DOCUMENT

Space Situational Awareness - Space Weather Customer Requirements Document

Prepared by	ESA SSA Team
Reference	SSA-SWE-RS-CRD-1001
Issue	4
Revision	5a
Date of Issue	2011-07-28
Status	Draft
Document Type	RQ
Distribution	

European Space Agency
Agence spatiale européenne

APPROVAL

Title Space Situational Awareness - Space Weather Customer Requirements Document	
Issue 4	**Revision 5**
Author ESA SSA Team	**Date**
Approved by	**Date**
S. Moulin - SSA Governance and Data Policy Manager J.-P. Luntama - SSA SWE Manager N. Bobrinsky -SSA Programme Manager	

CHANGE LOG

Reason for change	Issue	Revision	Date

CHANGE RECORD

Issue	Revision		
Reason for change	**Date**	**Pages**	**Paragraph(s)**

Table of contents:

1 INTRODUCTION

This document has been generated with the following Doors module baseline :

SSA-SWE CRD : 1.15

SSA-COM CRD : 1.11

1.1 The European SSA System

The objective of the Space Situational Awareness (SSA) system is to support the European independent utilisation of and access to space for research or services, through providing timely and quality data, information, services and knowledge regarding the environment, the threats, and the sustainable exploitation of the outer space.

The high-level users' needs for the European SSA system, as expressed by the SSA user group during its meetings in the 2006-2008 timeframe, can be summarized as follows:

- support safe and secured operation of space assets and related services
- support risk management (on orbit and during re-entry) and liability assessment
- assess the status and basic characteristics of space objects (both human-made and natural).
- detect non-compliance with applicable international treaties and recommendations;
- enable the allocation of responsibility for space objects (to launching State) or Organisations (ESA, Member States, etc.), and support confidence building measures (identification of owner and/or operator)

ESA will be responsible for the technical definition and the developments of the European SSA system up to the operational stage [AD01]. It is planned to carry out the SSA objectives in successive programmatic steps with a view to achieve a full operational capability over a framework of ten years [AD01]. ESA has proposed an architectural breakdown of the objectives into the following three segments:

- Space Surveillance and Tracking
- Near-Earth Objects
- Space Weather

The different nature of these three segments, different development schedules and dislocated centres of expertise suggest a modular design with a high degree of independence between the segments. User-level requirements will therefore directly be addressed by the segments in so-called Customer Requirements Documents (CRDs). However, some system-level design activities are required to avoid duplication of functions and assure a harmonised design. In particular, a global governance model and data policy will be developed to which all three segments would have to comply.

The applicable baseline for each segment will therefore be formed by this Segment Customer Requirements Document, a Segment Interface Control Document, a Common Customer Requirements Document, a Data Governance and Data Policy Customer Requirements and a Security Customer Requirements Document.

1.2 Scope of this document

This document contains the customer requirements for the Space Weather (SWE) Segment of the SSA system. The SWE Segment customer requirements are related to the monitoring of the Sun, the solar wind, the radiation belts, the magnetosphere, the ionosphere, the thermosphere, and the microparticle environment. It is addressing the high-level user requirements and identifies the services of this segment as part of the applicable baseline for all SWE segment design definition and development activities. It is the key document for the qualification and acceptance of the segment. Qualification and acceptance will be done on the basis of the requirements formulated in this document.

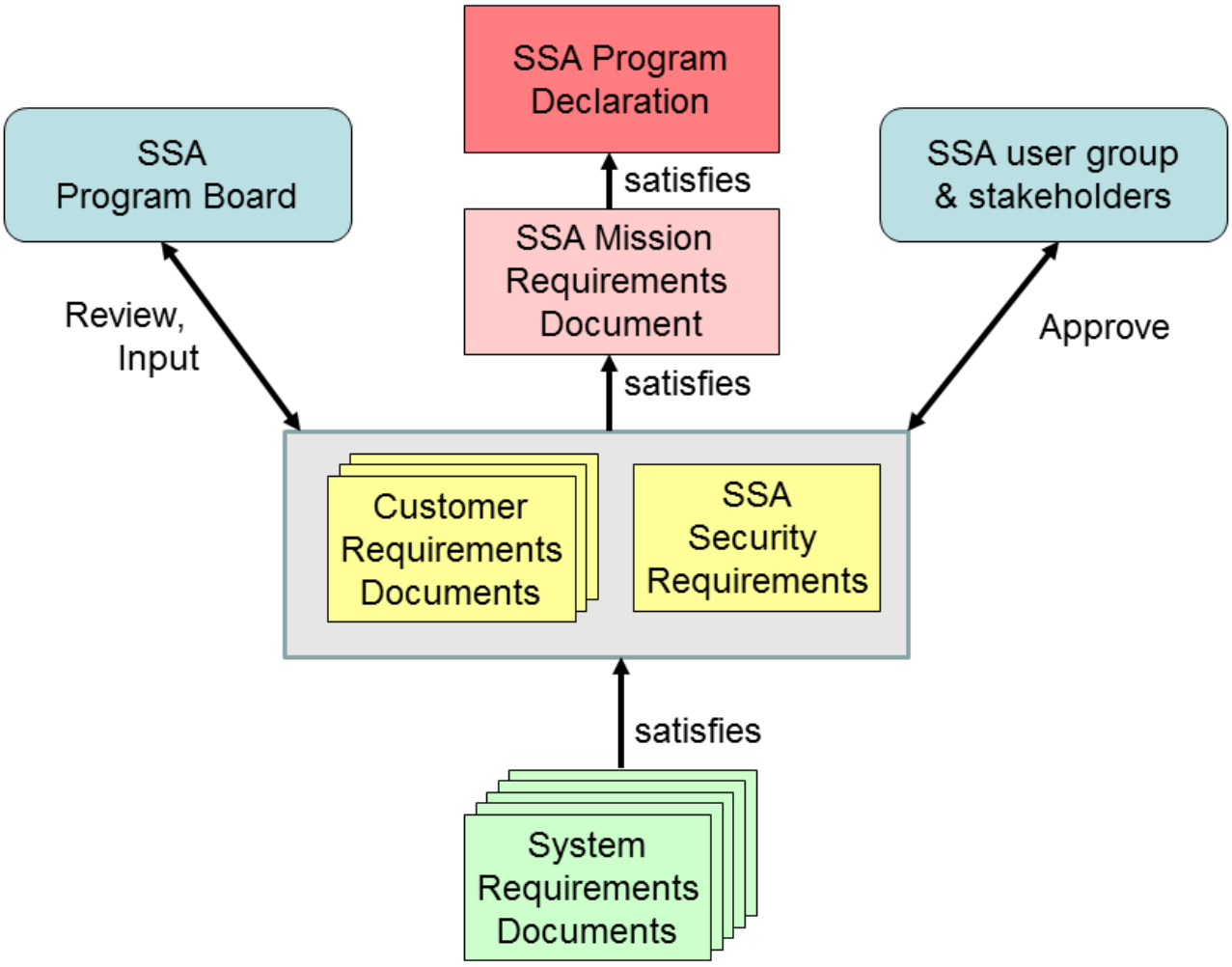
The requirements on this document are formulated from the perspective of the user and are thus directed to the output of services to be provided by the system. Implementation-level or design-related requirements are not in the scope of this document.

In the absence of requirements on data governance and data policy, security-related functions, design harmonisation requirements and overall system requirements, this issue of the document is primarily a response (in the form of an expansion) to the user needs for the SWE services defined in AD01.

Services related to microparticles, be they data services or short- and long-term flux predictions are recognised SSA customer requirements. Where microparticles are considered as a statistical ensemble rather than discrete objects, then they may be covered by the Space Weather Segment Customer Requirements Document. The Space Surveillance and Tracking Segment CRD and the Near-Earth Objects Segment CRD many also cover this domain where appropriate.

1.3 Role of this document

This document is the starting point for SSA-SWE engineering activities and accordingly segment specifications will have to satisfy these customer requirements and the segment will have to be qualified against them. The overall document hierarchy is given in Figure 1. In this context, “Element” refers to any sub-part of the segment and may refer to measurement or service provision modules.



<Picture>

Figure 1 : Position of the SWE CRD in the SSA documentation

This document is the starting point for SWE engineering activities and accordingly segment specifications will have to satisfy these customer requirements and the segment will have to be qualified against them. The overall document hierarchy is given in Figure 1. In this context, “Element” refers to any sub-part of the segment and may refer to measurement or service provision modules.

2 APPLICABLE AND REFERENCE DOCUMENTS

2.1 Applicable documents

[AD-01]	ESA Council "Declaration on the Space Situational Awareness (SSA) Preparatory Programme"	ESA/C/SSA-PP/VII/Dec. 1 (Final) 08 December 2008
[AD-02]	ESA Space Situational Awareness Programme Proposal	ESA/SSA-PP(2008)5 04 June 2008
[AD-03]	ECSS standards documentation	http://www.ecss.nl
[AD-04]	SSA Mission Requirements Document SSA-GEN-RS-MRD-1000	i3.0, 29/04/2011
[AD-05]	SSA Common Customer Requirements Document SSA-GEN-RS-CRD-1002	i2.1, 01/07/2011

2.2 Reference documents

[RD-01]	ECSS-E-ST-70C European Cooperation for Space Standardisation "Space Engineering - Ground Segment and Operation"	31 July 2008
[RD-02]	Space Weather Effects Catalogue, H. Koskinen, E. Tanskanen, R. Pirjola, A. Pulkkinen, C. Dyer, D. Rodgers, P. Cannon, FMI, QinetiQ, RAL Consortium	
[RD-03]	Space Weather Parameters, C. Lathuillere, J. Lilensten, M.Menvielle, LPG, Alcatel-LPCE Consortium	
[RD-04]	Space Weather Parameters Required by the Users, Synthesis of User Requirements, R. B. Horne, BAS, Alcatel-LPCE Consortium	
[RD-05]	RAL Synthesis of User Requirements	
[RD-06]	Space Weather Market Analysis Summary Report for the ESA Space Weather Working Team, Astrium, RAL Consortium	
[RD-07]	Market Analysis Final Report, ESYS CoNSOlting, Alcatel-LPCE Consortium	
[RD-08]	Benefits of a European Space Weather Programme, RAL Consortium	
[RD-09]	Benefits of a European Space Weather Programme, Alcatel-LPCE Consortium	
[RD-10]	Space Environment Information System to support Satellites Operations (SEISOP) System Requirements Documents	Issue 1.0 Feburay 2009
[RD-11]	SWNS-RAL-TN0001 Nano satellite beacons for space weather monitoring: space weather effects and requirements analysis, SFTC/RAL	2005

2.3 Acronyms

AD	Applicable Document
CCD	Charge Coupled Device

CME	Coronal Mass Ejection
COSPAR	Committee on Space Research
CRD	Customer Requirements Document
DAT	Data Products Service
ECSS	European Cooperation for Space Standardisation
EGNOS	European Geostationary Navigation Overlay Service (EGNOS)
EMC	Electromagnetic Compatibility
ERD	Element Requirements Document
ESA	European Space Agency
ESD	Electrostatic Discharge
EUV	Extreme ultraviolet
EVA	Extra-Vehicular Activity
GEN	General Requirement
GEO	Geostationary Earth Orbit
GIC	Geomagnetically induced current
GNSS	Global Navigation Satellite Systems
HF	High frequency
ICD	Interface Control Document
IG12	12-month-running mean of the ionospheric IG index
IMF	Interplanetary Magnetic Field
ISES	International Space Environment Service
ISS	International space station
ITEC	Ionospheric TEC
L1	First Lagrangian point
L5	Fifth Lagrangian point
LAU	Launch Operation Service
LEO	Low Earth Orbit
LET	Linear energy transfer
MEO	Medium Earth Orbit
N/A	Not applicable
NEO	Near-Earth Object
NIEL	Non ionising energy loss
NOAA	National Oceanic and Atmospheric Administration
NSO	Non-Space System Operators Service
PCA	Polar Cap Absorption
PRBEM	COSPAR Panel on Radiation Belt Environment Modelling
PRS	Policy Requirements Service
PSP	Pipe-to-soil potential
RD	Reference Document
RSK	Collision risks with the Earth Service
RTK	Real-time kinematic
S/C	Spacecraft
SATCOM	Satellite communications
SCD	SpaceCraft Design Service
SCH	Human Space Flight Service
SCO	SpaceCraft Operation Service
SEG	Segment level programme requirement
SEE	Single Event Effect

SEP	Solar energetic particle
SEU	Single Event Upset
SPE	Solar particle event, solar proton event
SRD	Segment Requirements Document
SRM	Solid Rocket Motor
SSA	Space Situational Awareness
SSN	Smoothed Sunspot Number
SST	Space Surveillance and Tracking
SWE	Space Weather
SWPC	Space Weather Prediction Centre
TBC	To Be Confirmed
TBD	To Be Defined
TEC	Total Electron Content
TID	Travelling Ionospheric Disturbance
TIO	Transionospheric radio link Service
UHF	Ultra-high Frequency
URG	User Representatives Group
URSI	International Union of Radio Science (Union Radio-Scientifique Internationale)
USAF	United States Air Force
VO	Virtual Observatory
VSO	Virtual Solar Observatory

2.4 Definitions

2.4.1 Table

Concept	Definition
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.
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.
Alarm	Near real-time notification issued when a dangerous condition occurs.
Data	Raw or processed measurements of any space weather parameter.
End user	An SSA user is anyone, a person/institution or an electronic system, that accesses or receives SSA products or services.
Forecast	Description of the space environment at a future date based on actual data, proxies and models.
Indices	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, IG12, IMF, R, R12, F10.7, S10, E10, M10, Y10; • Ionospheric scintillation: S4, sigma_phi, fading depth, fade duration, time between fades
Micro-particle	Space object with size below one millimetre and above 0.1 micrometer
Near Real-time	Statement that an action is occurring as close as possible to the same rate at which an observable is measured/observed.
No-proton event	No proton event means that the >10 MeV flux in outer magnetosphere (GEO) is below 10 particles cm-2 sr-1 s-1
Nowcast	Reconstruction in near real-time of a description of the present space environment based on actual data, proxies and models
Products	Derived data generated using one or more space weather tool or model. An SSA Product is a digital file(s) delivered to members of a user community from an operational element of the SSA 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 SSA segments. Software tools made available to users or a technical report are not considered as products.
Real-time	Statement that an action is occurring at the same rate at which an observable is measured/observed.
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”.
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 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.
Space Situational Awareness	Comprehensive knowledge, understanding and maintained awareness of the (i) population of space objects, of the (ii) space environment, and of the (iii) existing threats/risks.
Space weather	Conditions on the sun and in the solar wind, magnetosphere, ionosphere, and thermosphere that can influence the performance and reliability of space-borne and ground-based technological systems and

	can endanger human life or health. Cosmic rays are covered by this definition.
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).
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.
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, spacecraft anomalies and damage caused by microparticle impacts.
SSA customer	Entity responsible for procuring the establishment and operation of an SSA system.
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)
Third Party Service Provider	Entity (research institute or commercial) developing and establishing a service based on data provided by the foreseen SSA system through an individual customer-service agreement that goes beyond the scope of the other SWE tailored services.
Warning	Near real-time notification of a potentially hazardous situation.

3 MISSION OVERVIEW

Space weather is a component of the natural environment which induces threats through its effects on human health and technology both in space and on ground. Micro-particles in space of natural or human origin and below 1 millimetre in size similarly constitute an environmental threat to human and technology in space and related requirements are covered in this document.

Space weather segment measurements can contribute to the primary high-level users' needs for the European SSA system, as expressed by the SSA user group during its meetings in the 2006-2008 timeframe (cf section 1.1) as indicated in the table below.

High level user's needs

3.1.1 Table

Identified high level users' needs	**Possible contribution from a space weather service**
Support safe and secured operation of space assets and related services.	Specify, monitor, and predict conditions and risks to space systems and transionospheric links affected by space weather.
Support risk management (on orbit, during launch, re-entry and other critical operations) and liability assessment	Specify, monitor, and predict conditions and risks to space systems and transionospheric links affected by space weather. Provide data aimed at identifying the cause of failure of these systems.
Assess the status and basic characteristics of space objects (both human-made and natural).	Support radar data interpretation and correction
Detect non-compliance with applicable international treaties and recommendations;	Provide data aimed at identifying whether the cause of an anomalous phenomenon originating from space or occurring in space is environmental.
Enable the allocation of responsibility for space objects (to launching State) or Organisations (ESA, Member States, etc.), and support confidence building measures (identification of owner and/or operator)	Provide data aimed at identifying whether the cause of an anomalous phenomenon originating from space or occurring in space is environmental.

The USA has a nearly complete space weather monitoring and data service system operated by NOAA/SWPC in collaboration with USAF. Many of the space weather data products are made available on the web without any restriction. Also, protocols and procedure for international space weather data exchange and service coordination are established and implemented by ISES.

The SSA space weather segment is intended to provide for its customers and end users a non-dependent 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]. Micro-particle effects explicitly addressed include impacts of small space debris and meteoroid particles, impacts of debris cloud particles and impacts of meteoroid stream particles.

3.2 High level requirements

The following user needs for the space weather segment can be directly taken from the programme proposal:

- provision of comprehensive knowledge, understanding and maintained awareness of the natural space environment and space weather,
- the detection and forecasting of space weather and its effects,
- the detection and understanding of interferences due to space weather,
- the understanding and prediction of the natural meteoroid and small size space debris environment that is not covered by the Space Surveillance and Tracking (SST) Segment, and its effects,
- the prediction and/or detection of permanent or temporary disruption of mission and/or service capabilities due to space weather.
- 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, ionospheric perturbations, aircraft radiation hazards, geomagnetic disturbances and current induced in large conductive networks such as power lines and pipelines.
- the provision of all required predicted local spacecraft and launcher radiation, plasma and electromagnetic environment data.

The requirements have been expanded in this document also taking additional sources into account [RD-01 to RD-11].

4 INTRODUCTION TO THE REQUIREMENTS SECTION

4.1 Organisation of requirements

The user requirements in the CRD will obtain identifiers according to the following key:

AAA-CRD-BBB-XXXX

Where:

- AAA is a three-character identifier denoting the SSA Segment (NEO, SWE, SST), COM for common requirements or SEC for Security Requirements
- BBB is a three letter service identifier,
- XXXX is a number, giving each requirement an **identifier being unique for each segment** (AAA)

Requirements or text marked (*) will have to go through a consolidation process which will be settled in the system definition phase. The consolidation process is necessary in order to iterate customer wishes together with the design process, feasibility and budget constraints.

Each user requirement has a list of attributes associated with it:

- *Service* refers to the service to which the requirement applies
- *Priority* marks if the requirement is considered 'Essential', 'Highly Desirable' or 'Desirable'.
  - 'Essential' means that without fulfilling this requirement, the system is not working.
  - A 'Highly Desirable' requirement is one that would provide additional highly desirable functionality which may be implemented at extra cost. The cost for implementing optional requirements should be evaluated individually.
  - A 'Desirable' requirement is one that would provide additional functionality which may be implemented at extra cost. The cost for implementing optional requirements should be evaluated individually.
- *Justification* provides a justification for the requirement (if applicable)
- *Comment* provides a comment on the requirement (if applicable)
- *Source Requirements* refers to the parent MRD requirement (if applicable)

- *Related Requirements* refers to requirements, which are in relation to the requirement
- *Verification Method* identifies the main method to perform acceptance test of the requirement

4.2 Service domains

The following 8 space weather service domains are identified:

(1) Spacecraft design

(2) Spacecraft operation

(3) Human space flight

(4) Launch operation

(5) Transionospheric radio link

(6) SSA Space Surveillance and Tracking

(7) Non-space systems operation

(8) General data service

The first seven service domains are especially identified because they explicitly address life-threatening, system threatening or service threatening issues.

4.3 Customers and end users

In accordance with the ECSS standard definitions, an SSA Customer should be an entity procuring an SSA service. However, the identification of the procurement source is within the scope of the SSA governance study which has not been concluded yet. Therefore the current version of the CRD focuses on the identification of the requirements of end users of the SSA Space Weather Segment.

Furthermore, the following assumptions are made on the foreseen end users of the SSA space segment system.

Assumptions on end users

4.3.1.1 Table

Service domain	End user
Spacecraft design	Personnel involved in generating space environment specifications for the design of spacecraft.

