space Weather System equipment.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3701			
Timely information about technical vulnerabilities of system components being used shall be obtained, the vulnerabilities evaluated and appropriate measures taken to address the associated risk.			
Justification:	This is to ensure that there is no vulnerable component in the Space Weather System that could endanger the overall security of the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3704			
Destruction or disposal of storage media containing sensitive or classified information shall be executed in compliance with the applicable security policy.			
Justification:	This ensures that no potentially sensitive or classified information is leaked from disposed storage media.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3706			
The Space Weather System shall have procedures and controls to ensure that that all employees, contractors, and third-party staff working with the Space Weather System shall return all of the Space Weather System assets in their possession upon termination of their employment, contract or agreement.			
Justification:	This ensures that no Space Weather System equipment containing potentially sensitive information is kept by personnel no longer associated with the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3707			
The Space Weather System shall have procedures and controls to remove the access rights of all employees, contractors, and third party staff working with the Space Weather System to Space Weather System information and information processing facilities upon termination of their employment, contract or agreement, or adjusted upon change.			
Justification:	This ensures that all personnel working with the Space Weather System have only access to parts of the Space Weather System as allowed by their current status. Upon change of this status, their rights are to be reviewed.		
Comments:			
Source Requirements:	SEC-CRD-27 SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Review of Design Test Analysis

SEC-SRD-3709			
All Space Weather System personnel and, where relevant, contractors and third party provider personnel shall receive appropriate awareness training and regular updates in organizational policies and procedures, as relevant for their roles and access rights.			
Justification:	Space Weather System personnel need to be able to understand the operational security policies and procedures and their rationale.		
Comments:	Untrained personnel are usually more negligent with respect to security policies and procedures.		
Source Requirements:	SEC-CRD-3557		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3710			
There shall be a formal disciplinary process for employees who have committed a security breach.			
Justification:	This is required to raise awareness of the consequences of committing a security breach.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3712			
Formal event reporting and escalation procedures shall be in place for the case of a security incident.			
Justification:	This is required to ensure prompt reaction to any security incident that may occur.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3713			
The Space Weather System shall have a procedure to make all employees, contractors and third party staff aware of the procedures for reporting the different types of event and weaknesses that might have an impact on the security. The procedure shall personnel to report any information security events and weaknesses as quickly as possible to the designated point of contact.			
Justification:	This reduces the response time between discovery of a weakness and the capability by the Space Weather System to put in place appropriate mitigation actions.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3714			
A process of continuous improvement shall be applied to the response to, monitoring, evaluating, and overall management of information security incidents.			
Justification:	The processes and procedures related to management of security incidents need to be kept up to data and adapted to changing environments if necessary.		
Comments:			
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

3.2.7.1.15. Physical Security

SEC-SRD-3831			
The Space Weather System shall establish and maintain physical security measures at physical Space Weather System entities as appropriate to the applicable classification and/or sensitivity and in compliance with the applicable security policy.			
Justification:	Physical Security Measures provide perimeter protection to prevent access to sensitive Space Weather Systems.		
Comments:	The ESA Security Regulations [AD-SEC-02] provide physical security requirements to be put in place depending on the classification of data.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3832			
The physical security measures for each physical Space Weather System entity shall be specified in the applicable System Security Requirements Statement (SSRS).			
Justification:	Physical Security Measures provide perimeter protection to prevent access to sensitive Space Weather Systems.		
Comments:	The ESA Security Regulations [AD-SEC-02] provide physical security requirements to be put in place depending on the classification of data.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

3.2.7.1.16. Assurance

SEC-SRD-3879			
The rules and procedures that govern the security functions of the Space Weather System shall be laid down in the security policy. The security policy, as a subset of the Space Weather System data policy, shall be composed from the Space Weather System PSI [AD-SEC-05], the ESA Security Regulations [AD-SEC-02], the ESA Security Directives [AD-SEC-06] and applicable SecOps by the governing authority.			
Justification:	Functional security requirements only specify the technical means to enforce security concepts. However, the security policy is needed to lay down the rules how these concepts are used in the context of the Space Weather System.		
Comments:			
Source Requirements:	SEC-CRD-31 SEC-CRD-33 SEC-CRD-35 SEC-CRD-36 SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3766			
Security sensitive components of the Space Weather System shall be certified according to [AD-SEC-01] if required by governance & data policy.			
Justification:	This is a pre-requisite for handling classified information and cryptographic material such as keys.		
Comments:	It should be noted that a decision for certification of certain system components shall be taken very early in the development phase since it is a time consuming process.		
Source Requirements:	SEC-CRD-3562		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3767			
The Space Weather System shall be developed to be able to handle sensitive information in accordance with [AD-SEC-02].			
Justification:	The Space Weather System must be capable to provide appropriate protections to: • Classified Information according to the classification level • Unclassified, but sensitive information		
Comments:			
Source Requirements:	SEC-CRD-3562		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3789			
The Space Weather System shall be developed in compliance with [AD-SEC-02].			
Justification:	It was decided that the ESA Security Regulations are the reference for development and operation for the Space Weather System. They are compliant with the EC Security Regulations.		
Comments:	This compliance includes, among others, all regulations related to physical security, information security, and personnel security.		
Source Requirements:	SEC-CRD-25 SEC-CRD-33 SEC-CRD-3557		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3806			
The Space Weather System shall be operated in compliance with [AD-SEC-02].			
Justification:	It was decided that the ESA Security Regulations are the reference for development and operation for the Space Weather System. They are compliant with the EC Security Regulations.		
Comments:	This compliance includes, among others, all regulations related to physical security, information security, and personnel security.		
Source Requirements:	SEC-CRD-25 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3798			
All Space Weather System software development processes shall include secure software development lifecycle elements.			
Justification:	Many Space Weather System software components are exposed to the Internet and thus subject to potential attacks. For this reason, the applications need to be developed in a secure way to ensure sufficient robustness against attacks.		
Comments:	[RD-50] provides documentation and tools for this process with regard to secure development of web applications and web services.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3804			
The Space Weather System shall only use hardware items for cryptographic operations manipulating sensitive and/or information classified ESA Restricted that are certified at least FIPS 140-2 Level 2 and accredited according to the ESA Security Regulations.			
Justification:	Cryptographic hardware (e.g. for random number generation) should be sufficiently secure to be used in the context of Space Weather System.		
Comments:	If information classified ESA Confidential or above, FIPS 140-2 Level 2 no longer the appropriate certification level. More stringent certifications need to be in place for this case.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3562 SEC-CRD-3592		
Related Requirements:		**Verification Method:**	Test Analysis

SEC-SRD-3863			
All security critical system components shall be verified by external entities in compliance with ISO 27001 [AD-SEC-03] series.			
Justification:			
Comments:	Certification of components that handle classified information shall be performed in close collaboration as the above proposed new requirement.		
Source Requirements:	SEC-CRD-3557 SEC-CRD-3592 SEC-CRD-3612		
Related Requirements:		**Verification Method:**	Test Analysis

