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 Jiggens)
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 Jiggens)
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 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 Jiggens)

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

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 Jiggens)

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

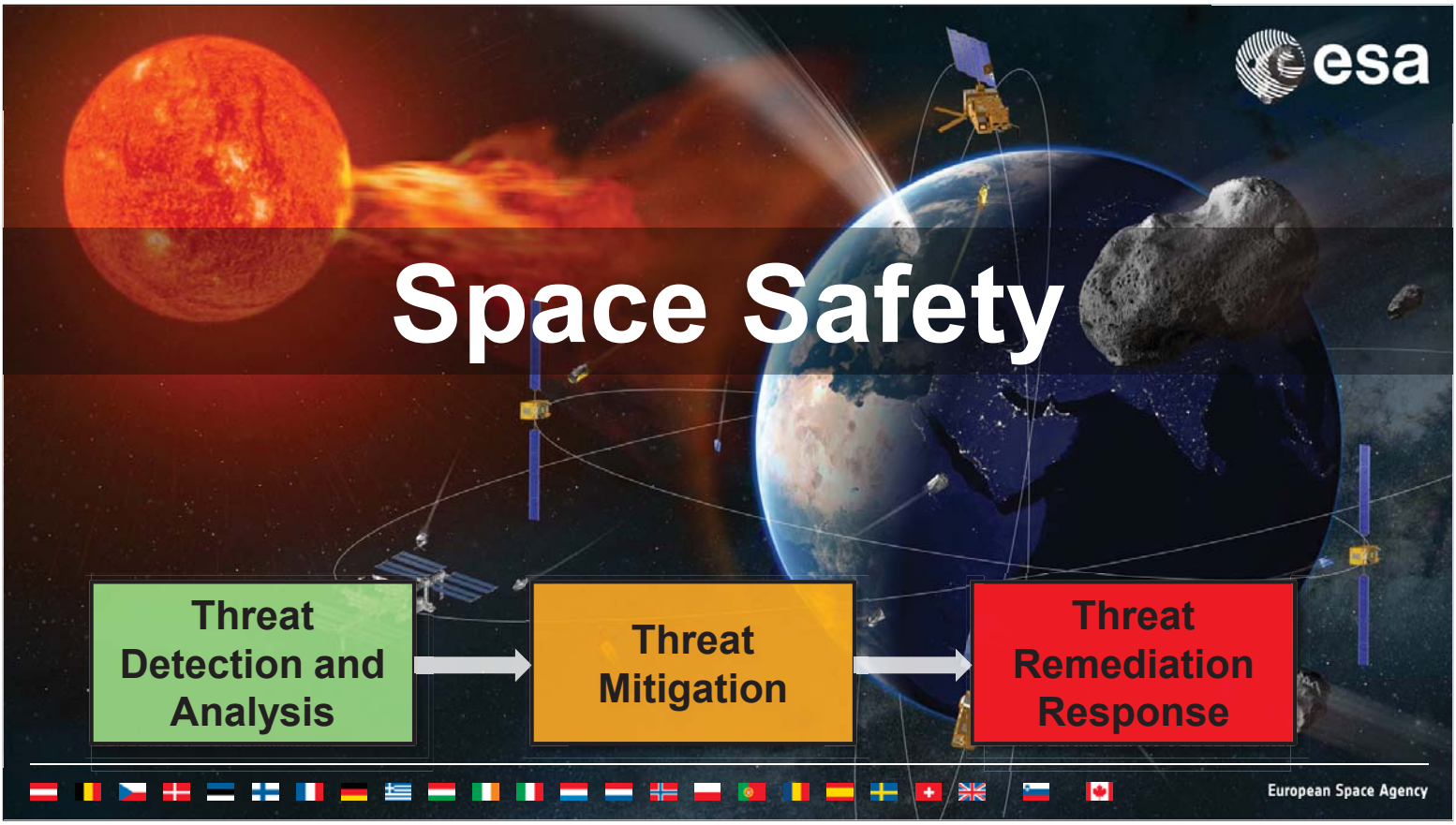
Juha-Pekka Luntama
Head of Space Weather Office
Space Safety Programme Office

16th European Space Weather Week
18-22 November 2019, Liege, Belgium

Space Situational Awareness

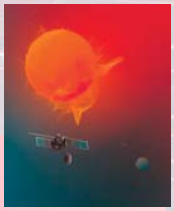
Provide European autonomy in civil systems and services needed to protect satellites and the Earth


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


esa
Space Safety
Threat Detection and Analysis
Threat Mitigation
Threat Remediation Response
European Space Agency

ESA Space Safety Programme

1 **Core**



2 **Lagrange Mission**

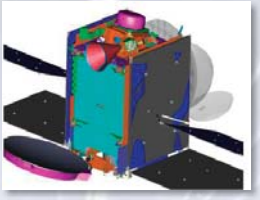
3 **HERA**

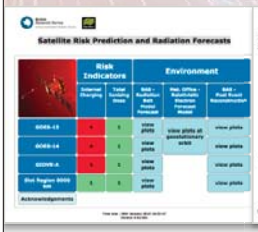
4 **ADRIOS(Active Debris Removal/In-Orbit Servicing)**

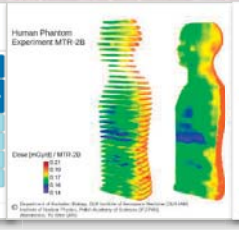
5 **CREAM(Collision Risk Estimation & Automated MitigatioN)**