Spacecraft operation	Flight Control Teams, operations support engineers, and science operations centre teams of European and national space agencies, public and private spacecraft operators.
Human space flight	The operation teams of human spaceflight including during launch, activities inside and outside of the ISS, future space tourism flight operators and future human missions in outer space. It is anticipated that they will be represented by space agencies and European entities operating sub-orbital or orbital flights for space tourists, e.g. EADS-ST, Virgin Galactic.
Launch operation	Personnel involved in launch operation. It is anticipated that they will be represented by space agencies and European entities operating launchers: Arianespace, EADS-ST, Virgin Galactic.
Transionospheric radio link	Service users from space-based systems using electromagnetic waves propagating through the ionosphere and for which service performance may be affected by ionospheric disturbances due to space weather events. The main users are GNSS but also some satellite communication and earth observation services are included.
SSA Space Surveillance and Tracking	Personnel involved in the Space Surveillance and Tracking segment of the SSA system. This is therefore a space weather service internal to SSA.
General data service	Expert users in the space industry, third party service providers in a range of domains, the education sector and the general public (including amateur radio/disaster monitoring-communication)
Non-space systems operation	Such as pipeline, power grid operators, surveying industry, airlines.

5 SEGMENT LEVEL PROGRAMME REQUIREMENTS

SWE-CRD-SEG-1504	Service:	SEG	Priority:	Essential	SWE
Data sets 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 (classified; public).					
Justification:	Needed for assessment of accuracy of the services.				
Comments:	If possible, metadata shall follow standard recommendations, e.g. COSPAR PRBEM recommendation for energetic particle data.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-350				
Related Requirements:			**Verification Method:**	Analysis Inspection	

SWE-CRD-SEG-2632	Service:	SEG	Priority:	Essential	SWE
The SSA system shall provide information about the data reliability.					
Justification:	Needed for assessment of accuracy of the services.				
Comments:	If possible, metadata shall follow standard recommendations, e.g. COSPAR PRBEM recommendation for energetic particle data. New CR created from CRD review SWE-CRD-SEG-1504				
Source Requirements:	MR-SSA-SWE-350				
Related Requirements:			**Verification Method:**	Analysis Inspection	

SWE-CRD-SEG-1505	Service:	SEG	Priority:	Essential	SWE
For the data sources that provide calculated values (whether indices, derived parameters, extrapolations of basic parameters or any result from a calculation process), the SSA 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:	Needed for assessment of accuracy of the services.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-350				
Related Requirements:			**Verification Method:**	Inspection	

SWE-CRD-SEG-1506	Service:	SEG	Priority:	Essential	SWE
Assessment of accuracy of all data and data products shall be provided by the SSA system.					
Justification:	Required to determine domain of applicability.				
Comments:	This may be based on a posteriori monitoring of performance.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-350 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Analysis Design Review Test	

SWE-CRD-SEG-1638	Service:	SEG	Priority:	Essential	SWE

The SSA 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. This can be possibly provided through quality flag.		
Comments:			
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-350 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Analysis Design Review Test

SWE-CRD-SEG-1677	**Service:**	SEG	**Priority:**	Essential	SWE
The SSA 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:	Timely alarms support decision making. Standard thresholds support a general overview of current space weather conditions and alert users to potential hazards.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SEG-2633	**Service:**	SEG	**Priority:**	Essential	SWE
The SSA System shall provide a Subscription service allowing for tailored automated alarms on a particular parameter/datasets"					
Justification:	User defined thresholds allow the user to receive alarms only when thresholds of interest to their particular system are crossed. Automatic provision facilitates incorporation into the user´s normal operational procedures.				
Comments:	New CR created from CRD review SWE-CRD-SEG-1677				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SEG-2634	**Service:**	SEG	**Priority:**	Essential	SWE
Services and products shall provide whenever possible their relevant data not only as tables or curves but also in a visual representation					
Justification:	Service output formats shall be defined in order to best support the user in reducing the time needed to take critical decisions				
Comments:	New CR created from CRD review SWE-CRD-SEG-1677				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SEG-1740	Service:	SEG	Priority:	Highly Desirable	SWE
Uncertainties in the presented data shall be quantified in the form of quality flags					
Justification:	While the service will be available continuously, uncertainties and ambiguities in the data must be presented to the user, particularly if data is to be used operationally.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:				Verification Method:	Analysis Design Review

SWE-CRD-SEG-1786	Service:	SEG	Priority:	Highly Desirable	SWE
Uncertainties in the model outputs shall be quantified in the form of quality metrics.					
Justification:	While the service will be available continuously, uncertainties and ambiguities in the model output must be presented to the user, particularly if data is to be used operationally.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:				Verification Method:	Analysis Design Review

6 SERVICE DOMAIN #1: SPACECRAFT DESIGN

The type of services to be delivered by the space weather segment to spacecraft designers are given in the table below:

Services to be delivered

6.1.1 Table

Service	Description	Service products
Environment specification: data archive	Provide statistical data to derive environments and effects on space systems	SWE-CRD-SCD-1507 SWE-CRD-SCD-1508 SWE-CRD-SCD-1511
Environment specification: in orbit verification	Provide estimate of the environment and its effects actually experienced.	SWE-CRD-SCD-1509
Post event analysis	Provide means to correlate a particular (spacecraft) event with space environment data.	SWE-CRD-SCD-1510

6.2 Required service products to be delivered

The following service products shall be delivered.

SWE-CRD-SCD-1507	**Service:**	SCD	**Priority:**	Essential	SWE
The SSA system shall provide 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, microparticles, atmosphere, and UV.					
Justification:	Space environment specifications are needed for tailored design of space systems especially in relation to radiation protection, EMC and micro-particle impacts. Data will come from sensors in orbit and modelling to fill gaps.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related 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-1524 SWE-CRD-SCD-1525		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1508	**Service:**	SCD	**Priority:**	Essential	SWE

The SSA system shall provide 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, effects from microparticle impacts. 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. The user shall be informed of the limitations to anomalies databases that may occur due to data confidentiality.			
Justification:	Environment specifications for future space missions can be directly derived from effects measurements. Data will come from sensors in orbit and modelling to fill gaps.		
Comments:			
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCD-1520 SWE-CRD-SCD-1521 SWE-CRD-SCD-1522 SWE-CRD-SCD-1526	**Verification Method:**	Design Review Test

SWE-CRD-SCD-1509	**Service:**	SCD	**Priority:**	Essential	SWE
The SSA system shall provide a best estimate of the local environment that has been experienced by a spacecraft either through measurements or reconstruction (ionising radiation, plasma, microparticles, atmosphere, and UV) for in-flight validation of specifications of environments and effects.					
Justification:	Provide feedback for model improvement and update of environment specifications and effects predictions.				
Comments:	Limitations of accuracy may occur 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 provided to the user.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-390 MR-SSA-SWE-400				
Related 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-1520 SWE-CRD-SCD-1521		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1510	**Service:**	SCD	**Priority:**	Essential	SWE
The SSA system shall provide to the user TBD 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:	Provide information on vulnerability of components, equipments or spacecraft that can be used for future spacecraft models or versions. Relevant tools (e.g., superposed epoch analysis, data mining) shall be defined in a later phase.				

Comments:	Service shall operate within the limitations brought by data confidentiality of the spacecraft information.		
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCD-1522	**Verification Method:**	Design Review Test

SWE-CRD-SCD-1511	**Service:**	SCD	**Priority:**	Essential	SWE
The SSA system shall provide long-term solar cycle prediction (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 over TBD periods with a forecast period depending on the parameter.					
Justification:	Several spacecraft effects exhibit solar cycle variation which has a ~11 year timescale.				
Comments:	Note that the requirement 1686 is the same requirement.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

6.3 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users.

SWE-CRD-SCD-1512	**Service:**	SCD	**Priority:**	Essential	SWE
High energy (>1 MeV) proton energy spectrum					
Justification:	A factor in a wide range of dose, NIEL and single-event related effects. Protons in the range 1-10 MeV affect solar cells. A possible upper bound is 300 MeV.				
Comments:	Highest priority to E > 3 MeV				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1513	**Service:**	SCD	**Priority:**	Essential	SWE
High energy (>1 MeV) ion energy spectrum					
Justification:	A factor in a wide range of dose, NIEL and single-event related effects. In addition, there may be special sensitivity of some equipment (e.g. X-ray detectors) to low energy ions (500 keV to 1 MeV).				
Comments:	Highest priority to E > 10 MeV				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1514	Service:	SCD	Priority:	Essential	SWE
High energy (>30keV) electron energy spectrum					
Justification:	A factor in a wide range of dose, NIEL and internal charging related effects.				
Comments:	Highest priority to E > 100 keV				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		Verification Method:	Design Review Test	

SWE-CRD-SCD-1515	Service:	SCD	Priority:	Essential	SWE
High energy (> 30 keV and < 1 MeV) ion energy spectrum					
Justification:	A factor in a wide range of degradation effects of surfaces and sensitive components such as CCD's.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		Verification Method:	Design Review Test	

SWE-CRD-SCD-1516	Service:	SCD	Priority:	Essential	SWE
Thermal and superthermal electrons energy spectrum (0-30 keV)					
Justification:	A factor in a wide range of charging and current collection effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		Verification Method:	Design Review Test	

SWE-CRD-SCD-1517	Service:	SCD	Priority:	Essential	SWE
Thermal ions density and temperature.					
Justification:	A factor in a wide range of charging, current collection and surface erosion effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		Verification Method:	Design Review Test	

SWE-CRD-SCD-1518	Service:	SCD	Priority:	Essential	SWE
Ultraviolet light and soft X-ray. Spectral range(*).					
Justification:	A factor in a wide range of charging and current collection effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509		Verification Method:	Design Review Test	

SWE-CRD-SCD-1519	Service:	SCD	Priority:	Essential	SWE
Atmospheric density					

Justification:	Principally important because of its effect on spacecraft drag.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509	**Verification Method:**	Design Review Test

SWE-CRD-SCD-1520	**Service:**	SCD	**Priority:**	Essential	SWE
Dose, equivalent dose, dose equivalent, ambient dose, non-ionising dose.					
Justification:	Effect measurement for radiation damage including skin dose for effects on human cells.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1508 SWE-CRD-SCD-1509		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1521	**Service:**	SCD	**Priority:**	Essential	SWE
Charging current					
Justification:	Effect measurement for charging hazards				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1508 SWE-CRD-SCD-1509		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1522	**Service:**	SCD	**Priority:**	Highly Desirable	SWE
Anomalies on equipment (*)					
Justification:	Measurement of component sensitivity which may have a variety of causes depending on location				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1508 SWE-CRD-SCD-1509 SWE-CRD-SCD-1510		**Verification Method:**	Design Review Inspection	

SWE-CRD-SCD-1523	**Service:**	SCD	**Priority:**	Essential	SWE
Atomic oxygen density					
Justification:	Leads to surface erosion in low Earth orbits				
Comments:	This is closely related to SWE-CRD-SCD-1519 since atomic oxygen is the principal component of the upper atmosphere, except perhaps during major magnetic storms				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1507 SWE-CRD-SCD-1509 SWE-CRD-SCD-1519		**Verification Method:**	Design Review Test	

SWE-CRD-SCD-1524	Service:	SCD	Priority:	Essential	SWE
Microparticle flux as a function of size, velocity, angular distribution					
Justification:	Leads to impact effects				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:				Verification Method:	Design Review Test

SWE-CRD-SCD-1525	Service:	SCD	Priority:	Essential	SWE
Known periods/events of increased microparticle flux (meteoroid streams, debris clouds).					
Justification:	Indicate increased risk of impacts by micro-particles. In particular recently generated debris clouds might significantly increase the threat for specific spacecraft.				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1723			Verification Method:	Design Review Test

SWE-CRD-SCD-1526	Service:	SCD	Priority:	Desirable	SWE
Floating spacecraft potential for specified spacecraft.					
Justification:	Effect measurement of spacecraft charging				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:				Verification Method:	Design Review Test

SWE-CRD-SCD-2635	Service:	SCD	Priority:	Essential	SWE
The user shall be allowed to specify freely the orbits and time spans for his historical de-archiving and/or reconstitution requests, within the maximum ranges covered by the services.					
Justification:	The user shall be able to extract all relevant data according to the time range and orbit of interest.				
Comments:	New CR created from CRD review SWE-CRD-SEG-1507				
Source Requirements:	MR-SSA-SWE-400				
Related 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-1524 SWE-CRD-SCD-1525			Verification Method:	Design Review Test

6.4 Performance requirements

SWE-CRD-SCD-1527	Service:	SCD	Priority:	Essential	SWE
Maximum service interruption time shall not exceed 1 working day (except for scheduled maintenance). The service shall not be offline for more than 3-4 days per year.					
Justification:	99% is required for the credibility of the service. This allows 3-4 days of downtime a year. One day is the usual time scale to provide first assessment of in-orbit failure analysis.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Test	

SWE-CRD-SCD-1528	Service:	SCD	Priority:	Essential	SWE
Environmental data shall be available for the statistical service products at most 1 month after acquisition from sensors.					
Justification:	Latency time is driven by the service for spacecraft anomaly analysis.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Test	

SWE-CRD-SCD-1529	Service:	SCD	Priority:	Essential	SWE
Environmental data shall be available for the local spacecraft environment products at most 1 day after acquisition from sensors.					
Justification:	This is to respond to urgent analysis requests for critical spacecraft failures.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Test	

7 SERVICE DOMAIN #2: SPACECRAFT OPERATION

The type of services to be delivered by the space weather segment to spacecraft and payload operators and the related service products are given in the table below:

Services to be delivered

7.1.1 Table

Service name	Service description	Service products
In-orbit environment and effects monitoring	Provide near real-time estimate of the environment and its effects actually experienced.	SWE-CRD-SCO-1530 SWE-CRD-SCO-1531 SWE-CRD-SCO-1534 SWE-CRD-SCO-1535 SWE-CRD-SCO-1536 SWE-CRD-SCO-1539 SWE-CRD-SCO-1547 SWE-CRD-SCO-1540 SWE-CRD-SCO-1541 SWE-CRD-SCO-1546
Post-event analysis	Provide means to correlate a particular (spacecraft) event with space environment data.	SWE-CRD-SCO-1534 SWE-CRD-SCO-1536 SWE-CRD-SCO-1537 SWE-CRD-SCO-1538 SWE-CRD-SCO-1542
In-orbit environment and effects forecast	Provide forecast of the environment and of its effects.	SWE-CRD-SCO-1532 SWE-CRD-SCO-1533 SWE-CRD-SCO-1543 SWE-CRD-SCO-1540 SWE-CRD-SCO-1541 SWE-CRD-SCO-1546 SWE-CRD-SCO-1547
Mission risk analysis	Provide mission risk analysis based on expected space environment conditions and mission susceptibility assessment.	SWE-CRD-SCO-1538 SWE-CRD-SCO-1544 SWE-CRD-SCO-1545

7.2 Required service products to be delivered

The following service products are required.

SWE-CRD-SCO-1530	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide near real-time quantitative assessment of the space environment.					
Justification:	Continuous real-time monitoring of the space weather environment conditions provides the relevant information to take informed decisions related to S/C operations and help in the correlation of results in future analysis.				
Comments:	For SCO the space environment data required in real time relate to sudden effects that could occur on the spacecraft, SEE, ESD, errors in magnetorquing and sudden drag-induced orbit changes in LEO.				

Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1577 SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1531	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide 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, meteor streams, debris clouds) that can lead to potentially hazardous effects on spacecraft, through a fast first level processing with a TBD given accuracy during those events, and with a better TBD accuracy at most TBD hours after acquisition from sensors.					
Justification:	A qualitative description of significant changes in the space environment (such as solar flares, CMEs, meteoroid streams) provides useful information for warnings/alarms.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1549 SWE-CRD-SCO-1550 SWE-CRD-SCO-1551 SWE-CRD-SCO-1584 SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1532	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide forecasts over a TBD period with estimates of probability of occurrence of space weather events (including as a minimum: magnetic storm, solar energetic particle events, Earth-directed CMEs, meteor streams, debris clouds) and of “All quiet conditions”, with users being given the confidence level of the forecast.					
Justification:	To put staff on alert, and consequently help to lower the risk for spacecraft and payloads Useful also to plan critical orbital manoeuvres including at end of launch operations.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1583 SWE-CRD-SCO-1585 SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1533	**Service:**	SCO	**Priority:**	Essential	SWE

The SSA system shall provide 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, effects from microparticle impacts. 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 if he/she could not declare all the materials and designs of his spacecraft due to data confidentiality.			
Justification:	Allows monitoring and forecasting of the expected accumulated radiation dose due to ionising radiation leading to e.g. reduction in solar cell power. A forecast of the likelihood of internal charging leading to discharge and the likelihood of single event effects can be used to take preventive measures and prepare recovery measures in case of disruption		
Comments:	Component information, together with shielding geometry, is needed prior to launch, preferably at the start of the project.		
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1553 SWE-CRD-SCO-1554 SWE-CRD-SCO-1556 SWE-CRD-SCO-1586 SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1534	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide 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. 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 if he/she could not declare all the materials and designs of his spacecraft due to data confidentiality.					
Justification:	Useful to monitor the S/C health and identify anomalies. The inclusion of real measured data allows correlation with the forecast data and consequently evaluation of the performance and accuracy of the forecasting models. This information could be retrieved e.g, from ESA S/C systems. Only a sub-set of housekeeping data is required so it does not duplicate the mission control system but a link to it may be considered. The relevant housekeeping data has to be defined on a case-by-case basis.				
Comments:	The requirement is dependent on data availability and is only applicable to those missions that agree to provide their housekeeping data.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1535	**Service:**	SCO	**Priority:**	Essential	SWE

The SSA system shall provide 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. 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 if he/she could not declare all the materials and designs of his spacecraft due to data confidentiality.			
Justification:	Provide real-time assessment of space weather risk on spacecraft.		
Comments:			
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1555 SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1536	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The SSA system shall generate and distribute to the authorized users reports of S/C anomalies detected across a predefined S/C fleet.					
Justification:	Other S/C anomalies may be used as an estimate of risk to user's spacecraft. In practice, the quality of this proxy may be limited by difference of orbits and of manufacturers.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1537	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system 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:	Useful to identify space weather events responsible for anomalies.				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1538	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide access to historical Space Weather Environment data, Spacecraft Effects, and Space Weather Events data.					
Justification:	Used to perform correlation of spacecraft effects with environmental parameters. Also used for science planning: the optimisation of payload scientific planning requires a proper characterisation of the radiation environment and its effects on scientific instruments.				
Comments:					

Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1553 SWE-CRD-SCO-1558 SWE-CRD-SCO-1559 SWE-CRD-SCO-1560 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1588 SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1539	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide forecast and near real-time assessment of the effects of ionospheric disturbances on spacecraft operations.					
Justification:	Spacecraft operations are affected by ionospheric effects for e.g. positioning or for communication and data link.				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1561 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1566 SWE-CRD-SCO-1589 SWE-CRD-SCO-1590 SWE-CRD-SCH-1598		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1540	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The SSA system shall provide nowcast and forecast of the atmospheric data required for drag calculation.					
Justification:	Increased atmospheric drag can cause early re-entry, which leads to additional fuel needed to correct the orbit. Required for mission planning and scheduling.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1558 SWE-CRD-SCO-1562 SWE-CRD-SCO-1585 SWE-CRD-SCO-1591 SWE-CRD-SCH-1598		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1541	**Service:**	SCO	**Priority:**	Desirable	SWE
The SSA system shall provide nowcast and forecast of atmospheric properties for drag calculation on Mars, Venus and other relevant planets.					

Justification:	It is important to know the properties of the atmosphere in order to predict the impacts on the orbit driven by large density variations. Note that this may require information on the longitudinal distribution of activity on the solar surface, including the farside as seen from Earth.		
Comments:			
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1548 SWE-CRD-SCO-1566 SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1542	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide data and tools to correlate the space environment with anomaly events on specific spacecraft, equipment or components.					
Justification:	Provide information on vulnerability of components, equipment or spacecraft that can be used for future spacecraft models or versions.				
Comments:	Requires spacecraft and/or component specific information from user.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review	

SWE-CRD-SCO-1544	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The SSA system shall be able to provide, upon request, an assessment of mission/system susceptibility before the operations phase for a given spacecraft.					
Justification:	Awareness of conditions before a new operation phase begins helps to increase the level of confidence of the S/C operators.				
Comments:	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 if he could not declare all the materials and designs of his spacecraft due to data confidentiality. See section 2.4 for definition of susceptibility.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1545	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The SSA system shall be able to provide, upon request, an assessment of mission/system risks before operations phase for a given spacecraft.					
Justification:	Awareness of conditions before a new operation phase begins helps to increase the level of confidence of the S/C operators.				

