

SPENVIS in the ESA-SSA Programme

Alexi Glover & Juha-Pekka Luntama

SSA Programme Space Weather Segment, OPS-L
ESA/ESAC, Madrid, Spain

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- 2. Space Weather Segment Scope*
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- 6. European Landscape*
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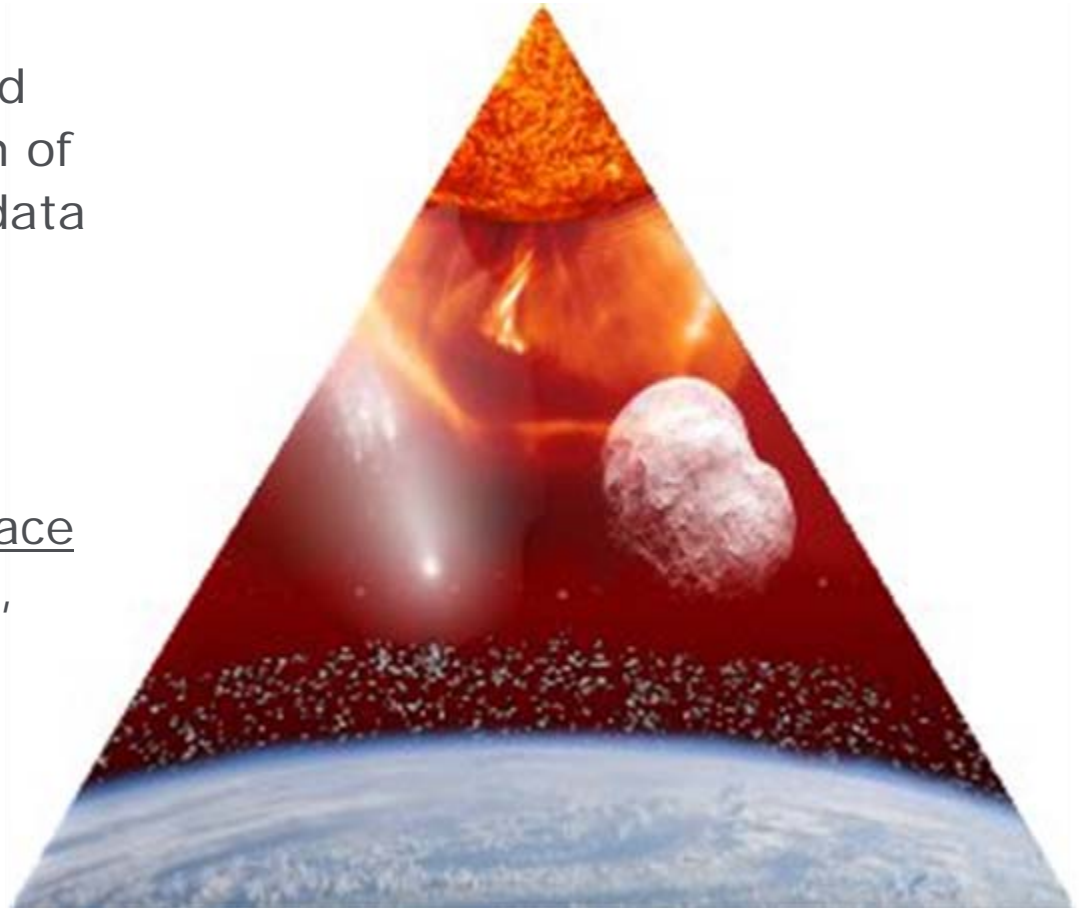
The need for SSA:

Support Europe's utilisation of, and access to, space through provision of timely and accurate information, data and services

Comprehensive knowledge, understanding and maintained awareness of the population of space objects, of the space environment, and of the existing threats/risks.