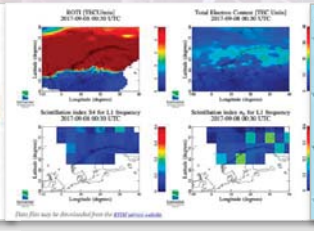
ESA SSA Space Weather System Today

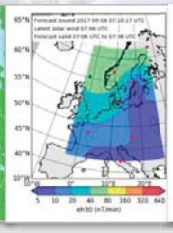
- 29 pre-operational services based on >200 products
- European Service Network of >40 Expert Groups
- > 1100 registered users
- > 700 000 hits on service portal monthly
- Hosted payload missions in progress
- Lagrange mission & D3S

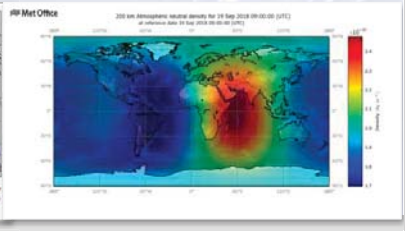




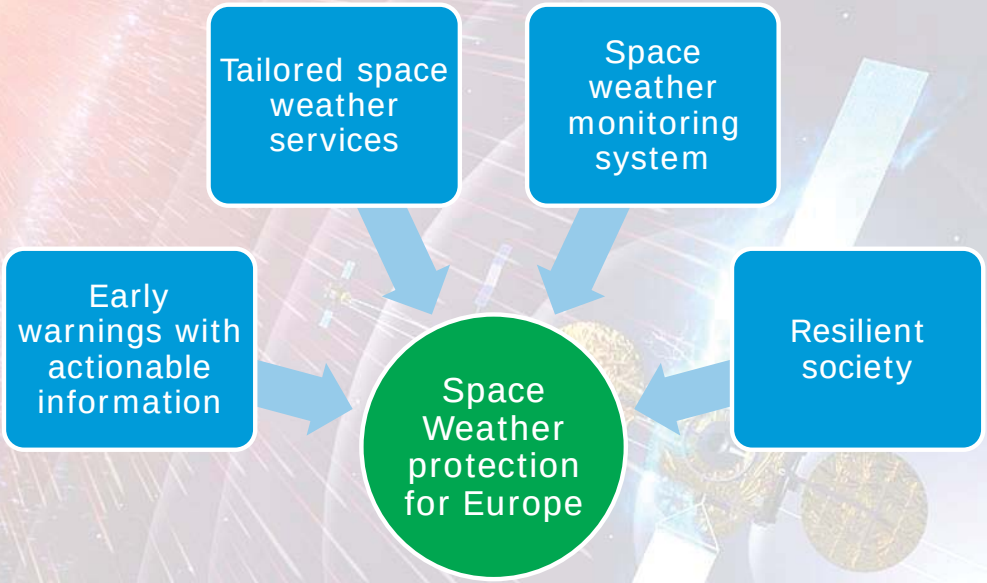




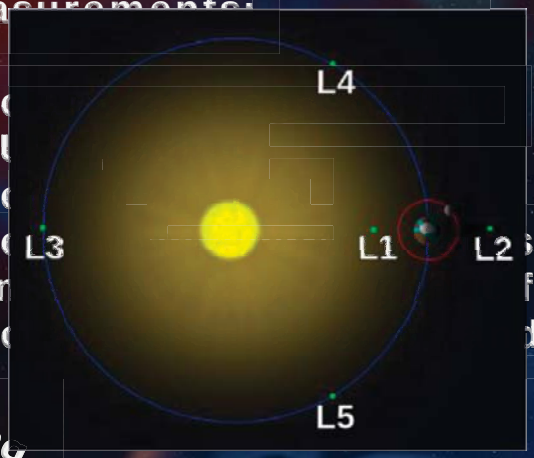




Space Weather System Objectives by 2030



Lagrange Mission

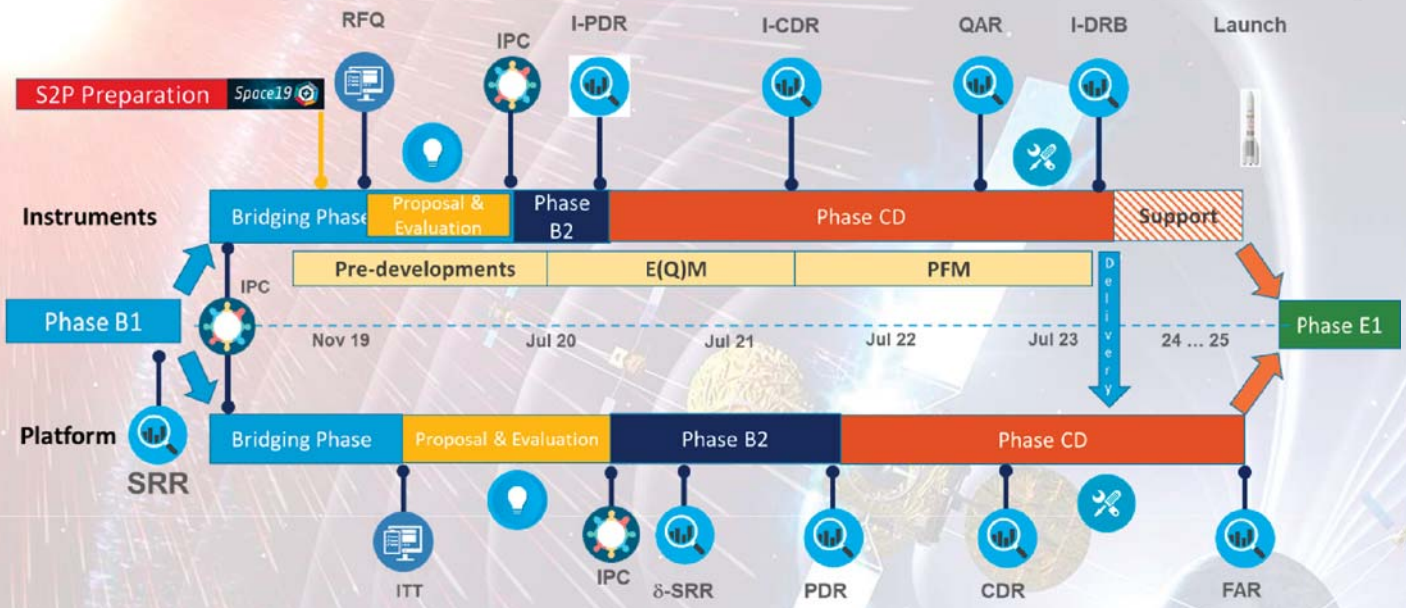


Heliospheric imaging

Wide-angle coronagraphy

Complementary to Sun-Earth line measurements

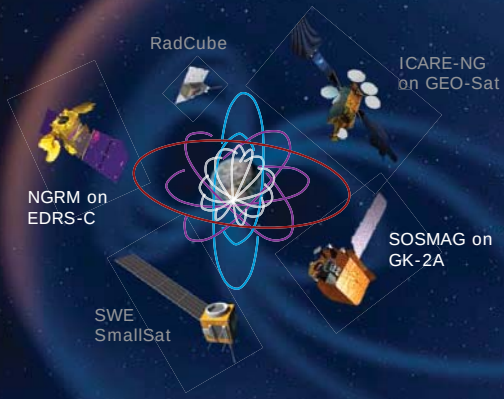
Lagrange Mission Timeline



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



