

# SWWT Plenary Meeting 40

---

*Wednesday, 20 November 2019, 14:00 to 16:00*

*Liège, Belgium, Room: Elisabeth*

## **Agenda**

- 2:00PM Welcome and Introduction (Stefaan Poedts)
- 2:05PM Space Weather Prospects in ESA Space Safety Programme (Juha-Pekka Luntama)
- 2:25PM ESA Space Weather Service Network Achievements and Outlook (Alexi Glover)
- 2:50PM ESA Space Environment and Effects Technology Developments in 2019 and Beyond (Piers Jiggins)
- 3:15PM Reports from TWGs (TWG leaders)
- 3:30PM Reports on national activities and perspectives (all members, 15 min)
- 3:45PM Discussion on the ESWW format (Piers Jiggins)
- 3:55PM Any other business

# participants: 110

## Minutes

### Welcome and Introduction

*(Stefaan Poedts)*

SP welcomes the participants and presents the agenda of the meeting which is adopted without any changes.

### Space Weather Prospects in ESA Space Safety Programme

*(Juha-Pekka Luntama)*

Jussi starts by mentioning that the SSA programme will be followed up by the new ESA Space Safety Programme from 2020, subject to the decision of the Space19+ MC meeting next week in Sevilla. This new programme is close to what SSA was but goes beyond it in the sense that active measures will be taken to reduce the detected risks, i.e. threat mitigation and threat remediation response. The structure of the programme (slide 5) shows core activities and 4 dedicated 'corner stones': Lagrange mission, HERA mission, ADRIOS (Active Debris Removal/In-Orbit Servicing) that will actively pick up debris in space, and CREAM (Collision Risk Estimation and Automated Mitigation).

The ESA SSA SWE system today involves 29 pre-operational services based on > 200 products, and more than 40 expert groups. It currently has more than 1100 users and two hosted payload missions are in progress. The objectives by 2030 include early warnings with actionable information, tailored SWE services, a SWE monitoring system.

The Lagrange mission will go to L5 to look 'behind the corner' at the Sun before it is visible from the Earth. The plan is to measure the solar disk magnetic field, EUV imaging, solar X-ray flux, solar wind characteristics, IP magnetic field, solar proton, electron and ion fluxes, all complementary to Sun-Earth measurements. The time schedule is mentioned on Slide 9 of Annex 1 (to be confirmed on the Space19+ meeting next week).

D3S will be covered in a TDM so Jussi did not go into too much detail on this Distributed SWE Sensor System for monitoring SWE impact on the magnetosphere.

The current SWE system will be enhanced (cf. talk of Alexi Glover, next item on agenda).

See the slides in Annex 1.

### SA Space Weather Service Network Achievements and Outlook

*(Alexi Glover)*

Alexi started with an overview of current SWE service network. More than 40 new and updated products were deployed with the latest service upgrade and 4 new services were deployed (in the domains of space surveillance & tracking, spacecraft operation and human spaceflight).

There was the first release of the VSWMC as a 'demonstration product' (a new concept that was created). There was also a restart of the Geomagnetic Conditions ESC this year, with a new coordinator and consortium lead (Michael Hesse, Univ. of Bergen) now taking up the main G-ESC network tasks and going for a new and extended set of products in the planning.

New developments starting in Q4 of 2019 include enhanced solar weather event analysis (UPSud) and a L5 data utilization study (consortium led by RAL Space), focusing on CME propagation. There is also a transition foreseen to the new SWE Portal with a preview on slide 6 of Annex 2. I will include service Dashboards, adapt to mobile devices. The first deployment is expected in May 2020.

The P3-SWE-VIII Service System Design builds on the work done so far to develop the SWE service network and includes a detail system design with an approach and a roadmap for transition to 24/7 operation. The Kick-off is expected in December. The ESCs and SSCC, SWE Data centre continue to be the core of the system, providing the Network framework. It has 3 layers: Data Acquisition (Level 1), Data Processing (Level 2) and Services (Level 3). The system developments will support the overall business logic.

Upcoming SSA P3 Activities include SWE Data System Enhancement, an Arctic Region SWE Data System, etc. See the last slide of Annex 2.

See the slides in Annex 2.

## **ESA Space Environment and Effects Technology Developments in 2019 and Beyond**

*(Piers Jiggins)*

First, Piers gave a quick overview of the responsibilities of Space Environment and Effects Section (TEC-EPS) and then an overview of the wide range of ESA Technology Programmes spanning different TRLs (see slide 3 of Annex 3). He then explained the TRL concept with a fictive but very clear illustration of the different TRLs. The ESA technology programmes include a Technology Development Element (TDE, nominal TRL 1-3), a General Support Technology Programme (GSTP, nominal TRL 3-6), and the Space Situational Awareness (SSA) now transitioning into the Space Safety Programme (S2P, nominal TRL 5-9).

The Open Space Innovation Platform (OSIP) provides a new, open way to inject ideas to ESA. It was tested via an internal call on Space Safety with 61 Ideas and is externally operational since 12 April.

The TDE ongoing activities include the SEP Radiation Advanced Warning System, Plasma Environment modelling, Radiation belt model development, and many others (see slides 7 and 8 in Annex 3). The GSTP Programme also includes many activities, incl. the VSWMC –Part III, 3D EES, SCOPE, XFM-CS, NORM, etc. (cf. slides 9 & 10 in Annex 3).

Upcoming and planned activities include Heliospheric Modelling Techniques (GSTP), etc. (slides 11 and 12 of Annex 3).

See the slides in Annex 3.

## Reports from TWGs

*(TWG leaders)*

**Drivers of Space Weather - Solar Storms:** Olga Malandraki reported that they organized a TDM this morning on the debate of the acceleration mechanisms behind the SEPs.

**Forecaster Forum:** Larisa Trichtchenko reports that forecast is still needed as part of the services.

## Reports on (inter)national activities and perspectives (all members)

Hermann Opgenoorth reports on the European Space Weather Assessment and Consolidation Committee (ESWACC) commissioned by the European Space Sciences Committee of the ESF. ESWACC provided an assessment and recommendations for a Consolidated European Approach to Space Weather as Part of a Global Space Weather Effort. This report, with the recommendations, appeared in J. Space Weather Space Clim. Volume 9, 2019, a few months ago. So it is available to everyone: [https://www.swsc-journal.org/articles/swsc/full\\_html/2019/01/swsc190036/swsc190036.html](https://www.swsc-journal.org/articles/swsc/full_html/2019/01/swsc190036/swsc190036.html)

Hermann Opgenoorth reports that COSPAR has restructured the Space Weather Panel with the request to update the space weather roadmap. Input will be solicited via a web tool generating an update of the roadmap every 5 years. The web tool will be announced on the fair, right after this PM.