Three SSA segments:

- Surveillance and Tracking
- Space Weather
- Near Earth Objects



- **Support safe and secured operation of space assets and related services**
- **Support risk management (during launch, in orbit, re-entry and other critical operations) and liability assessment**
- Assess the status and basic characteristics of space objects (man-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)

- Programme proposal accepted at ESA Council of Ministers Nov '08
- The Programme will be executed in two phases
 - 2009-2011: SSA Preparatory Programme
 - 2012-2019: SSA Fully Operational System Implementation
- During the preparatory programme:
 - Core Element: Comprising activities related to system architecture, governance, data policy, security and the SST segment
 - Space Weather Element: Including development of both the SWE Segment and the NEO Segment
 - Radar Element: Focusing on the specifications and design for a future radar system and creation of a prototype radar
 - Pilot Data Element: All activities related to common data storage and system-wide management for all segments

- **Objective:** strengthen European capability in detection and forecasting of space-weather events and their effects on European space assets and ground-based infrastructure.
- Coordinate European expertise and assets in space weather
- Prepare measurement and service infrastructure development
- Service prototypes ready for assessment by beginning of 2011.
- Seek synergy with other SSA segments (SST, NEO).
- builds on work done in Space Env section including identification of existing resources, prototyping and characterising the potential user community for SWE services

- High level user needs for the SSA SWE Segment include:
 - Knowledge, understanding and maintained awareness of the natural space environment and space weather
 - Detection and forecasting of space weather and its effects
 - Detection and understanding of interference due to space weather
 - Predict meteoroid/small-size space debris population and effects

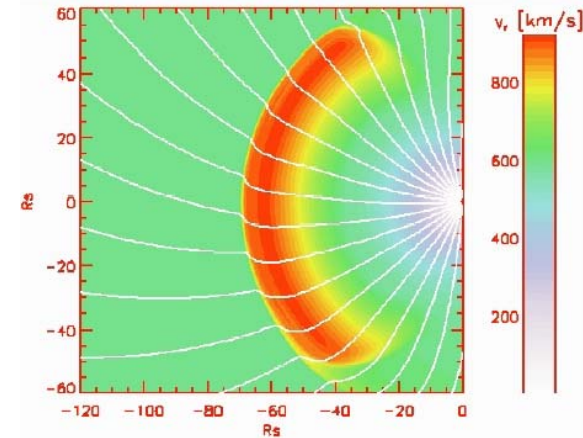
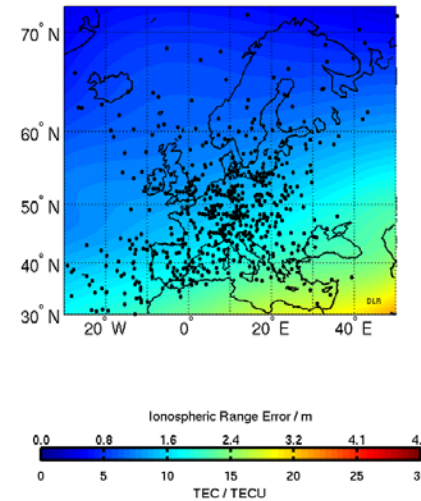
 - Service and data provision needs to be timely, accurate and reliable

- Full review prepared in 2009 with the support by the SSA User Representative Group and the national representatives in the SSA Programme Board.

SWE Service Domains



1. Spacecraft design
2. Spacecraft operation
3. Human space flight
4. Launch operation
5. Transionospheric radio link
6. SSA surveillance and tracking
7. Non-space system operation
8. General data service (includes space weather modelling)