3.2.7.2. Data Policy

SWE-SRD-11975			
The system shall identify the owner of the data from Third Party Providers within the associated meta-data.			
Justification:	This is a key requirement for IPR application.		
Comments:	Note that in some specific cases agreements may be put into place such that input data shall be provided to the system in order to generate products, and not to be provided directly to users. In these cases the data provider may opt not to be identified in the meta data of the final product.		
Source Requirements:	SYS-CRD-DAT-3235		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11976			
The system shall reference the data policy rules on IPR and ownership of the data provided by Third Party Data Providers in the meta-data associated to that data.			
Justification:	External entities have to provide the attribute for IPR application, independently of the data source.		
Comments:			
Source Requirements:	COM-SRD-48		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12875			
The Space Weather System shall receive Data Policy Directives from the designated Governing Authority.			
Justification:	The designated Governing Authority will drive the Data Policy of the Space Weather System.		
Comments:	The terms "Directives" and "the designated Governing Authority" are defined in [AD-06].		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12877			
The Space Weather System shall process the Data Policy Directives defining all the SWE specific Data Policy parameters and rules to be applied by the Space Weather System.			
Justification:	The designated Governing Authority will drive the Data Policy of the Space Weather System.		
Comments:	The terms "Directives" is defined in [AD-06].		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12878			
The system shall enforce the Directives.			
Justification:	This is to ensure that the system operates always within the rules & regulations laid down in the Data Policy Directives		
Comments:	The Data Policy should address all data types managed by the system, as well as all the provided services and products. The term "Directives" is defined in [AD-06].		
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12879			
The system shall enforce the Data Policy at the level of each data item and data item attribute.			
Justification:	In order to comply with the Directives.		
Comments:	The term "Directives" is defined in [AD-06].		
Source Requirements:			
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12880			
The system shall allow the Administrator and the Security Officer to configure the Data Policy.			
Justification:	In order to make sure that the Data Policy is maintained and updated according to Data Policy requirements.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12881			
The system shall implement and manage the Data Policy approval cycle established by the designated Governing Authority.			
Justification:	In order to make sure that a new or an updated version of the Data Policy is properly approved before it is being taken into operation.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12099			
The system shall enforce the versioning of the data policy as a whole as well as any subpart of the data policy arborescence.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3975		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12100			
The system shall allow the user operator to manage (i.e. enter, modify, delete) a version of the data policy.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3976		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12101			
The system shall allow to check the consistency of the data policy or any subpart of the data policy arborescence entered into the system.			
Justification:			
Comments:	It is important that the consistency of a newly installed data policy is checked before it is taken into operations. This ensures that no contradicting policies are enforced.		
Source Requirements:	COM-SRD-3977		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12102			
The system shall allow to define an approval cycle applicable to the data policy or any subpart of the data policy arborescence.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3978		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12103			
The system shall allow to include as part of the data policy approval cycle individuals belonging to the operating entity as well as individuals from the designated Governing Authority.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3979		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12104			
Any change to the system due to the data policy update shall be tested and validated successfully prior to be rolled out in operation.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3980		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12105			
The system shall not allow to distribute a particular data if its data policy has not been defined.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3981		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12106			
The operating entity shall be in charge of configuring the system such that it complies with the data policy.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3982		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11968			
The system shall be able to enforce Data Policy at the level of each data item and data item attribute.			
Justification:	In order to associate to any data item/attribute its Data Policy metadata.		
Comments:			
Source Requirements:	COM-SRD-1591		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11969			
The system shall allow the administrator and the security officer to configure the Data policy.			
Justification:	In order to make sure that the data policy is maintained and updated according to data policy requirements.		
Comments:			
Source Requirements:	COM-SRD-1614		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-11970			
The system shall implement the data policy approval cycle established by the designated Governing Authority.			
Justification:	In order to make sure that a new or an updated version of the data policy is properly approved before it is being taken into operation.		
Comments:			
Source Requirements:	COM-SRD-3843		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-11971			
The system shall allow to change the Data Policy directives applicable to the system without requiring to modify the applications (configurability).			
Justification:	In order to ensure maximum flexibility of the system with respect to changes in the data policy.		
Comments:	When the limit of the application configurability foreseen by its design will be reached, a change to the s/w applications versus a change of the requirement shall be considered (trade-off). Application is referring to software components.		
Source Requirements:	COM-SRD-1618		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11972			
The system shall monitor the compliance of the policies and shall be capable of generating reports and warnings when required.			
Justification:	In order to make sure that data policy violations are flagged and the operator is informed.		
Comments:			
Source Requirements:	COM-SRD-270		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11974			
The Space Weather system shall be able to handle data while maintaining the Intellectual Property Right (IPR) and ownership of the data owner.			
Justification:	In order to ensure that the data owner IPR is not violated.		
Comments:	The Space Weather System data policy will specify the IPR restrictions.		
Source Requirements:	SYS-CRD-DAT-3235		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12162			
The implementation of the data policy shall minimise the overhead on the user of the services and products.			
Justification:			
Comments:	From end-user perspective, minimise the constrains on accessing a service and obtaining a product.		
Source Requirements:	COM-SRD-3965		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12201			
The data policy directives shall be defined and approved by the governing authority.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3939		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12202			
The data policy shall address the civilian and dual use needs of the user community.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3940		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12204			
The data policy shall establish the rules for the acquisition of, production, access to, dissemination and use of the various data types managed by the system.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3942 SYS-CRD-DAT-3237		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12205			
The data policy shall comply with the applicable regulations on privacy and personal data protection.			
Justification:	Personal data protection must be consistent with GDPR regulations.		
Comments:	ESA privacy framework provides equivalent protection. No sensitive personal data shall be handled by the system.		
Source Requirements:	COM-SRD-3943 SYS-CRD-DAT-3239		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12206			
The data policy shall comply with applicable regulations on privacy and personal data protection of the country in which the system is operated.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3944 SYS-CRD-DAT-3239		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12207			
The data policy shall cover the whole life cycle of the system including the development, maintenance, operation and retirement phases.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3945 SYS-CRD-DAT-3236 SYS-CRD-DAT-3238		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12208			
The data policy shall define the liability boundaries of the operating entity with respect to the provision of services and products.			
Justification:	Liability is a critical aspect of the system. Furthermore, liability information must be communicated as part of the data policy related attributes of service product data.		
Comments:			
Source Requirements:	COM-SRD-3946		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12209			
The data policy shall define the liability boundaries of the designated Governing Authority with respect to the provision of services and products.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3947		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12210			
The data policy shall define the liability boundaries of the developing entity with respect to the provision of services and products.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3948		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12211			
The data policy shall define the thresholds for identified security risks to decide whether risks shall be mitigated or be accepted.			
Justification:	Periodic information risk assessments are executed and may uncover new risks or risks with a changing acceptability threshold.		
Comments:			
Source Requirements:	COM-SRD-3949		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12212			
The data policy shall establish rules and procedures for the interaction and data exchange with any Third Party Provider.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3950		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12213			
The data policy shall establish rules and procedures for the interaction between the designated Governing Authority, operating entity, any third party provider and the developing entity.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3951		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12214			
The data policy shall establish rules and procedures for the interaction between the entities participating to the designated Governing Authority.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3952		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12215			
The data policy shall establish charging model and condition for the products and services.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3953		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12216			
The data policy shall establish the end-user license terms and conditions that shall be applicable to the data and service provision.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3954		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12219			
The data policy shall define the data interchange standards to be used within the system as well as between the system and third party providers.			
Justification:	The system is distributed. It requires interaction between different components and systems. A well-established set of interoperability standards is required in order to ensure smooth integration of all these components.		
Comments:			
Source Requirements:	COM-SRD-3957		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12220			
The data policy shall mandate, during the whole life cycle of the system, periodical information risk assessments according to well established and recognised standards.			
Justification:	This is according to the iterative principle for risk assessment.		
Comments:			
Source Requirements:	COM-SRD-3958		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12221			
The data policy shall mandate, during the whole life cycle of the system, every time the system's requirements, design, implementation or environment changes information risk assessments according to well established and recognised standards.			
Justification:	This is according to the iterative principle for risk assessment.		
Comments:			
Source Requirements:	COM-SRD-3959		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12222			
The data policy shall ensure that all components that process classified information are not taken into operation before a security accreditation has been granted by the designated Governing Authority or any other authorised entity (defined as part of the governance).			
Justification:			
Comments:	In many cases National Security Authorities are also required to grant a security accreditation before the system can be taken into operation.		
Source Requirements:	COM-SRD-3960		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12223			
The data policy shall address the handling of commercially sensitive third party or end-user data.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3961		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12224			
The data policy shall implement a capability to enforce non-repudiation for products that are distributed by the system.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3962		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12226			
Each product/service provided by the system shall have its associated data policy defined and approved by the designated Governing Authority.			
Justification:			
Comments:	Unless the data policy has been established, the product/service cannot be provided during the operations of the system.		
Source Requirements:	COM-SRD-49		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12227			
Data policy shall take into account data policy coming from Third Parties.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-1619		
Related Requirements:		**Verification Method:**	Design Review Analysis Test

SWE-SRD-12228			
The data policy shall take into account the SLAs established with Third Party Providers.			
Justification:			
Comments:	This means that the system should guarantee that the SLAs applicable to the system (when interfacing to Third Party Providers) are correctly applied and should monitor its application.		
Source Requirements:	COM-SRD-63		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12230			
The Data Policy shall address the following data types: • Sensor Data • Third Party Data • Intermediate Data • System Control Data • System Metric Data • System Usage Data • User Data • Product Data • Management Data • Development/Maintenance Data			
Justification:			
Comments:			
Source Requirements:	COM-SRD-1264 SYS-CRD-QUA-3220		
Related Requirements:		**Verification Method:**	Analysis Test

3.2.7.3. Licenses

SWE-SRD-12217			
The end-user license terms and conditions shall address the liability of both, the operating entity and the end-user.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3955		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12218			
The end-user license terms and conditions shall address the conditions for the end-user use of the data including but not limited to commercialisation of the product or derived products.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3956		
Related Requirements:		**Verification Method:**	Design Review Test

3.2.8. Operational Requirements

SWE-SRD-11834			
The Space Weather System shall systematically and as far as possible automatically monitor the health and status of the SWE sensor network.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12253			
The Space Weather System shall systematically evaluate the validity of any received sensor data: testing the data format and verifying each parameter versus its validity range.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12249			
The Space Weather System shall perform periodic assessment of the performance, availability and integrity of the network of Space Weather System Sensors.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12250			
In order to perform monitoring of the performance of the network of SWE Sensors, the Space Weather System shall request calibration activities.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11844			
Scheduled maintenance of domain 2 services shall be announced to the users with a 30 day forewarning.			
Justification:	Advises users of potential unavailability and allows them to take action accordingly.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1575		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-11842			
Scheduled maintenance of domain 2 services shall be postponed if an event is in progress without impacting service availability requirements.			
Justification:	During short-duration critical periods the users need for up-to-date space weather information is considered to be higher priority than regular maintenance.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1575		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12239			
The system shall ensure end-to-end (from the source to the final product) traceability of the data from Third Party Providers.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12242			
The system shall perform a validation process of all data received from the Third Party Providers to ensure its validity, integrity and quality.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12246			
The system shall make use of Third Party Data for cross-checking the data produced by the system and eventually to perform analysis based on this data.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10134			
The Space Weather System shall receive SWE information from ground or space-based sensors and their associated systems based on agreed SLA (periodicity, format, sources, ...).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10137			
The Space Weather System shall forward to ground or space-based sensors and their associated systems the requests for SWE environment information based on agreed SLA.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10139			
Based on agreed SLA, the Space Weather System shall receive requested information from the satellite control centre on orbits and planned or performed spacecraft manoeuvres.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10141			
Based on agreed SLA, the Space Weather System shall receive from the satellite control centres the requested information related to the satellite telemetry, overall equipment status, on-board anomalies detected.			
Justification:			
Comments:	Note that depending on satellite, this information may be received from the control centre or from the data processing centre.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10120			
The Space Weather System shall receive the 'Request for system activity data' from the system authority and shall reply to it with a 'System activity data'.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12038			
The deployment of any new or updated functional block for the system shall have a two-step process: 1) Completion of the successful installation and test in the testing environment, 2) Completion of the successful installation and test in the staging environment (operational validation).			
Justification:	In order to ensure that each new or updated functional block is sufficiently testing and evaluated before being used operationally.		
Comments:			
Source Requirements:	COM-SRD-3742		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12039			
The testing of any new or updated functional block for the system in the testing environment shall be representative of the acceptance testing to be performed as part of the operational validation.			
Justification:	In order to ensure successful acceptance testing.		
Comments:			
Source Requirements:	COM-SRD-3743		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12040			

The system test shall include:
• Compatibility tests whose aim is to check the two by two coupling and technical interface of any component of the system this includes on board to ground interfaces and centre to centre ground interfaces.
• The Technical Qualifications test whose aim is to validate the functional behaviour of the system including:
  ○ System loops validation
  ○ Performance assessment
  ○ Sensors compatibility tests
• System Validation tests involving the whole set of Space Weather System entities, running long duration tests on realistic and sizing scenarios
• The Operational Qualification tests whose aim is to validate the capability of the Operational teams to operate the system and to finalize the operational documentation needed to operate the system
• Security Tests to verify and validate the security functions of the Space Weather System and to satisfy potential security assurance requirements that may be implied by a certification process			