Comments:	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 if he could not declare all the materials and designs of his spacecraft due to data confidentiality. System risk is based on whether susceptibility to the various effects listed under the definition of Susceptibility in Section 2.4 exceeds levels that would be of concern, e.g. whether probability of destructive SEE is significant over the mission duration, whether surface potentials and internal charging fields exceed ESD thresholds, whether Dose and NIEL degradation would exceed performance margins (including solar array power margin) and whether deviations in magnetic torque and orbit changes would exceed control limits.		
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCH-1598	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1546	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide nowcast and forecast of solar and geomagnetic activity indices.					
Justification:	These data are often used for models run by the end users.				
Comments:	The list of such indices is to be defined in the SRD.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1547	**Service:**	SCO	**Priority:**	Essential	SWE
The SSA system shall provide nowcast and forecast of meteoroid and space debris fluxes, including streams and debris clouds.					
Justification:	Provide awareness of increased impact risk.				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1598		**Verification Method:**	Design Review Test	

7.3 Data requirements

SWE-CRD-SCO-1548	**Service:**	SCO	**Priority:**	Essential	SWE
Measurements of solar flares, CMEs, solar energetic particle events, coronal holes, and solar magnetic fields.					
Justification:	Required to predict changes in the environment induced by solar eruptive phenomena and coronal holes. Note that space weather services around planets other than Earth require information on the longitudinal distribution of activity on the solar surface, including the farside as seen from Earth.				
Comments:					

Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1531 SWE-CRD-SCO-1532 SWE-CRD-SCO-1533 SWE-CRD-SCO-1540 SWE-CRD-SCO-1541 SWE-CRD-SCH-1605	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1549	**Service:**	SCO	**Priority:**	Essential	SWE
Data from spacecraft radiation monitors.					
Justification:	Provide local spacecraft radiation data (when available) and information on distribution and propagation of solar particle radiation in space.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1531 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1550	**Service:**	SCO	**Priority:**	Essential	SWE
Orbital data of spacecraft carrying space weather instruments					
Justification:	Needed to ingest the space weather data into models along with spatial information.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1531 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-2637	**Service:**	SCO	**Priority:**	Essential	SWE
Information on the space weather instruments carried by relevant spacecraft.					
Justification:	Provides the user with information on the data available for a given environment/location.				
Comments:	New CR created from SWE-CRD-SCO-1550.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1531 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1551	**Service:**	SCO	**Priority:**	Essential	SWE
A subset of the spacecraft housekeeping telemetry data that users have accepted to make available through SSA.					
Justification:	Operators are interested in visual correlation between spacecraft telemetry and space weather environment data.				
Comments:	The requirement is dependent on data availability and is only applicable to those missions that agree to provide their housekeeping data.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1531 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-2650	Service:	SCO	Priority:	Essential	SWE
Geomagnetic Storm Conditions					
Justification:	Required to determine risk of internal charging leading to discharge. This can be based on geomagnetic indices. The forecast is required to take preventative measures and prepare recovery measures in case of disruption				
Comments:	Formerly SWE-CRD-SCO-1552, accidentally deleted and recreated as new requirement with different numbering.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCO-1541 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1553	Service:	SCO	Priority:	Essential	SWE
Electron and ion energy spectra in the range 0 to 30 keV.					
Justification:	Required to determine likelihood of surface charging leading to discharge.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCO-1538 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1554	Service:	SCO	Priority:	Essential	SWE
Proton flux spectra from radiation belts in the range from 1 MeV up to 400 MeV.					
Justification:	Required to determine likelihood of internal charging leading to discharge, single event effects and long term radiation dose.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1555	Service:	SCO	Priority:	Essential	SWE
Electron flux spectra environment along the orbit (50 keV to 8 MeV).					
Justification:	Required to determine likelihood of internal charging leading to discharge, single event effects and long term radiation dose.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1535 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1556	Service:	SCO	Priority:	Essential	SWE
Solar ultraviolet light and soft X-rays. Spectra(*)					
Justification:	A factor in a wide range of charging and current collection effects.				
Comments:					

Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCH-1605	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1557	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
Spacecraft anomalies and events					
Justification:	Spacecraft anomalies and events can be cross correlated to the occurrence of Space Weather events. Service is required to study cause-effect of space weather events.				
Comments:	Date, location, and nature of anomaly/event may be subject to dissemination restriction.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1536 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1558	**Service:**	SCO	**Priority:**	Essential	SWE
Magnetospheric and solar energetic particle fluxes (electrons and protons)					
Justification:	Required to determine likelihood of internal charging leading to discharge, single event effects and long term radiation dose. The forecast is required to take preventative measures and prepare recovery measures in case of disruption.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCO-1540 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1559	**Service:**	SCO	**Priority:**	Essential	SWE
Ground based geomagnetic field					
Justification:	Required to determine risk of energetic plasma injection along field line.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1560	**Service:**	SCO	**Priority:**	Essential	SWE
Cosmic ray energy and ion-species flux spectra					
Justification:	Required to monitor the S/C health and identify anomalies. Instead of flux spectra LET spectra can be considered.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1561	Service:	SCO	Priority:	Essential	SWE
Altitude dependent TEC (Total Electron Content) maps					
Justification:	For ionospheric correction for satellites with a single frequency GNSS receiver. Shall provide information on TEC above the satellite.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1539 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1562	Service:	SCO	Priority:	Essential	SWE
Absolute measurements of electron density height profiles (ionosonde data)					
Justification:	Provide ionospheric density as a function of the altitude and other critical parameters.				
Comments:	c.f. also TIO domain user requirements.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCO-1539 SWE-CRD-SCO-1540 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1563	Service:	SCO	Priority:	Essential	SWE
Ionospheric scintillation, location and intensity					
Justification:	Required by Navigation/Positioning to reschedule operations dependent on precision measurements. Required to identify signal disruption caused by TEC variations, in order to accommodate the Ionospheric irregularities by adjusting the signal filter.				
Comments:	c.f. also TIO domain user requirements.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCO-1539 SWE-CRD-SCO-1540 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1564	Service:	SCO	Priority:	Essential	SWE
Geomagnetic indices (such as Kp, Ap, Dst), solar indices (such as R, F10.7, S10, E10, M10, Y10) and other indices such as IG12, IMF					
Justification:	Required in orbit determination to desired accuracy. Required for mission planning and scheduling. Also required as input to several forecast models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1540 SWE-CRD-SCH-1605		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1565	Service:	SCO	Priority:	Essential	SWE
Global and local neutral density and neutral winds as a function of altitude, latitude and longitude (local time)					

Justification:	For instance for LEO missions is important to know the status of the atmosphere in order to predict the impacts on the orbit driven by large density variations.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1538 SWE-CRD-SCO-1540 SWE-CRD-SCH-1605	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1566	**Service:**	SCO	**Priority:**	Essential	SWE
Solar Wind velocity, density and magnetic field.					
Justification:	Required to forecast many space environment parameters and as input to near real-time models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1539 SWE-CRD-SCO-1540 SWE-CRD-SCO-1541 SWE-CRD-SCH-1605		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1567	**Service:**	SCO	**Priority:**	Essential	SWE
Dose					
Justification:	Effect measurement for radiation damage.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCO-1535 SWE-CRD-SCH-1605		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1568	**Service:**	SCO	**Priority:**	Essential	SWE
Net electrical current to spacecraft surface.					
Justification:	Effect measurement for charging hazards				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533 SWE-CRD-SCO-1535 SWE-CRD-SCH-1605		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1569	**Service:**	SCO	**Priority:**	Essential	SWE
High energy >1 MeV proton flux spectra					
Justification:	A factor in a wide range of dose, NIEL and single-event related effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		**Verification Method:**		Design Review Test

SWE-CRD-SCO-1570	Service:	SCO	Priority:	Essential	SWE
High energy (>1 MeV) ion flux spectra					
Justification:	A factor in a wide range of dose, NIEL and single-event related effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1571	Service:	SCO	Priority:	Essential	SWE
High energy (>30 keV) electron flux spectra					
Justification:	A factor in a wide range of dose, NIEL and internal charging related effects. A possible upper limit is 5 MeV.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1572	Service:	SCO	Priority:	Essential	SWE
Thermal and superthermal (0-30 keV) electron flux spectra					
Justification:	A factor in spacecraft charging and other spacecraft plasma interactions effects.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1573	Service:	SCO	Priority:	Essential	SWE
Microparticle flux as a function of size, velocity, angular distribution					
Justification:	Indicate increased risk of impacts by micro-particles				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-1574	Service:	SCO	Priority:	Essential	SWE
Known periods/events of increased microparticle flux (meteoroid streams, debris clouds).					
Justification:	Indicate increased risk of impacts by micro-particles				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1530 SWE-CRD-SCH-1605		Verification Method:	Design Review Test	

SWE-CRD-SCO-2636	Service:	SCO	Priority:	Essential	SWE

The user shall be allowed to specify freely the orbits and time spans for his historical de-archiving and/or reconstitution requests, within the maximum ranges covered by the services.			
Justification:	Used to perform correlation of spacecraft effects with environmental parameters. Also used for science planning: the optimisation of payload scientific planning requires a proper characterisation of the radiation environment and its effects on scientific instruments.		
Comments:	New CR created fromSWE-CRD-SCO-1538.		
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1553 SWE-CRD-SCO-1558 SWE-CRD-SCO-1559 SWE-CRD-SCO-1560 SWE-CRD-SCO-1562 SWE-CRD-SCO-1563 SWE-CRD-SCO-1588	**Verification Method:**	Design Review Test

7.4 Performance requirements.

SWE-CRD-SCO-1575	**Service:**	SCO	**Priority:**	Essential	SWE
Maximum service interruption time shall not exceed 1 working day (except for scheduled maintenance that shall be announced to the users with a 30 day forewarning). The service shall not be offline for more than 3-4 days per year with solar flare monitoring on-line on all days. Scheduled maintenance shall be postponed if an active event is in progress. Missing data shall be recovered after service offline periods. Interruption of part of the service e.g. if a specific data stream is interrupted, shall be clearly indicated.					
Justification:	99% is required for the credibility of the service. This allows 3-4 days of downtime a year. One day is the usual time scale to provide first assessment of in-orbit failure analysis.				
Comments:	This requirement describes how we measure whether the availability of the service is acceptable. Clearly 100% availability is desired but not liable to be achieved and it seems unrealistic to single out solar monitoring for 100% availability.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Analysis Test	

SWE-CRD-SCO-1576	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
A subset of S/C payload data relevant to Space Weather services (e.g. from radiation monitors) shall be made available to the 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) depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				

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

SWE-CRD-SCO-1577	**Service:**	SCO	**Priority:**	Essential	SWE
Space Weather environment 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:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCO-1578	**Service:**	SCO	**Priority:**	Essential	SWE
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 depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCO-1579	**Service:**	SCO	**Priority:**	Essential	SWE
The outputs of the forecasting models shall be made available to users as soon as they can be produced.					
Justification:	The usability and usefulness of the forecast data depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCO-1580	**Service:**	SCO	**Priority:**	Desirable	SWE
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:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCO-1581	Service:	SCO	Priority:	Desirable	SWE
It shall be possible to retrieve the data already stored in the system at sampling rates lower than the 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:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCO-1582	Service:	SCO	Priority:	Essential	SWE
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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCO-1583	Service:	SCO	Priority:	Highly Desirable	SWE
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 depends on its quality and the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1532			**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCO-1584	Service:	SCO	Priority:	Essential	SWE
Nowcasts of Space Weather Events or potentially dangerous conditions shall be provided in near real-time, and at most within the following delays after event happening: TBD for CME, TBD for SEP, TBD for radio bursts TBD for high-speed streams, TBD for flares, five days (TBC) for micro-particle generation events, 30 minutes for the other data.					
Justification:	The usability and usefulness of the data depends on the timely availability to the final users. Current timeliness requirements if for routine spacecraft operations. Stronger timeliness requirements may apply for human space flight, launch operation or some critical operations.				

Comments:	TBDs have to be lower than 30 minutes, CME observations on the Sun do not require very urgent notice but confirmation from L1 that the CME is actually reaching the Earth is urgent.		
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1531	**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCO-1585	**Service:**	SCO	**Priority:**	Essential	SWE
The forecasts or risk estimate of hazardous Space Weather environment conditions and of the atmospheric environment shall be provided for the following days, in advance within the following time ranges: TBD for CME, TBD for coronal holes, TBD for high-speed streams, TBD for flares, TBD for SRM firing clouds (in case of known firings) and meteoroid streams etc.					
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:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1532 SWE-CRD-SCO-1540		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1586	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The forecasts of S/C effects shall be provided as a minimum 1 to 2 days in advance.					
Justification:	The usability and usefulness of the forecasted data depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1533		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1587	**Service:**	SCO	**Priority:**	Highly Desirable	SWE
The anomaly information shall be made available after detection with a target of within 10 minutes.					
Justification:	The usability and usefulness of the forecast data depends on timely availability to the final users.				

Comments:	This relates to SWE-CRD-SCO-1536 and defines the timeliness of accessing the anomaly data. Information on the exact nature of the anomaly may take longer to analyse and report. 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. This information is valuable is in near-real time because many spacecraft have similar equipment with similar sensitivities. Although reports received after a day or two would be useful in anomaly diagnosis the event which caused it will generally have passed. This justifies a target requirement for information within 10 minutes but later data would be of some value.		
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1536	**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCO-1588	**Service:**	SCO	**Priority:**	Essential	SWE
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:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-2638	**Service:**	SCO	**Priority:**	Essential	SWE
The nowcast shall be archived over a TBD long term period. As a minimum, Space Weather Environmental data covering the time spent from the start of the mission to present shall be available**.**					
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:	New CR created from SWE-CRD-SCO-1588.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1538		**Verification Method:**	Design Review Test	

SWE-CRD-SCO-1589	**Service:**	SCO	**Priority:**	Essential	SWE
The forecast of uncertainties caused by the ionosphere shall be available 1 hour (TBC) 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:	Knowing TEC variations 1 hour in advance seems difficult to achieve for transient events at equator.				

Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCO-1539	**Verification Method:**	Design Review Test

SWE-CRD-SCO-1590	**Service:**	SCO	**Priority:**	Essential	SWE
The ionospheric service products shall have TBD update rates					
Justification:	The usability and usefulness of the forecasted data depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1539		**Verification Method:**	Analysis Design Review Test	

SWE-CRD-SCO-1591	**Service:**	SCO	**Priority:**	Essential	SWE
Daily forecasts, 3-day forecast and 27-day forecast of the Atmospheric Environment shall be available					
Justification:	The usability and usefulness of the forecast data depends on the timely availability to the final users.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCO-1540		**Verification Method:**	Design Review Test	

8 SERVICE DOMAIN #3: HUMAN SPACE FLIGHT

The type of services to be delivered by the space weather segment to operators of human space flights are given in the table below:

Services to be delivered

8.1.1 Table

Service	Description	Service products
In flight crew radiation exposure	Provide near real-time estimate of the radiation dose received by a person in space.	SWE-CRD-SCH-1592 SWE-CRD-SCH-1593 SWE-CRD-SCH-1594
Cumulative crew radiation exposure	Provide estimate of the past radiation dose accumulated by a person in space.	SWE-CRD-SCH-1595 SWE-CRD-SCH-1596
Increased crew radiation exposure risk	Provide estimate of the risk of increased level of radiation along trajectory.	SWE-CRD-SCH-1592 SWE-CRD-SCH-1593 SWE-CRD-SCH-1594

8.2 Required service products to be delivered

In addition to the products for the Spacecraft Operation serviced domains the following data products shall be delivered.

SWE-CRD-SCH-1592	**Service:**	SCH	**Priority:**	Essential	SWE
Forecast estimate of SEP onset with protons/ions in the range 30 MeV to 200 MeV above given flux threshold, with lead times of 1 hour.					
Justification:	Higher confidence in exposure forecast. Reduce EVA activity.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCH-1593	**Service:**	SCH	**Priority:**	Essential	SWE
Solar activity forecast					
Justification:	Put staff and astronauts on alert				
Comments:	c.f. services of domain 2 (SWE-CRD-1532).				
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-SCH-1594	**Service:**	SCH	**Priority:**	Essential	SWE

All quiet forecast			
Justification:	EVA scheduling flexibility		
Comments:	c.f. services of domain 2 (SWE-CRD-1532).		
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-SCH-1595	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services shall provide 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.					
Justification:	Maintain accurate records of local area radiation fluxes combined with spacecraft and human phantom shielding geometry models and onboard passive or active dosimeter data (e.g. thermoluminescent dosimeters [TLDs], tissue equivalent proportional counters [TEPCs]).				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1596	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services shall provide data on the radiation doses in human bodies accumulated over a TBD period.					
Justification:	Monitor and forecast the accumulated radiation dose due to ionising radiation				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1598	**Service:**	SCH	**Priority:**	Essential	SWE
All products for the Spacecraft Operation serviced domains shall also be made available to the users of Human Space Flight service domain.					
Justification:	Human space flights are a particular category of spacecraft				
Comments:					
Source Requirements:					
Related Requirements:	SWE-CRD-LAU-1622		**Verification Method:**	Design Review	

8.3 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users in addition to the data required for the Spacecraft Operation service domains.

SWE-CRD-SCH-1599	**Service:**	SCH	**Priority:**	Essential	SWE

near real-time high energy >10MeV protons and ions in interplanetary medium			
Justification:	Indicate whether there is an ongoing solar particle event.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCH-1592 SWE-CRD-SCH-1594 SWE-CRD-SCH-1595 SWE-CRD-SCH-1596	**Verification Method:**	Design Review Test

SWE-CRD-SCH-1600	**Service:**	SCH	**Priority:**	Essential	SWE
Plasma and fields in the interplanetary medium (preferably significantly sunward of Earth and distributed in solar longitude)					
Justification:	Interplanetary field topology for SEP propagation.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1594		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1601	**Service:**	SCH	**Priority:**	Essential	SWE
Solar disk imaging: X-ray, EUV, visible, including magnetogram.					
Justification:	Information for the forecast of solar particle events. Magnetic field boundary conditions				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1592 SWE-CRD-SCH-1593 SWE-CRD-SCH-1594 SWE-CRD-SCH-1595 SWE-CRD-SCH-1596		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1602	**Service:**	SCH	**Priority:**	Essential	SWE
Wide-angle coronagraph imaging					
Justification:	CME observations.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1593 SWE-CRD-SCH-1594		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1603	**Service:**	SCH	**Priority:**	Essential	SWE
Local area radiation flux and dosimeter measurements					
Justification:	Provision of energetic particle fluxes and doses inside and outside the spacecraft				
Comments:					
Source Requirements:	MR-SSA-SWE-400				

Related Requirements:	SWE-CRD-SCH-1595 SWE-CRD-SCH-1596	**Verification Method:**	Design Review Test

SWE-CRD-SCH-1604	**Service:**	SCH	**Priority:**	Essential	SWE
near real-time geomagnetic indices and EUV flux					
Justification:	Input data for radiation propagation calculation to the vehicle via a model (Kp is enough for altitudes above 100 km).				
Comments:	Use as input for geomagnetic cutoff.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1595 SWE-CRD-SCH-1596			**Verification Method:**	Design Review Test

SWE-CRD-SCH-1605	**Service:**	SCH	**Priority:**	Essential	SWE
All data for the Spacecraft Operation service domain shall also be made available to the users of the human space flight service domain.					
Justification:	Human space flights are a particular category of spacecraft				
Comments:					
Source Requirements:					
Related Requirements:	SWE-CRD-LAU-1626			**Verification Method:**	Design Review

8.4 Performance requirements

SWE-CRD-SCH-1606	**Service:**	SCH	**Priority:**	Essential	SWE
During crewed operations, the maximum service interruption shall not exceed 1hour for the forecast and post-event analysis and 5 minutes for the nowcast of solar energetic particles.					
Justification:	The maximum downtime is driven by the error acceptable for dose estimate for post-event analysis and by the acceptable dose level that can be received by astronauts in EVA during downtime.				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1592 SWE-CRD-SCH-1593 SWE-CRD-SCH-1594			**Verification Method:**	Analysis Design Review Test

SWE-CRD-SCH-1607	**Service:**	SCH	**Priority:**	Essential	SWE
Forecast of SPE onset shall be calculated for the next 72 hours and updated every 30 minutes from 72 hours to 24 hours ahead of launch to 5 minutes during the last 24 hours before launch.					
Justification:	The lead time and update time are driven by the lead time required for taking decision on scheduling an EVA.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				

Related Requirements:	SWE-CRD-SCH-1592 SWE-CRD-SCH-1594	**Verification Method:**	Design Review Test

SWE-CRD-SCH-1608	**Service:**	SCH	**Priority:**	Essential	SWE
The service provision of real-time solar X-ray levels, solar X-ray/UV image, and energetic proton/electron fluxes should have a downtime of at most 5 minutes.					
Justification:	The maximum downtime is driven by the acceptable dose level that can be received by astronauts in EVA during downtime.				
Comments:	The resolution is at most equal to the maximum downtime acceptable				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1599		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-2681	**Service:**	SCH	**Priority:**	Essential	SWE
The refresh rate of real-time solar X-ray levels, solar X-ray/UV image, and energetic proton/electron fluxes should be higher than any of the input sources data rates.					
Justification:	Provision of data in a timely manner is critical for the user.				
Comments:	Minimum value of refresh rate to be determined in SRD. New CR created from SWE-CRD-SCH-1608.				
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1599		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1609	**Service:**	SCH	**Priority:**	Essential	SWE
Information on the local spacecraft energetic proton and electron environment shall be provided every 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:	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1603		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1610	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services shall provide forecast of the solar activity 1 day ahead.					
Justification:	This lead time allows short term planning of human activities in space.				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1593		**Verification Method:**	Design Review Test	

SWE-CRD-SCH-1611	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services shall provide the probability of no solar proton events for the next seven days.					