Enhanced Space Weather Readiness

- 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

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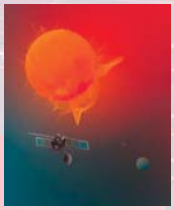
ESA Space Weather Service Network: Achievements & Outlook

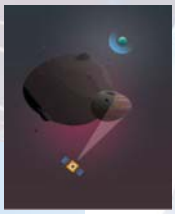
Alexi Glover, Juha-Pekka Luntama
Space Weather Office, ESA Space Safety Programme Office
ESOC, Darmstadt, Germany

Space Safety

1 Core



2 Lagrange Mission



3 HERA

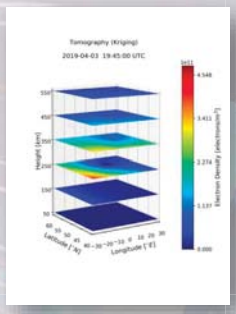
4 ADRIOS(Active Debris Removal/In-Orbit Servicing)

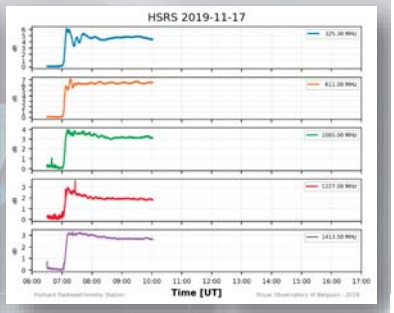
5 CREAM(Collision Risk Estimation & Automated MitigatioN)

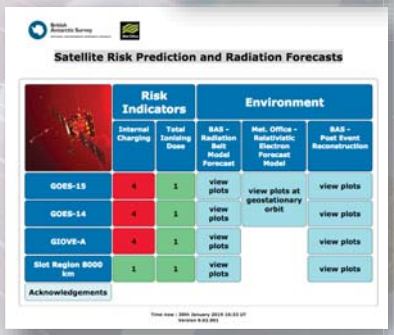
SWE Service Network: Some Highlights 2019

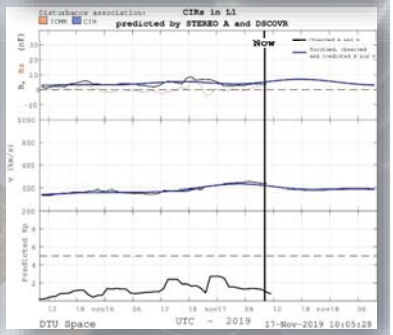
Some highlights from 2019:

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









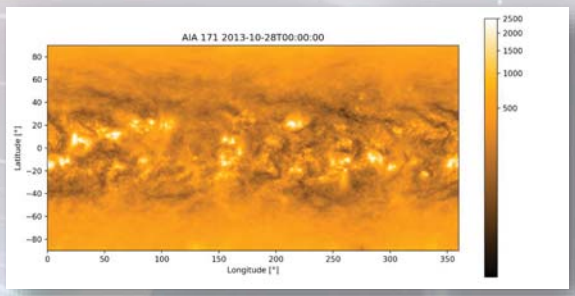
Geomagnetic Conditions ESC Restart

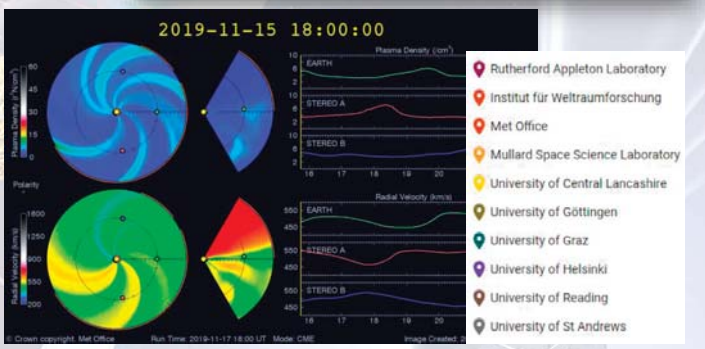
- New Coordinator and consortium lead, Univ Bergen: Michael Hesse
- Consortium now taking up main G-ESC network tasks
- New & extended set of product developments in planning
- See poster, Session 1

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

New Developments Starting Q4 2019

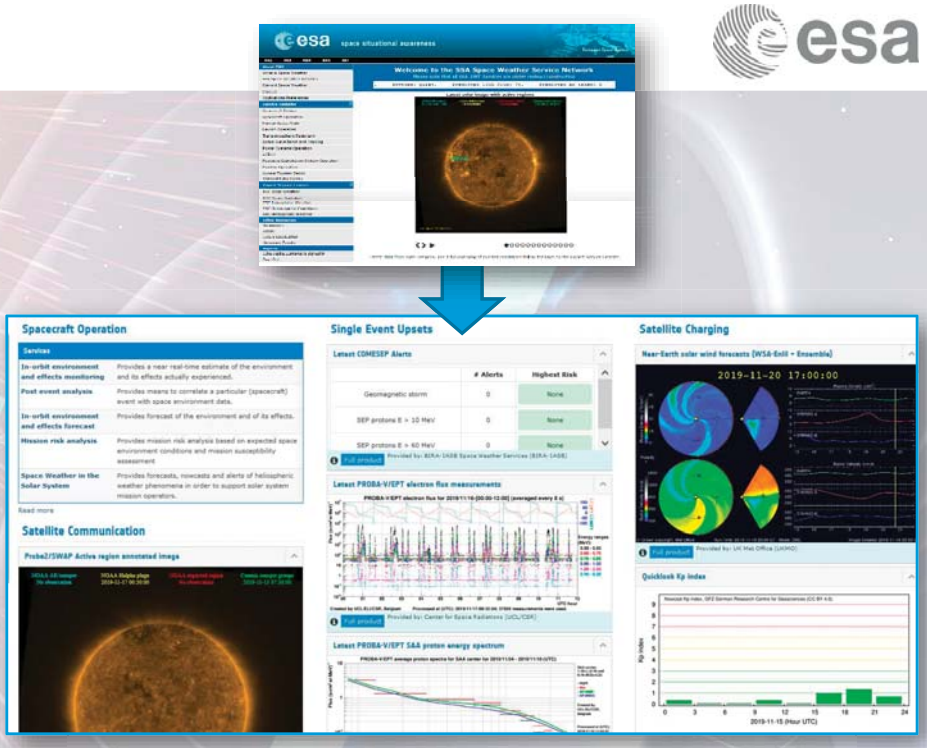
- Enhanced solar weather event analysis [UPSud]
  - EUV maps (SDO/AIA & STEREO/EUVI)
  - DEM(T) maps
  - Jz maps of active regions
- L5 Data Utilisation Study [RAL Space]
  - Analysis of the benefits of L1/L5 data in combination
  - Focus on CME propagation
  - Modelling approaches and use cases aim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