Justification:	In order to implement standard testing procedures.		
Comments:			
Source Requirements:	COM-SRD-3745		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12049			
The staging environment(s) shall support the training of the operators.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3832 SYS-CRD-FUN-3196		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12055			
The simulators shall support the training of the operators.			
Justification:			
Comments:	This implies that the simulators can be installed and configured as part of the training environment.		
Source Requirements:	SYS-CRD-SYS-3210 SYS-CRD-FUN-3196		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12056			
The simulators shall support the validation of operational procedures.			
Justification:			
Comments:	This implies that the simulators can be installed and configured as part of the operational environment.		
Source Requirements:	SYS-CRD-SYS-3210		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-9556			
The Space Weather System shall be operated according to the applicable documents on data governance and cooperation (part of the data policy).			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9561			
The Space Weather System shall be able to be operated by dedicated personnel, allowing support from external personnel in case some services are outsourced.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12087			
The permanent manpower required to operate the system shall be minimised by optimisation of automatic procedures implementation.			
Justification:	In order to safe resources needed for the operation of the system.		
Comments:			
Source Requirements:	COM-SRD-3628		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12093			
English shall be the official language of all communication within the Space Weather System.			
Justification:	In order to ensure language consistency across the system.		
Comments:			
Source Requirements:	COM-SRD-3820		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12094			
All operational staff for the system shall be trained and fully qualified to perform the tasks assigned to them.			
Justification:	In order to ensure efficient operation of the system.		
Comments:			
Source Requirements:	COM-SRD-3822		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12095			
All operational staff for the system shall have the necessary security clearance to perform the tasks assigned to them.			
Justification:	In order to ensure efficient operation of the classified parts of the system.		
Comments:			
Source Requirements:	COM-SRD-3821		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12127			
The system shall define and implement its own safety procedures for nominal and contingency operations.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-277		
Related Requirements:		**Verification Method:**	Analysis Inspection

SWE-SRD-9564			
In case of foreseen downtime of an element of the system, the Space Weather System shall provide the means to inform the customers 5 days in advance.			
Justification:			
Comments:	Element downtime is treated differently to system downtime.		
Source Requirements:			
Related Requirements:	SWE-SRD-11847	**Verification Method:**	

SWE-SRD-12133			
The system shall define a maintenance policy including, but not limited to, the number of spares required, location, preventive/corrective maintenance actions and procedures to meet all Space Weather System service availability requirements.			
Justification:	As required by the objective of ensuring maintainability through selection of long-term maintainable components.		
Comments:			
Source Requirements:	COM-SRD-77 SYS-CRD-SYS-3201		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12141			
Without hampering the operational use, the system shall: • Provide training and courses for new functionalities; • Provide training tools to optimise the overall use of the Space Weather System; • Supply all operators with updated documentation.			
Justification:	This requirement is a by-product of the need to accommodate new functionalities, which in turn is driven by the need for maintainability over an extended lifetime.		
Comments:			
Source Requirements:	COM-SRD-1275 SYS-CRD-FUN-3196		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12145			
All hardware elements of the system shall be subject to an on-going maintenance agreement with a certified provider. Maintenance shall cover the following types: Corrective (fixing latent errors or failures including temporary patches and work-arounds), Adaptive (responding to external changes), and Preventative (improves future maintainability).			
Justification:	In order to ensure flawless operation of all hardware elements in the system.		
Comments:	Also foresees a replacement plan for components which can no longer be maintained.		
Source Requirements:	COM-SRD-3835		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12146			
All software elements of the system shall be subject to an on-going maintenance agreement with a certified provider. Maintenance shall cover the following types: Corrective (fixing latent errors including temporary patches and work-arounds), Adaptive (responding to external changes), Perfective (improving the as-delivered software to address) and Preventative (improves future maintainability).			
Justification:	In order to ensure flawless operation of all software elements in the system.		
Comments:	Also foresees a replacement plan for components which can no longer be maintained.		
Source Requirements:	COM-SRD-3836		
Related Requirements:		**Verification Method:**	Design Review Analysis

SWE-SRD-12153			
During the development phase of the system sensors, the services shall be provided using data from collaborating sensors where possible.			
Justification:			
Comments:	Information from collaborating sensors may not be sufficient to provide the full set of system services. However, a reduced performance is acceptable while the system is still under development.		
Source Requirements:	COM-SRD-3816		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12550			
The operation of the system shall be automated to the maximum extent possible.			
Justification:	To optimise the operation of the system and to reduce cost.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12229			
The SLAs established with Third Party Providers shall be approved by the designated Governing Authority.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3844		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-9185			
The services provided by the Space Weather System shall incorporate strategies for handling gaps in data availability for critical datasets.			
Justification:	These services shall be made operationally available both for direct use and for use as input to third party service providers who also need to guarantee the reliability of their service products. The solution shall be selected on a case-by-case basis by considering what is most suitable to each case. The solutions may include: (a) switch to backup sensors, (b) extrapolation from the last measured data value towards values from an appropriate climatological model, with the model being reached over a typical correlation time for data series. The services should include a status flag to indicate the nature of the delivered data. Strategies for handling gaps shall be identified as for any data source.		
Comments:			
Source Requirements:	SWE-CRD-GEN-1737		
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-21052			
Operational procedures shall be developed and implemented for the transition of elements from one environment to another environment.			
Justification:	This is needed to ensure that clear processes are in place and followed for critical operations.		
Comments:	This requirement is related to SWE-SRD-11982. Elements can be anything related to software or hardware components as well as elements of a service capability.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Review Test

SWE-SRD-21053			
Operational procedures shall be developed and implemented for the transition of elements from the R2O2R system to the operational part of the Space Weather System.			
Justification:	This is needed to ensure that clear processes are in place and followed for critical operations.		
Comments:	Elements can be anything related to software or hardware components as well as elements of a service capability.		
Source Requirements:			
Related Requirements:		**Verification Method:**	Review Test

3.3. Data Acquisition Segment

All requirements in Section 3.2 Overall System Requirements and all subsections therein apply here. The following subsections identify additional requirements which apply specifically to Data Acquisition.

3.3.1. Functional Requirements

SWE-SRD-9107			
The Space Weather System shall have a subsystem in charge of managing the timely acquisition of Space Weather measurements from internal sensors or from cooperating sensors.			
Justification:	Functional analysis of the Space Weather System		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12270			
The data acquisition shall be configurable in terms of the observation performance and quality parameters.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-3606		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12254			
The system shall be able to calibrate its sensors against known references.			
Justification:	In order to ensure that data coming from cooperating sensors can be processed by the system.		
Comments:			
Source Requirements:	COM-SRD-3606		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21010			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Sun Data Measurement (-M) products: • Solar disk magnetic fields • Solar index F10.7 (F10) • EUV images of Sun • White light solar imaging • H-alpha images of Sun • Soft X-ray images of the Sun • Solar EUV Images Outside of Sun-Earth Line • Solar Coronagraphic Images Outside of Sun-Earth Line • Solar far-side maps (using helioseismology technique) • Ly-alpha images (for measure of solar far-side activity) • White-light wide-angle coronagraph images • Solar radiospectrographic observations (for monitoring of radio bursts) • Solar X-ray flux • Solar EUV integrated flux • Solar UV flux • Heliospheric imaging of Sun-Earth line (tracking of Earth-directed CMEs) • EUV images of Sun, taken from L4 point • Solar coronagraphic images, taken from L4 point • EUV images of Sun, taken from L5 point • Solar magnetograph images, taken from L5 point • White-light solar images, taken from L5 point • H-alpha solar images, taken from L5 point • Soft X-ray solar images, taken from L5 point • White-light coronagraph images, taken from L5 point • Solar X-ray flux, measured at L5 point • Solar EUV integrated flux, measured at L5 point • Solar UV flux, measured at L5 point • Solar radio bursts, measured at L5 point • Heliospheric imaging, taken from L5 point			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21011			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Interplanetary Medium Measurement (-M) products: • High energy >10 MeV protons at L1 • High energy >10 MeV ions at L1 • 1-to-10 MeV protons at L1 • 1-to-10 MeV ions at L1 • 30 keV-to-1 MeV ions at L1 • 2-50 MeV solar electrons at L1 • E>30 keV-8 MeV electrons at L1 • Interplanetary Magnetic field (IMF) at L1 • Solar wind bulk velocity at L1 • Solar wind bulk density at L1 • Solar wind bulk temperature at L1 • Solar energetic particles outside L1 • Data on Interplanetary Medium outside L1 • Solar wind bulk velocity at L5 • Solar wind bulk density at L5 • Solar wind bulk temperature at L5 • Interplanetary Magnetic field (IMF) at L5 • 1 MeV to >500 MeV interplanetary protons at L5 • 30keV to 1 MeV interplanetary ions at L5 • 30 keV - 8 MeV solar electrons at L5 • Solar wind bulk velocity at L4 • Solar wind bulk density at L4 • Solar wind bulk temperature at L4 • Interplanetary Magnetic field (IMF) at L4 • 1 MeV to >500 MeV interplanetary protons at L4 • 30keV to 1 MeV interplanetary ions at L4 • 30 keV - 8 MeV solar electrons at L4 • Interplanetary scintillation			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21012			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Earth Magnetosphere and Radiation Belt Measurement (-M) products: • High energy >10 MeV protons • High energy >10 MeV ions • 1-to-10 MeV protons • 1-to-10 MeV ions • 30 keV-to-1 MeV ions • 30 keV-to-8 MeV electrons • Thermal and supra-thermal electron and ion energy spectra in the range 0 to 30 keV • Magnetospheric radiowave spectra • Thermal ions density and temperature • Local magnetospheric magnetic field in orbit • Plasma drift velocity			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21013			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Earth Ionosphere and Thermosphere Measurement (-M) products: • Vertical Total Electron Content • 3D electron density grids • URSI ionospheric parameters • Riometer data • Neutral density in thermosphere • Neutral wind velocity in thermosphere • Scintillation parameters • Atomic Oxygen density • Local magnetospheric magnetic field in orbit • Plasma drift velocity			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21014			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Earth Atmosphere and Geomagnetic Environment Measurement (-M) products: • Auroral visible imaging • Auroral UV imaging • Local Magnetospheric Magnetic Field on ground • Atmospheric density and wind • Atmospheric neutrons • Atmospheric muons			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-21015			
The Space Weather System shall own sensors or federate data to provide, as a minimum, the following Spacecraft Data Measurement (-M) products: • Anomalies on spacecraft equipment • Data from spacecraft radiation monitors • Orbital data of spacecraft carrying space weather instruments • Spacecraft housekeeping telemetry data • Dose • Deep dielectric charging • Surface charging • Floating spacecraft potential • Dosimeter data onboard aircraft			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

3.3.2. Performance Requirements

SWE-SRD-11915			
The Space Weather System shall condition the data raw data coming from sensors including: • Formatting/reformatting • Resampling • Debiasing • Calibration • Time stamping			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10318			
When sensors provide calibrated and instantiated data, the data from the sensor shall be taken by the Space Weather System directly without further action.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10230			
The Space Weather System shall perform quality control of the observations coming from each sensor.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12257			
The Space Weather System shall be able to verify that the observations performed by the SWE sensor meets the quality requirements.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review Test

3.3.3. Interface Requirements

No additional requirements are identified at this stage.