Justification:	This lead time allows medium term planning of human activities in space.		
Comments:			
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCH-1594	**Verification Method:**	Design Review Test

8.5 Coordination requirements.

SWE-CRD-SCH-1612	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services when provided to ISS staff shall be compatible with all applicable ISS regulations and procedures related to safety. This includes both the stay, and the transit to and from, the ISS.					
Justification:	To avoid conflicting requirements. This may also include exchange of data.				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review	

SWE-CRD-SCH-1613	**Service:**	SCH	**Priority:**	Essential	SWE
The SWE services when provided to staff in private launchers shall be compatible with all applicable national regulations and procedures related to safety and confidentiality of personal data.					
Justification:	To avoid conflicting requirements.				
Comments:	All SSA Space Weather Services will have to be compliant with ESA rules.				
Source Requirements:	MR-SSA-SWE-310 MR-SSA-SWE-350 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review	

9 SERVICE DOMAIN #4: LAUNCH OPERATION

The type of services to be delivered by the space weather segment to launch operators are given in the table below:

Services to be delivered

Service	Description	Service products
In-flight monitoring of radiation effects in sensitive electronics	Provide near real-time estimate of the radiation effects in sensitive electronics along trajectory.	
Estimate of radiation effects in sensitive electronics	Provide estimate of past radiation effects in sensitive electronics along trajectory.	SWE-CRD-LAU-1617
Forecast of radiation storms	Provide estimate of the risk of increased level of radiation along trajectory.	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616
Atmospheric density forecast	Provide estimate of the neutral density along trajectory	SWE-CRD-LAU-1618
Risk estimate of service disruption caused by ionospheric scintillations	Provide estimate of the level of ionospheric scintillations between ground station and launch vehicle along the trajectory.	SWE-CRD-LAU-1619
Risk estimate of micro-particle impacts	Provide estimate of the risk of impacts by objects with sizes below 1 mm	SWE-CRD-LAU-1620

The type of services to be delivered by the space weather segment to launch operators are given in the table below:

9.1 Required service products to be delivered

The following data products shall be delivered.

SWE-CRD-LAU-1614	**Service:**	LAU	**Priority:**	Essential	SWE
Forecast estimate of Solar Particle Event onset with ions (including protons and heavy ions) with energy above a pre-defined threshold in the range 10MeV to 300MeV					
Justification:	Higher confidence in SEE risk.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1606 SWE-CRD-SCH-1607 SWE-CRD-SCH-1608 SWE-CRD-SCH-1609 SWE-CRD-SCH-1610		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1615	**Service:**	LAU	**Priority:**	Essential	SWE
Solar activity forecast					
Justification:	Put staff on alert				
Comments:					

Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-SCH-1606 SWE-CRD-SCH-1607 SWE-CRD-SCH-1608 SWE-CRD-SCH-1609 SWE-CRD-SCH-1610 SWE-CRD-SCH-1611	**Verification Method:**	Design Review Test

SWE-CRD-LAU-1616	**Service:**	LAU	**Priority:**	Essential	SWE
All quiet forecasts					
Justification:	Higher confidence in SEE risk				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCH-1606 SWE-CRD-SCH-1612		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1617	**Service:**	LAU	**Priority:**	Essential	SWE
Post Event Analysis: recreate environment at a given time and location to accurately evaluate SEEs in launcher's electronics					
Justification:	Retrieve information to analyse flight data.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1618	**Service:**	LAU	**Priority:**	Essential	SWE
Atmospheric density forecast along the trajectory of the launcher up to TBD km altitude(*).					
Justification:	Monitor and forecast the density for fairing ejection				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1619	**Service:**	LAU	**Priority:**	Essential	SWE
Ionospheric scintillation forecast/nowcast					
Justification:	Monitor and forecast possible communication disruptions.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1620	**Service:**	LAU	**Priority:**	Essential	SWE
The SSA system shall provide nowcast and forecast of micro-particle fluxes, including streams and debris clouds.					
Justification:	Provide awareness of increased impact risk.				

Comments:			
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-LAU-1622	**Service:**	LAU	**Priority:**	Essential	SWE
All products for the Spacecraft Operation service domains shall also be made available to the users of launch operation service domain.					
Justification:	Launchers are a particular category of spacecraft				
Comments:					
Source Requirements:					
Related Requirements:			**Verification Method:**	Design Review	

SWE-CRD-LAU-2683	**Service:**	LAU	**Priority:**	Essential	SWE
In-flight monitoring of radiation effects in sensitive electronics					
Justification:	Provide a near real-time estimate of the radiation effects in sensitive electronics along a trajectory.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

9.2 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users.

SWE-CRD-LAU-1623	**Service:**	LAU	**Priority:**	Essential	SWE
High energy >10MeV protons and ions at 1 AU.					
Justification:	Inform whether there is a solar particle event on-going.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616 SWE-CRD-LAU-1617		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1624	**Service:**	LAU	**Priority:**	Essential	SWE
Solar disk imaging (X or EUV), visible light including magnetogram, H-alpha, imaging of solar far-side and radio observations.					

Justification:	It will be possible to inform users of the probability of solar particle events using these data. It is important to consider not only solar disk monitoring but also the details relative to a given active region that may be at the origin of an eruption. Moreover not only the observations are needed but also their interpretation in terms of e.g. flare magnitude, active region magnetic classification, radio burst type... Data relative to the present status of solar activity is important.		
Comments:			
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616	**Verification Method:**	Design Review Test

SWE-CRD-LAU-1625	**Service:**	LAU	**Priority:**	Essential	SWE
Near real-time geomagnetic indices, solar indices (e.g. F10.7, sunspot number) and EUV/X-ray flux					
Justification:	Input data for atmospheric density estimate via a model. Input data for radiation propagation calculation to the launcher via a model. Input data for ionospheric scintillation forecasts.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1618		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1626	**Service:**	LAU	**Priority:**	Essential	SWE
All data for the Spacecraft Operation service domains shall also be made available to the users of Launch Operation service domain.					
Justification:	Launchers are a particular category of spacecraft				
Comments:					
Source Requirements:					
Related Requirements:			**Verification Method:**	Design Review	

SWE-CRD-LAU-2684	**Service:**	LAU	**Priority:**	Essential	SWE
In-flight monitoring data of radiation effects on sensitive electronics					
Justification:	Provide a near real-time estimate of the radiation effects in sensitive electronics along a trajectory.				
Comments:	New DAT requirement extrapolated from SN-I analysis related PRD requirement.				
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

9.3 Performance requirements.

SWE-CRD-LAU-1627	Service:	LAU	Priority:	Essential	SWE
Maximum service interruption shall not exceed 30 minutes during the 3 days prior to launch.					
Justification:	3 days is the critical period for decision on whether to launch or not when space weather conditions will be taken into account. A maximum downtime of 30 minutes is compatible with the refresh rate requirement.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616 SWE-CRD-LAU-1617		**Verification Method:**	Analysis Design Review Test	

SWE-CRD-LAU-1628	Service:	LAU	Priority:	Essential	SWE
Forecast of SPE onset shall be calculated for the next 72 hours and updated every 30 minutes from 72 hours to 24 hours ahead of launch to 5 minutes during the last 24 hours before launch.					
Justification:	The lead time and update rate are driven by the lead time required for taking a decision on scheduling the launch.				
Comments:	A requirement on the avoidance of false alarms may be needed.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1629	Service:	LAU	Priority:	Essential	SWE
Information on current solar activity including interplanetary high energy protons and heavy ions fluxes shall be provided every 30 minutes.					
Justification:	The update time is driven by the lead time required for taking a decision on scheduling a 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:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616		**Verification Method:**	Design Review Test	

SWE-CRD-LAU-1630	Service:	LAU	Priority:	Essential	SWE
Energetic proton and electron environment shall be monitored with five minute resolution.					

Justification:	Allow accurate identification of the onset time of a solar particle event for post event analysis.		
Comments:			
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616 SWE-CRD-LAU-1617	**Verification Method:**	Design Review Test

SWE-CRD-LAU-1631	**Service:**	LAU	**Priority:**	Essential	SWE
Solar activity shall be forecast 1 day ahead and refined 1 hour ahead prior to launch.					
Justification:	This lead time allows short term planning of launch activities.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1614 SWE-CRD-LAU-1615 SWE-CRD-LAU-1616		**Verification Method:**		Design Review Test

SWE-CRD-LAU-1632	**Service:**	LAU	**Priority:**	Essential	SWE
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 the update of the drag estimates available for the launch period.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-LAU-1618		**Verification Method:**		Design Review Test

SWE-CRD-LAU-1621	**Service:**	LAU	**Priority:**	Essential	SWE
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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**		Analysis Design Review Test

10 SERVICE DOMAIN #5: TRANSIONOSPHERIC RADIO LINK

The following user types are assumed:

10.1.1 Table

User types	Characteristics
SWE-CRD-TIO-USR-01	Users of GNSS Single frequency services with average accuracy, no integrity (*e.g.* typical GNSS mass market user)
SWE-CRD-TIO-USR-02	Users of GNSS Single frequency services with average accuracy, using integrity (*e.g.* EGNOS user)
SWE-CRD-TIO-USR-03	Users of multi-frequency GNSS systems with average multifrequency accuracy, no integrity (commercial services, PRS).
SWE-CRD-TIO-USR-04	Users of multi-frequency GNSS systems with average accuracy, integrity (aeronautical multifrequency).
SWE-CRD-TIO-USR-05	Users or multi-frequency GNSS systems with very high accuracy (*e.g.* GNSS geodetic users, RTK)
SWE-CRD-TIO-USR-06	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). 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)

The type of services to be delivered by the space weather segment to trans-ionospheric radio link users are given in the table below:

Services to be delivered

10.1.2 Table

Service	Description	Service products
near real-time TEC maps	Provide near real-time TEC maps	SWE-CRD-TIO-1633
Forecast TEC maps	Provide forecasted TEC maps	SWE-CRD-TIO-1637
Quality assessment of ionospheric correction	Provide information on whether standard corrections to GNSS signal are applicable.	SWE-CRD-TIO-1634 SWE-CRD-TIO-1637
near real-time ionospheric scintillation maps	Provide near real-time estimate of the scintillation maps	SWE-CRD-TIO-1635
Monitoring and forecast of ionospheric disturbances	Provide estimate of the occurrence risk of ionospheric disturbances	SWE-CRD-TIO-1636 SWE-CRD-TIO-1637

10.2 Required service products to be delivered

The following data products shall be delivered.

SWE-CRD-TIO-1633	Service:	TIO	Priority:	Essential	
The SSA system shall provide near real-time and forecast over 7 days (TBC) TEC core products for different service users as defined in SWE-CRD-TIO-1650, SWE-CRD-TIO-1651 and SWE-CRD-TIO-1652.					
Justification:	Most transionospheric effects affecting signal propagation are related to Total Electron Density, therefore, real-time maps serve to estimate high-level description of the state of the ionosphere.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1641 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644 SWE-CRD-TIO-1645		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1634	Service:	TIO	Priority:	Essential	SWE
The SSA system shall provide for TEC core products specified in SWE-CRD-TIO-1633 a posteriori and estimated parameters together with near real-time alarms to indicate the level of degradation of ionospheric correction models with respect to the actual state of the ionosphere. Update rate for different service users will be considered as defined in SWE-CRD-TIO-1650, SWE-CRD-TIO-1651 and SWE-CRD-TIO-1652.					
Justification:	Space systems affected by ionospheric propagation many times implement ionospheric correction models. Estimating, on the basis of real-time alarms, the degradation of ionospheric corrections will serve to verify system performance.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1641 SWE-CRD-TIO-1645		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1635	Service:	TIO	Priority:	Essential	SWE
The SSA system shall provide near real time measurements and forecasts of the ionospheric scintillation Index (S4) and sigma phase error (Sphi) for frequencies from UHF to C band (30 Mhz to 5 Ghz) for different service users as defined in SWE-CRD-TIO-1650, SWE-CRD-TIO-1651 and SWE-CRD-TIO-1652.					
Justification:	Ionospheric Scintillations may affect the availability and continuity of service of GNSS and other systems, therefore timely detection and nowcasting is of primary importance.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1640 SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1636	Service:	TIO	Priority:	Essential	SWE
The system shall provide 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					

Justification:	Local and narrow disturbances in the ionosphere (trough, TIDs, patches, depletions, D-region absorption) affect system performance in localised regions which are difficult to detect and mitigate by the system.		
Comments:			
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1641 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	**Verification Method:**	Design Review Test

SWE-CRD-TIO-1637	**Service:**	TIO	**Priority:**	Essential	SWE
The SSA system shall provide detection of geomagnetic storms.					
Justification:	Geomagnetic storms often generate abnormal disturbances of the ionosphere resulting in service performance degradation difficult to estimate. It must be noted however that a metric should be defined to characterise ionospheric storms as the ionospheric effects of geomagnetic storms are very diverse.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1642 SWE-CRD-TIO-1646		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-2652	**Service:**	TIO	**Priority:**	Highly Desirable	SWE
The SSA system shall provide nowcast and forecast of 3D electron density grids**.**					
Justification:	In the future some GNSS and radio propagation applications may need 3D electron density grids.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1633 SWE-CRD-TIO-1634 SWE-CRD-TIO-1636		**Verification Method:**	Design Review Test	

10.3 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users.

SWE-CRD-TIO-1639	**Service:**	TIO	**Priority:**	Essential	SWE
Total Electron Content					

Justification:	An important characteristic for analysis of ionospheric effects.		
Comments:			
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-TIO-1633 SWE-CRD-TIO-1634 SWE-CRD-TIO-1636	**Verification Method:**	Design Review Test

SWE-CRD-TIO-1640	**Service:**	TIO	**Priority:**	Essential	SWE
Scintillation indices and parameters (S4, sigma_phi, fading depth, fade duration, time between fades)					
Justification:	Data required to characterise ionospheric scintillation events allowing to estimate performance degradation due to those events.				
Comments:	Performance degradation is highly system dependent, thus general estimates on availability/accuracy due to scintillation are limited.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1635		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1641	**Service:**	TIO	**Priority:**	Essential	SWE
Height of maximum electron density in F2 layer					
Justification:	A factor to estimate degradation of single layered models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1633 SWE-CRD-TIO-1634 SWE-CRD-TIO-1636		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1642	**Service:**	TIO	**Priority:**	Essential	SWE
Geomagnetic storm indices: global, auroral, mid-latitude and ring current.					
Justification:	A factor to estimate general disturbances of the ionosphere.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1634 SWE-CRD-TIO-1635 SWE-CRD-TIO-1636		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1643	**Service:**	TIO	**Priority:**	Essential	SWE
Smoothed Sunspot number (SSN)					
Justification:	A parameter proportional to level of ionisation in the ionosphere.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1633 SWE-CRD-TIO-1634 SWE-CRD-TIO-1635 SWE-CRD-TIO-1636		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1644	Service:	TIO	Priority:	Essential	SWE
Solar flux density from entire solar disk at 10.7 cm (F10.7)					
Justification:	A parameter proportional to level of ionisation in the ionosphere.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1633 SWE-CRD-TIO-1634 SWE-CRD-TIO-1635 SWE-CRD-TIO-1636		Verification Method:	Design Review Test	

SWE-CRD-TIO-1645	Service:	TIO	Priority:	Essential	SWE
URSI ionospheric parameter values.					
Justification:	foF2 and M(3000)F2, fmin, and fbE are important characteristics to accurate estimate transionopheric propagation from URSI recommendations. fmin is the minimum useable frequency. This becomes significant during strong solar activity, both as short spikes from flares and a long-lived effect when the solar X-ray background is enhanced. hmF2 and ITEC are derived from true-height analysis of ionosonde data: a. hmF2, the height of the F2 layer peak density. This parameter is a valuable input and constraint on real-time models of the ionosphere b. ITEC, the vertical total electron content of the ionosphere. This is valuable for comparison and validation against GPS TEC measurements.				
Comments:					
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-TIO-1646	Service:	TIO	Priority:	Essential	SWE
Vector measurements of local geomagnetic field.					
Justification:	Direct values of geomagnetic field in various locations.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1636 SWE-CRD-TIO-1637		Verification Method:	Design Review Test	

SWE-CRD-TIO-1647	Service:	TIO	Priority:	Desirable	SWE
Riometer data					
Justification:	Detect D region absorption events				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1636		Verification Method:	Design Review Test	

SWE-CRD-TIO-1648	Service:	TIO	Priority:	Essential	SWE
X-ray flares and SEP fluxes.					

Justification:	Cause D region absorption.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-TIO-1636	**Verification Method:**	Design Review Test

10.4 Performance requirements

SWE-CRD-TIO-1649	**Service:**	TIO	**Priority:**	Essential	SWE
Maximum service interruption time shall not exceed 5 minutes (except for scheduled maintenance). The service shall not be offline for more than 3-4 days per year.					
Justification:	The maximum service downtime depends on the users but is driven by the most demanding users.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Analysis Test	

SWE-CRD-TIO-1650	**Service:**	TIO	**Priority:**	Essential	SWE
For user SWE-CRD-TIO-USR-01 Data shall be obtained globally with a 5x2.5 degrees longitude-latitude 2D grid with an update not larger than 2 hours.					
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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1651	**Service:**	TIO	**Priority:**	Essential	SWE
For users SWE-CRD-TIO-USR-02 and 04, 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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1652	**Service:**	TIO	**Priority:**	Essential	SWE
For users SWE-CRD-TIO-USR-05 and 06, Data shall be obtained for specific regions with narrow 3D volumetric grid with a TBD spatial resolution with an update not larger than 30 minutes.					
Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.				
Comments:					

Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-TIO-1639 SWE-CRD-TIO-1640	**Verification Method:**	Design Review Test

SWE-CRD-TIO-1653	**Service:**	TIO	**Priority:**	Essential	SWE
For SWE-CRD-TIO-1642, SWE-CRD-TIO-1643 and SWE-CRD-TIO-1644, the data shall be available daily.					
Justification:	To not reduce data resolution.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1642 SWE-CRD-TIO-1643 SWE-CRD-TIO-1644		**Verification Method:**	Design Review Test	

SWE-CRD-TIO-1654	**Service:**	TIO	**Priority:**	Essential	SWE
For SWE-CRD-TIO-1641, SWE-CRD-TIO-1645 and SWE-CRD-TIO-1646, the data shall be available with an update not larger than 2 hours.					
Justification:	Takes into account spatial scale of disturbances affecting the user.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-TIO-1641 SWE-CRD-TIO-1645 SWE-CRD-TIO-1646		**Verification Method:**	Design Review Test	

11 SERVICE DOMAIN #6: SPACE SURVEILLANCE AND TRACKING

The end users targeted by the services covered by this service domain are personnel involved in the Space Surveillance and Tracking operation of SSA system, collision warning services and re-entry risk assessment services. This is therefore a space weather service internal of the SSA.