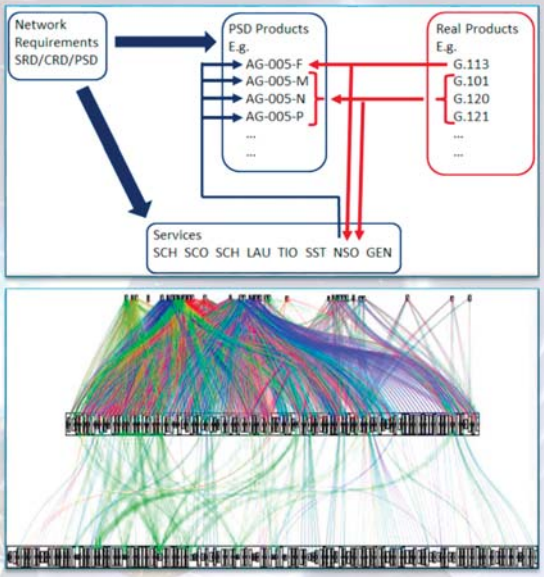
New SWE Portal

- 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



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



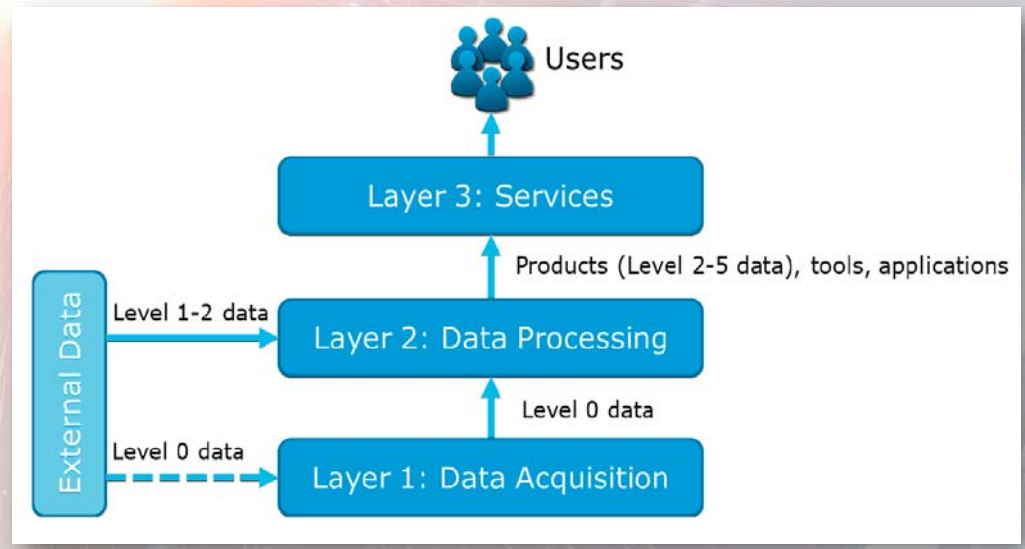
Core – Structured Development Within the SWE Network

Modelling & underpinning developments	Product & application developments	ESCs and SSCC, SWE Datacentre
Physics-based, (semi)empirical modelling for improved services	Product development: new/improved where gaps identified	Provide Network Framework
L1/L5 data utilisation studies	Application development: Spacecraft operations, GNSS performance, VSWMC…	Pre-operational activities, according to agreed KPIs
Feasibility studies incl. facilities & new techniques		Continued product & system development & exploitation of SWE data (SOSMAG/NGRM)

SWE Domain

- Preparation for 24/7 operation
- SWE coordinated communication protocol
- Focus on high priority service needs identified during SSA P1-3 & key enabling developments also emerging needs
- SWE network validation for quantitative assessment of service capability

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

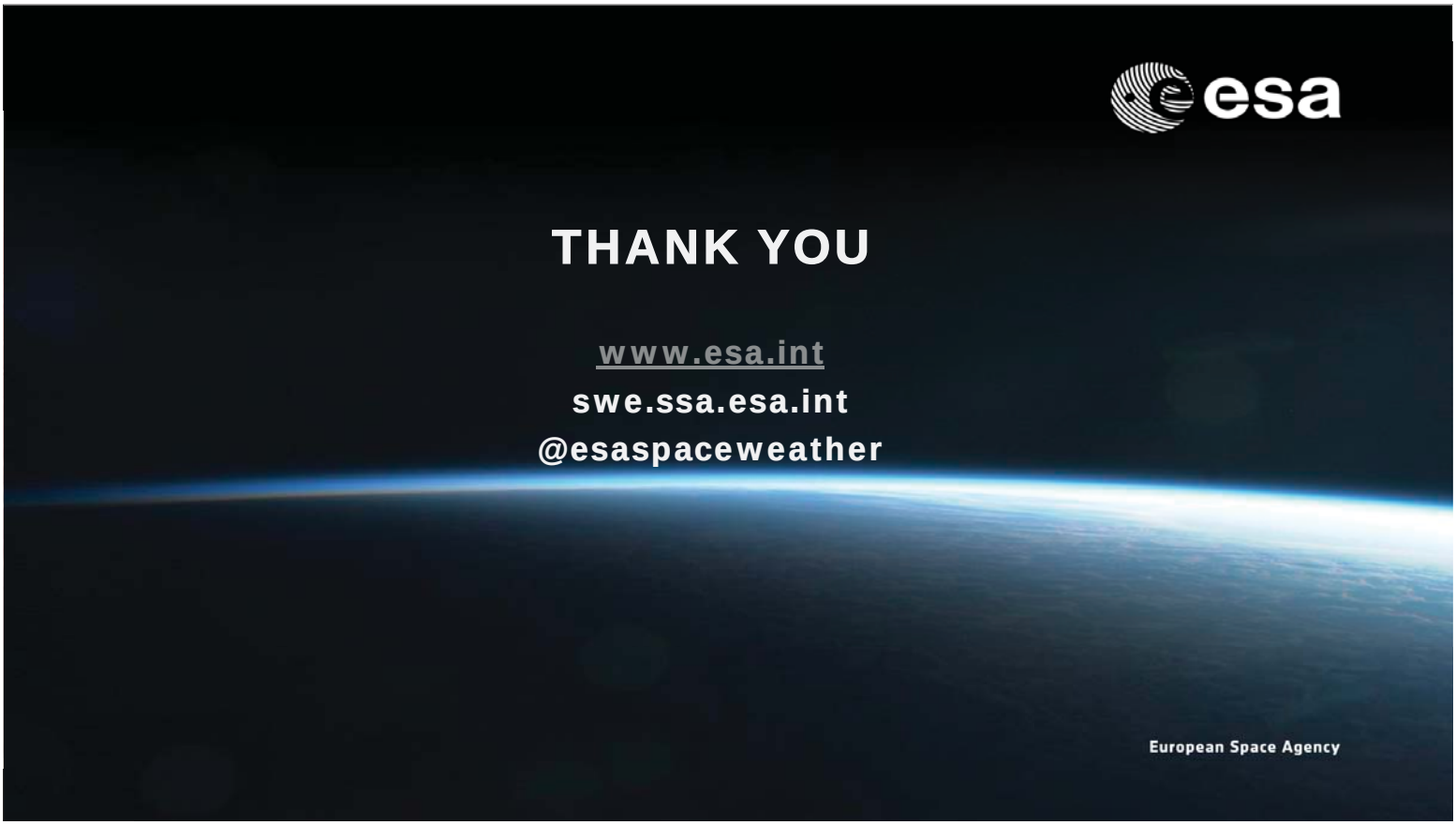
- P3-SWE-XLIV: SWE Data System Enhancement, 200k€
- P3-SWE-XXXIX: Arctic Region SWE Data System, 600k€