3.3.4. Design and Implementation Requirements

No additional requirements are identified at this stage.

3.3.5. Availability and Reliability Requirements

SWE-SRD-11837			
The operational availability of the Space Weather System network of sensors shall be such that all Space Weather System service availability requirements are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12864			
The maximum contiguous downtime of the Space Weather System network of sensors shall be such that all required maximum contiguous downtimes of Space Weather System services are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.3.6. Security and Data Policy Requirements

No additional requirements are identified at this stage.

3.3.7. Operational Requirements

SWE-SRD-11935			
The Space Weather System shall request observations by internal or cooperating sensors as necessary to produce the end-user requested products.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12237			
The Space Weather System shall receive all observations made by internal or cooperating sensors as necessary to produce the end-user requested products.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12238			
The Space Weather System shall take any directives from the governing authority into account when requesting and prioritising observations by internal or cooperating sensors.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12256			
The system shall systematically report the sensor status to the operators in order to ensure the health and performance of the sensors.			
Justification:	In order to ensure that data coming from cooperating sensors can be processed by the system.		
Comments:			
Source Requirements:	COM-SRD-3606		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12255			
The system shall ensure that the sensors are systematically calibrated to maintain the system performance.			
Justification:	In order to ensure that data coming from cooperating sensors can be processed by the system.		
Comments:			
Source Requirements:	COM-SRD-3606		
Related Requirements:		**Verification Method:**	Design Review Test

3.4. SWE Data System

All requirements in Section 3.2 Overall System Requirements and all subsections therein apply here. The following subsections identify additional requirements which apply specifically to Data Processing.

3.4.1. Functional Requirements

SWE-SRD-11940			
The system shall allow be capable of providing access to and make available stored data.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-1604		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11941			
The system shall allow registered users to search and retrieve stored data in compliance with the applicable data policy.			
Justification:	In order to allow registered users access to stored data.		
Comments:	The Space Weather System data policy will specify the user access rights to use the search and retrieval function.		
Source Requirements:	SYS-CRD-DAT-3237		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11942			
The system shall allow the registered users to filter stored data based on any predefined metadata.			
Justification:			
Comments:	The Space Weather System data policy will specify the user access rights to use the browsing function.		
Source Requirements:	COM-SRD-45		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-10729			
The Space Weather System shall have a Space Weather database that provides centralised access to Space Weather data.			
Justification:	This database is an essential underpinning component of the SWE Services including in particular Service Domain 12 – General Data Services.		
Comments:	Note that the access is centralised, but the database itself may consist of multiple federated elements. Note that in further requirements the acronym SWE database is used when meaning a Space Weather database with centralised access.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9549			
The Space Weather System shall provide handling of data user requests for data retrieval and provision.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10732			
The Space Weather System shall store all measurements including any meta-data from the sensors in the SWE database.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10733			
The Space Weather System shall store all the data products in the SWE database.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12267			
The system shall be able to handle both real-time feeds of data to be stored and batch data storage.			
Justification:	Analysis of the CRD		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12172			
The system databases shall allow: • storage of multiple values for one data field • storage of multiple instances of the same data item • storage of historical sequence of value for one field			
Justification:	In order to ensure that the implemented databases support the minimum necessary features.		
Comments:			
Source Requirements:	COM-SRD-3610		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-12173			
The system databases shall be searchable according to the most common combination of logical and numerical search criteria. Simple pre-defined searches shall be provided.			
Justification:	In order to ensure that the implemented databases support the minimum necessary features.		
Comments:			
Source Requirements:	COM-SRD-3612		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-11997			
The Space Weather System shall have the capability to the reprocess bulk data.			
Justification:	In order to cope with performance requirements.		
Comments:	This should include the capability to replay operational data stored in the system in real and accelerated time. The capability shall be in place for the production environment as well as for any staging and testing environment.		
Source Requirements:	COM-SRD-3689		
Related Requirements:		**Verification Method:**	Test

SWE-SRD-12000			
For the support of the bulk data processing capability, Space Weather System shall provide tools for cross-comparison of the results of the reprocessing campaigns with the previously operationally produced data.			
Justification:	In order to cope with performance requirements.		
Comments:	The tools shall allow an efficient comparison of the reprocessed data. The tools shall be available for the production environment as well as for any staging and testing environment.		
Source Requirements:	COM-SRD-3694		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-12001			
The bulk data processing capability shall allow to execute the reprocessing at an accelerated rate compared to the nominal processing rate in the production environment of the operational Space Weather System.			
Justification:	In order to cope with performance requirements.		
Comments:			
Source Requirements:	COM-SRD-3695		
Related Requirements:		**Verification Method:**	Analysis

SWE-SRD-21016			
The Space Weather System shall provide Measurement (-M) products in observation domains including, but not limited to: • Solar Data • Data on Interplanetary Medium at L1 • Data on Interplanetary Medium outside L1 • Data for Earth Magnetosphere and Radiation Belt • Data on Earth Ionosphere and Thermosphere • Data on Earth Atmosphere and Geomagnetic Environment • Data about Spacecraft			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21017			
The Space Weather System shall provide Solar Data: Measurement (-M) products including, but not limited to: • Solar disc magnetic fields • Solar index F10.7 (F10) • EUV images of Sun • White light solar imaging • H-alpha images of Sun • Soft X-ray images of the Sun • Solar EUV Images Outside of Sun-Earth Line • Solar Coronagraphic Images Outside of Sun-Earth Line • Solar far-side maps (using helioseismology technique) • Ly-alpha images (for measure of solar far-side activity) • White-light wide-angle coronagraph images • Solar radiospectrographic observations (for monitoring of radio bursts) • Solar X-ray flux • Solar EUV integrated flux • Solar UV flux • Heliospheric imaging of Sun-Earth line (tracking of Earth-directed CMEs) • EUV images of Sun, taken from L4 point • Solar coronagraphic images, taken from L4 point • Solar magnetograph images, taken from L4 point • EUV images of Sun, taken from L5 point • Solar magnetograph images, taken from L5 point • White-light solar images, taken from L5 point • H-alpha solar images, taken from L5 point • Soft X-ray solar images, taken from L5 point • White-light coronagraph images, taken from L5 point • Solar X-ray flux, measured at L5 point • Solar EUV integrated flux, measured at L5 point • Solar UV flux, measured at L5 point • Solar radio bursts, measured at L5 point • Heliospheric imaging, taken from L5 point • Solar microwave index F30			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21018			
The Space Weather System shall provide Data on Interplanetary Medium at L1: Measurement (-M) products including, but not limited to: • High energy >10 MeV protons • High energy >10 MeV ions • 1-to-10 MeV protons • 1-to-10 MeV ions • 30 keV-to-1 MeV ions • 2-50 MeV solar electrons • E>30 keV-8 MeV electrons • Interplanetary Magnetic field (IMF) • Solar wind bulk velocity • Solar wind bulk density • Solar wind temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21019			
The Space Weather System shall provide Data on Interplanetary Medium outside L1: Measurement (-M) products including, but not limited to: • Solar Energetic Particles • Data on Interplanetary Medium Outside L1 • Solar wind bulk velocity, measured at the L5 point • Solar wind bulk density, measured at the L5 point • Solar wind temperature, measured at the L5 point • Interplanetary magnetic field, measured at the L5 point • 1 MeV to >500 MeV interplanetary protons, measured at the L5 point • 30keV to 1 MeV interplanetary ions, measured at the L5 point • 30 keV - 8 MeV solar electrons, measured at the L5 point • Solar wind bulk velocity, measured at the L4 point • Solar wind bulk density, measured at the L4 point • Solar wind temperature, measured at the L4 point • Interplanetary magnetic field, measured at the L4 point • 1 MeV to >500 MeV interplanetary protons, measured at the L4 point • 30keV to 1 MeV interplanetary ions, measured at the L4 point • 30 keV - 8 MeV solar electrons, measured at the L4 point • Interplanetary scintillation			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21020			
The Space Weather System shall provide Data for Earth Magnetosphere and Radiation Belt: Measurement (-M) products including, but not limited to: • High energy >10MeV protons • High energy >10MeV ions • 1-to-10MeV protons • 1-to-10MeV ions • 30keV-to-1MeV ions • 30 keV-8 MeV electrons • Thermal and supra-thermal electron and ion energy spectra in the range 0 to 30 keV • Magnetospheric radiowave spectra • Thermal ions density and temperature • Local magnetospheric magnetic field in orbit • Plasma drift velocity			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21021			
The Space Weather System shall provide Data for Earth Ionosphere and Thermosphere: Measurement (-M) products including, but not limited to: • Vertical Total Electron Content • 3D electron density grids • URSI ionospheric parameters • Riometer data • Neutral density in thermosphere • Neutral wind velocity in thermosphere • Scintillation parameters • Atomic Oxygen Density • Global high-latitude convection electric field • Neutral atmosphere temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21022			
The Space Weather System shall provide Data for Earth Atmosphere and Geomagnetic Environment: Measurement (-M) products including, but not limited to: • Auroral visible imaging • Auroral UV imaging • Local magnetospheric magnetic field on ground • Neutral density and wind • Atmospheric neutrons • Atmospheric muons			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21023			
The Space Weather System shall provide Data about Spacecraft: Measurement (-M) products including, but not limited to: • Anomalies on spacecraft equipment • Data from spacecraft radiation monitors • Orbital data of spacecraft carrying space weather instruments • Spacecraft housekeeping telemetry data • Dose • Deep dielectric charging • Surface charging • Floating spacecraft potential • Dose at aircraft altitudes			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10437			
The Space Weather System data processing shall produce nowcast data products by recovering measurement-derived data products from the data base, feeding them into models and producing a best estimate of the near real time value of variables at a requested location in space or on the ground.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21024			
The Space Weather System shall provide Nowcast (-N) products in observation domains including, but not limited to: • Solar Data • Data on Interplanetary Medium at L1 • Data on Interplanetary Medium outside L1 • Data for Earth Magnetosphere and Radiation Belt • Data for other Planets Magnetospheres • Data on Earth Ionosphere and Thermosphere • Data on Earth Atmosphere and Geomagnetic Environment • Data about Spacecraft			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21025			
The Space Weather System shall provide Solar Data: Nowcast (-N) products including, but not limited to: • Solar flares • Coronal mass ejections (CMEs) • Coronal holes • Solar disc magnetic fields • Solar index R • Smoothed sunspot number (SSN, R12) • Solar index F10.7 (F10) • Solar index S10.7 (S10) • Solar index E10.7 (E10) • Solar index M10.7 (M10) • Solar index Y10.7 (Y10) • Solar index IG12 • EUV images of Sun • White light solar imaging • H-alpha images of Sun • Soft X-ray images of the Sun • Solar EUV Images Outside of Sun-Earth Line • Solar Coronagraphic Images Outside of Sun-Earth Line • Solar far-side maps (using helioseismology technique) • Ly-alpha images (for measure of solar far-side activity) • White-light wide-angle coronagraph images • Solar radiospectrographic observations (for monitoring of radio bursts) • Solar X-ray flux • Solar EUV integrated flux			