Larisa Trichtchenko reports that WMO renewed its 4 years SWE programme. The documents are available online via the WMO website.

## Short discussion on the ESWW format

*(Piers Jiggins)*

Piers requested inputs (ideas, suggestions) using Slido, via the ESWW website:

<https://app.sli.do/event/rauukajb/live/ideas>

## Any other business

The ESWW17 Meeting will be in Glasgow **from 2 to 6 November 2020**.

The meeting closed at 3:30PM



# Space Weather Prospects in ESA Space Safety Programme

Juha-Pekka Luntama  
Head of Space Weather Office  
Space Safety Programme Office

16<sup>th</sup> European Space Weather Week  
18-22 November 2019, Liege, Belgium

ESA UNCLASSIFIED - For Official Use



European Space Agency



# Space Situational Awareness

Provide European autonomy in civil systems and services needed to protect satellites and the Earth



European Space Agency

# Space Safety

Protection of our planet, humanity,  
and assets in space and on Earth from dangers  
originating in Space



# Space Safety

Threat  
Detection and  
Analysis

Threat  
Mitigation

Threat  
Remediation  
Response



## 1 Core



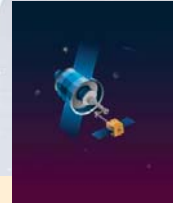
## 2 Lagrange Mission



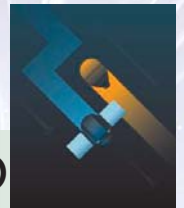
## 3 HERA



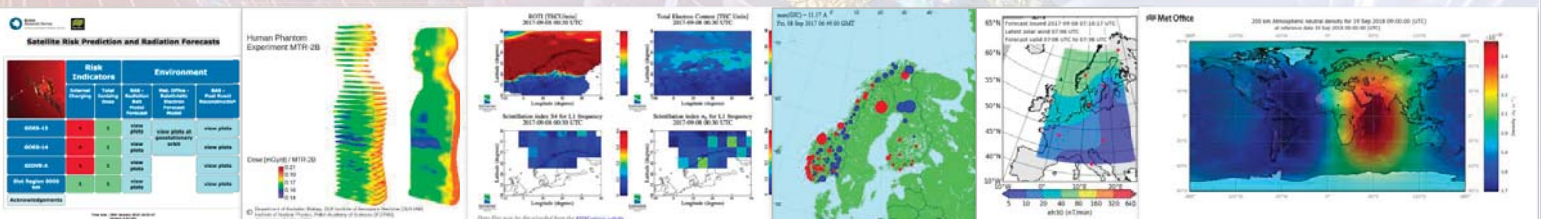
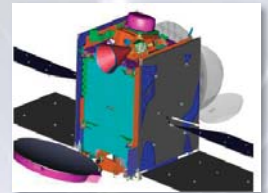
## 4 ADRIOS(Active Debris Removal/In-Orbit Servicing)



## 5 CREAM(Collision Risk Estimation & Automated Mitigation)

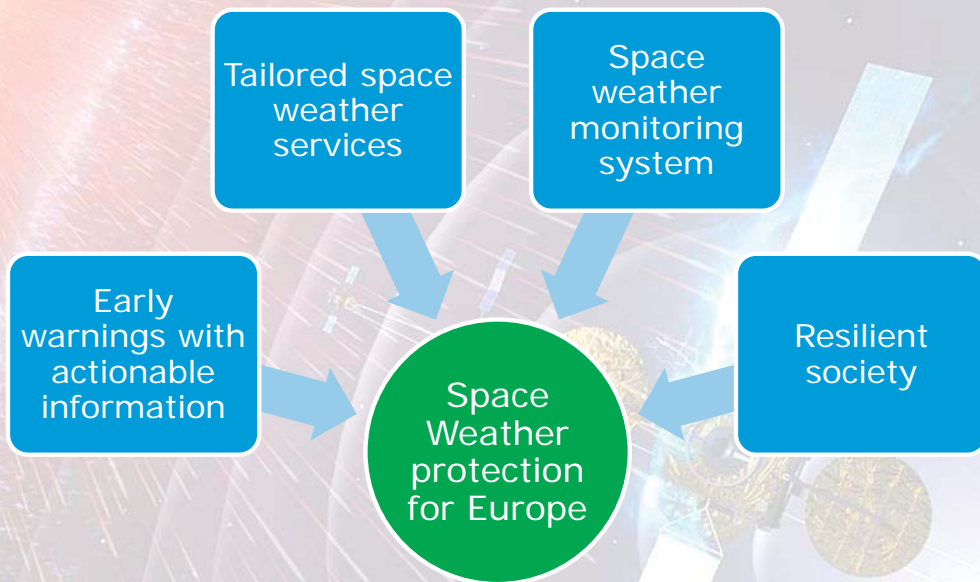


- 29 pre-operational services based on >200 products
- European Service Network of >40 Expert Groups
- > 1100 registered users
- > 700 000 hits on service portal monthly
- Hosted payload missions in progress
- Lagrange mission & D3S