(some) Planned services

1. Spacecraft Designers

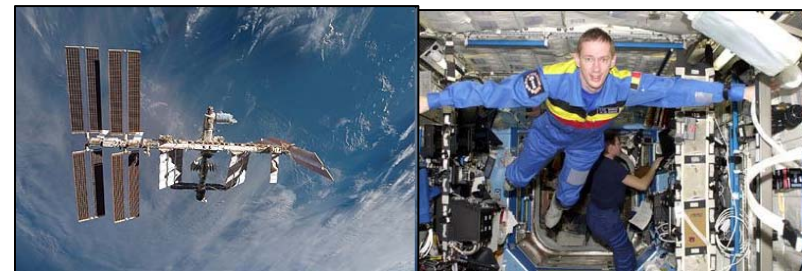
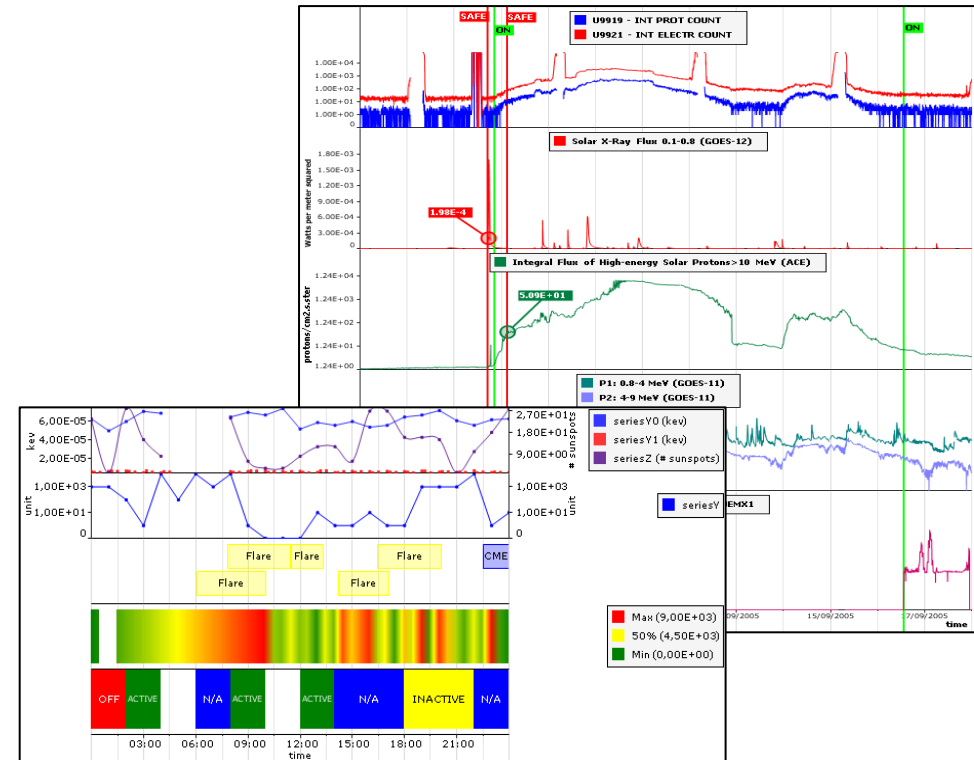
- Environment specification: data archive plus in-orbit verification tools
- Post-event analysis

2. Spacecraft Operators

- In-orbit environment and effects monitoring & forecast
- Post-event analysis
- Mission analysis

3. Human Spaceflight

- In-flight crew radiation exposure
- Cumulative crew radiation exposure
- Increased crew radiation risk