• Solar UV flux • Heliospheric imaging of Sun-Earth line (tracking of Earth-directed CMEs) • Characteristics of Sunspot groups • Characteristics of Filaments • Characteristics of Solar Radiobursts • CME arrival times & solar wind values • EUV images of Sun, taken from L4 point • Solar coronagraphic images, taken from L4 point • Solar magnetograph images, taken from L4 point • EUV images of Sun, taken from L5 point • Solar magnetograph images, taken from L5 point • White-light solar images, taken from L5 point • H-alpha solar images, taken from L5 point • Soft X-ray solar images, taken from L5 point • White-light coronagraph images, taken from L5 point • Solar X-ray flux, measured at L5 point • Solar EUV integrated flux, measured at L5 point • Solar UV flux, measured at L5 point • Solar radio bursts, measured at L5 point • Heliospheric imaging, taken from L5 point • Solar microwave index F30			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21026			
The Space Weather System shall provide Data on Interplanetary Medium at L1: Nowcast (-N) products including, but not limited to: • High energy >10 MeV protons • High energy >10 MeV ions • 1-to-10 MeV protons • 1-to-10 MeV ions • 30 keV-to-1 MeV ions • 2-50 MeV solar electrons • E>30 keV-8 MeV electrons • Interplanetary Magnetic field (IMF) • Solar wind bulk velocity • Solar wind bulk density • Solar wind temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21027			
The Space Weather System shall provide Data on Interplanetary Medium outside L1: Nowcast (-N) products including, but not limited to: • Solar Energetic Particles • Data on Interplanetary Medium Outside L1 • Solar wind bulk velocity, measured at the L5 point • Solar wind bulk density, measured at the L5 point • Solar wind temperature, measured at the L5 point • Interplanetary magnetic field, measured at the L5 point • 1 MeV to >500 MeV interplanetary protons, measured at the L5 point • 30keV to 1 MeV interplanetary ions, measured at the L5 point • 30 keV - 8 MeV solar electrons, measured at the L5 point • Solar wind bulk velocity, measured at the L4 point • Solar wind bulk density, measured at the L4 point • Solar wind temperature, measured at the L4 point • Interplanetary magnetic field, measured at the L4 point • 1 MeV to >500 MeV interplanetary protons, measured at the L4 point • 30keV to 1 MeV interplanetary ions, measured at the L4 point • 30 keV - 8 MeV solar electrons, measured at the L4 point			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21028			
The Space Weather System shall provide Data for Earth Magnetosphere and Radiation Belt: Nowcast (-N) products including, but not limited to: • Geomagnetic storm condition (indices: global, auroral, mid-latitude and high-latitude) • Geomagnetic indices Kp and K • Geomagnetic index Ap and A • Geomagnetic index Dst • High energy >10MeV protons • High energy >10MeV ions • 1-to-10MeV protons • 1-to-10MeV ions • 30keV-to-1MeV ions • 30 keV-8 MeV electrons • Thermal and supra-thermal electron and ion energy spectra in the range 0 to 30 keV • Magnetospheric radiowave spectra • Thermal ions density and temperature • Local magnetospheric magnetic field in orbit • Transpolar electric field • Auroral particle precipitation • Geomagnetic index AE, AL and AU • Geomagnetic index PC • Auroral kilometric radiation (AKR) • Geomagnetic index AZ • Local Geomagnetic Activity index • Plasmaspheric TEC • Geomagnetic Indices Hpo (Hp30 and Hp60)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21029			
The Space Weather System shall provide Data for other Planets Magnetospheres: Nowcast (-N) products including, but not limited to: • Planetary atmospheric properties (other than Earth)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21030			
The Space Weather System shall provide Data for Earth Ionosphere and Thermosphere: Nowcast (-N) products including, but not limited to: • Vertical Total Electron Content • 3D electron density grids • URSI ionospheric parameters • Riometer data • Neutral density in thermosphere • Neutral wind velocity in thermosphere • Scintillation indices and parameters (S4, sigma_phi, fading depth, fade duration, time between fades) • Atomic oxygen density • Ionospheric disturbances • Ionospheric Hall and Pedersen conductances • Global high-latitude convection electric field • VLF radio measurements • Neutral atmosphere temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21031			
The Space Weather System shall provide Data for Earth Atmosphere and Geomagnetic Environment: Nowcast (-N) products including, but not limited to: • Auroral visible imaging • Auroral UV imaging • Local magnetospheric magnetic field on ground • Local geomagnetically induced geoelectric field • Neutral density and wind • Atmospheric neutrons • Data on Ground Level Events			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21032			
The Space Weather System shall provide Data about Spacecraft: Nowcast (-N) products including, but not limited to: • Data from spacecraft radiation monitors • Orbital data of spacecraft carrying space weather instruments • Spacecraft housekeeping telemetry data • Dose • Deep dielectric charging • Surface charging • Floating spacecraft potential • Dose at aircraft altitudes			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10398			
The Space Weather System shall produce a-posteriori reconstruction data products by recovering measurement-derived data products from the data base, feeding them into models and producing a best estimate of variables at a given location in space or on the ground, and at a given time in the past.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10399			
The Space Weather System shall correlate their a-posteriori reconstruction data products with the measurements available in the data base and provide this correlation analysis along with the data product.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21033			
The Space Weather System shall provide Archives and A-Posteriori Reconstruction (-P) products in observation domains including, but not limited to: • Solar Data • Data on Interplanetary Medium at L1 • Data on Interplanetary Medium outside L1 • Data for Earth Magnetosphere and Radiation Belt • Data for other Planets Magnetospheres • Data on Earth Ionosphere and Thermosphere • Data on Earth Atmosphere and Geomagnetic Environment • Data about Spacecraft			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21034			
The Space Weather System shall provide Solar Data: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Solar flares • Coronal mass ejections (CMEs) • Coronal holes • Solar disc magnetic fields • Solar index R • Smoothed sunspot number (SSN, R12) • Solar index F10.7 (F10) • Solar index S10.7 (S10) • Solar index E10.7 (E10) • Solar index M10.7 (M10) • Solar index Y10.7 (Y10) • Solar index IG12 • EUV images of Sun • White light solar imaging • H-alpha images of Sun • Soft X-ray images of the Sun • Solar EUV Images Outside of Sun-Earth Line • Solar Coronagraphic Images Outside of Sun-Earth Line • Solar far-side maps (using helioseismology technique) • Ly-alpha images (for measure of solar far-side activity) • White-light wide-angle coronagraph images • Solar radiospectrographic observations (for monitoring of radio bursts) • Solar X-ray flux • Solar EUV integrated flux			