Applications interfaces

- P3-SWE-IX, Heliospheric Weather Focussed Applications, 400k€
- P3-SWE-XLII: Targeted Applications for Spacecraft Operations, 300k€

Product Development

- P3-SWE-XXXVII: SWE Products for Southern Europe- pt1, 1000k€
- 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€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ESA Space Environment and Effects Technology Developments in 2019 and Beyond

Piers Jiggens – ESA/ESTEC

2019-11-20

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 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

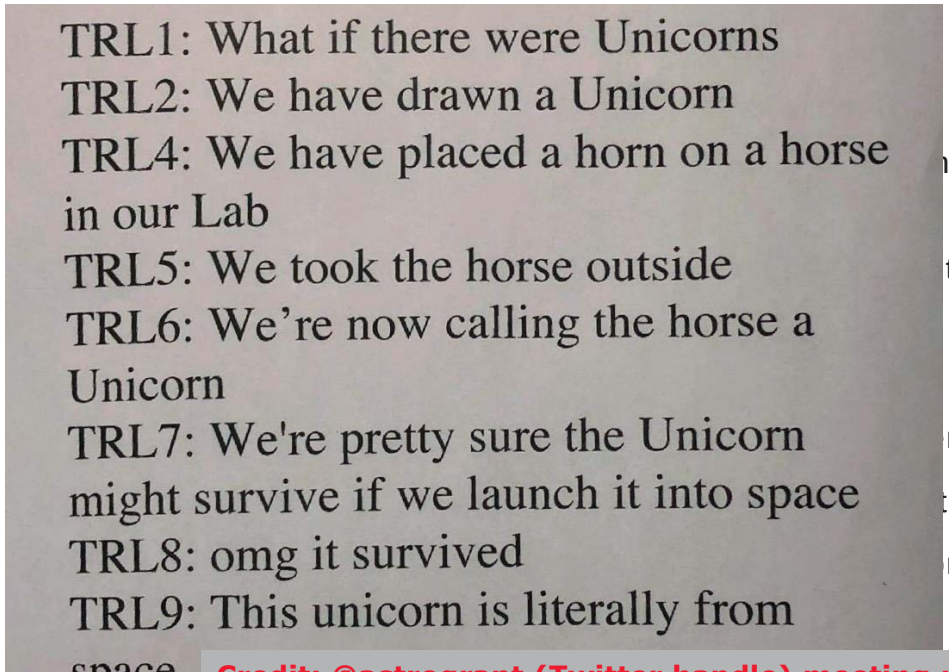
ExPeRT – Exploration Preparation , Research and Technology

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

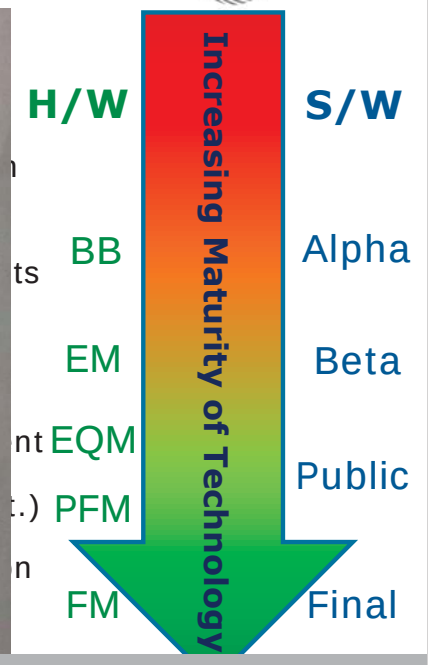
Earth Observation (EOP): EOEP - Earth Observation Envelope Programme

Navigation (NAV): EGEP - European GNSS Evolution Programme

Technology Readiness Levels (TRLs)



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



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)

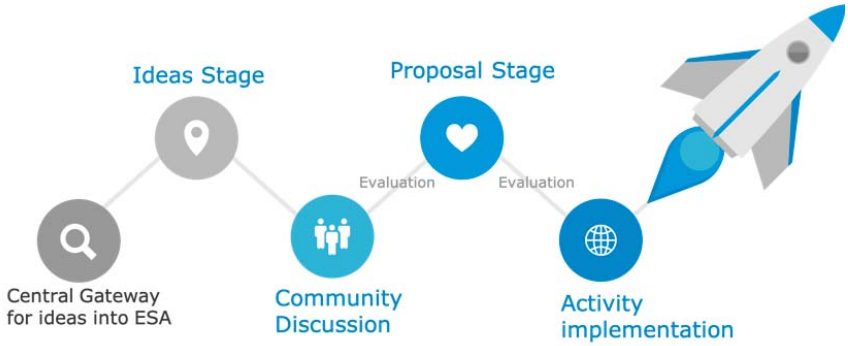
- Nominal TRL: 3-6
- Optional Programme, funding requested per activity
- Check EMITS, **GSTP 2019 compendium of potential activities**