# Space Weather System Objectives by 2030



ESA UNCLASSIFIED - For Official Use

Juha-Pekka Luntama | ESA | 20/11/2019 | Slide 7



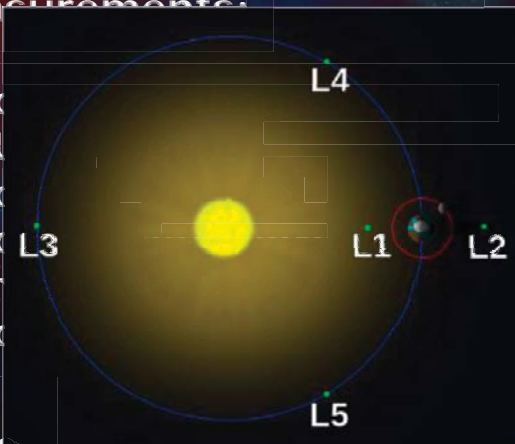
European Space Agency

## Lagrange Mission



### Measurements

- Solar wind
- EUV
- Solar
- Solar
- In
- Solar



Heliospheric imaging

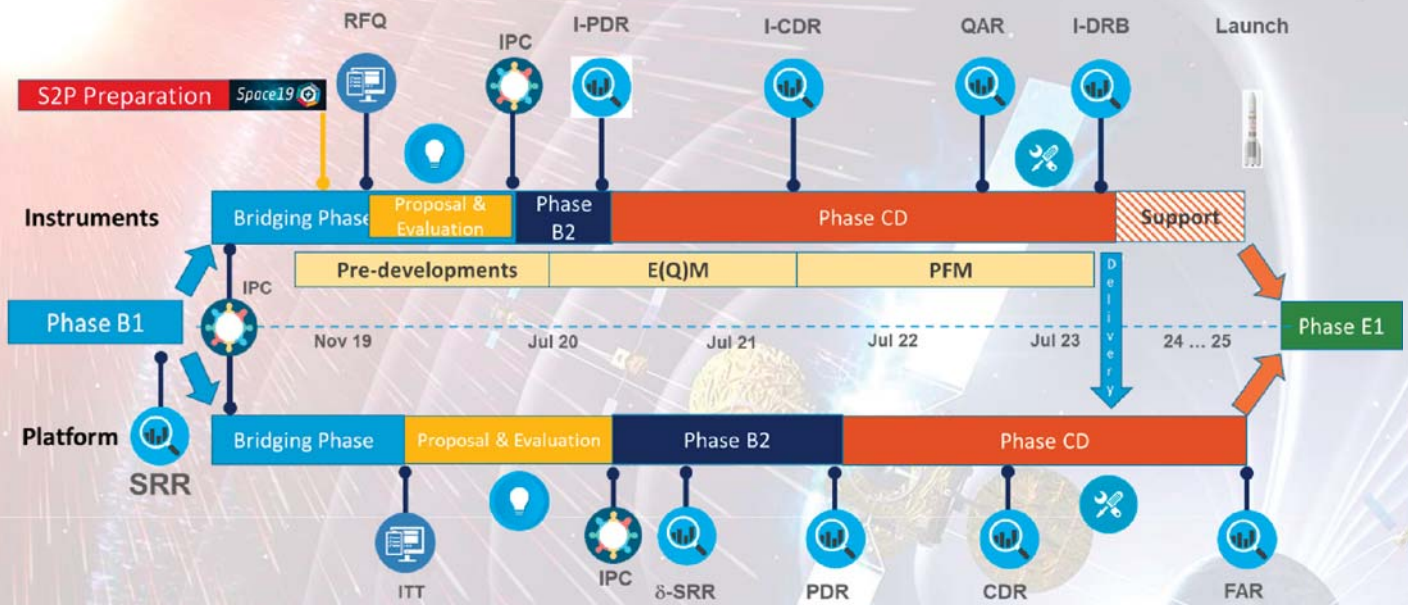
Wide-angle coronagraphy

Complementary to Sun-Earth line measurements



European Space Agency

# Lagrange Mission Timeline



ESA UNCLASSIFIED - For Official Use

Juha-Pekka Luntama | ESA | 20/11/2019 | Slide 9



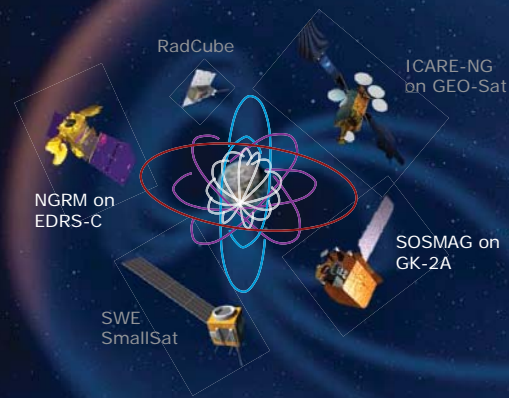
European Space Agency

## Distributed Space Weather Sensor System (D3S)

### Monitoring of SWE impact within Earth's magnetosphere:

- Magnetic field, neutral/charged particle, plasma and micro-particle environment measurements, auroral imaging, ...:

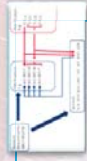
- Hosted Payloads
- Dedicated Small/CubeSats
- LEO/MEO/HEO/GEO
- Ground based observations



European Space Agency



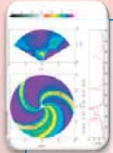
Enhancing Space Weather Service Network



Elaboration of system architecture



Improved space weather data system



Development of models, tools, applications



R2O & O2R



Continuous interaction with users



Coordinated communication protocol



Space weather benchmarks and CBA

## THANK YOU

[swe.ssa.esa.int](http://swe.ssa.esa.int)

[www.esa.int](http://www.esa.int)

*@esaspaceweather*

# ESA Space Weather Service Network: Achievements & Outlook

Alexi Glover, Juha-Pekka Luntama  
Space Weather Office, ESA Space Safety Programme Office  
ESOC, Darmstadt, Germany

ESA UNCLASSIFIED - For Official Use



European Space Agency

## Space Safety

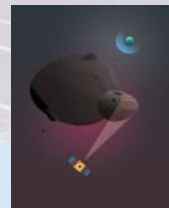
1 Core



2 Lagrange Mission



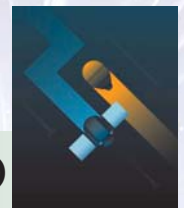
3 HERA



4 ADRIOS (Active Debris Removal/In-Orbit Servicing)



5 CREAM (Collision Risk Estimation & Automated Mitigation)



ESA UNCLASSIFIED - For Official Use

Alexi Glover | 17/11/2019 | Slide 2



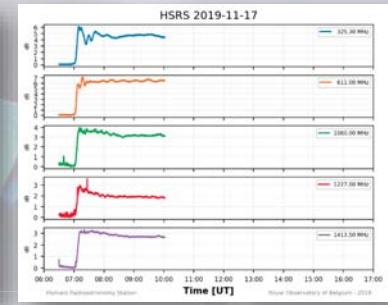
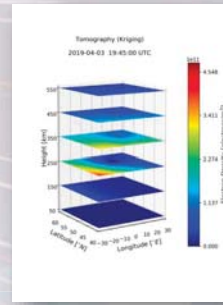
European Space Agency