• Solar UV flux • Heliospheric imaging of Sun-Earth line (tracking of Earth-directed CMEs) • Characteristics of Sunspot groups • Characteristics of Filaments • Characteristics of Solar Radiobursts • CME arrival times & solar wind values • EUV images of Sun, taken from L4 point • Solar coronagraphic images, taken from L4 point • Solar magnetograph images, taken from L4 point • EUV images of Sun, taken from L5 point • Solar magnetograph images, taken from L5 point • White-light solar images, taken from L5 point • H-alpha solar images, taken from L5 point • Soft X-ray solar images, taken from L5 point • White-light coronagraph images, taken from L5 point • Solar X-ray flux, measured at L5 point • Solar EUV integrated flux, measured at L5 point • Solar UV flux, measured at L5 point • Solar radio bursts, measured at L5 point • Heliospheric imaging, taken from L5 point • Solar microwave index F30			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21035			
The Space Weather System shall provide Data on Interplanetary Medium at L1: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • High energy >10 MeV protons • High energy >10 MeV ions • 1-to-10 MeV protons • 1-to-10 MeV ions • 30 keV-to-1 MeV ions • 2-50 MeV solar electrons • E>30 keV-8 MeV electrons • Interplanetary Magnetic field (IMF) • Solar wind bulk velocity • Solar wind bulk density • Solar wind temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21036			
The Space Weather System shall provide Data on Interplanetary Medium outside L1: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Solar Energetic Particles • Data on Interplanetary Medium Outside L1 • Solar wind bulk velocity, measured at the L5 point • Solar wind bulk density, measured at the L5 point • Solar wind temperature, measured at the L5 point • Interplanetary magnetic field, measured at the L5 point • 1 MeV to >500 MeV interplanetary protons, measured at the L5 point • 30keV to 1 MeV interplanetary ions, measured at the L5 point • 30 keV - 8 MeV solar electrons, measured at the L5 point • Solar wind bulk velocity, measured at the L4 point • Solar wind bulk density, measured at the L4 point • Solar wind temperature, measured at the L4 point • Interplanetary magnetic field, measured at the L4 point • 1 MeV to >500 MeV interplanetary protons, measured at the L4 point • 30keV to 1 MeV interplanetary ions, measured at the L4 point • 30 keV - 8 MeV solar electrons, measured at the L4 point • Interplanetary scintillation			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21037			
The Space Weather System shall provide Data for Earth Magnetosphere and Radiation Belt: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Geomagnetic storm condition (indices: global, auroral, mid-latitude and high-latitude) • Geomagnetic indices Kp and K • Geomagnetic index Ap and A • Geomagnetic index Dst • High energy >10MeV protons • High energy >10MeV ions • 1-to-10MeV protons • 1-to-10MeV ions • 30keV-to-1MeV ions • 30 keV-8 MeV electrons • Thermal and supra-thermal electron and ion energy spectra in the range 0 to 30 keV • Magnetospheric radiowave spectra • Thermal ions density and temperature • Local magnetospheric magnetic field in orbit • Plasma drift velocity • Transpolar electric field • Auroral particle precipitation • Geomagnetic index AE, AL and AU • Geomagnetic index PC • Magnetopause location • Auroral kilometric radiation (AKR) • Geomagnetic index AZ • Geomagnetic index AZ long-term variation • Local Geomagnetic Activity index • Plasmapause location • Plasmaspheric TEC • Galactic Cosmic Rays (GCR) • Geomagnetic Indices Hpo (Hp30 and Hp60)			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-3270		
Related Requirements:		**Verification Method:**	

SWE-SRD-21038			
The Space Weather System shall provide Data for other Planets Magnetospheres: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Planetary atmospheric properties (other than Earth)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21039			
The Space Weather System shall provide Data for Earth Ionosphere and Thermosphere: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Vertical Total Electron Content • 3D electron density grids • URSI ionospheric parameters • Riometer data • Neutral density in thermosphere • Neutral wind velocity in thermosphere • Scintillation indices and parameters (S4, sigma_phi, fading depth, fade duration, time between fades) • Atomic oxygen density • Ionospheric disturbances • Ionospheric Hall and Pedersen conductances • Global high-latitude convection electric field • VLF radio measurements • Neutral atmosphere temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21040			
The Space Weather System shall provide Data for Earth Atmosphere and Geomagnetic Environment: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Auroral visible imaging • Auroral UV imaging • Local magnetospheric magnetic field on ground • Local geomagnetically induced geoelectric field • Neutral density and wind • Atmospheric neutrons • Atmospheric muons • Magnetotelluric data on ground impedance tensor • Data on Ground Level Events			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-3270		
Related Requirements:		**Verification Method:**	

SWE-SRD-21041			
The Space Weather System shall provide Data about Spacecraft: Archives and A-Posteriori Reconstruction (-P) products including, but not limited to: • Anomalies on spacecraft equipment • Data from spacecraft radiation monitors • Orbital data of spacecraft carrying space weather instruments • Spacecraft housekeeping telemetry data • Dose • Deep dielectric charging • Surface charging • Floating spacecraft potential • Dose at aircraft altitudes			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10620			
The Space Weather System shall produce forecast data products by recovering measurement-derived data products from the data base, feeding them into models and producing a best estimate of variables at a given location in space or on the ground, and at a given moment in the future.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21042			
The Space Weather System shall provide Forecast (-F) products in observation domains including, but not limited to: • Solar Data • Data on Interplanetary Medium at L1 • Data on Interplanetary Medium outside L1 • Data for Earth Magnetosphere and Radiation Belt • Data for other Planets Magnetospheres • Data on Earth Ionosphere and Thermosphere • Data on Earth Atmosphere and Geomagnetic Environment • Data about Spacecraft			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21043			
The Space Weather System shall provide Solar Data: Forecast (-F) products including, but not limited to: • Solar flares • Coronal mass ejections (CMEs) • Coronal holes • Solar disc magnetic fields • Solar index R • Smoothed sunspot number (SSN, R12) • Solar index F10.7 (F10) • Solar index S10.7 (S10) • Solar index E10.7 (E10) • Solar index M10.7 (M10) • Solar index Y10.7 (Y10) • Solar index IG12 • EUV images of Sun • White light solar imaging • Soft X-ray images of the Sun • White-light wide-angle coronagraph images • Solar X-ray flux • Solar EUV integrated flux • Solar UV flux • Long-term solar activity • Characteristics of Sunspot groups • Characteristics of Filaments • CME arrival times & solar wind values • EUV images of Sun, taken from L4 point • Solar coronagraphic images, taken from L4 point • Solar magnetograph images, taken from L4 point • EUV images of Sun, taken from L5 point • Solar magnetograph images, taken from L5 point • White-light solar images, taken from L5 point • Soft X-ray solar images, taken from L5 point • White-light coronagraph images, taken from L5 point • Solar X-ray flux, measured at L5 point • Solar EUV integrated flux, measured at L5 point • Solar UV flux, measured at L5 point • Solar microwave index F30			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21044			
The Space Weather System shall provide Data on Interplanetary Medium at L1: Forecast (-F) products including, but not limited to: • High energy >10 MeV protons • High energy >10 MeV ions • 1-to-10 MeV protons • 1-to-10 MeV ions • 30 keV-to-1 MeV ions • 2-50 MeV solar electrons • E>30 keV-8 MeV electrons • Interplanetary Magnetic field (IMF) • Solar wind bulk velocity • Solar wind bulk density • Solar wind temperature • Activity at L1 – Long-term Forecast			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21045			
The Space Weather System shall provide Data on Interplanetary Medium outside L1: Forecast (-F) products including, but not limited to: • Solar Energetic Particles • Data on Interplanetary Medium Outside L1 • Solar wind bulk velocity, measured at the L5 point • Solar wind bulk density, measured at the L5 point • Solar wind temperature, measured at the L5 point • Interplanetary magnetic field, measured at the L5 point • 1 MeV to >500 MeV interplanetary protons, measured at the L5 point • 30keV to 1 MeV interplanetary ions, measured at the L5 point • 30 keV - 8 MeV solar electrons, measured at the L5 point • Solar wind bulk velocity, measured at the L4 point • Solar wind bulk density, measured at the L4 point • Solar wind temperature, measured at the L4 point • Interplanetary magnetic field, measured at the L4 point • 1 MeV to >500 MeV interplanetary protons, measured at the L4 point • 30keV to 1 MeV interplanetary ions, measured at the L4 point • 30 keV - 8 MeV solar electrons, measured at the L4 point			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21046			
The Space Weather System shall provide Data for Earth Magnetosphere and Radiation Belt: Forecast (-F) products including, but not limited to: • Geomagnetic storm condition (indices: global, auroral, mid-latitude and high-latitude) • Geomagnetic indices Kp and K • Geomagnetic index Ap and A • Geomagnetic index Dst • High energy >10MeV protons • High energy >10MeV ions • 1-to-10MeV protons • 1-to-10MeV ions • 30keV-to-1MeV ions • 30 keV-8 MeV electrons • Thermal and supra-thermal electron and ion energy spectra in the range 0 to 30 keV • Thermal ions density and temperature • Local magnetospheric magnetic field in orbit • Transpolar electric field • Auroral particle precipitation • Geomagnetic index AE, AL and AU • Geomagnetic index PC • Magnetopause location • Geomagnetic index AZ • Local Geomagnetic Activity index • Plasmapause location • Plasmaspheric TEC • Geomagnetic Indices Hpo (Hp30 and Hp60)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21047			
The Space Weather System shall provide Data for other Planets Magnetospheres: Forecast (-F) products including, but not limited to: • Planetary atmospheric properties (other than Earth)			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21048			
The Space Weather System shall provide Data for Earth Ionosphere and Thermosphere: Forecast (-F) products including, but not limited to: • Vertical Total Electron Content • 3D electron density grids • URSI ionospheric parameters • Riometer data • Neutral density in thermosphere • Neutral wind velocity in thermosphere • Scintillation indices and parameters (S4, sigma_phi, fading depth, fade duration, time between fades) • Atomic oxygen density • Ionospheric disturbances • Ionospheric Hall and Pedersen conductances • Global high-latitude convection electric field • Neutral atmosphere temperature			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21049			
The Space Weather System shall provide Data for Earth Atmosphere and Geomagnetic Environment: Forecast (-F) products including, but not limited to: • Visible Aurora probability • Local magnetospheric magnetic field on ground • Local geomagnetically induced geoelectric field • Neutral density and wind			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21050			
The Space Weather System shall provide Data about Spacecraft: Forecast (-F) products including, but not limited to: • Orbital data of spacecraft carrying space weather instruments • Deep dielectric charging • Surface charging • Floating spacecraft potential • Dose at aircraft altitudes			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-21051			
The Space Weather System shall provide Alerts and Event-based Alarms including, but not limited to: • All quiet alert - Archives • End-of-quiet alert - Archives • Event Based Alarm - All Archive • All-Quiet Alert • End-of-Quiet Alert • Solar Flare Detection • Solar Flare Detection and Location • CME Onset • Halo CME Onset • Coronal Hole Notification • Corotating Interaction Region (CIR) Alert • Solar Particle Event Onset • Geomagnetic Storm Warning/solar wind shock arrival • Geomagnetic Storm Onset • Ionsopheric Disturbance Detection • Ground Level Enhancement (GLE) Detection • Solar Radioburst Detection			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.4.2. Performance Requirements

SWE-SRD-9108			
The Space Weather System shall store Space Weather Data or federate, in a coordinated way, the storage of the Space Weather data.			
Justification:	Functional analysis of the Space Weather System		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-12176			
It shall be possible to receive information from assets using different time references and to use its information by means of reference conversions.			
Justification:	It's not possible to impose reference time to external entities; by other hand, the system has to be able to handle independently of applied reference time.		
Comments:			
Source Requirements:	COM-SRD-28		
Related Requirements:		**Verification Method:**	Design Review Test

3.4.3. Interface Requirements

No additional requirements are identified at this stage.