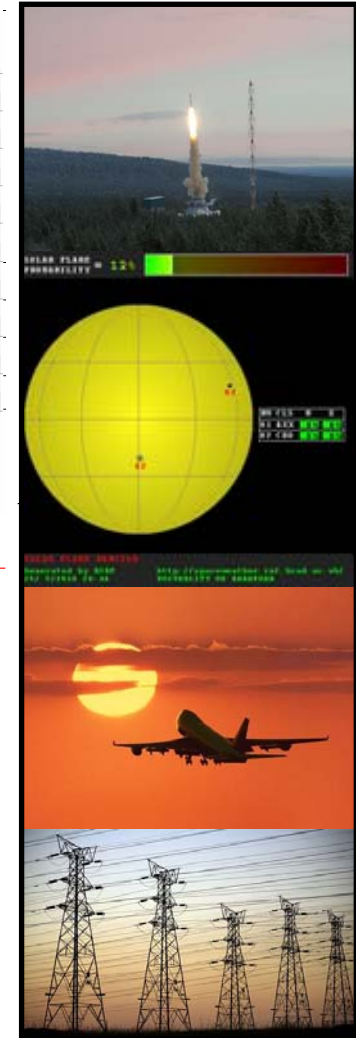
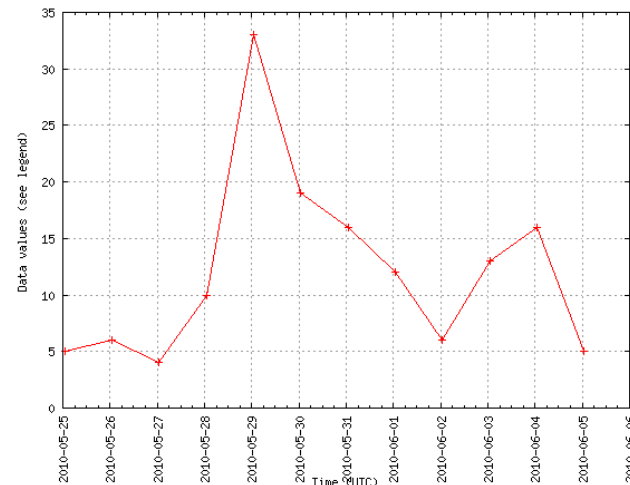
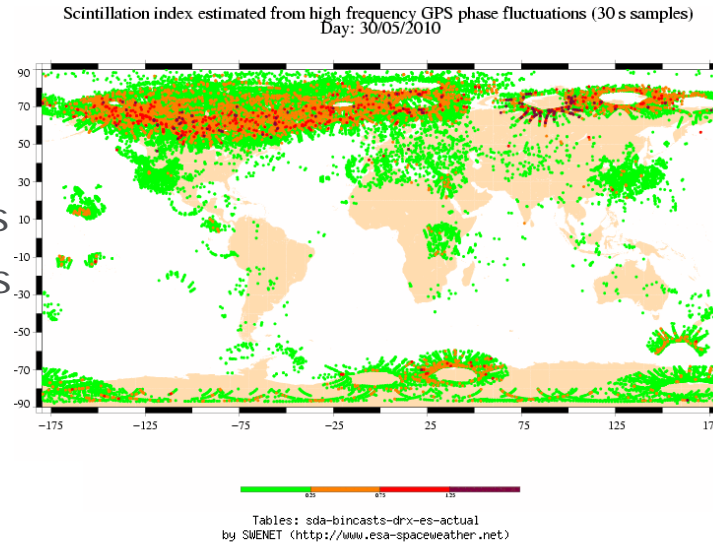
Planned services, cont'd

1. Launch operators

- a. In-flight monitoring radiation effects
- b. Preflight estimate radiation effects
- c. Forecast increased radiation levels
- d. Atmospheric density forecast
- e. Risk estimate scintillations
- f. Risk estimate micro-particle impacts

2. Data Services

- a. Space weather data archive
- b. Latest data guaranteed service (+ 3rd party support)
- c. Nowcast and forecast products
- d. Event based alarms
- e. Virtual SWE modelling system



Prototype service development builds on existing assets and services

A set of precursor services will be deployed in 2010.