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

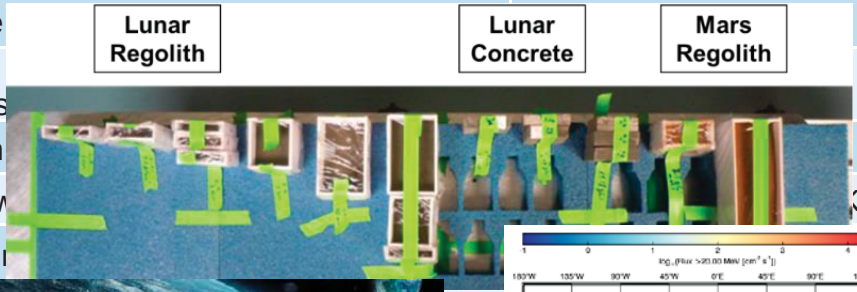
Open Space Innovation Platform (OSIP)

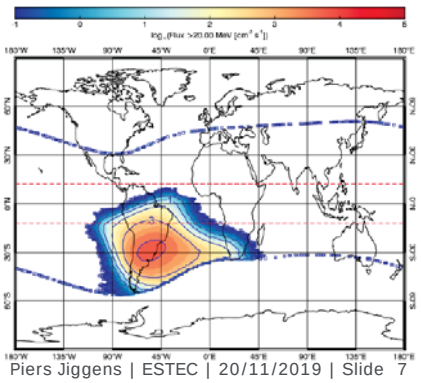
- A new open way to inject ideas to ESA (IPC(2017)1,ADD.59)
- Tested via internal call on Space Safety with 61 Ideas
  (7 Space Weather; 41 Debris; 13 Planetary Defence)
- 9 selected (3 techno-demos, 3 system studies, 3 research)
- Public roll out under https://ideas.esa.int
- Externally operational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



TDE ongoing Activities (1)

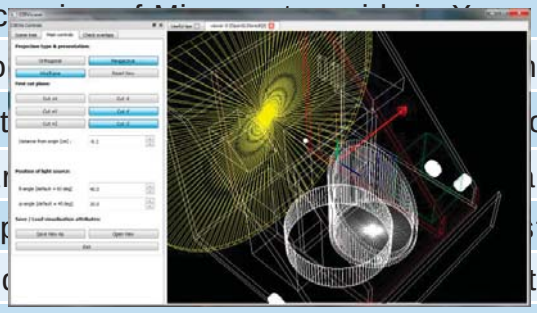
Activity	Prime Contractor
SEP Radiation Advanced Warning Syste	
GEO telecoms radiation tools efficiency geometry exchanges for industrial tools	
Plasma environment modelling in Earth	
Radiation environment at extremely low	
Radiation Hazards and Scenarios Syste	
Radiation Belt Model Developm	
Innovative materials for passiv spaceflight (ROSSINI-3)	
Multi-scale high accuracy engin analysis in modern technologie	
Tissue-equivalent crew dosime	
Mini-Ion Emitter for Spacecraft	

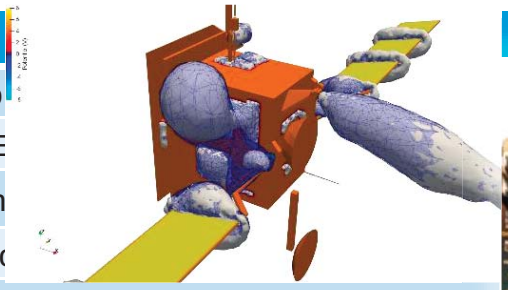


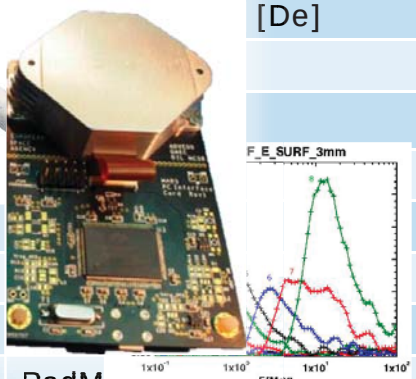


TDE/TRP ongoing Activities (3)

Activity	Prime Contractor
Foc o	[De]
Pro n E	
Dat on	
Mar ati	
Imp ter plasma plume interactions	
Mod t of Ion Emitting Spacecraft	
Two Components Additive Manufacturing for Space Radiation Dosimeter	
Collaborative iterative radiation shielding optimisation system (CIRSOS)	RadM
Highly Miniaturised ASIC Radiation Detector (MIDAS)	
Micro-particle impact related attitude disturbances	HTG S
Micrometeoroid risk assessment tool for missions leaving Earth orbits	Etam
DEBIE-1 database update and systematic data processing	Etam