3.4.4. Design and Implementation Requirements

SWE-SRD-12175			
The system shall be synchronised to a single common system time by using UTC.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-27 SYS-CRD-SYS-3204		
Related Requirements:		**Verification Method:**	Design Review Test

3.4.5. Availability and Reliability Requirements

SWE-SRD-9563			
The operational availability of the Space Weather System Data Centre shall be such that all Space Weather System service availability requirements are met for those elements of the system that depend on it.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12865			
The maximum contiguous downtime of the Space Weather System Data Centre shall be such that all required maximum contiguous downtimes of Space Weather System services are met for those elements of the system that depend on it.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.4.6. Security and Data Policy Requirements

No additional requirements are identified at this stage.

3.4.7. Operational Requirements

SWE-SRD-11933			
The Space Weather System shall be able to receive SWE data from cooperating centres and their services as defined by associated SLAs and ICDs.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.5. Space Weather Model Access via the Service Provision Segment

All requirements in Section 3.2 Overall System Requirements and all subsections therein apply here.

3.5.1. Functional Requirements

SWE-SRD-12307			
The Space Weather System models shall contain: • Space Weather Models of the Sun • Space Weather Models of the Interplanetary Medium • Space Weather Models of Geospace • Space Weather Models of the Magnetosphere • Space Weather Models of the Ionosphere • Space Weather Models of the Thermosphere • Space Weather Models of geomagnetism and ground conductivity • Space Weather Model for other Planets			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12309			
The system shall have a repository for managing models.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12308			
The system shall archive all previous versions of models for traceability and history.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12331			
The system shall support model and data interfacing.			
Justification:	To generate both near real-time and non real-time service products.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12332			
The system shall allow interfacing with models hosted at contributing centres.			
Justification:	To generate both near real-time and non real-time service products.		
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10707			
The Space Weather System Sun models shall contain: • Solar cycle model • Solar activity prediction • Sound travel time analysis (helioseismology) • Solar flare and CME onset model • Model of global solar magnetic field, to incorporate into end-to-end space weather simulations • Model of solar magnetic field configuration used to predict flares and CMEs • Predict solar wind velocity based on coronal hole maps and solar rotation • Solar active region evolution • Models to predict (E)UV integrated flux • Models to predict (E)UV integrated flux on planet facing solar hemisphere			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-3019		
Related Requirements:		**Verification Method:**	

SWE-SRD-12549			
The Space Weather System models of the Interplanetary Medium shall contain: • Model of Solar Wind and IMF • Model of Ambient Solar Wind (without eruptive phenomena), to incorporate into end-to-end space weather simulations • CME Propagation and Particle Acceleration • Solar Energetic Particle Transport Model • Interplanetary hydrogen density distribution (for Ly-alpha images)			
Justification:			
Comments:			
Source Requirements:	SWE-CRD-GEN-3035		
Related Requirements:		**Verification Method:**	

SWE-SRD-12525			
The Space Weather System Geospace models shall contain: • Models of interaction of solar wind with Earth's magnetosphere • Magnetosphere models • Magnetosphere-Ionosphere coupling models • Ionosphere models • Ionosphere-Thermosphere coupling models • Thermosphere models • Ground models			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12534			
The Space Weather System Magnetosphere models shall contain: • Model of the earth magnetosphere • Model of geomagnetic field of earth • Model of Radiation Belt • Geomagnetic cut-off • Model for particle transport, diffusion and acceleration • Model to describe incoming galactic cosmic rays contribution			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11876			
The Space Weather System Ionosphere models shall contain: • Ionosphere TEC model • Ionosphere 3D model • Ionosphere general plasma circulation model • Calculate transpolar electric field model • Scintillation model • Ray-tracing code for RF wave propagation • High-latitude convection model			
Justification:			
Comments:	Global coverage is required		
Source Requirements:	SWE-CRD-GEN-3036 SWE-CRD-GEN-3037		
Related Requirements:		**Verification Method:**	

SWE-SRD-11879			
The Space Weather System Thermosphere models shall contain: • Thermosphere model • Thermosphere wind model			
Justification:			
Comments:	Global coverage is required		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11881			
The Space Weather System Ground models shall contain: • Geomagnetic field at surface • Model of ground electrical conductivity			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10728			
The Space Weather System models for other planets shall contain: • Models of Venus • Models of Mars • Models of Jupiter			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11891			
The Space Weather System models for Venus shall contain: • Models of the Solar Wind interaction with Venus • Model of Venus induced magnetosphere • Model of Venus ionosphere • Venus atmospheric model			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11893			
The Space Weather System models for Mars shall contain: • Models of the Solar Wind interaction with Mars • Model of Martian Remnant crustal magnetic field • Model of Mars ionosphere • Mars atmospheric model			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11895			
The Space Weather System models for Jupiter shall contain: • Models of the Solar Wind interaction with Jupiter • Model of Jupiter magnetosphere • Model of Jupiter radiation belt			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.5.2. Performance Requirements

SWE-SRD-10312			
Uncertainties in the model outputs shall be quantified in the form of quality metrics.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12310			
The system shall maintain and improve the models continuously based on new measurements.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10706			
The Space Weather System shall acquire or develop, then maintain, the models of the Sun and of its corona needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12548			
The Space Weather System shall acquire or develop, then maintain, models of the Interplanetary Medium, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10708			
The Space Weather System shall acquire or develop, then maintain, the models of the Geospace needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11874			
The Space Weather System shall acquire or develop, then maintain, the models of the coupling of the solar wind to the Earth's Magnetosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12533			
The Space Weather System shall acquire or develop, then maintain, the models of the Earth concerning its magnetosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12531			
The Space Weather System shall acquire or develop, then maintain, models of the coupling between the Earth's Magnetosphere and Ionosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11877			
The Space Weather System shall acquire or develop, then maintain, models of the Earth's ionosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:	Global coverage is required		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12536			
The Space Weather System shall acquire or develop, then maintain, models of the coupling between the Earth's Ionosphere and Thermosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:	Global coverage is required.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11878			
The Space Weather System shall acquire or develop, then maintain, models of the Earth's thermosphere, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:	Global coverage is required.		
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11880			
The Space Weather System shall acquire or develop, then maintain, models of the Earth's ground characteristics, as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10710			
The Space Weather System shall provide (guidance on) access to microparticle environment information where relevant rather than providing this as part of any of the services.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-10727			
The Space Weather System shall acquire or develop, then maintain, space weather relevant models of other planets than Earth as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11890			
The Space Weather System shall acquire or develop, then maintain, models of Venus as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11892			
The Space Weather System shall acquire or develop, then maintain, models of Mars as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11894			
The Space Weather System shall acquire or develop, then maintain, models of Jupiter as needed for the elaboration of the data products they shall produce.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11920			
The Space Weather System shall be able to verify that the quality of the SWE data from cooperating sensors is met as defined by the associated SLA and ICD.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9531			
The Space Weather System shall be able to receive SWE data from cooperating sensors as defined by associated SLAs and ICDs.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-11919			
The Space Weather System shall be able to monitor and request data from cooperating sensors as defined by associated SLAs and ICDs.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.5.3. Interface Requirements

No additional requirements are identified at this stage.

3.5.4. Design and Implementation Requirements

SWE-SRD-20244			
The users shall be allowed to specify freely the orbits and time spans for their historical de-archiving and/or reconstitution requests, within the maximum ranges covered by the services.			
Justification:	The user shall be able to specify the orbit using a series of two line elements, classical ephemerides or trajectory upload depending on the tool in use. Mission profiles supported shall include electric orbit raising.		
Comments:			
Source Requirements:	SWE-CRD-SCD-2635		
Related Requirements:		**Verification Method:**	

SWE-SRD-20262			
All service elements forming part of the Space Weather System shall be presented with a common look and feel.			
Justification:	To ensure design harmonisation		
Comments:			
Source Requirements:	SYS-CRD-PRE-3199		
Related Requirements:		**Verification Method:**	Design Review

3.5.5. Availability and Reliability Requirements

SWE-SRD-9567			
The operational availability of the Space Weather System Service Centre shall be such that all Space Weather System service availability requirements are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-12866			
The maximum contiguous downtime of the Space Weather System Service Centre shall be such that all required maximum contiguous downtimes of Space Weather System services are met.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

3.5.6. Security and Data Policy Requirements

No additional requirements are identified at this stage.

3.5.7. Operational Requirements

SWE-SRD-10313			
The Space Weather System shall warn the user when the accuracy and confidence of the delivered data products are degraded.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	

SWE-SRD-9137			
Data forecasts shall be calculated immediately after reception of the input data that is required for the models.			
Justification:	The usability and usefulness of data forecast depend on the timely availability to the final users.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1578		
Related Requirements:		**Verification Method:**	Design Review Test

3.6. User Interface Segment

All requirements in Section 3.2 Overall System Requirements and all subsections therein apply here. The following subsections identify additional requirements which apply specifically to the User Interface.

3.6.1. Functional Requirements

No additional requirements are identified at this stage.