# SWE Service Network: Some Highlights 2019



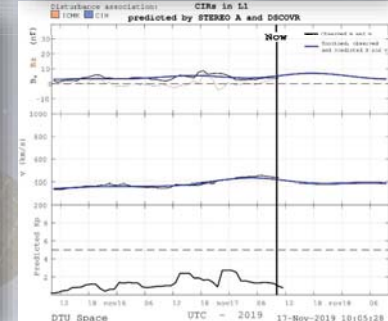
Some highlights from 2019:

- >40 new and updated products available
- 4 new services available
  - Space Surveillance & tracking, spacecraft operation and human spaceflight
- Demonstration product concept
- First release of VSWMC
- Results of development activities integrated into ongoing ESC provision



**Satellite Risk Prediction and Radiation Forecasts**

	Risk Indicators		Environment	
	Internal Charging	Total Ionizing Dose	RAE - Radiation Area Forecast Model	RAE - Other - Relativistic Electron Forecast Model
GOES-15	4	1	view plots	view plots at geostationary orbit
GOES-14	4	1	view plots	view plots
GOES-13	4	1	view plots	view plots
Slot Region 8000 km	1	1	view plots	view plots



ESA UNCLASSIFIED - For Official Use

Alexi Glover | 17/11/2019 | Slide 3



# Geomagnetic Conditions ESC Restart



<http://swe.ssa.esa.int/geomagnetic-conditions>

- New Coordinator and consortium lead, Univ Bergen: Michael Hesse
- Consortium now taking up main G-ESC network tasks
- New & extended set of product developments in planning
- See poster, Session 1



**Geomagnetic Conditions Expert Service Centre (G-ESC)**

**Mission Statement**

The mission of the Geomagnetic Conditions ESC (G-ESC) is to provide and develop the functionalities, capabilities and expertise in the domain of geomagnetism that are needed within the ESA SSA SWE Network to achieve as a collaborative enterprise its mission of demonstrating and assessing the influences of Space Weather and informing and supporting end-users through the provision of accurate, reliable and timely products and (pre) operational services, tailored to their requirements. The G-ESC thus provides, implements and supports the geomagnetic products and capabilities of the ESA SSA SWE network for monitoring, interpreting, and forecasting variations of the geomagnetic field on various timescales, relying on in situ ground-based, as well as space-borne measurements and related derived quantities and models.

The Earth's magnetic field exhibits variations on a wide range of time scales: slow variation over years and centuries, regular diurnal variations, magnetic storms with violent, rapid and irregular fluctuations, and tiny pulsations with periods of a fraction of a second. Typically, magnetic storms go through a sequence of phases which altogether last for several days. They are observed globally, but are particularly strong in the Polar Regions, e.g. northwest Russia, Finland, Scandinavia, Iceland and Greenland. In addition, major and severe storms can be detected in central Europe.

Geomagnetic storms represent the terrestrial end of the Space Weather chain starting at the Sun, and propagating through interplanetary space. Upon approaching the Earth, the terrestrial magnetosphere is perturbed, subsequently generating magnetic fields observed at the ground as magnetic storms. These disturbances induce electric fields in the ground which in turn drive electric currents potentially harmful to technical installations such as power grids and long pipelines.

Monitoring the geomagnetic storm evolution can be done from a range of space and ground based vantage points. Ground based magnetometer stations provide a valuable contribution here owing to a large number of stations in Europe operating with continuous recording. Data from these stations are important for monitoring harmful effects at the ground, but equally important, they also form an indispensable part of the information needed to describe the state of the ionosphere and magnetosphere, and therefore complete the overall Space Weather picture.

Illustration of the Earth's magnetic field (© ESA/AOES Medialab)

ESA UNCLASSIFIED - For Official Use

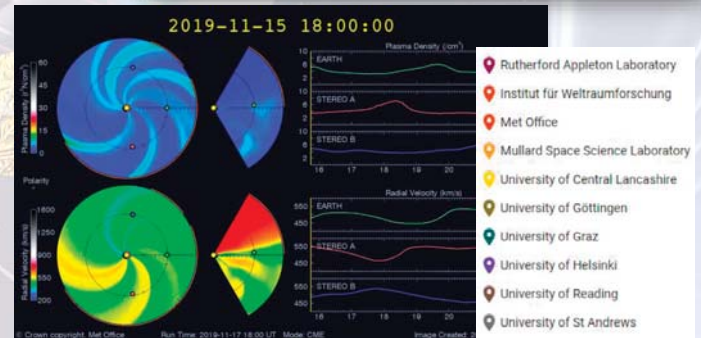
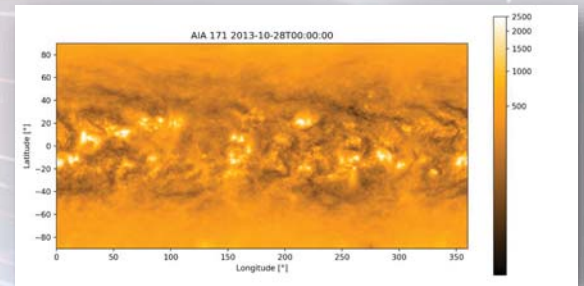
Alexi Glover | 17/11/2019 | Slide 4



# New Developments Starting Q4 2019



- Enhanced solar weather event analysis [UPSud]
  - EUV maps (SDO/AIA & STEREO/EUVI)
  - DEM(T) maps
  - Jz maps of active regions
- L5 Data Utilisation Study [RAL Space]
  - Analysis of the benefits of L1/L5 data in combination
  - Focus on CME propagation
  - Modelling approaches and use cases aim to provide quantitative assessment



- Rutherford Appleton Laboratory
- Institut für Weltraumforschung
- Met Office
- Mullard Space Science Laboratory
- University of Central Lancashire
- University of Göttingen
- University of Graz
- University of Helsinki
- University of Reading
- University of St Andrews