More specifically the following end users are foreseen:

11.1.1 Table

User types	Characteristics
SWE-CRD-SST-USR-01	Surveillance and tracking centre(s), stations and services
SWE-CRD-SST-USR-02	S/C operators (cf also spacecraft operators service domain)
SWE-CRD-SST-USR-03	Collision warning services
SWE-CRD-SST-USR-04	Re-entry risk assessment services

The type of services to be delivered by the space weather segment to the space surveillance and tracking segment are given in the table below:

Services to be delivered

11.1.2 Table

Service	Description	Service products
Atmospheric estimates for drag calculations	Estimate of atmospheric density in the past years and predicted in near real-time.	SWE-CRD-SST-1655 SWE-CRD-SST-1656 SWE-CRD-SST-1661
Archive of geomagnetic and solar indices for drag calculation	Database of past values of solar and geomagnetic indices relevant to drag calculation.	SWE-CRD-SST-1655 SWE-CRD-SST-1661 SWE-CRD-SST-1662 SWE-CRD-SST-1664
Forecast of geomagnetic and solar indices for drag calculation	Provide forecast of geomagnetic and solar induces for drag calculation.	SWE-CRD-SST-1659 SWE-CRD-SST-1663 SWE-CRD-SST-1665
Nowcast of ionospheric group delay	Provide nowcast of ionospheric group delay to estimate effects on radar signal.	SWE-CRD-SST-1657 SWE-CRD-SST-1658 SWE-CRD-SST-1666

11.2 Required service products to be delivered

The following data products shall be delivered.

SWE-CRD-SST-1655	**Service:**	SST	**Priority:**	Highly Desirable	SWE

The SSA system shall provide high altitude atmospheric density estimate for the past year			
Justification:	Used to include drag effect in computing objects trajectory back in time.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-SST-1656	**Service:**	SST	**Priority:**	Highly Desirable	SWE
The SSA system shall provide high altitude atmospheric density forecast					
Justification:	Used to include drag effect in computing objects trajectory in the future.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1657	**Service:**	SST	**Priority:**	Essential	SWE
The SSA system shall provide relevant environmental data to estimate ionospheric refraction of radio waves					
Justification:	Used to correct positions derived by radar tracking.				
Comments:	Refraction can shift the apparent position perpendicular to the radar line-of-sight. It is dependent on the slant electron content between the radar and the tracked object.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1658	**Service:**	SST	**Priority:**	Essential	SWE
The SSA system shall provide relevant environmental data to estimate ionospheric group delay					
Justification:	Used to correct positions derived by radar tracking.				
Comments:	Group delay can shift the apparent position parallel to the radar line-of-sight. It is dependent on the slant electron content between the radar and the tracked object.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1659	**Service:**	SST	**Priority:**	Essential	SWE
The SSA system shall provide geomagnetic activity forecast.					
Justification:	Used to put staff on alert and predict risk of losing track of objects.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1661	Service:	SST	Priority:	Essential	SWE
The SSA system shall provide relevant environmental data for the user to compute drag of spacecraft in the altitude range below 1500 km(*).					
Justification:	Most often the user already has an in-house model and requires input data such as solar or geomagnetic indices.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			Verification Method:		Design Review Test

SWE-CRD-SST-1665	Service:	SST	Priority:	Essential	SWE
Forecast values of Geomagnetic activity indices used in atmosphere models (e.g., Ap, Kp, Dst, IG12, IMF and other indices depending on the models used by the user)					
Justification:	Allow to forecast high altitude density or its effect from a model usually run by the user.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:		Design Review Test

SWE-CRD-SST-2682	Service:	SST	Priority:	Essential	SWE
Archive of geomagnetic and solar indices					
Justification:	Most often the user already has an in-house model and requires input data such as solar or geomagnetic indices.				
Comments:	Introduce a new PRD requirement "Archive of geomagnetic and solar indices" and link SST-1662-DAT and SST-1664-DAT as related child requirements.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			Verification Method:		Design Review Test

SWE-CRD-SST-1663	Service:	SST	Priority:	Essential	SWE
Forecast values of solar activity indices used in atmosphere models(R, F10.7, S10, E10, M10, Y10 and other indices depending on the models used by the user)					
Justification:	Allow to forecast high altitude density or its effect from a model usually run by the user				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:		Design Review Test

11.3 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users.

SWE-CRD-SST-1662	Service:	SST	Priority:	Essential	SWE
Solar activity indices used in atmosphere models (e.g., R, F10.7, S10, E10, M10, Y10 and other indices depending on the models used by the user) over the last year.					
Justification:	Allow to compute high altitude density or its effect from a model usually run by the user.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SST-2682		Verification Method:	Design Review Test	

SWE-CRD-SST-1664	Service:	SST	Priority:	Essential	SWE
Geomagnetic activity indices used in atmosphere models (e.g., Ap, Kp, Dst, IG12, IMF and other indices depending on the models used by the user)					
Justification:	Allow to compute high altitude density or its effect from a model usually run by the user.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SST-2682		Verification Method:	Design Review Test	

SWE-CRD-SST-1666	Service:	SST	Priority:	Essential	SWE
Ionospheric electron density as a function of altitude.					
Justification:	Allow to compute ionospheric effects on radar				
Comments:	Could be provided by vertical incidence sounding or 3D density maps (e.g., from path delay measurements).				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SST-1657 SWE-CRD-SST-1658		Verification Method:	Design Review Test	

11.4 Performance requirements.

SWE-CRD-SST-1667	Service:	SST	Priority:	Essential	SWE
Forecast of all specified data for SWE-CRD-SST-USR-01 users shall be made for days, weeks and months ahead with daily update.					
Justification:	Should be greater or equal to update time of SSA orbit calculation.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-SST-1668	Service:	SST	Priority:	Essential	SWE
Forecast of all specified data for SWE-CRD-SST-USR-02 users shall be made from 1 day to 1 year ahead with 1 day resolution and daily update.					
Justification:	Should be greater or equal to update time of SSA orbit calculation.				
Comments:					

Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-SST-1669	**Service:**	SST	**Priority:**	Essential	SWE
Forecast of all specified data for SWE-CRD-SST-USR-03 users shall be possible from 1 hour ahead with hourly provision of data to-1 month ahead with daily provision of data.					
Justification:	Should be greater or equal to update time of SSA collision prediction.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1670	**Service:**	SST	**Priority:**	Essential	SWE
Forecast of all specified data for SWE-CRD-SST-USR-04 users shall be possible from 1 hour ahead with hourly provision of data to 5 years ahead with daily provision of data.					
Justification:	Time scales of re-entry encompass 1 hour during event to 5 years for prediction.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-SST-1671	**Service:**	SST	**Priority:**	Essential	SWE
Maximum service interruption time shall not exceed 1 day (except for scheduled maintenance). The service shall not be offline for more than 3-4 days per year.					
Justification:	99% is required for the credibility of the service. Maximum downtime is driven by acceptable error in the drag correction.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Analysis Test	

12 SERVICE DOMAIN #7: NON-SPACE SYSTEMS OPERATION

The end users targeted by this service domain cover a range of industries and represent those requiring space weather data and services for both operation and development of non-space systems that may be impacted by space weather effects.

User Types

12.1.1 Table

User types	Characteristics
SWE-NSO-USR-001	**Power System Operators**: Geomagnetic storms due to space weather disturbances produce enhanced currents that flow in the magnetosphere-ionosphere system which induce electric fields in long conductors at the earth's surface. These electric fields drive electric currents (GICs) through power systems where they can produce a variety of effects that are detrimental to system operation.
SWE-NSO-USR-002	**Pipeline Operators**: Long-distance oil and gas pipelines are also affected by geomagnetic disturbances. GICs create galvanic effects that may lead to rapid corrosion of the pipeline if it is not protected properly leading to a reduction of the expected lifetime of the pipeline.
SWE-NSO-USR-003	**Airlines and The Aerospace Sector**: In the case of the airline industry, a range of space weather phenomena can impact aviation operations. Effects include degradation or loss of HF radio transmission and satellite navigation signals; navigation system disruptions; and avionics errors. Dispatchers need space weather forecasts for flight planning at high latitudes. In addition, the European Union's Basic Safety Standards Directive (96/29/Euratom) sets out safety standards for the protection of workers and the general public against the effects of ionising radiation. Article 42 of the Directive deals with the protection of aircrew. Space weather services are needed in order to maintain an accurate record of exposure and, in some cases, to take mitigating action.
SWE-NSO-USR-004	**Resource Exploration**: Geomagnetic prospecting and surveying companies or organisations require near real-time data on geomagnetic disturbances together with precise positioning location from GNSS services.
SWE-NSO-USR-005	**Tourism**: The tourism sector is also a user of space weather services. Auroral forecast services, coupled with weather (cloudiness) forecasts can be provided to tourists visiting the auroral region in order to increase their likelihood of viewing aurora. Incorporation of these services as part of a marketing strategy is expected to increase the market share of hotels/businesses offering such services.

Services to be delivered

12.1.2 Table

Service	Description	Service products
Service to power systems operators	Nowcast and forecast GIC in power systems based on local magnetometer networks and	SWE-CRD-NSO-1744 SWE-CRD-NSO-1745

	solar wind data (in case of forecasts)	SWE-CRD-NSO-1746
Service to pipeline operators	Nowcast and forecast E field in vicinity of pipelines based on local magnetometer networks and solar wind data	SWE-CRD-NSO-1745 SWE-CRD-NSO-1746 SWE-CRD-NSO-1747 SWE-CRD-NSO-1748
Service to airlines	Global provision of data relating to increased radiation levels at aircraft altitudes and degraded communications, in particular for high-latitude routes	SWE-CRD-NSO-1749 SWE-CRD-NSO-1750 SWE-CRD-NSO-1751 SWE-CRD-NSO-1752 SWE-CRD-NSO-1753 SWE-CRD-NSO-1754 SWE-CRD-NSO-1755 SWE-CRD-NSO-1756 SWE-CRD-NSO-1757 SWE-CRD-NSO-1759
Service to resource exploitation system operators	Forecast and nowcast disturbed magnetic conditions in the vicinity of high latitude magnetometer stations, coupled with precise information on position (TIO services)	SWE-CRD-NSO-1754 SWE-CRD-NSO-1755 SWE-CRD-NSO-1758
Service to auroral tourism sector	Regional auroral forecast coupled with meteorological forecast (cloud cover) geared towards tourism sector	SWE-CRD-NSO-1760

12.2 Required service products to be delivered

The following data products shall be delivered.

SWE-CRD-NSO-1744	**Service:**	NSO	**Priority:**	Highly Desirable	SWE
The system shall provide a tailored service for generating Network maps showing geomagnetically induced currents throughout the power system including plotting local E-field and GIC by substation for registered users.					
Justification:	GIC estimate based on data and modelling shall be available for customer grid				
Comments:	Requires information on grid from customer.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1745	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall offer 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.					
Justification:	Products indicating recent GIC history are required for fast anomaly identification and resolution				
Comments:	Both modelled and measured GIC values will be available to users. Requires information on grid from customer.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1746	Service:	NSO	Priority:	Essential	SWE
The system shall provide global forecast of geomagnetic activity from 15 min ahead up to 27 days ahead.					
Justification:	Advanced warning of conditions likely to lead to enhanced GIC				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-NSO-2640	Service:	NSO	Priority:	Essential	SWE
The system shall provide local forecast of geomagnetic activity from 15 min ahead up to 27 days ahead for specific regions.					
Justification:	Advanced warning of conditions likely to lead to enhanced GIC				
Comments:	New CR created from SWE-CRD-NSO-1746.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-NSO-1747	Service:	NSO	Priority:	Desirable	SWE
The system shall offer a tailored service for specific users providing Pipe-to-soil potential difference (PSP) variations in the users pipe network.					
Justification:	Allows monitoring of cathodic protection system on long-distance pipeline.				
Comments:	Requires information on pipeline from customer.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-NSO-1748	Service:	NSO	Priority:	Essential	SWE
The system shall offer a tailored service for specific users providing time-dependent maps of geoelectric field variations for the users´ ground infrastructure.					
Justification:	Allows monitoring of geomagnetic disturbances level close to affected ground infrastructure				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-NSO-1749	Service:	NSO	Priority:	Desirable	SWE
The system shall provide cosmic ray dose forecasts of up to one year for a given airline flight defined by the user.					
Justification:	Allows estimate of crew radiation exposure, in particular at high latitudes				
Comments:	Estimate refers to model of galactic cosmic rays with a lead-time of up to 1 year, to allow estimation of background radiation dose for airline crew members.				
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-400				

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

SWE-CRD-NSO-1750	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide forecast of radiation storms with energies affecting crew and passengers (6, 12, 18 hours ahead).					
Justification:	In combination with existing medical data, allows crew change and/or flight plan change				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-NSO-1751	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide short term (<30mins) warnings of radiation storms with energies affecting crew and passengers.					
Justification:	Allows mitigation procedures to limit doses				
Comments:					
Source Requirements:	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-NSO-1752	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide post event information on radiation levels on a series of pre-defined routes used by commercial airlines (<1 week delay if significant activity).					
Justification:	Allows computation of crew exposure				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-NSO-1753	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide a graphical forecast including intensity, onset, duration and boundary of degraded communications for polar routes (12-24 hours) in accordance with international standards.					
Justification:	Assists with route selection and management, emergency response.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-NSO-1754	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide global ionospheric scintillation maps, nowcast and forecast alerts and data.					

Justification:	Alert operators to ionospheric effects that may lead to GNSS errors during precision approach and landing. Required for precise location determination during resource exploration/surveying activities.		
Comments:			
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-NSO-1755	**Service:**	NSO	**Priority:**	Essential	SWE
The SSA system shall provide global near real-time and forecast TEC maps on medium and large scales.					
Justification:	Alert operators to ionospheric effects that may lead to GNSS errors during precision approach and landing. Correct for effects of TEC on positioning data and, where applicable, variation on altimeter data.				
Comments:					
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1756	**Service:**	NSO	**Priority:**	Essential	SWE
The SSA system shall provide statistical information on the radiation environment at aircraft altitude for avionics.					
Justification:	Input to avionics design for aircraft				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1757	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide radiation and ionospheric data for post-event analyses for aircraft operators.					
Justification:	Support anomaly resolution and dose reconstruction in case of observed in-flight avionics errors.				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1758	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide nowcast and forecast (0-6hr, 24-48hr) of local geomagnetic activity for directional drilling					
Justification:	Mainly used to verify outlier points in survey rather than measurement interruption				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				

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

SWE-CRD-NSO-1759	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide nowcast and forecast (0-6hr, 24-48hr) of local geomagnetic activity for aeromagnetic surveys.					
Justification:	Reschedule flight in case of strong activity.				
Comments:					
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1760	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide forecast of the probability of visible auroras (>12hours, >6hours).					
Justification:	Alert tourists during daylight hours of probability of visible aurora				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1772		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2597	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide data and tools to support power grid operators in post-event analysis.					
Justification:	Investigation of anomalies				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2598	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide data and tools to support pipeline operators in post-event analysis.					
Justification:	Investigation of anomalies				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2599	**Service:**	NSO	**Priority:**	Essential	SWE
The system shall provide data and tools to support drilling operators in post-event analysis.					
Justification:	Investigation of anomalies				
Comments:					
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2600	Service:	NSO	Priority:	Desirable	SWE
The system shall provide forecast of dB/dt at specific user-defined locations.					
Justification:	Short-term and long-term forecasts are needed for power grid and pipeline operators (pipe-to-soil potential) for proper immediate correction and further planning".				
Comments:	Products will be determined in consultation with the system operator in each case.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

12.3 Data requirements

The following primary data on the environment and its effects shall be available.

SWE-CRD-NSO-1761	Service:	NSO	Priority:	Desirable	SWE
Network of magnetometer measurements in vicinity of customer power grid, pipeline or drilling/survey site					
Justification:	Used in combination with Earth model to derive local electric field and then in combination with network map, GICs. Used in combination with Earth model to derive local electric field in vicinity of pipeline. Used to verify outlier points in case of drilling or to delay measurements in case of aeromagnetic survey.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1744 SWE-CRD-NSO-1745 SWE-CRD-NSO-1746 SWE-CRD-NSO-1747 SWE-CRD-NSO-1748			**Verification Method:**	Design Review Test

SWE-CRD-NSO-1762	Service:	NSO	Priority:	Essential	SWE
Solar wind bulk velocity at L1					
Justification:	Shock detection in the solar wind in order to advise of upcoming activity				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1760			**Verification Method:**	Design Review Test

SWE-CRD-NSO-1763	Service:	NSO	Priority:	Essential	SWE
Solar wind bulk density at L1					
Justification:	Shock detection in the solar wind in order to advise of upcoming activity				
Comments:					
Source Requirements:	MR-SSA-SWE-400				

Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1760	**Verification Method:**	Design Review Test

SWE-CRD-NSO-1764	**Service:**	NSO	**Priority:**	Essential	SWE
Interplanetary magnetic field at L1					
Justification:	Shock detection in the solar wind in order to advise of upcoming activity				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1760		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1765	**Service:**	NSO	**Priority:**	Essential	SWE
Solar disk imaging					
Justification:	Monitor solar activity in order to support >1 hour advance warning of geomagnetic activity				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1760		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1766	**Service:**	NSO	**Priority:**	Essential	SWE
Solar coronal imaging (coronagraph)					
Justification:	Monitor solar activity in order to support >1 hour advance warning of geomagnetic activity				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1760		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1767	**Service:**	NSO	**Priority:**	Essential	SWE
Near real-time and archived measurements of atmospheric neutrons					
Justification:	Monitor ground level and aircraft altitude level events caused by solar particle events				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1751 SWE-CRD-NSO-1752 SWE-CRD-NSO-1756 SWE-CRD-NSO-1757		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1768	**Service:**	NSO	**Priority:**	Essential	SWE
Near real-time and archive 2 MeV to >100 MeV protons					
Justification:	Monitor solar energetic particle events and resulting dose received by aircrew and possible interaction with avionics. Also, monitor for PCA (polar cap absorption) events affecting communications at high latitudes.				

Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-NSO-1751 SWE-CRD-NSO-1752 SWE-CRD-NSO-1756 SWE-CRD-NSO-1757	**Verification Method:**	Design Review Test

SWE-CRD-NSO-1769	**Service:**	NSO	**Priority:**	Essential	SWE
Solar X-ray flux nowcast					
Justification:	Monitor D-region absorption for communication in HF (shortwave fadeout events) and contribute to SEP and global activity forecast.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1746 SWE-CRD-NSO-1750 SWE-CRD-NSO-1753 SWE-CRD-NSO-1760		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1770	**Service:**	NSO	**Priority:**	Essential	SWE
Total Electron Content					
Justification:	Measure of ionospheric influence on signal for GNSS and SATCOM				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1753 SWE-CRD-NSO-1755		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1771	**Service:**	NSO	**Priority:**	Essential	SWE
Scintillation indices (S4, sigma_phi, fading depth, fade duration, time between fades)					
Justification:	Measure performance degradation of GNSS due to scintillation. Required by users 003 and 004				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1753 SWE-CRD-NSO-1754		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1772	**Service:**	NSO	**Priority:**	Essential	SWE
Auroral visible imaging					
Justification:	Input to tourism oriented services: ground based or space based data applicable.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-NSO-1760		**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2596	**Service:**	NSO	**Priority:**	Desirable	SWE

Magnetotelluric data on geoelectric field in the vicinity of customer power grids, pipelines, or drilling/survey site			
Justification:	Used in combination with magnetometer measurements to map the spatial variation of the Earth's resistivity.		
Comments:	Ground conductivity models to be provided by customer.		
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-NSO-2596 SWE-CRD-NSO-2597 SWE-CRD-NSO-2598 SWE-CRD-NSO-2599 SWE-CRD-NSO-2600	**Verification Method:**	Design Review Test

12.4 Performance requirements.

SWE-CRD-NSO-1773	**Service:**	NSO	**Priority:**	Essential	
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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-2641	**Service:**	NSO	**Priority:**	Essential	SWE
Data relating to precise location determination shall be obtained for specific regions with a narrow 3D volumetric grid with an update not larger than 30 minutes					
Justification:	Takes into account spatial and temporal scales of disturbances affecting the user.				
Comments:	New CR created from SWE-CRD-NSO-1773.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1774	**Service:**	NSO	**Priority:**	Essential	SWE
Post-event radiation data shall be available <2 days following crew dose evaluation. Longer than 2 days is applicable if no activity is observed					
Justification:	Radiation data is used in crew rotation planning, so a decision to temporarily ground crew following an event may be taken.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-NSO-1775	Service:	NSO	Priority:	Essential	SWE
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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

13 SERVICE DOMAIN #8: GENERAL DATA SERVICE

The output of this service will support the activities of a wide range of users including expert users in the space industry, ground system operators (the requirement for which was expressed by the SSA Programme Board at its first meeting), airlines, third party service providers in a range of domains, the education sector and the general public (including amateur radio/disaster monitoring-communication). This service gives users the maximum amount of flexibility to use SSA-SWE data according to their needs, in conjunction with the tailored services where appropriate. The availability of data products and model outputs shall be guaranteed to the same level as tailored services for this purpose. Caveats relating to model accuracy will be provided as needed.