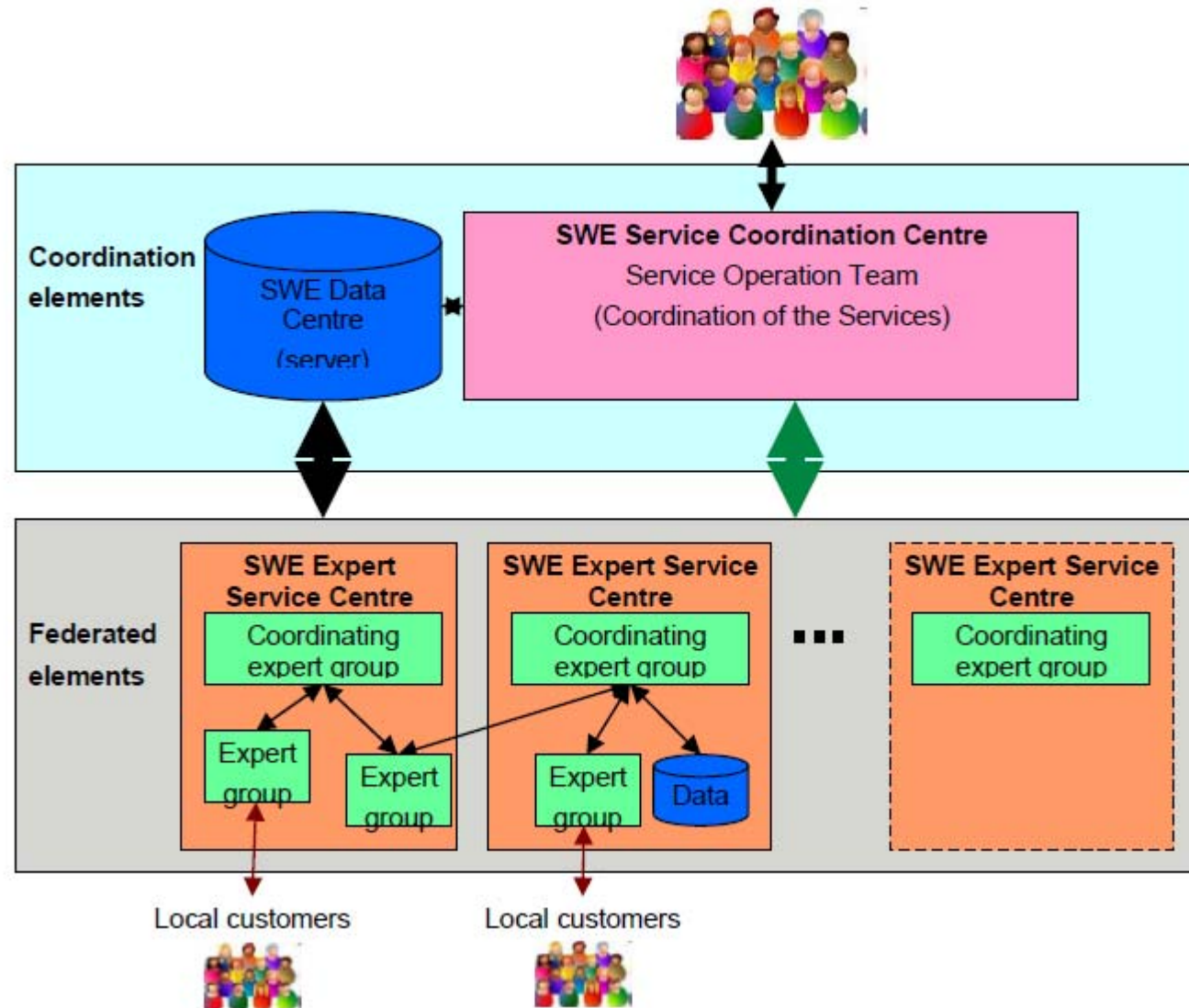
Three categories of maturity:

- **Cat 1:** services for which there is at least one application already running in an operational environment
 - consider for redeployment
- **Cat 2:** services for which there is no currently end to end application but the essential building blocks exist.
- **Cat 3:** services for which at least one critical building block is missing.
- Feasibility of adding more precursor services from CAT-2 will be assessed
- Complete set of services to be established during the full SSA Programme

SWE Segment Service Topology



- **Federated** service provision
- **SSCC operated by the Service Operation Team (SOT)** coordinates service provision, handles the day-to-day operations and provides first level of user support.
- **ESC:** consortium of expert groups with expertise in a particular service/group of services.