ESA UNCLASSIFIED - For Official Use

Alexi Glover | 17/11/2019 | Slide 5

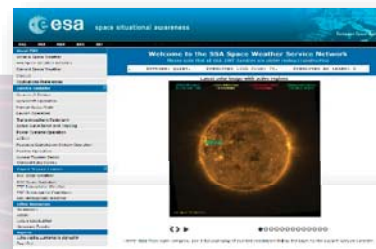


European Space Agency

# New SWE Portal



- Update of the SWE portal interface
- Service Dashboards
- Adapts to mobile devices
- First deployment expected May 2020**
- First demonstration TDM tomorrow @14:00, Mozane 5
- Simplification of registration procedure for portal & services



ESA UNCLASSIFIED - For Official Use

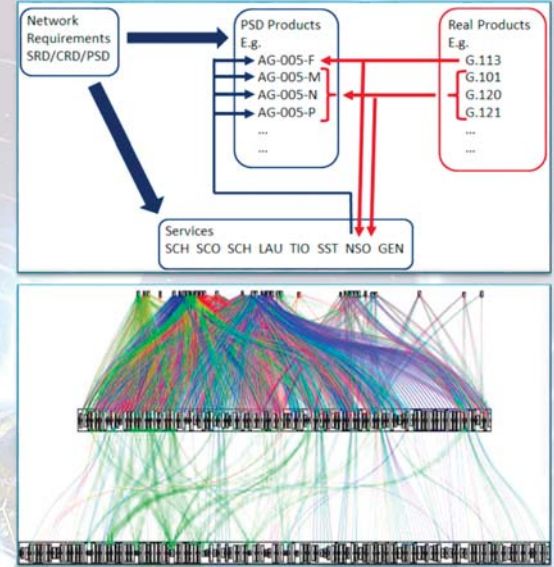
Alexi Glover | 17/11/2019 | Slide 6



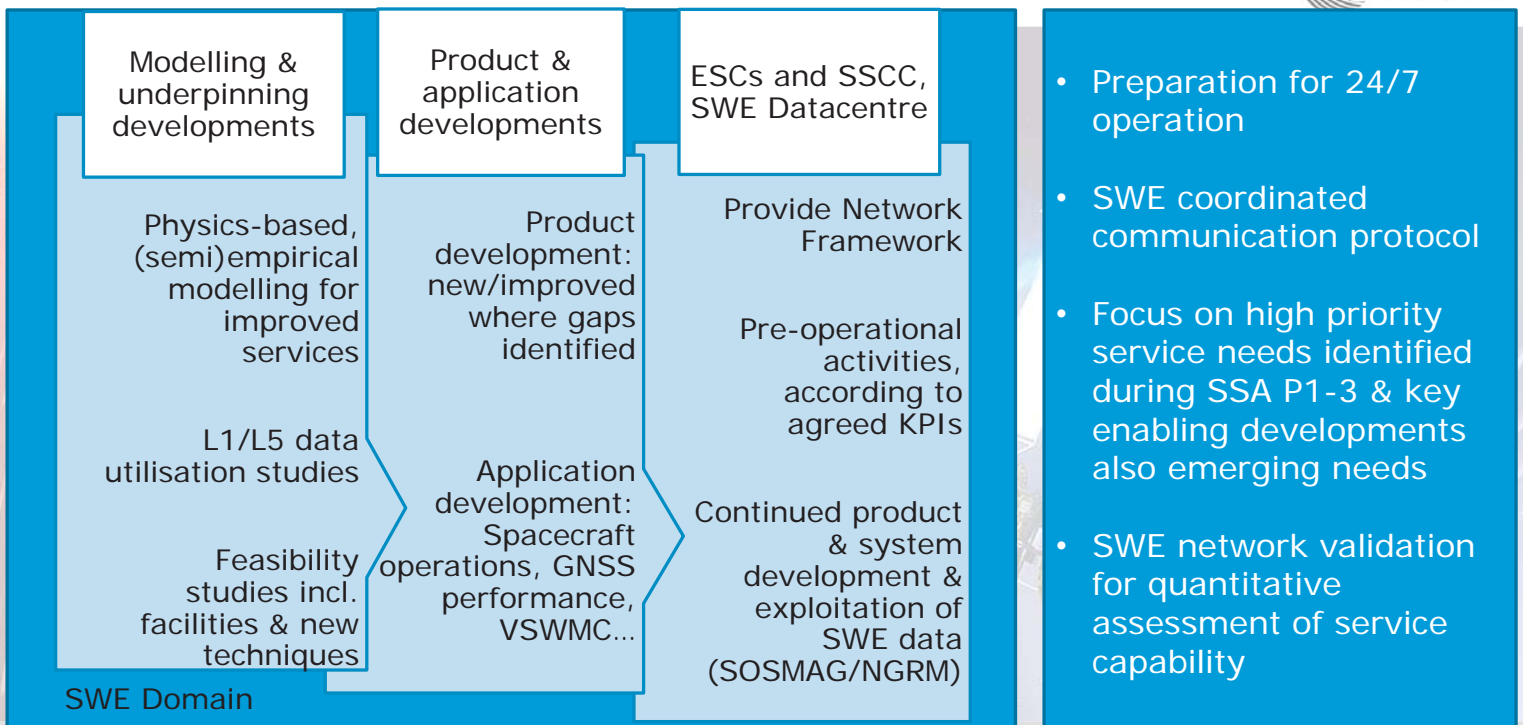
European Space Agency

# P3-SWE-VIII SWE Service System Design

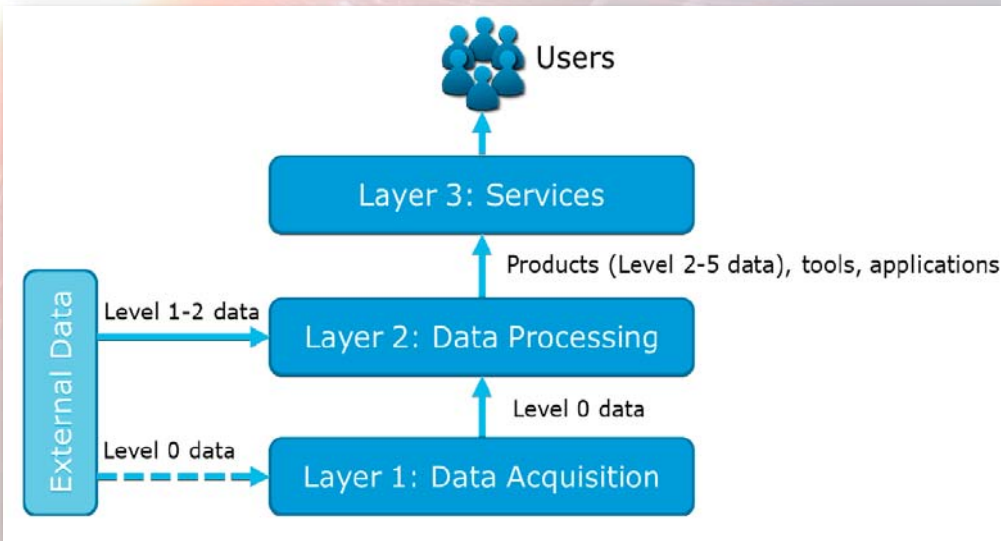
- Builds on work done so far to develop SWE service network
- Detailed system design including approach and roadmap for transition to 24/7 operation
- Improved interfacing and standardisation & supporting tools
- Trade-offs between centralisation and federation of system elements
- KO expected in December