The users include external users as well as the Service Domains 1-7 as internal “users“ utilising service products.

Services to be delivered

13.1.1 Table

Service	Description	Service products
Space weather data archive	Archive of all available European space weather data	SWE-CRD-GEN-1678
Latest data guaranteed service	Provide agreed set of guaranteed data required to provide input to tailored service and non-tailored customer service available on a registration basis.	SWE-CRD-GEN-1672
Space weather nowcast and forecast products (daily, weekly)	Provide nowcast/forecast space weather parameters	SWE-CRD-GEN-1673 SWE-CRD-GEN-1674 SWE-CRD-GEN-1675 SWE-CRD-GEN-1676 SWE-CRD-GEN-1679 SWE-CRD-GEN-1680 SWE-CRD-GEN-1686
Event based alarms	Alarms on an as-needed basis (flare, CME, SPE, magnetic storm onset, meteoroid stream, etc). Incorporate relevant data and where feasible rapid model 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.	SWE-CRD-GEN-1672 SWE-CRD-GEN-1673
Virtual space weather modelling system	Service geared towards end-to-end space weather modelling. Model integration and validation as part of a coordinated framework. Service will aim to provide the best possible end-to-end space weather simulation, coupling European modelling assets in order to simulate	SWE-CRD-GEN-1682 SWE-CRD-GEN-1683

	propagation of space weather phenomena from the Sun. Both users and developers will benefit from this service as incorporation of models into a coherent framework will stimulate further development of targeted models.	
Guaranteed data service for third-party/added-value service providers	Services to be built by service providers (commercial/non-commercial) external to SSA in order to develop customer focussed products (e.g., for airlines, power industry, prospecting, auroral tourism)	SWE-CRD-GEN-1672 SWE-CRD-GEN-1685
Space Weather Support Material	Educational material, web based content	SWE-CRD-GEN-1681

13.2 Required service products to be delivered

The following data products shall be delivered.

SWE-CRD-GEN-1672	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide the latest values for an agreed set of guaranteed data					
Justification:	"Guaranteed" w.r.t. the service reliability shall be defined by the service level agreement with the customer. "Guaranteed" w.r.t the data served should be a list of the data that shall be provided by the system.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2659	**Service:**	GEN	**Priority:**	Essential	SWE
The latest data shall be provided with a maximum delay agreed with the customer for each dataset.					
Justification:	In many cases timeliness of data provision to the user is a critical element of a service, allowing decision making based on current information.				
Comments:	All GEN data requirements are relevant for this product				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2658	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide an alert to registered users if the latest value for a dataset is older than a given threshold, i.e. stale. The Alert will be in machine and human processable form					
Justification:	Relevant if providing input to tailored service and non-tailored customer services.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				

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

SWE-CRD-GEN-2657	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall guarantee provision of latest data values for specific users, either by pushing it to the customer, notification to the customer that new data is available or RSS type feed.					
Justification:	Guaranteed service can/needs not be provided in all cases.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-2656		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2656	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall be able to provide Event based alarms for any of the latest values produced in SWE-CRD-GEN-2657					
Justification:	Provides alerts on the latest data generated. These alarms shall be in a format to provide for processing by both human and machines (to allow for the automated initiation by the customer of their event processing models).				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-2657		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2655	**Service:**	GEN	**Priority:**	Essential	SWE
A general set of alarms for latest values shall be defined for each Service Domain.					
Justification:	Alarms can be tailored to thresholds appropriate for a given User Domain.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2654	**Service:**	GEN	**Priority:**	Essential	SWE
Registered users shall be able to define their own event-based alarms for latest values.					
Justification:	In cases where users have a particular interest/sensitivity, this will allow them to tailor the alarms received accordingly.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1673	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide nowcast products based on data and modelling for specific datasets.					
Justification:	The service shall make use of data and modelling in order to provide a nowcast as close as possible to the actual situation encountered by the user's system/asset.				

Comments:	The initial list of product types should be defined in the SRD. The available products will grow over time, it is important that the types of products be specified in the SRD, so that their interface peculiarities can be addressed in the interface definition. It is unlikely that a complete list of products will ever be available, but the type of products can be specified. All GEN data and model requirements are relevant for this product.		
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-2665	**Service:**	GEN	**Priority:**	Essential	SWE
The nowcast service shall be able to cover a diverse range of data products.					
Justification:	Nowcasts will include several different types of data product.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2666	**Service:**	GEN	**Priority:**	Essential	SWE
Nowcast parameters shall include and be grouped according to the following categories: solar activity, solar wind key parameters (density, magnetic field), geomagnetic, radiation environment (at GEO, MEO, LEO),ionospheric propagation conditions, neutral density, indices, microparticle flux and known periods of increased flux intensity.					
Justification:	Nowcasts of different parameters are required by users in several different domains.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-370 MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-2667		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2667	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall be able to provide Event-based alarms for any of the nowcast products produced in SWE-CRD-GEN-2666 in machine and human readable form.					
Justification:	Alarms/alerts are to be in machine readable and human readable form to permit triggering of automated processing.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-2666		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2668	**Service:**	GEN	**Priority:**	Essential	SWE
A general set of alarms for nowcasts shall be defined for each Service Domain. in machine and human readable form.					

Justification:	Alarms/alerts are to be in machine readable and human readable form to permit triggering of automated processing.		
Comments:	All GEN data and model requirements are relevant for this product.		
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-2669	**Service:**	GEN	**Priority:**	Essential	SWE
Registered users shall be able to define their own event based alarms for nowcasts.					
Justification:	Alarms/alerts are to be in machine readable and human readable form to permit triggering of automated processing.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1674	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide forecasts for a list of data products based on data and modelling.					
Justification:	The service shall make use of data and modelling in order to provide a forecast as close as possible to the actual situation encountered by the user's system/asset.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2670	**Service:**	GEN	**Priority:**	Essential	SWE
The forecast service shall be able to cover diverse types of data products					
Justification:	Forecasts will include several different types of data product.				
Comments:	The service needs to be generic enough to incorporate new data sets. No specific list of datasets needs to be defined in the CRD. All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2671	**Service:**	GEN	**Priority:**	Essential	SWE
Forecast parameters shall include the following categories: solar activity, solar wind key parameters (density, magnetic field), geomagnetic, radiation environment (at GEO, MEO, LEO),ionospheric propagation conditions, neutral density, indices, microparticle flux and known periods of increased flux intensity.					
Justification:	Forecasts of different parameters are required by users in several different domains.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				

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

SWE-CRD-GEN-2672	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide forecast with validities for 3, 6, 12, 24, 48, 72 hours, depending on parameter and models applied.					
Justification:					
Comments:	This is not valid for some parameters e.g. solar cycle. All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1675	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide Daily Forecasts for a list of data products with 1 day, 2 days and weekly outlook.					
Justification:	Collected distribution of key forecast parameters. Outlook to extend to recurrent features such as coronal holes. Of use to a wide range of users who may use the forecast to provide alarms or to decide whether to look more closely at a certain parameter. In wide use via the ISES network.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1676	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide a daily activity report (plus last 24 hours) summarising reported disturbances.					
Justification:	Reported disturbance summary: include all from solar, through magnetospheric, ionospheric to ground based. Standard format using as reference NOAA scales to categorise events.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1678	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall provide a long term database as an archive of space weather and micro-particle data.					
Justification:	Long term database including sensor data and derived products such as model runs and an event catalogue. This will support generation of new indices and further understanding of long term trends, supporting development of improved models and forecast tools.				
Comments:	Data provision and distribution agreements are required. Database will be compatible and cross-referenceable with VO activities (e.g. VSO, Virbo). All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				

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

SWE-CRD-GEN-2673	**Service:**	GEN	**Priority:**	Essential	SWE
The Long Term Database shall serve as a central access to archived data and service products generated in other services.					
Justification:	The database shall serve as an archive for information generated by the SWE services.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-310 MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2674	**Service:**	GEN	**Priority:**	Essential	SWE
The long term database shall include and provide access to derived products including model runs and an event catalogue.					
Justification:	The database shall serve as an archive for information generated by the SWE services.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2675	**Service:**	GEN	**Priority:**	Essential	SWE
The Long Term Database shall store and provide access to data generated by sources external to the SWE System and those data provided to the SWE System through an SLA or other collaboration agreement.					
Justification:	The database shall provide a centralised access point for relevant space weather data, facilitating analysis.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-310 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2676	**Service:**	GEN	**Priority:**	Essential	SWE
The Long Term database shall provide a mechanism to support addition and/or generation of new indices.					
Justification:	Analysis of longer term trends can support generation of new indices and future planning.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2677	**Service:**	GEN	**Priority:**	Essential	SWE
The Long Term database shall provide a mechanism to support the reprocessing and versioning of the data					

Justification:	This may be required for example in the case of recalibration or implementation of a new index algorithm.		
Comments:	All GEN data and model requirements are relevant for this product.		
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-2678	**Service:**	GEN	**Priority:**	Essential	SWE
The Long Term database shall provide mechanisms to support the further understanding of long term trends.					
Justification:	Analysis of longer term trends can support generation of new indices and future planning.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2679	**Service:**	GEN	**Priority:**	Essential	SWE
The archive shall include any data used in any service of the SWE domains					
Justification:	The database shall provide a centralised access point for relevant space weather data, facilitating analysis.				
Comments:	All GEN data requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-380 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2680	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall allow the user to identify the origin and main characteristics of the dataset.					
Justification:	Appropriate metadata will be available such that the user can immediately identify the main characteristics and origin of the datasets prior to incorporating them into any decision making process.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1679	**Service:**	GEN	**Priority:**	Essential	SWE
The service shall provide weekly and monthly reports collating information on reported disturbances in the given period.					
Justification:	Collation of information covering the period in question. Used in post event analysis in order to identify periods of interest.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-2653		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2653	Service:	GEN	Priority:	Essential	SWE
The weekly/monthly reports shall include as a minimum: TBD					
Justification:	Collation of information covering the period in question. Used in post event analysis in order to identify periods of interest.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1679		Verification Method:	Design Review Test	

SWE-CRD-GEN-1680	Service:	GEN	Priority:	Essential	SWE
The Service shall provide a notification on "all quiet conditions" indicating long periods of low activity forecast.					
Justification:	Indication of long (several days) periods of low activity applicable to several user domains including spacecraft operators and human spaceflight.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-GEN-2642	Service:	GEN	Priority:	Essential	SWE
The all quiet condition shall be defined separately for each user domain.					
Justification:	Thresholds and/or key dataset on which the all-quiet threshold is set may vary according to user domain.				
Comments:	New CR created from SWE-CRD-GEN-1680. All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-GEN-2643	Service:	GEN	Priority:	Essential	SWE
An “End-of-quiet” alert will be provided by the SSA System.					
Justification:	Indication of the end of long (several days) periods of low activity applicable to several user domains including spacecraft operators and human spaceflight.				
Comments:	New CR created from SWE-CRD-GEN-1680. All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-GEN-1681	Service:	GEN	Priority:	Essential	SWE
The Service shall provide access to web-based Educational courses, material and tutorials for Space Weather and micro-particles.					

Justification:	Tutorials covering aspects of space weather geared towards users and customers. Include information on the types of products available and associated caveats.		
Comments:	All GEN data and model requirements are relevant for this product.		
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-1682	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall provide a Virtual Space Weather Modelling System to provide predictions (~30 minutes to days) of space weather events.					
Justification:	Using physical models to predict the propagation of phenomena enables short and long-term forecasting of the environment and effects.				
Comments:	All GEN model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2645	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall allow the integration and validation of models as part of a coordinated framework.					
Justification:	Models must be tested and compared with developer versions to verify installation and configuration.				
Comments:	New CR created from SWE-CRD-GEN-1682. All GEN model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2646	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall provide a coherent framework to allow coupling of European modelling assets and access to relevant data in order to simulate propagation of space weather phenomena from the Sun to the Earth.					
Justification:	Coupling of models covering domains from the Sun to the Earth is needed to produce reliable predictions for users.				
Comments:	New CR created from SWE-CRD-GEN-1682. All GEN model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-310 MR-SSA-SWE-360 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-2647	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall provide tools for validating the respective models based on measurements and by other means (e.g. comparison with other global model coupling efforts).					

Justification:	Accuracy and reliability are important for users of space weather modelling predictions.		
Comments:	New CR created from SWE-CRD-GEN-1682. All GEN model requirements are relevant for this product.		
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-1683	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall provide an interface allowing graphical visualisation (3-D visualisation, 2-D maps and time animation) of combined results of model simulation outputs and subsets thereof.					
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:	All GEN model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1685	**Service:**	GEN	**Priority:**	Essential	SWE
The user shall be able to configure automated data retrieval/distribution requests.					
Justification:	Allow adaptation to evolving user needs.				
Comments:	All GEN data and model requirements are relevant for this product.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review	

SWE-CRD-GEN-1686	**Service:**	GEN	**Priority:**	Essential	SWE
The SSA system shall provide long-term solar cycle prediction (with a quantification of the forecast uncertainties) including at least Sun Spot Number, Solar Flux EUV, F10.7, expected flare activity level, mean and standard deviation of interplanetary magnetic field strength, median and upper/lower sextiles of solar wind pressure over TBD periods with a forecastability period depending on the parameter.					
Justification:	Useful for many long term activities including spacecraft design, mission planning.				
Comments:	Requirement 1511 has the same requirement.				
Source Requirements:	MR-SSA-SWE-340 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

It is expected that all data products and all integrated models will be input to each of these high level service products. The exception is the integrated modelling suite, which may take a subset of the available data as boundary conditions for the end-to-end simulations.

13.3 Data requirements

Data on the following primary components of the space environment and their effects shall be made available to the end users.

The following data requirements are relevant for all high level services described above. Particular exceptions are noted along with the related modelling requirements.

SWE-CRD-GEN-1687	**Service:**	GEN	**Priority:**	Essential	SWE
EUV images of Sun					
Justification:	Monitor solar activity and input to prediction models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1724		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1688	**Service:**	GEN	**Priority:**	Essential	SWE
Solar magnetograph images					
Justification:	Monitor evolution of solar magnetic fields in advance of solar activity. Input to modelling and forecast.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1724 SWE-CRD-GEN-1725		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1689	**Service:**	GEN	**Priority:**	Essential	SWE
White light solar imaging					
Justification:	Input to calculation of international sunspot number.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1732		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1690	**Service:**	GEN	**Priority:**	Essential	SWE
H-alpha images of Sun					
Justification:	Monitor solar flare and quiescent filament development for activity prediction.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1724		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1691	**Service:**	GEN	**Priority:**	Essential	SWE
Soft X-ray images of the Sun					
Justification:	Monitor solar activity and input to modelling activities.				
Comments:					

Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1724	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1692	**Service:**	GEN	**Priority:**	Essential	SWE
Stereoscopic solar images of CMEs and Corotating Interaction Regions.					
Justification:	Monitor solar activity (e.g. CME eruption) from non-L1 positions, e.g. from L5, as input to forecast.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1724 SWE-CRD-GEN-1725		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1693	**Service:**	GEN	**Priority:**	Essential	SWE
Solar far-side maps					
Justification:	Identify formation and evolution of large solar active regions on the far side of the Sun. Extends forecast validity period to up to 14 days.				
Comments:	Use helioseismology technique to plot magnetic activity on the far side of the Sun.				
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1674		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1694	**Service:**	GEN	**Priority:**	Essential	SWE
Ly-alpha images					
Justification:	Identification of solar active regions on the far side of the sun through illumination of interplanetary Hydrogen atoms.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1674		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1695	**Service:**	GEN	**Priority:**	Essential	SWE
White-light coronagraph images					
Justification:	Monitor coronal mass ejections as they extend out into the low corona (~1-20 solar radii)				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1725 SWE-CRD-GEN-1726		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1696	**Service:**	GEN	**Priority:**	Essential	SWE
Solar X-ray flux					
Justification:	Monitor full sun integrated X-ray flux at 1-8A, 0.5-4A for monitoring and identifying solar flares.				

Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-1697	**Service:**	GEN	**Priority:**	Essential	SWE
Solar EUV integrated flux					
Justification:	Monitor full sun integrated flux for input to upper atmosphere models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1731		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1698	**Service:**	GEN	**Priority:**	Essential	SWE
Solar UV flux					
Justification:	Monitor full sun integrated flux for input to upper atmosphere models				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1731		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1699	**Service:**	GEN	**Priority:**	Essential	SWE
Solar radio bursts					
Justification:	Monitor solar radio bursts as a means of tracking solar activity and input to forecast models.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1731		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1700	**Service:**	GEN	**Priority:**	Essential	SWE
Solar wind bulk velocity at L1					
Justification:	Monitor solar wind parameters upstream of the Earth in order to advise of upcoming activity.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1727 SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1701	**Service:**	GEN	**Priority:**	Essential	SWE
Solar wind bulk density at L1					
Justification:	Monitor solar wind parameters upstream of the Earth as input to nowcast and forecast of upcoming activity.				
Comments:					

Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1727 SWE-CRD-GEN-1731	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1702	**Service:**	GEN	**Priority:**	Essential	SWE
Solar wind temperature at L1					
Justification:	Monitor solar wind parameters upstream of the Earth as input to nowcast and forecast of upcoming activity.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1727 SWE-CRD-GEN-1732		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1703	**Service:**	GEN	**Priority:**	Essential	SWE
Interplanetary magnetic field at L1					
Justification:	Monitor solar wind parameters upstream of the Earth as input to nowcast and forecast of upcoming activity.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1727 SWE-CRD-GEN-1733		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1704	**Service:**	GEN	**Priority:**	Essential	SWE
1 MeV to >100 MeV interplanetary protons					
Justification:	Associated with dose, NIEL and SEE effects on spacecraft.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1726 SWE-CRD-GEN-1729		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1705	**Service:**	GEN	**Priority:**	Essential	SWE
1 MeV to >100 MeV interplanetary ions					
Justification:	Associated with dose, NIEL and SEE effects on spacecraft.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1726 SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1706	**Service:**	GEN	**Priority:**	Essential	SWE
2-50 MeV solar electrons					
Justification:	Shown to precede some solar proton events. Monitor and provide alarm if significant enhancement observed.				
Comments:					

Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1674	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1707	**Service:**	GEN	**Priority:**	Essential	SWE
Auroral UV imaging					
Justification:	Identify strength and extent of auroral region during active periods.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1708	**Service:**	GEN	**Priority:**	Essential	SWE
Auroral particle precipitation					
Justification:	Inputs to upper atmospheric modelling				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1709	**Service:**	GEN	**Priority:**	Essential	SWE
Auroral visible imaging					
Justification:	Auroral boundary may be used as input to magnetospheric modelling activities.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1710	**Service:**	GEN	**Priority:**	Essential	SWE
Auroral kilometric radiation (AKR)					
Justification:	Measurement of disturbance above auroral regions.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1711	**Service:**	GEN	**Priority:**	Essential	SWE
Magnetospheric magnetic field					
Justification:	Monitoring spacecraft environment and disturbances				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1728 SWE-CRD-GEN-1730		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1712	Service:	GEN	Priority:	Essential	SWE
In-situ magnetospheric E field					
Justification:	Monitoring plasmasphere and ring-current dynamics. Input to models of inner magnetosphere.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1728 SWE-CRD-GEN-1730		Verification Method:	Design Review Test	

SWE-CRD-GEN-1713	Service:	GEN	Priority:	Essential	SWE
1-400 MeV protons in radiation belt.					
Justification:	Factor into a wide range of dose, NIEL and internal charging effects				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			Verification Method:	Design Review Test	

SWE-CRD-GEN-1714	Service:	GEN	Priority:	Essential	SWE
1-10keV, 10->100 keV electrons in magnetosphere and radiation belts					
Justification:	Factor into a wide range of surface charging (lower energies), dose, NIEL and internal charging effects				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1728		Verification Method:	Design Review Test	

SWE-CRD-GEN-1715	Service:	GEN	Priority:	Essential	SWE
Neutral density in thermosphere					
Justification:	Monitor for input to spacecraft drag calculations				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1731		Verification Method:	Design Review Test	

SWE-CRD-GEN-1716	Service:	GEN	Priority:	Essential	SWE
Neutral wind in thermosphere					
Justification:	Monitor for input to spacecraft drag calculations				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1731		Verification Method:	Design Review Test	

SWE-CRD-GEN-1717	Service:	GEN	Priority:	Essential	SWE

Geomagnetic Data from Ground based Observatories			
Justification:	Monitor disturbances for input to nowcast and forecast models of the magnetosphere and upper atmosphere. Determination of dB/dt, monitoring disturbance levels leading to geomagnetically induced currents in power lines. Generation of indices. Determination of Earth's electrical conductivity structure from ground magnetotelluric measurements for estimating geomagnetically threats by GICs to power lines. Determination of magnetospheric plasma density through magnetospheric seismology		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review Test

SWE-CRD-GEN-1718	**Service:**	GEN	**Priority:**	Essential	SWE
Ionospheric vertical density profile.					
Justification:	Monitoring of signal propagation conditions for nowcast and forecast, e.g. by network of ionosondes.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1732		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1719	**Service:**	GEN	**Priority:**	Essential	SWE
Near real-time measurement of atmospheric neutrons					
Justification:	Monitor ground level and aircraft altitude level events caused by solar particle events or observe anisotropies in the background distribution caused by CME propagation in the solar wind.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1720	**Service:**	GEN	**Priority:**	Essential	SWE
Near real-time measurements of atmospheric muons					
Justification:	Observe anisotropies in the background distribution caused by CME propagation in the solar wind.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1721	**Service:**	GEN	**Priority:**	Essential	SWE
Provision of geomagnetic indices					

Justification:	Provide access to latest planetary indices such as Kp, Ap, F10.7 and archive. All form key inputs to modelling activities.		
Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1727 SWE-CRD-GEN-1728 SWE-CRD-GEN-1729 SWE-CRD-GEN-1730 SWE-CRD-GEN-1731 SWE-CRD-GEN-1732	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1722	**Service:**	GEN	**Priority:**	Essential	SWE
Microparticle flux as a function of size, velocity, angular distribution					
Justification:	Indicate increase risk of impacts by micro-particles				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1723	**Service:**	GEN	**Priority:**	Essential	SWE
Known periods/events of increased microparticle flux (meteoroid streams, debris clouds).					
Justification:	Indicate increased risk of impacts by micro-particles				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-SCD-1525		**Verification Method:**	Design Review Test	

13.4 Model Requirements

The following constitute key thematics and part of the end-to-end modelling element of this service. This service will be able to support more than one model per area and will provide an element of validation for service developers as well as providing the user with a global estimate of upcoming conditions.