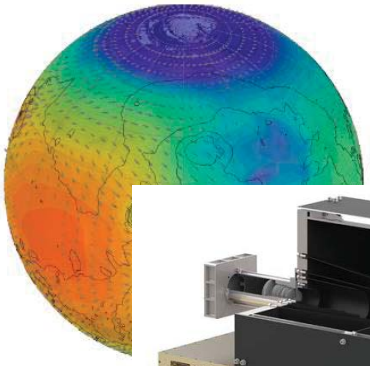


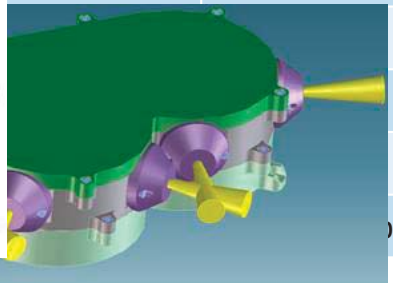


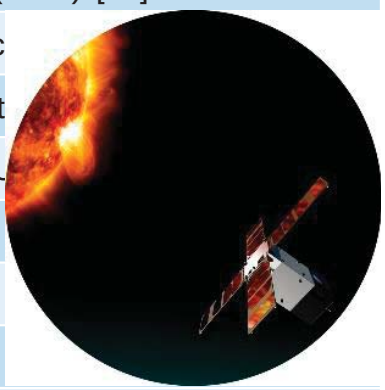


GSTP ongoing Activities

Activity	Prime Contractor
Mars Climate Database (MCD) Maintenance and Update	Laboratoire de Météorologie Dynamique (LMD) [Fr]
ectrometer (3D EES) Phase C1	QinetiQ Spac
robe (M-NLP)	Eisdvoll Elect
perations (SCOPE)	RAL Space [U
	Isaware [Fi]
Virtual s	[Be]
RadMag	best [Hu]

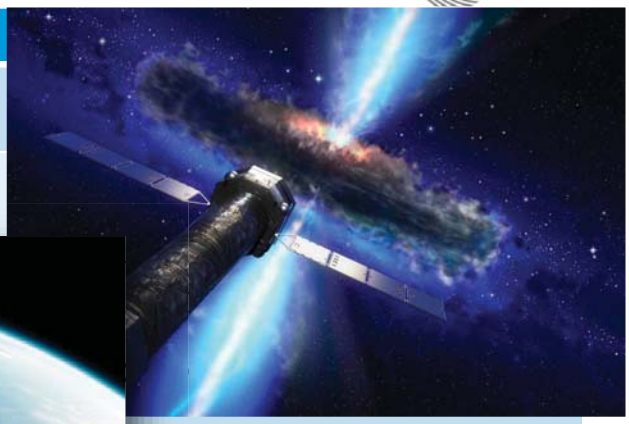


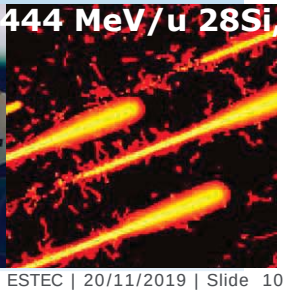




GSP, CTP, ARTES and other ongoing Activities

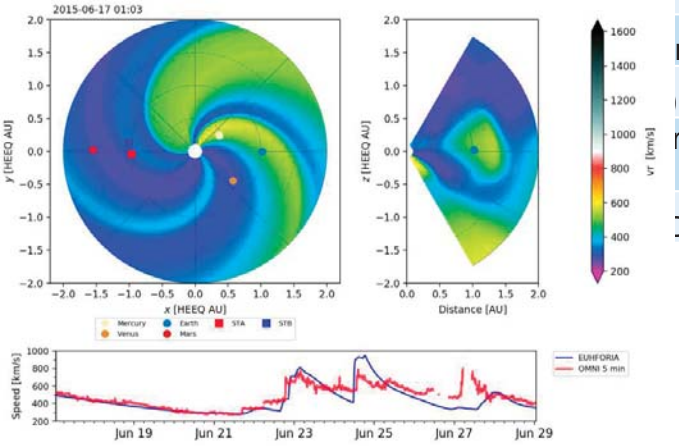
Activity
European Contribution to the International Radiation Environment Near Earth (IRENE) collaboration
Geant4 “The simulation of the passage of particles through matter” Greece (G4G)
M
Modelling activities o environments (AREM
SpacePix 2
RadMag for Distributed Space Weather Sensor System

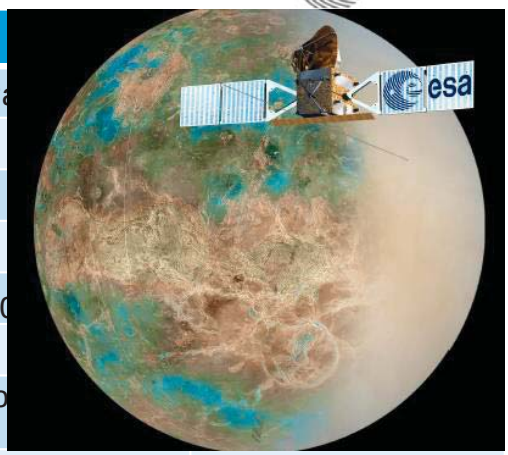




Upcoming and Planned Activities

Activity	
Electric Orbit Raising Radiation Environment and Solar Array Degra	
Large area low resource integrated impact detector [TDE]	
Heliospheric Modelling Techniques [GSTP]	
SPENVIS-NG	
Comprehens	n (€40
Test mass cl	[TDE]
Multi-scale c protection (=	radiatio
Neutral atm	DE] ITT closes 9th 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.jiggens@esa.int