## Core – Structured Development Within the SWE Network



# Core – SWE Service System Emphasis



- System developments will support overall business logic
- Increase robustness of underlying data systems & interfacing
- SLAs to secure essential data
- Further elaboration of SWE Network roles within processing and provision layers



# Upcoming SSA P3 Activities

System elements	Applications interfaces	Product Development
P3-SWE-XLIV: SWE Data System Enhancement, 200k€	P3-SWE-IX, Heliospheric Weather Focussed Applications, 400k€	P3-SWE-XXXVII: SWE Products for Southern Europe- pt1, 1000k€
P3-SWE-XXXIX: Arctic Region SWE Data System, 600k€	P3-SWE-XLII: Targeted Applications for Spacecraft Operations, 300k€	P3-SWE-XXXVIII: Energetic Particle Forecast in the Heliosphere, 400k€
		P3-SWE-XLV: 3D MHD Modelling of the Earth's Magnetosphere, 350k€
		P3-SWE-XL & P3-SWE-XLIX: Enhanced Ionosphere Models for Event Analysis & Scintillation products for arctic, 425k€







**THANK YOU**

[www.esa.int](http://www.esa.int)

[swe.ssa.esa.int](http://swe.ssa.esa.int)

[@esaspaceweather](https://twitter.com/esaspaceweather)

European Space Agency

# ESA Space Environment and Effects Technology Developments in 2019 and Beyond

Piers Jiggins – ESA/ESTEC

2019-11-20

ESA UNCLASSIFIED - For Official Use



European Space Agency

## Space Environment and Effects Section (TEC-EPS)

ESA's Space Environment and Effects Section based at ESTEC in Noordwijk, The Netherlands is responsible for:

- Environment definitions (e.g. radiation, plasma, micro-particles, planetary atmospheres)
- Effects calculation (e.g. radiation dose, single event effects, charging, ESD, particle impacts)
- Project (mission) support (environment specification, impacts assessment, etc.)

The Research and Development (R&D) can be sub-divided into the main research area's of the Space Environment and Effects (TEC-EPS) section:

- Radiation environment and Instrumentation
- Space debris environment
- Plasma environment
- Atmosphere and planetary environments
- Atomic oxygen environment
- Space Weather Technology Development

ESA UNCLASSIFIED - For Official Use

Piers Jiggins | ESTEC | 20/11/2019 | Slide 2



European Space Agency

# ESA Technology Programmes



There are a wide range of technology programmes in ESA funding developments spanning the different TRL levels including:

## Technology Engineering and Quality directorate (TEC)

**Discovery Element** - Disruptive Ideas & **Preparation Element** – Future Missions

**TDE** – Technology Development Element

**GSTP** – General Support Technology Programme [Develop – Make – Fly (small missions)]

## Other directorates

**Science (SCI): CTP** – Core Technology Programme

**Telecommunications (TIA): ARTES** - Advanced Research in Telecommunications Systems

**Human spaceflight and Robotic Exploration (HRE): E3P** – Exploration Envelope Programme

**ExPeRT** – Exploration Preparation , Research and Technology

**Space Transportation (STS): FLPP** - Future Launchers Preparatory Programme

**Earth Observation (EOP): EOEP** - Earth Observation Envelope Programme

**Navigation (NAV): EGEP** - European GNSS Evolution Programme

ESA UNCLASSIFIED - For Official Use

Piers Jiggins | ESTEC | 20/11/2019 | Slide 3

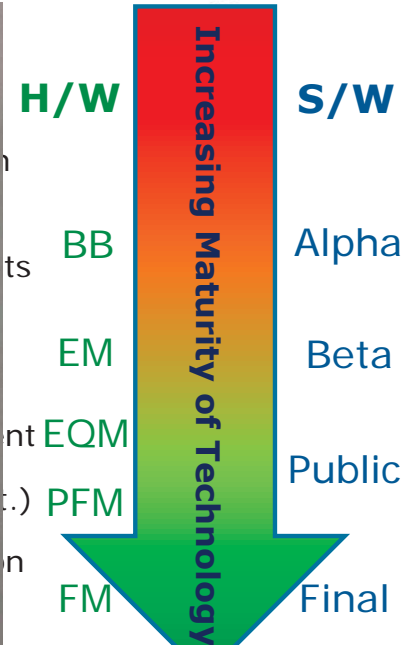


European Space Agency

# Technology Readiness Levels (TRLs)



- TRL 1** TRL1: What if there were Unicorns
- TRL 2** TRL2: We have drawn a Unicorn
- TRL 3** TRL4: We have placed a horn on a horse
- TRL 4** in our Lab
- TRL 5** TRL5: We took the horse outside
- TRL 6** TRL6: We're now calling the horse a Unicorn
- TRL 7** TRL7: We're pretty sure the Unicorn might survive if we launch it into space
- TRL 8** TRL8: omg it survived
- TRL 9** TRL9: This unicorn is literally from space



Credit: @astrogrant (Twitter handle) meeting room door at NASA/JPL

ESA UNCLASSIFIED



European Space Agency

# ESA Technology Programmes and SSA



## Technology Development Element (TDE)

- Nominal TRL: 1-3
- Mandatory programme, budget from mandatory contribution of all member states
- EMITS – <http://emits.sso.esa.int>

## General Support Technology Programme (GSTP)

- Nominal TRL: 3-6
- Optional Programme, funding requested per activity
- Check EMITS, **GSTP 2019 compendium of potential activities**