SWE-CRD-GEN-1724	**Service:**	GEN	**Priority:**	Essential	SWE
Solar activity, flare and CME onset.					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1687 SWE-CRD-GEN-1688 SWE-CRD-GEN-1689 SWE-CRD-GEN-1690 SWE-CRD-GEN-1691		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1725	Service:	GEN	Priority:	Essential	SWE
CME propagation through heliosphere					
Justification:	For incorporation into end-to-end space weather simulation.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1687 SWE-CRD-GEN-1688 SWE-CRD-GEN-1689 SWE-CRD-GEN-1690 SWE-CRD-GEN-1691		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1726	Service:	GEN	Priority:	Essential	SWE
Solar particle events					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1687 SWE-CRD-GEN-1688 SWE-CRD-GEN-1689 SWE-CRD-GEN-1690 SWE-CRD-GEN-1691 SWE-CRD-GEN-1692 SWE-CRD-GEN-1695		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1727	Service:	GEN	Priority:	Essential	SWE
Solar wind interaction with magnetosphere					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1700 SWE-CRD-GEN-1701 SWE-CRD-GEN-1702 SWE-CRD-GEN-1703		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1728	Service:	GEN	Priority:	Essential	SWE
Radiation belts					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1711 SWE-CRD-GEN-1714		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1729	Service:	GEN	Priority:	Essential	SWE
Geomagnetic cut-off					
Justification:	For incorporation into end-to-end space weather simulation and estimation of radiation levels at aircraft altitude.				

Comments:			
Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1721	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1730	**Service:**	GEN	**Priority:**	Essential	SWE
Magnetosphere-Ionosphere coupling					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1700 SWE-CRD-GEN-1701 SWE-CRD-GEN-1702 SWE-CRD-GEN-1703 SWE-CRD-GEN-1704		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1731	**Service:**	GEN	**Priority:**	Essential	SWE
Ionosphere-Thermosphere coupling					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1707 SWE-CRD-GEN-1708 SWE-CRD-GEN-1709 SWE-CRD-GEN-1710 SWE-CRD-GEN-1721		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1732	**Service:**	GEN	**Priority:**	Essential	SWE
Global data assimilation models of ionospheric TEC and scintillation including cosmic ray ionisation of upper atmosphere models.					
Justification:	For incorporation into end-to-end space weather simulation				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:	SWE-CRD-GEN-1689 SWE-CRD-GEN-1718 SWE-CRD-GEN-1719 SWE-CRD-GEN-1720 SWE-CRD-GEN-1721		**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1733	**Service:**	GEN	**Priority:**	Essential	SWE
Rate of change of magnetic field components at Earth's surface (dB/dt) and sudden impulse or storm sudden commencement events detection, as well as ground electrical conductivities.					
Justification:	For input to GIC calculations and for incorporation into end-to-end space weather simulation.				
Comments:					

Source Requirements:	MR-SSA-SWE-400		
Related Requirements:	SWE-CRD-GEN-1717	**Verification Method:**	Design Review Test

SWE-CRD-GEN-1734	**Service:**	GEN	**Priority:**	Essential	SWE
Model for meteoroid stream fluxes					
Justification:	For input to impact risk calculation.				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

SWE-CRD-GEN-1735	**Service:**	GEN	**Priority:**	Essential	SWE
Model for debris cloud evolution					
Justification:	For input to impact risk prediction.				
Comments:					
Source Requirements:	MR-SSA-SWE-390 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review Test

As for the data requirements, it is expected that, taken individually, these models would support all of the high level services. Exceptions are stated in addition to the relevant data requirements.

13.5 Performance requirements

SWE-CRD-GEN-1736	**Service:**	GEN	**Priority:**	Essential	SWE
Appropriate values of maximum outage duration, minimum time between outages, and maximum time to repair in case of outage shall be established for all services.(*)					
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. Consequently, the services, the data and products should be available on as near to a continuous 24-7 basis as possible and any unexpected outages shall be guaranteed to be dealt with in an agreed time period.				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:				**Verification Method:**	Design Review

SWE-CRD-GEN-1737	**Service:**	GEN	**Priority:**	Essential	SWE
The services provided by the SSA 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.		
Comments:	strategies for handling gaps shall be identified as for any data source.		
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400		
Related Requirements:		**Verification Method:**	Design Review

SWE-CRD-GEN-1738	**Service:**	GEN	**Priority:**	Essential	SWE
The SSA 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:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1739	**Service:**	GEN	**Priority:**	Essential	SWE
Space and ground segments shall include calibration information on SSA-SWE data.					
Justification:	Good calibration of data is required with a view to standardisation.				
Comments:					
Source Requirements:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Analysis Design Review Inspection	

SWE-CRD-GEN-1741	**Service:**	GEN	**Priority:**	Essential	SWE
The Service shall simulate 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-magnetopsheric-ionospheric environment is required for forecasting and future architecture optimisation				
Comments:					
Source Requirements:	MR-SSA-SWE-320 MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review Test	

SWE-CRD-GEN-1742	Service:	GEN	Priority:	Essential	SWE
The service 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:	MR-SSA-SWE-400				
Related Requirements:			**Verification Method:**	Design Review	

14 COMMON REQUIREMENTS

14.1 Governance Requirements

COM-CRD-GEN-893	Service:	GEN	Priority:	Desirable
All observational and intermediate data and all resulting products shall be stored and made available on request for a period of at least 50 years(*). This shall comprise: - Sensor raw data, - Intermediate data, - Transmitted service products - All data transfers across the segment boundaries in both directions and in between the elements				
Justification:	It may be required to reanalyse data. While the intial development and operations lifetime of SSA is 30 years, stored data may need to be accessed even after the termination of the program i.e. after 50 years.			
Comments:	The 50 years are an initial starting assumption. The services for spacecraft designers will require analysis of historical data in the form of entire datasets which will have a timescale of >50 years. What is on-line or off-line depends of the technology available at a time and affordability. The archive shall be evolutive over this period of time, allowing to follow the technology.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-894	Service:	GEN	Priority:	Essential
It shall be possible to browse and filter all "archived data" as required in COM-CRD-GEN-893. Filtering functions are intended customisable by users.				
Justification:	Required in order to retrieve data sets			
Comments:	“Customizable” means that the user can specify exactly what data he wants to retrieve.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Test	

COM-CRD-GEN-895	Service:	GEN	Priority:	Essential
Once an operational service is established, any changes to the related systems shall not interrupt the provision of the operational service.				
Justification:	Operational (sometimes time critical) activities rely on the continuity of the service			
Comments:	The transition may a period of unavailability, as far as compliance to overall availability requirements is met.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-899	Service:	GEN	Priority:	Essential
The SSA segments shall be able to handle data while maintaining the Intellectual Property Right of the data producer. Ownership and IPR issues shall be addressed by the SSA segments				
Justification:	Otherwise they may not provide certain data.			
Comments:	An example are measurements of asteroid taxonomy by scientific groups - they may want to keep their measurements for themselves until they have published the data, but the SSA-NEO centre may want to use it before publication. The implementation mechanism could be a non-disclosure agreement which would be part of any service-level agreements.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Analysis	

COM-CRD-GEN-900	Service:	GEN	Priority:	Essential
Subject to agreement with third parties entities, it shall be legally possible to handover the system or parts of it (development, maintenance, evolution and data) to third parties.				
Justification:	ESA may have to hand over the system after development to third-party operations. Contributing sensors are systems that are not developed in the frame of the SSA program.			
Comments:	Software licences, hardware, maintenance contract, SLA, data, etc. must be handover to third parties (in part or as a whole).			
Source Requirements:				
Related Requirements:		**Verification Method:**	Analysis	

COM-CRD-GEN-902	Service:	GEN	Priority:	Essential
All developments shall follow the ECSS suite of standards for space engineering [AD3] tailored as per the need of the programme.				
Justification:	The development of the segments is an ESA project and shall therefore follow the usual standardised approach. This only refers on components to be developed in the frame of the program. Following a standard will reduce risk and errors.			
Comments:	The detailed standards to be followed will be defined in the system definition phase.			
Source Requirements:				
Related Requirements:	ECSS standards.	**Verification Method:**	Design Review	

COM-CRD-GEN-903	Service:	GEN	Priority:	Essential
The SSA system development and operations shall comply with applicable safety regulations and standards.				
Justification:	In order to sensure safe operations of all SSA related systems in compliance with the applicable safetly standards of the development and operating entity(ies).			
Comments:	References to applicable safety standards are available at ESA sites. The list of applicable standards for the SSA operation is not defined at the present time. It will be defined at a later stage once the future SSA operating entity (ies) are known.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-904	Service:	GEN	Priority:	Essential
All space-based components shall be designed and operated according to the Requirements on Space Debris Mitigation for Agency Projects [AD4]. After hand-over to a third party, [AD4] and ISO standards [AD5] shall apply as well as the applicable regulations available at the time of development and operations. The proposed approach is to identify at the time of design/development of such sensor the existing regulations (national, European and international) on the subject and to make applicable the most stringent regulation.				
Justification:	[AD4] is mandatory for all space missions initiated by ESA since April 1st 2008. The applicable regulations and standards will be integrated and referred to in the SSA data policy.			
Comments:	Space-based components might be required.			
Source Requirements:				
Related Requirements:		Verification Method:	Design Review	

COM-CRD-GEN-905	Service:	GEN	Priority:	Essential
The SSA system shall be developed, operated and maintained according to SSA governance and data policy.				
Justification:	In order to follow the applicable governance scheme			
Comments:				
Source Requirements:	**MR-SSA-POL-610** **MR-SSA-POL-620** **MR-SSA-POL-690**			
Related Requirements:		Verification Method:	Design Review	

COM-CRD-GEN-906	Service:	GEN	Priority:	Essential
The SSA system shall be designed to be maintainable throughout the service lifetime. The selection of long-term maintainable components shall be preferred to new component adaptation/re-qualification.				
Justification:	The selection of long-term maintainable components is preferred to segment adaptation/re-qualification w.r.t to new components			
Comments:				
Source Requirements:				
Related Requirements:		Verification Method:	Analysis	

COM-CRD-GEN-908	Service:	GEN	Priority:	Essential
The SSA system shall first rely on the federation of the declared assets in Europe, providing they satisfy the necessary requirements in terms of performances, data policy and availability, and that their use is proven to be cost effective.				
Justification:	First services (even with limited coverage and performance) shall be made available quickly for core SSA functions, such as to support the safe operation of spacecraft.			
Comments:				
Source Requirements:				
Related Requirements:		Verification Method:	Design Review	

COM-CRD-GEN-909	Service:	GEN	Priority:	Essential
The SSA system shall provide training facilities for operators covering all services operational at a given time.				
Justification:	New procedures and new personal can be trained			

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

COM-CRD-GEN-910	**Service:**	GEN	**Priority:**	Essential
The SSA system shall allow replaying processes associated with all services using archived data and recorded data exchange.				
Justification:	This is meant to support trouble-shooting and handling of user requests and claims			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Test	

COM-CRD-GEN-911	**Service:**	GEN	**Priority:**	Essential
The SSA system shall provide a simulation environment for training and validation processes that shall be independent of the operational environment and shall not interfere with the operational environment (specific resources, no disturbance to the operational environment).				
Justification:	Continuity and integrity of the services is to be guaranteed			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-912	**Service:**	GEN	**Priority:**	Essential
The SSA system shall provide a user support.				
Justification:	This is intended to provide a concept how the system shall respond to non-standardised user requests outside of the specified envelope (e.g. special requests, helpdesk, request for archived data, particular technical questions of interests, dedicated analysis requests,...)			
Comments:	An operational concept shall be defined later.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-914	**Service:**	GEN	**Priority:**	Essential
The SSA system shall be able to make available any selected raw data from archive (off-line archive) within 48 hours (*) after the commanding request.				
Justification:	Such stored data is required for offline applications only (training, calibration,...)			
Comments:	The requirement on the storage of raw data is mentioned in the related requirement SST-CRD-GEN-3050			
Source Requirements:				
Related Requirements:	SST-CRD-GEN-3050	**Verification Method:**	Test	

COM-CRD-GEN-917	**Service:**	GEN	**Priority:**	Essential

The services provided by the SSA system to the users shall be accessible from the most common operating systems.			
Justification:	In order to ensure that the services provided by the SSA system can actually be accessed by the intended user community.		
Comments:	At least for the most common platforms		
Source Requirements:			
Related Requirements:		**Verification Method:**	Test

COM-CRD-GEN-918	**Service:**	GEN	**Priority:**	Essential
The interface between the system and the users shall be such that it is possible for the user to develop his/her own tool to access the services.				
Justification:	In order to allow development of efficent third-party services (added value services) based on data provided by the SSA system through its services.			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Analysis Design Review	

COM-CRD-GEN-919	**Service:**	GEN	**Priority:**	Essential
For the development of the SSA system, the procurement of advanced technology shall be performed in priority with European companies. The procurement of non-European technologies shall be duly justified. For all developments of the SSA system within ESA, the procurement rules of ESA shall be applicable.				
Justification:	A large degree of independence from non-European suppliers shall be maintained for critical components			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Inspection	

COM-CRD-GEN-924	**Service:**	GEN	**Priority:**	Essential
The SSA system shall be designed to support an initial lifetime of 50 years.				
Justification:	In order to envisage architecture implications from the system lifetime, this initial assumption has been made.			
Comments:	The initial lifetime shall be counted from the day when the system becomes operational.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Analysis	

COM-CRD-GEN-925	**Service:**	GEN	**Priority:**	Essential
The standard time of the segments will be synchronised to UTC				
Justification:	UTC is a well defined time-frame to which most of the available synchronisation sources comply to. For liability reasons, data, products, information have to be time tagged on UTC. The initial lifetime stats with the initialization of the full SSA programme and includes development and operations.			
Comments:				

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

COM-CRD-GEN-926	**Service:**	GEN	**Priority:**	Essential
All SSA segments shall use common reference coordinate systems: Earth-fixed, geocentric inertial, and barycentric inertial.				
Justification:	For Earth-fixed a realisation of the ITRS (ITRF coordinates) is most appropriate, for geocentric inertial EME2000/J2000 is recommended, for the barycentric inertial a realisation of the ICRS(ICRF coordinates).			
Comments:	This would avoid inter-segment inconsistencies.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-2278	**Service:**	GEN	**Priority:**	
The SSA System shall use standard SI units and fundamental constants.				
Justification:	In order to ensure consistency between the SSA system and other systems in term of SI units and fundamental constants.			
Comments:	The values defined by the Committee on Data for Science and Technology (CODATA) shall be considered.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-2279	**Service:**	GEN	**Priority:**	
The values of fundamental constants (eg. the speed of light) shall be defined and used systematically and consistently throughout the SSA system.				
Justification:	In order to ensure consistency between different subsystems using the same fundamental constants.			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-928	**Service:**	GEN	**Priority:**	Essential
The SSA System shall have the capability of interfacing with external systems, such as contributing sensors or data centres, for the purpose of exchanging data.				
Justification:	Minor planet center is the main source of NEO data. NOAA/SWPC and ISES regional warning centres are the main entities today for providing world wide space weather services.			
Comments:	According to the program proposal [AD2]. This is an integration in a technical sense to be implemented by service level agreements, ownerships will not change			
Source Requirements:				
Related		**Verification**	Design Review	

Requirements:		**Method:**	

COM-CRD-GEN-929	**Service:**	GEN	**Priority:**	Essential
The SSA shall contribute to the definition of guidelines and recommendations set up by the United Nations and shall aim complying with them.				
Justification:	To fit into the international framework.			
Comments:	UN-COPUOS currently discusses this issue. No SR may be linked to this CR.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Analysis	

COM-CRD-GEN-940	**Service:**	GEN	**Priority:**	Essential
Standard Man Machine Interface guidelines for design and implementation shall be applied to SSA.				
Justification:	Design harmonisation.			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

14.2 Data Policy

COM-CRD-GEN-1610	**Service:**	GEN	**Priority:**	
Each SSA segment shall be able to perform its functionality independently of the availability of the other segments within the system.				
Justification:	Segments have to be independent from each other. It is not required to have full performance of the segment if updated information is not available, but still function with be provided.			
Comments:	There may be some exceptions, see e.g. SST-CRD-GEN-720.			
Source Requirements:	**MR-SSA-POL-650** **MR-SSA-POL-710** **MR-SSA-POL-720** **MR-SSA-POL-730**			
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-1611	**Service:**	GEN	**Priority:**	
Interfaces between different components of the SSA system and between the SSA 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:			
Related Requirements:		**Verification Method:**	Design Review Test

COM-CRD-GEN-1612	**Service:**	GEN	**Priority:**	
It shall be possible to know the status of each of the SSA system segments and assets, including (whenever this information is provided) status of external entities, communication links and contributing sensors.				
Justification:	Knowledge of the status of the different components is essential for operations, failure detection and correction (increased system availability) and system analysis, which should be used in order to assess potential improvement, evolution proposals, etc.			
Comments:	Where possible, it is desirable to be able to monitor elements external to the system so that it is possible to correlate system errors/unavailability with these entities. Obviously, it is only possible when the owner of the entities/assets provide this information.			
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-930	**Service:**	GEN	**Priority:**	Essential
Reports (alert, warning, etc.) generated by the SSA services to end users shall contain a clear indication of the data they are based upon and the source and reliability of that data.				
Justification:	Needed for assessment of reliability of the services.			
Comments:				
Source Requirements:	**MR-SSA-POL-660**			
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-1609	**Service:**	GEN	**Priority:**	
The SSA data policy shall apply to all the SSA services. In case of conflict, this requirement shall take precedence to all other requirements.				
Justification:				
Comments:	New CR created following discussion on COM-CRD-GEN-930 during CRD review.			
Source Requirements:	**MR-SSA-POL-610** **MR-SSA-POL-690**			
Related Requirements:		**Verification Method:**	Design Review Test	

COM-CRD-GEN-931	**Service:**	GEN	**Priority:**	Essential
The SSA system shall provide metrics to quantify the quality (reliability, availability, accuracy, ...) of data, data sources, data products and services.				
Justification:	Needed for assessment of reliability of the services.			
Comments:				
Source Requirements:	**MR-SSA-POL-660**			
Related Requirements:	SWE-CRD—0090-DAT to 0110-DAT, 0150-DAT	**Verification Method:**	Design Review	

COM-CRD-GEN-2285	**Service:**	GEN	**Priority:**	Essential

The Data Policy shall govern the acquisition of, production, access to, dissemination and use of SSA data.			
Justification:			
Comments:			
Source Requirements:	**MR-SSA-POL-610**		
Related Requirements:	SWE-CRD—0090-DAT to 0110-DAT, 0150-DAT	**Verification Method:**	Design Review