3.6.2. Performance Requirements

SWE-SRD-9139			
The system shall provide to the user an estimated response delay for each data request that is submitted.			
Justification:	To allow the users to specify their requests according to their data needs vs their timeliness requirements.		
Comments:			
Source Requirements:	SWE-CRD-SCO-1580		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-SRD-9189			
The Space Weather System shall offer browsing facilities and appropriate visualisation tools and functionality in order to view simulation outputs.			
Justification:	The scales and complexity of the models involved in an end-to-end simulation make it difficult to grasp from tabulated data, the scope of the simulation outcomes. The service shall provide easy to use visualisation tools to ensure maximum usability of these results.		
Comments:			
Source Requirements:	SWE-CRD-GEN-1742		
Related Requirements:		**Verification Method:**	Design Review

3.6.3. Interface Requirements

SWE-SRD-12516			
The system shall provide, for each service available to the end user, an application-to-application interface.			
Justification:	In order to allow users to automate their use of the system.		
Comments:	Example of possible mechanism: Web Services		
Source Requirements:	COM-SRD-3755 SYS-CRD-SYS-3212		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-20259			
The interface between the System and the users shall be such that it is possible for the user to develop their own tool to access the services via API.			
Justification:	In order to allow development of efficient third-party services (added value services) based on data provided by the Space Weather System through its services.		
Comments:			
Source Requirements:	SYS-CRD-SYS-3212		
Related Requirements:		**Verification Method:**	Analysis Test

SWE-SRD-12517			
The SWE data shall be provided to the user by the system using mechanisms appropriate to each data type and size.			
Justification:	In order to ease the access to the data.		
Comments:	i.e. E-mail for small ASCII files, sftp for binary and large files, API etc. A limit on the number of requests and the size of the requested data has to be established in order to avoid overloading of the system or malicious use.		
Source Requirements:	COM-SRD-3755		
Related Requirements:		**Verification Method:**	Analysis Test

3.6.4. Design and Implementation Requirements

No additional requirements are identified at this stage.

3.6.5. Availability and Reliability Requirements

No additional requirements are identified at this stage.

3.6.6. Security and Data Policy Requirements

SWE-SRD-10915			
Each Space Weather System service shall offer the possibility to a non-registered user to subscribe to the service if this is authorized by the Data Policy.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

SWE-SRD-10916			
Each Space Weather System service shall offer the possibility to a registered user to un-subscribe from the service.			
Justification:			
Comments:			
Source Requirements:			
Related Requirements:		**Verification Method:**	Design Review

3.6.7. Operational Requirements

SWE-SRD-12157			
A Standard Human Machine Interface (HMI) guideline shall be defined for the system, assets and subsystems for all software products to be developed.			
Justification:			
Comments:			
Source Requirements:	COM-SRD-34 SYS-CRD-PRE-3199		
Related Requirements:		**Verification Method:**	Design Review

4. Annex 1: Definitions

Concept	Definition
Product Specific Terminology	
Accuracy of data	An estimate of the closeness of agreement between measured data and the observable being measured. In practice this is reflected by an uncertainty value taking into account all known and quantifiable sources of error in the data.
Alarm	Near real-time notification issued when a dangerous condition occurs.
Alert	Timely notification to the user that conditions of interest are taking place or are expected to take place.
Data	Model output, raw or processed measurements of any space weather parameter.
Forecast	Description of the space environment at a future date based on actual data, proxies and models
Index	A set of derived variables frequently used to parameterise space weather conditions and as input to models. The default sets of indices are: • Solar Activity and geomagnetism: Ap, Kp, Dst, AE, Polar Cap Index, IG12, IMF, R, R12, F10.7, F30, S10, E10, M10, Y10; • Ionospheric scintillation: S4, Sigma_phi, fading depth, fade duration, time between fades
Model	A representation of a physical phenomenon built on data (measured and/or theoretical). There are three types of model: • Empirical: A model that is based on observations. • Physics-based: A model that is based on first principles. It relies on mathematical descriptions of specific physical phenomena.

	• Semi-empirical: A model that is partially based on observations and partially on first principles
Near Real-time	Statement that an action is occurring as close as possible to the same rate at which an observable is measured/observed
Nowcast	Reconstruction in near real-time of a description of the present space environment based on actual data, proxies and models
Product interface	The means by which a particular product is accessed, examples of which are a user interface (GUI, web form, menu driven) or an API. Usually, the product interface will conform to some well-defined standard in order to aid interoperability and re-use
Real-time	Statement that an action is occurring at the same rate at which an observable is measured/observed
Report	This class of product consists of summary reporting tailored towards user needs describing ongoing, past or expected conditions and provided as part of a service. Reports build on products and expertise available within the SWE Service System. Reports are considered to be products where these are produced as part of the SWE Services.
Space Weather Guaranteed Dataset	A set of different variables delivered by an entity that verifies and guarantees, to the extent possible, not only the health and reliability of each individual datum but also the consistency of the set.
Warning	Near real-time notification of a potentially hazardous situation.
Space Weather Service Definitions	
Accuracy of service	An estimate of the closeness of agreement between service output and the associated observable conditions. In practice this is reflected by an uncertainty value based on known performance statistics.

Operational	A product, tool or service that has been validated and certified suitable for use in the intended operational context
Pre-operational	A product tool or service that has been validated against the criteria for use in the intended operational context but is not yet being demonstrated to meet operational use.
Product	Derived data generated using one or more space weather tool or model. A Product is a digital file(s) delivered to members of a user community from an operational element of the system that has a defined format and is archived and is reproducible. The generation of a product or a family of products is part of a service of the SWE Service System or to the SWE Service System. Software tools made available to users or a technical report are not considered as products.
Reliability	The ability of an element of the SWE service network to perform its required functions under its given operational conditions. The reliability of an element of the system is considered “undetermined” until it has been evaluated. When the element fulfils all predetermined criteria, it can be considered “reliable”.
Service	A service is a collection of derived data products, software tools, technical reports and associated user support addressing the high-level requirements of a specific group of users as defined by the Customer Requirements Document
Tool(kit)	A software application which provides the end user with the facility to retrieve and/or process and further modify a given set of products according to their needs as part of a SWE Service.
User requirement	The specification of what the user expects of the product, service or system to provide in order to fulfil their needs.
Validation	Validation is a process which demonstrates that the product is able to accomplish its intended use in the intended operational

	environment. The status of the product following validation is "validated". Verification is a pre-requisite for validation.
Verification	Verification is a process which demonstrates through the provision of objective evidence that the product is designed and produced according to its specifications and the agreed deviations and is free of defects. Verification can be accomplished by one or more of the following methods: • analysis (including similarity), • test, • inspection, • review of design. The status of the product following verification is "verified".
Roles Referred to in this document	
Customer	Entity responsible for procuring the establishment of the SWE Service System.
End user	A SWE service (end) user is anyone, a person/institution or an electronic system, that accesses or receives SWE products or services.
Third Party Service Provider	Entity (research institute or commercial) developing and establishing a service based on data provided by the Space Weather system through an individual customer-service agreement that goes beyond the scope of the other SWE tailored services.
Space Weather Domain Definitions	
Coronal Mass Ejection	An outflow of plasma from or through the solar corona. CMEs are often, but not always, associated with erupting prominences, disappearing solar filaments, and/or flares. CMEs vary widely in structure, density, and velocity. Large and fast CMEs can approach masses of 1.6 × 10^12 kg and approach velocities over 2000 km/s. Earth

	impacting CMEs can result in significant geomagnetic storms. Types of coronal mass ejections launched toward Earth are called "halo CMEs" because as they approach Earth, they appear larger than the Sun, making a halo of bright coronal emission completely around it.
Cosmic Rays	General term comprising galactic cosmic rays, anomalous cosmic rays and solar cosmic rays (e.g. solar energetic particles). • Galactic cosmic rays: High-energy charged particles (up to 10^21 eV) originating from outside the solar system. • Anomalous cosmic rays: Charged particles (approx. 10-100 MeV) originating from neutral interstellar atoms that have been ionised by solar UV radiation after entering the heliosphere. • Solar energetic particles: Charged particles (from a few keV up to GeV) originating in at least two distinct locations, namely the solar flare and the coronal mass ejection-driven interplanetary (IP) shock. Commonly referred to as solar energetic particles when they are observed in IP space and near Earth.
Interplanetary Shock	Interplanetary shocks are a type of collision-less shock - ones where particles transfer energy through electromagnetic fields instead of directly bouncing into one another.
Single Event Effects	With reference to the effects of energetic particles on spacecraft microcircuits - an unexpected change in the logic state of a single digital bit. SEUs can be either soft (the microcircuit is not damaged and can be rewritten to either state), or a latch up, which cannot easily be reset
Solar activity	The collective term for all active phenomena on the Sun, including sunspots, faculae,

	active regions, plages, active prominences, and flares.
Solar energetic particle (SEP) event	A solar energetic particle event is a sudden release of particles (protons, electrons and heavy ions) with energy ranging from a few tens of keV to GeV and associated with solar eruptive phenomena or interplanetary coronal mass ejections.
Solar Flare	A solar flare is an intense burst of radiative energy across the entire EM spectrum, with the largest enhancements in the X-ray, EUV and radio portions. Powerful flares are often, but not always, accompanied by a CME. Flares are labelled with a letter and number. The letter is the flare class and indicates the peak intensity in W/m2 of X-rays in the 0.1-0.8nm wavelength range as measured at Earth by the GOES spacecraft. The weakest one is A class followed by the classes B, C, M and X, each letter represents a 10-fold increase in energy output. Within each letter class there is a finer scale from 1-9 although X-class flares could be higher.
Spacecraft anomaly	Anomalous or unexpected behaviour of a spacecraft or any of its subsystems.
Spacecraft Effects	Effects observed as a result of the interaction of a spacecraft or device with the local space environment. Examples include radiation dose, single event effects, sensor background accumulated charge and spacecraft anomalies.
Space Weather	Space Weather is the physical and phenomenological state of natural space environments. The associated discipline aims, through observation, monitoring, analysis and modelling, at understanding and predicting the state of the Sun, the interplanetary and planetary environments, and the solar and non-solar driven perturbations that affect them, and also at forecasting and nowcasting the potential impacts on biological and technological system**s**

Space Weather Event	A time-limited condition of the space environment (e.g. Solar Flare, Solar energetic particle event, Substorm). Often this involves a propagating disturbance (e.g. CME or interplanetary shock).
Susceptibility	The response of a material or substance to a change in conditions. In the spacecraft case, this may be characterised by e.g. • SEP susceptibility: Rate of destructive and non-destructive SEEs in specified components under specified shielding levels due to an SEP event • Surface charging susceptibility: Surface potentials of defined materials due to ambient plasma • Internal charging susceptibility: Internal charging levels of specified dielectric components under specified shielding • Degradation due to radiation susceptibility: Dose and NIEL degradation of specified components under specified shielding (including solar cell degradation) • Satellite attitude change susceptibility: Deviations in magnetic torque • Satellite orbit change susceptibility: Orbit alteration due to drag enhancement in LEO • EM interference susceptibility: • Telecommunications interference (TBC)