## Space Situational Awareness (SSA) –> Space Safety Programme (S2P)

- Nominal TRL: 5-9
- Optional Programme, funding confirmed by the Member States separately for each period (presently in Period 3)
- EMITS - ITTs targeted to industry in participating Member States



# Open Space Innovation Platform (OSIP)



- A new open way to inject ideas to ESA (IPC(2017)1,ADD.59)
- Tested via internal call on Space Safety with 61 Ideas (7 Space Weather; 41 Debris; 13 Planetary Defence)
- 9 selected (3 techno-demos, 3 system studies, 3 research)
- Public roll out under <https://ideas.esa.int>
- Externally operational since 12 April



**→ THE OPEN SPACE INNOVATION PLATFORM**  
How to use ESA's entry point for innovative ideas

Our Open Space Innovation Platform (OSIP) offers you the opportunity to share your ideas and join a community of space enthusiasts. Anybody can submit ideas to OSIP and change the future of space research, technology and applications.

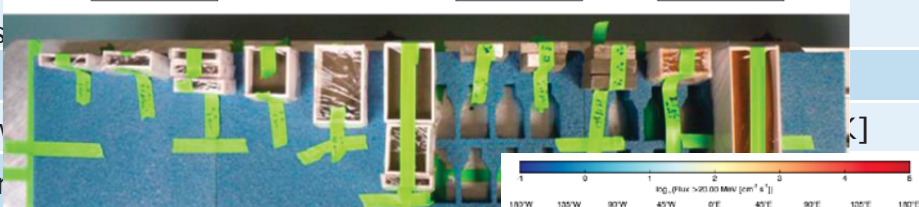

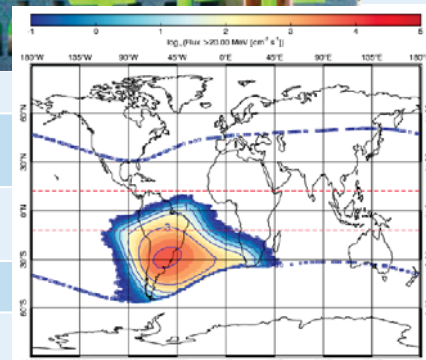
- REGISTER** as an OSIP user on [ideas.esa.int](https://ideas.esa.int) and join our community
- EXPLORE** open ideas campaigns on different topics
- SUBMIT** an idea in response to a campaign or via an open channel
- REVIEW** your idea alone or with the OSIP community
- GET REVIEWED** by ESA experts, based on novelty, feasibility and suitability of idea
- GET INVITED** to a follow-up activity according to implementation plan
- IMPLEMENT** your idea together with ESA\*

\* Restrictions exist for certain implementation paths, e.g. ESA procurement actions are restricted to entities eligible for doing business with ESA (see <https://ideas.esa.int>)

[ideas.esa.int](https://ideas.esa.int)

# TDE ongoing Activities (1)



Activity	Prime Contractor
SEP Radiation Advanced Warning System GEO telecoms radiation tools efficiency geometry exchanges for industrial tools Plasma environment modelling in Earth Radiation environment at extremely low Radiation Hazards and Scenarios System	<div style="display: flex; justify-content: space-around;"> <div style="border: 1px solid black; padding: 2px;">Lunar Regolith</div> <div style="border: 1px solid black; padding: 2px;">Lunar Concrete</div> <div style="border: 1px solid black; padding: 2px;">Mars Regolith</div> </div> 
Radiation Belt Model Development Innovative materials for passive spaceflight (ROSSINI-3) Multi-scale high accuracy engineering analysis in modern technologies Tissue-equivalent crew dosimeter Mini-Ion Emitter for Spacecraft	  <p style="font-size: small;">Piers Jiggins   ESTEC   20/11/2019   Slide 7</p>

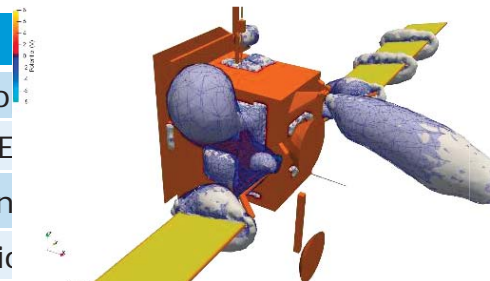
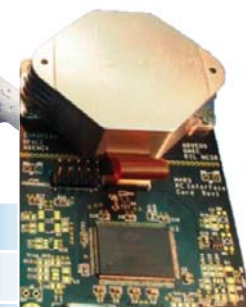
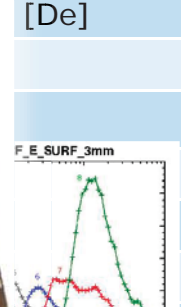
ESA UNCLASSIFIED - For Official Use



European Space Agency

# TDE/TRP ongoing Activities (3)



Activity	Prime Contractor
Focused on... Progress... Data... Mars... Impact... Model...	  <p style="font-size: small;">[De]</p> 
Two Components Additive Manufacturing for Space Radiation Dosimeter Collaborative iterative radiation shielding optimisation system (CIRSOS)	RadM...
Highly Miniaturised ASIC Radiation Detector (MIDAS)	HTG S...
Micro-particle impact related attitude disturbances	Etam...
Micrometeoroid risk assessment tool for missions leaving Earth orbits	Etam...
DEBIE-1 database update and systematic data processing	Etam...