COM-CRD-GEN-2286	**Service:**	GEN	**Priority:**	Essential
The SSA Data Policy shall cover data related to both, SSA development and SSA operational phases				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-620**			
Related Requirements:	SWE-CRD—0090-DAT to 0110-DAT, 0150-DAT	**Verification Method:**	Design Review	

COM-CRD-GEN-2287	**Service:**	GEN	**Priority:**	Essential
The SSA Data Policy shall comply with the applicable regulations on privacy and personal data protection.				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-630**			
Related Requirements:	SWE-CRD—0090-DAT to 0110-DAT, 0150-DAT	**Verification Method:**	Design Review	

14.3 Health and Safety Policy

COM-CRD-GEN-920	**Service:**	GEN	**Priority:**	Essential
For ground based systems, all electrical devices forming part of the segment shall be certified and labelled with a “CE” marking				
Justification:	In order to ensure that all electrical devices used within the SSA system are compliant with applicable EC Directives.			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Inspection	

COM-CRD-GEN-921	**Service:**	GEN	**Priority:**	Essential
For ground based systems, all radiating components and their shelters, housings and sites shall follow the applicable national and EU laws and regulations whichever are more stringent.				
Justification:	In order to ensure that all radiating devices used within the SSA system are compliant with applicable EU laws and regulations.			
Comments:				
Source Requirements:				

Related Requirements:		**Verification Method:**	Inspection

COM-CRD-GEN-922	**Service:**	GEN	**Priority:**	Essential
For ground based systems, the design, the development and operation of the SSA System shall be subject to the applicable safety standards of the relevant local, national, and international authorities.				
Justification:	In order to ensure that relevant local, national, and international safety standards are met be all components in the distributed SSA system.			
Comments:				
Source Requirements:				
Related Requirements:		**Verification Method:**	Design Review	

14.4 Auditing and Accounting

COM-CRD-GEN-2276	**Service:**	GEN	**Priority:**	Desirable
The SSA system shall maintain user statistics and shall be able to enforce usage policies, based on accounting that impose restrictions in terms of usage statistics and user properties.				
Justification:	Accounting may be required to support operational scenarios			
Comments:				
Source Requirements:	**MR-SSA-POL-670**			
Related Requirements:		**Verification Method:**	Design Review	

COM-CRD-GEN-2277	**Service:**	GEN	**Priority:**	Essential
The SSA system shall record all accesses to SSA information being either internal or external to the SSA system.				
Justification:				
Comments:	This is a precaution to be able to respond to legal issues.			
Source Requirements:	**MR-SSA-POL-630** **MR-SSA-POL-660** **MR-SSA-POL-670**			
Related Requirements:		**Verification Method:**	Design Review	

14.5 Priority Handling

COM-CRD-GEN-2263	**Service:**	GEN	**Priority:**	Essential
Every SSA system where one-to-many interfaces are present shall include mechanisms that allow the priority to be defined, configured, and implemented.				
Justification:				
Comments:	Need to allocate resources according to priority			
Source Requirements:	**MR-SSA-POL-610**			

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

COM-CRD-GEN-2264	**Service:**	GEN	**Priority:**	Essential
Every SSA system shall clearly document the priority handling mechanisms that are implemented.				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-610**			
Related Requirements:		**Verification Method:**	Inspection Test	

COM-CRD-GEN-2265	**Service:**	GEN	**Priority:**	Essential
Every SSA system shall clearly document the procedures to alter the configuration of the priority handling.				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-610**			
Related Requirements:		**Verification Method:**	Inspection Test	

COM-CRD-GEN-2266	**Service:**	GEN	**Priority:**	Essential
Every SSA system shall allow the operations teams to reconfigure the priority handling without interrupting normal operations.				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-610**			
Related Requirements:		**Verification Method:**	Inspection Test	

COM-CRD-GEN-2267	**Service:**	GEN	**Priority:**	Essential
Every SSA system shall allow the active configuration of the priority handling to be readily visualised.				
Justification:				
Comments:				
Source Requirements:	**MR-SSA-POL-610**			
Related Requirements:		**Verification Method:**	Inspection Test	

15 TRACEABILITY MATRIX

Reference	out-links to MRD (Historical Req Number)
SWE-CRD-SEG-1504	MR-SSA-SWE-320

	MR-SSA-SWE-350
SWE-CRD-SEG-2632	MR-SSA-SWE-350
SWE-CRD-SEG-1505	MR-SSA-SWE-320 MR-SSA-SWE-350
SWE-CRD-SEG-1506	MR-SSA-SWE-320 MR-SSA-SWE-350 MR-SSA-SWE-400
SWE-CRD-SEG-1638	MR-SSA-SWE-320 MR-SSA-SWE-350 MR-SSA-SWE-400
SWE-CRD-SEG-1677	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SEG-2633	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SEG-2634	MR-SSA-SWE-400
SWE-CRD-SEG-1740	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SEG-1786	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SCD-1507	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCD-1508	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCD-1509	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCD-1510	MR-SSA-SWE-330 MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCD-1511	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCD-1512	MR-SSA-SWE-400
SWE-CRD-SCD-1513	MR-SSA-SWE-400
SWE-CRD-SCD-1514	MR-SSA-SWE-400
SWE-CRD-SCD-1515	MR-SSA-SWE-400
SWE-CRD-SCD-1516	MR-SSA-SWE-400
SWE-CRD-SCD-1517	MR-SSA-SWE-400
SWE-CRD-SCD-1518	MR-SSA-SWE-400
SWE-CRD-SCD-1519	MR-SSA-SWE-400
SWE-CRD-SCD-1520	MR-SSA-SWE-400
SWE-CRD-SCD-1521	MR-SSA-SWE-400
SWE-CRD-SCD-1522	MR-SSA-SWE-400
SWE-CRD-SCD-1523	MR-SSA-SWE-400
SWE-CRD-SCD-1524	MR-SSA-SWE-390 MR-SSA-SWE-400

SWE-CRD-SCD-1525	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCD-1526	MR-SSA-SWE-400
SWE-CRD-SCD-2635	MR-SSA-SWE-400
SWE-CRD-SCD-1527	MR-SSA-SWE-400
SWE-CRD-SCD-1528	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SCD-1529	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SCO-1530	MR-SSA-SWE-320 MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SCO-1531	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCO-1532	MR-SSA-SWE-360 MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCO-1533	MR-SSA-SWE-340 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1534	MR-SSA-SWE-340 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1535	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1536	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1537	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1538	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1539	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1540	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1541	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1542	MR-SSA-SWE-320

	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1544	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1545	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1546	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-SCO-1547	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCO-1548	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SCO-1549	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1550	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-2637	MR-SSA-SWE-400
SWE-CRD-SCO-1551	MR-SSA-SWE-400
SWE-CRD-SCO-2650	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1553	MR-SSA-SWE-400
SWE-CRD-SCO-1554	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1555	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1556	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1557	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1558	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1559	MR-SSA-SWE-400
SWE-CRD-SCO-1560	MR-SSA-SWE-400
SWE-CRD-SCO-1561	MR-SSA-SWE-400
SWE-CRD-SCO-1562	MR-SSA-SWE-400
SWE-CRD-SCO-1563	MR-SSA-SWE-400
SWE-CRD-SCO-1564	MR-SSA-SWE-400
SWE-CRD-SCO-1565	MR-SSA-SWE-400
SWE-CRD-SCO-1566	MR-SSA-SWE-400
SWE-CRD-SCO-1567	MR-SSA-SWE-400
SWE-CRD-SCO-1568	MR-SSA-SWE-400
SWE-CRD-SCO-1569	MR-SSA-SWE-400
SWE-CRD-SCO-1570	MR-SSA-SWE-400
SWE-CRD-SCO-1571	MR-SSA-SWE-400
SWE-CRD-SCO-1572	MR-SSA-SWE-400
SWE-CRD-SCO-1573	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-SCO-1574	MR-SSA-SWE-390

	MR-SSA-SWE-400
SWE-CRD-SCO-2636	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1575	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SCO-1576	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1577	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1578	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1579	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1580	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1581	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCO-1582	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SCO-1583	MR-SSA-SWE-400
SWE-CRD-SCO-1584	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1585	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1586	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1587	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SCO-1588	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SCO-2638	MR-SSA-SWE-400
SWE-CRD-SCO-1589	MR-SSA-SWE-320 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCO-1590	MR-SSA-SWE-400
SWE-CRD-SCO-1591	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1592	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1593	MR-SSA-SWE-330

	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1594	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1595	MR-SSA-SWE-330 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCH-1596	MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-1598	
SWE-CRD-SCH-1599	MR-SSA-SWE-400
SWE-CRD-SCH-1600	MR-SSA-SWE-400
SWE-CRD-SCH-1601	MR-SSA-SWE-400
SWE-CRD-SCH-1602	MR-SSA-SWE-400
SWE-CRD-SCH-1603	MR-SSA-SWE-400
SWE-CRD-SCH-1604	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SCH-1605	
SWE-CRD-SCH-1606	MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-1607	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1608	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-2681	MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-1609	MR-SSA-SWE-320 MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-1610	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1611	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SCH-1612	MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-SCH-1613	MR-SSA-SWE-310 MR-SSA-SWE-350 MR-SSA-SWE-400
SWE-CRD-LAU-1614	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-LAU-1615	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-LAU-1616	MR-SSA-SWE-400
SWE-CRD-LAU-1617	MR-SSA-SWE-380

	MR-SSA-SWE-400
SWE-CRD-LAU-1618	MR-SSA-SWE-400
SWE-CRD-LAU-1619	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-LAU-1620	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-LAU-1622	
SWE-CRD-LAU-2683	MR-SSA-SWE-400
SWE-CRD-LAU-1623	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1624	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1625	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1626	
SWE-CRD-LAU-2684	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1627	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1628	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1629	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1630	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1631	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1632	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-LAU-1621	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1633	MR-SSA-SWE-320 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1634	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-TIO-1635	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1636	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-TIO-1637	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-2652	MR-SSA-SWE-340 MR-SSA-SWE-400

SWE-CRD-TIO-1639	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1640	MR-SSA-SWE-400
SWE-CRD-TIO-1641	MR-SSA-SWE-400
SWE-CRD-TIO-1642	MR-SSA-SWE-400
SWE-CRD-TIO-1643	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1644	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1645	MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-TIO-1646	MR-SSA-SWE-400
SWE-CRD-TIO-1647	MR-SSA-SWE-400
SWE-CRD-TIO-1648	MR-SSA-SWE-400
SWE-CRD-TIO-1649	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1650	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1651	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1652	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1653	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-TIO-1654	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SST-1655	MR-SSA-SWE-400
SWE-CRD-SST-1656	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1657	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1658	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1659	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SST-1661	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SST-1665	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SST-2682	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-SST-1663	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-SST-1662	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1664	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1666	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-SST-1667	MR-SSA-SWE-320

	MR-SSA-SWE-400
SWE-CRD-SST-1668	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SST-1669	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SST-1670	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-SST-1671	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-NSO-1744	MR-SSA-SWE-400
SWE-CRD-NSO-1745	MR-SSA-SWE-400
SWE-CRD-NSO-1746	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-2640	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1747	MR-SSA-SWE-400
SWE-CRD-NSO-1748	MR-SSA-SWE-400
SWE-CRD-NSO-1749	MR-SSA-SWE-330 MR-SSA-SWE-400
SWE-CRD-NSO-1750	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1751	MR-SSA-SWE-330 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1752	MR-SSA-SWE-400
SWE-CRD-NSO-1753	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1754	MR-SSA-SWE-360 MR-SSA-SWE-370 MR-SSA-SWE-400
SWE-CRD-NSO-1755	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-NSO-1756	MR-SSA-SWE-400
SWE-CRD-NSO-1757	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-NSO-1758	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1759	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1760	MR-SSA-SWE-400
SWE-CRD-NSO-2597	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-NSO-2598	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-NSO-2599	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-NSO-2600	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-NSO-1761	MR-SSA-SWE-400

SWE-CRD-NSO-1762	MR-SSA-SWE-400
SWE-CRD-NSO-1763	MR-SSA-SWE-400
SWE-CRD-NSO-1764	MR-SSA-SWE-400
SWE-CRD-NSO-1765	MR-SSA-SWE-400
SWE-CRD-NSO-1766	MR-SSA-SWE-400
SWE-CRD-NSO-1767	MR-SSA-SWE-400
SWE-CRD-NSO-1768	MR-SSA-SWE-400
SWE-CRD-NSO-1769	MR-SSA-SWE-400
SWE-CRD-NSO-1770	MR-SSA-SWE-400
SWE-CRD-NSO-1771	MR-SSA-SWE-400
SWE-CRD-NSO-1772	MR-SSA-SWE-400
SWE-CRD-NSO-2596	MR-SSA-SWE-400
SWE-CRD-NSO-1773	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-NSO-2641	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-NSO-1774	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-NSO-1775	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1672	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-GEN-2659	MR-SSA-SWE-320 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-GEN-2658	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-2657	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-2656	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2655	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2654	MR-SSA-SWE-400
SWE-CRD-GEN-1673	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-GEN-2665	MR-SSA-SWE-400
SWE-CRD-GEN-2666	MR-SSA-SWE-370 MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-GEN-2667	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2668	MR-SSA-SWE-400
SWE-CRD-GEN-2669	MR-SSA-SWE-400
SWE-CRD-GEN-1674	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2670	MR-SSA-SWE-400
SWE-CRD-GEN-2671	MR-SSA-SWE-360 MR-SSA-SWE-400

SWE-CRD-GEN-2672	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1675	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1676	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-GEN-1678	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-GEN-2673	MR-SSA-SWE-310 MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-GEN-2674	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-GEN-2675	MR-SSA-SWE-310 MR-SSA-SWE-400
SWE-CRD-GEN-2676	MR-SSA-SWE-400
SWE-CRD-GEN-2677	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-2678	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-GEN-2679	MR-SSA-SWE-380 MR-SSA-SWE-400
SWE-CRD-GEN-2680	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1679	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-2653	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1680	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2642	MR-SSA-SWE-400
SWE-CRD-GEN-2643	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-1681	MR-SSA-SWE-400
SWE-CRD-GEN-1682	MR-SSA-SWE-340 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2645	MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2646	MR-SSA-SWE-310 MR-SSA-SWE-360 MR-SSA-SWE-400
SWE-CRD-GEN-2647	MR-SSA-SWE-400
SWE-CRD-GEN-1683	MR-SSA-SWE-400
SWE-CRD-GEN-1685	MR-SSA-SWE-400
SWE-CRD-GEN-1686	MR-SSA-SWE-340 MR-SSA-SWE-400
SWE-CRD-GEN-1687	MR-SSA-SWE-400
SWE-CRD-GEN-1688	MR-SSA-SWE-400
SWE-CRD-GEN-1689	MR-SSA-SWE-400

SWE-CRD-GEN-1690	MR-SSA-SWE-400
SWE-CRD-GEN-1691	MR-SSA-SWE-400
SWE-CRD-GEN-1692	MR-SSA-SWE-400
SWE-CRD-GEN-1693	MR-SSA-SWE-400
SWE-CRD-GEN-1694	MR-SSA-SWE-400
SWE-CRD-GEN-1695	MR-SSA-SWE-400
SWE-CRD-GEN-1696	MR-SSA-SWE-400
SWE-CRD-GEN-1697	MR-SSA-SWE-400
SWE-CRD-GEN-1698	MR-SSA-SWE-400
SWE-CRD-GEN-1699	MR-SSA-SWE-400
SWE-CRD-GEN-1700	MR-SSA-SWE-400
SWE-CRD-GEN-1701	MR-SSA-SWE-400
SWE-CRD-GEN-1702	MR-SSA-SWE-400
SWE-CRD-GEN-1703	MR-SSA-SWE-400
SWE-CRD-GEN-1704	MR-SSA-SWE-400
SWE-CRD-GEN-1705	MR-SSA-SWE-400
SWE-CRD-GEN-1706	MR-SSA-SWE-400
SWE-CRD-GEN-1707	MR-SSA-SWE-400
SWE-CRD-GEN-1708	MR-SSA-SWE-400
SWE-CRD-GEN-1709	MR-SSA-SWE-400
SWE-CRD-GEN-1710	MR-SSA-SWE-400
SWE-CRD-GEN-1711	MR-SSA-SWE-400
SWE-CRD-GEN-1712	MR-SSA-SWE-400
SWE-CRD-GEN-1713	MR-SSA-SWE-400
SWE-CRD-GEN-1714	MR-SSA-SWE-400
SWE-CRD-GEN-1715	MR-SSA-SWE-400
SWE-CRD-GEN-1716	MR-SSA-SWE-400
SWE-CRD-GEN-1717	MR-SSA-SWE-400
SWE-CRD-GEN-1718	MR-SSA-SWE-400
SWE-CRD-GEN-1719	MR-SSA-SWE-400
SWE-CRD-GEN-1720	MR-SSA-SWE-400
SWE-CRD-GEN-1721	MR-SSA-SWE-400
SWE-CRD-GEN-1722	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-GEN-1723	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-GEN-1724	MR-SSA-SWE-400
SWE-CRD-GEN-1725	MR-SSA-SWE-400
SWE-CRD-GEN-1726	MR-SSA-SWE-400
SWE-CRD-GEN-1727	MR-SSA-SWE-400
SWE-CRD-GEN-1728	MR-SSA-SWE-400
SWE-CRD-GEN-1729	MR-SSA-SWE-400
SWE-CRD-GEN-1730	MR-SSA-SWE-400
SWE-CRD-GEN-1731	MR-SSA-SWE-400
SWE-CRD-GEN-1732	MR-SSA-SWE-400
SWE-CRD-GEN-1733	MR-SSA-SWE-400
SWE-CRD-GEN-1734	MR-SSA-SWE-390 MR-SSA-SWE-400
SWE-CRD-GEN-1735	MR-SSA-SWE-390

	MR-SSA-SWE-400
SWE-CRD-GEN-1736	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1737	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1738	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1739	MR-SSA-SWE-400
SWE-CRD-GEN-1741	MR-SSA-SWE-320 MR-SSA-SWE-400
SWE-CRD-GEN-1742	MR-SSA-SWE-400
COM-CRD-GEN-893	
COM-CRD-GEN-894	
COM-CRD-GEN-895	
COM-CRD-GEN-899	
COM-CRD-GEN-900	
COM-CRD-GEN-902	
COM-CRD-GEN-903	
COM-CRD-GEN-904	
COM-CRD-GEN-905	**MR-SSA-POL-610** **MR-SSA-POL-620** **MR-SSA-POL-690**
COM-CRD-GEN-906	
COM-CRD-GEN-908	
COM-CRD-GEN-909	
COM-CRD-GEN-910	
COM-CRD-GEN-911	
COM-CRD-GEN-912	
COM-CRD-GEN-914	
COM-CRD-GEN-917	
COM-CRD-GEN-918	
COM-CRD-GEN-919	
COM-CRD-GEN-924	
COM-CRD-GEN-925	
COM-CRD-GEN-926	
COM-CRD-GEN-2278	
COM-CRD-GEN-2279	
COM-CRD-GEN-928	
COM-CRD-GEN-929	
COM-CRD-GEN-940	
COM-CRD-GEN-1610	**MR-SSA-POL-650** **MR-SSA-POL-710** **MR-SSA-POL-720** **MR-SSA-POL-730**
COM-CRD-GEN-1611	
COM-CRD-GEN-1612	
COM-CRD-GEN-930	**MR-SSA-POL-660**
COM-CRD-GEN-1609	**MR-SSA-POL-610** **MR-SSA-POL-690**

COM-CRD-GEN-931	**MR-SSA-POL-660**
COM-CRD-GEN-2285	**MR-SSA-POL-610**
COM-CRD-GEN-2286	**MR-SSA-POL-620**
COM-CRD-GEN-2287	**MR-SSA-POL-630**
COM-CRD-GEN-920	
COM-CRD-GEN-921	
COM-CRD-GEN-922	
COM-CRD-GEN-2276	**MR-SSA-POL-670**
COM-CRD-GEN-2277	**MR-SSA-POL-630** **MR-SSA-POL-660** **MR-SSA-POL-670**
COM-CRD-GEN-2263	**MR-SSA-POL-610**
COM-CRD-GEN-2264	**MR-SSA-POL-610**
COM-CRD-GEN-2265	**MR-SSA-POL-610**
COM-CRD-GEN-2266	**MR-SSA-POL-610**
COM-CRD-GEN-2267	**MR-SSA-POL-610**