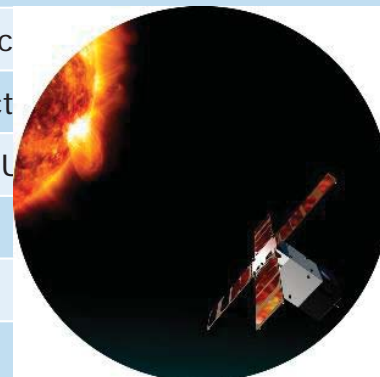
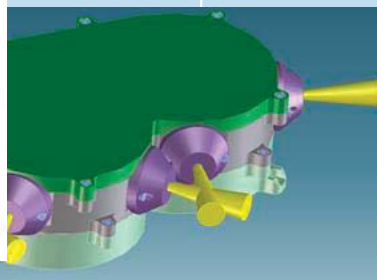
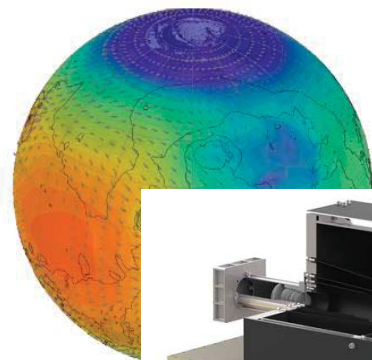


European Space Agency

# GSTP ongoing Activities



Activity	Prime Contractor
Mars Climate Database (MCD) Maintenance and Update	Laboratoire de Météorologie Dynamique (LMD) [Fr]
Spectrometer (3D EES) Phase C1	QinetiQ Space [UK]
Mars Science Lander (M-NLP)	Eisdvoll Electronics [UK]
Mars Science Lander Operations (SCOPE)	RAL Space [UK]
Virtual s	Isaware [Fi]
RadMag	[Be]
	Project [Hu]



Virtual s  
RadMag

[Be]  
Project [Hu]

ESA UNCLASSIFIED - For Official Use

Piers Jiggins | ESTEC | 20/11/2019 | Slide 9

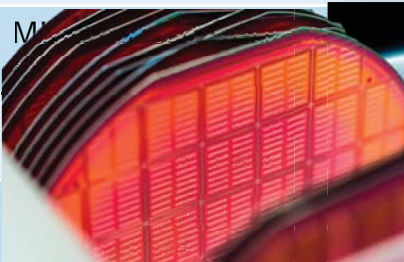
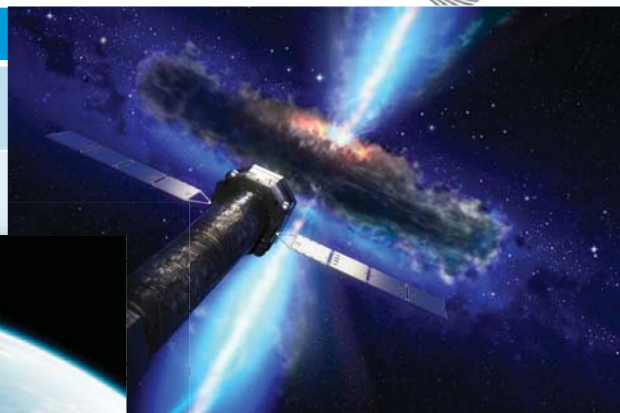


European Space Agency

# GSP, CTP, ARTES and other ongoing Activities



Activity
European Contribution to the International Radiation Environment Near Earth (IRENE) collaboration
Geant4 "The simulation of the passage of particles through matter" Greece (G4G)
Modelling activities of environments (AREM)
SpacePix 2
RadMag for Distributed Space Weather Sensor System



ESA UNCLASSIFIED - For Official Use

Piers Jiggins | ESTEC | 20/11/2019 | Slide 10



European Space Agency

# Upcoming and Planned Activities

## Activity

Electric Orbit Raising Radiation Environment and Solar Array Degradation

Large area low resource integrated impact detector [TDE]

Heliospheric Modelling Techniques [GSTP]

SPENVIS-NC

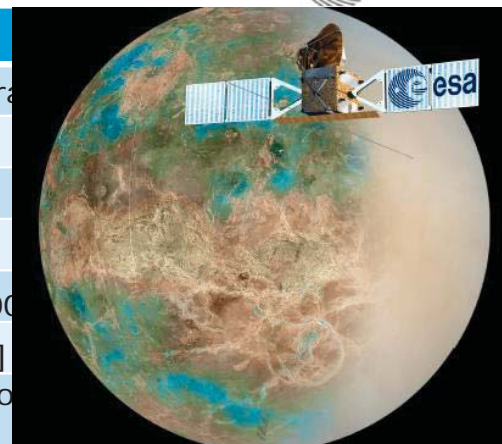
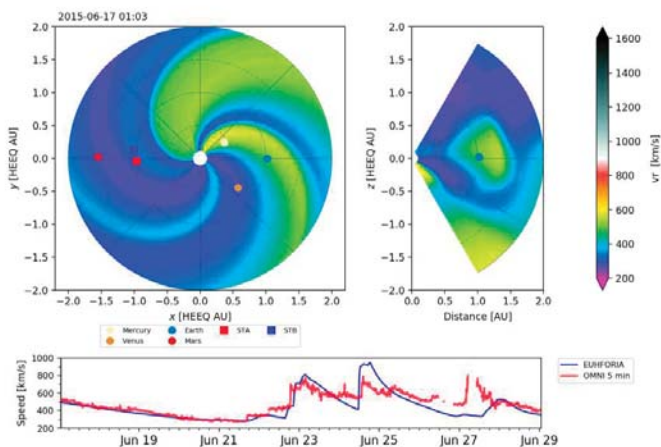
Comprehens

Test mass cl

Multi-scale c

protection (

Neutral atm



n (€400  
[TDE]  
radiatio  
DE]

ITT closes 9<sup>th</sup> Dec



# GSTP Compendium 2019 Items

Code	Title	Budget (k€)
GT17-389EP	Shape effects in hypervelocity impacts	550
GT17-390EP	Nanosat rated booms and deployment systems for space environment electro-magnetic fields sensors accommodation	800
GT17-391EP	Global radiation belt model improvement by radiation monitor data	700
GT17-392GF	Atmospheric models applied to operations	500
GT17-394EP	Plasma analyser for spacecraft charging characterisation	500
GT18-396SW	Low cost radiation monitor for large cooperative satellite missions	1000
GT18-397SW	Enhancement of physical and assimilation modelling of radiation belts	300



# GSTP Compendium 2017 Items



Code	Title	Budget (k€)
GT18-002EP	Solar Activity Onset Modelling	600
GT18-008EP	Space Weather Instruments for Hosted Payload Missions	1800
GT18-010EP	Global Magnetospheric Modelling to Drive Geomagnetic Services	600
GT18-001L	Data Analytics for Early Warning of Space Weather Events	300

Contact us and contact  
your GSTP Delegate



# EMITS (Electronic Mail Invitation to Tender System)



For information on upcoming and open ITTs (Invitations To Tender) go to EMITS:

<http://emits.sso.esa.int/>

Any questions you can contact me and if I don't know I'll find someone who does:

[Piers.jiggins@esa.int](mailto:Piers.jiggins@esa.int)