- **SN-I**: Precursor Services - Part-1: Definition and Service Consolidation
 - Consolidation of the service definition
 - evaluation of existing assets
 - identification of constraints and conditions of use of the assets
- => Deployment plan for the precursor services
- Re-deployment and operation of CAT-1 applications in SWE Service Coordination Centre
- Service assessment with the user in the loop via
 - operated applications
 - Service mock-ups or simulations

SN-II: Implementation design study of Space Weather instruments

- SN-II will consider the requirements for space weather information and to investigate:
 - the instruments needed to satisfy the requirements
 - the required satellite orbits for the measurements
 - the characteristics of the instruments and the planned satellite mission for suitable orbits
 - the degree to which planned instruments & spacecraft can satisfy the requirements.
- Support negotiations with spacecraft missions already in planning

SPENVIS in SSA

- An excellent example of a working service with active (and satisfied!) professional users
- Long development history
- Acknowledged reference in the field
- Addresses SWE services:
 - Spacecraft design
 - Spacecraft Operation
- Identified as CAT-1 service suitable for redeployment
- Expected to be part of an initial set of applications to be redeployed in the new SWE data centre at Redu



Model packages - Mozilla Firefox
http://localhost/spenvis/htbin/spenvis.exe/FIRST

SPENVIS DEVELOPER Project: G4SUW
Model packages
Planet: Earth

Output
Help

[Coordinate generators](#)
[Radiation sources and effects](#)
[Spacecraft charging](#)
[Atmosphere and ionosphere](#)
[Magnetic field](#)
[Meteoroids and debris](#)
[Data base queries](#)
[Miscellaneous](#)
[ECSS Space Environment Standard](#)

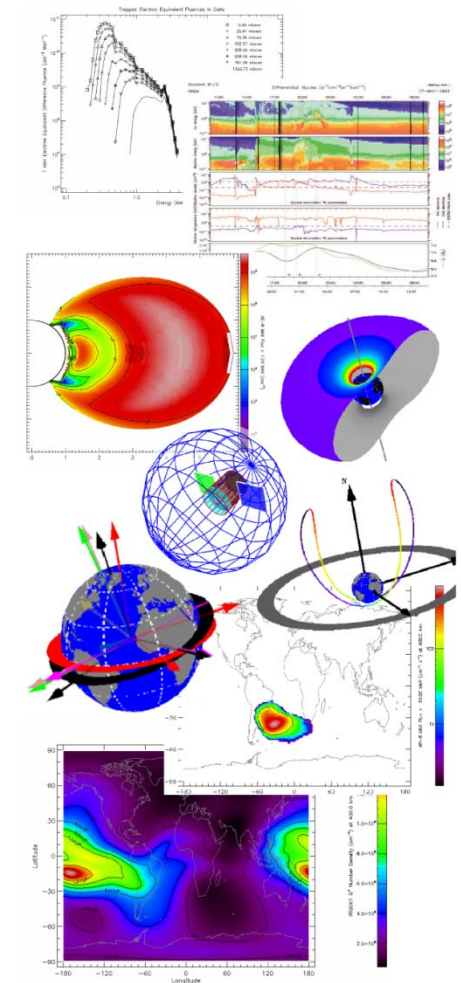
The models implemented in SPENVIS are combined in the packages listed above. Clicking on a package name will expand the table with a list of models. Some model suites have to be executed in a prescribed order. Model links will not be available when pre-required runs have not been executed yet. Most models run on both a spacecraft trajectory and a geographical coordinate grid. Clicking on the coordinate generator links and returning to this page toggles between the two sets of coordinates. The model links will adapt to the choice of coordinates.

The model pages have deliberately been kept as concise as possible. A navigation bar is figured at the top of each SPENVIS page. The [Help](#) link in the bottom right hand corner of this bar points to context sensitive help pages, which in turn contain their own navigation system, including access to guidelines on model usage and space environment.

's **Back** or **Forward** buttons (except for navigating in ons do not save input parameters. Full navigation ble through the menu bar at the top of each page and each page.

r consulting the help pages) and feedback, please

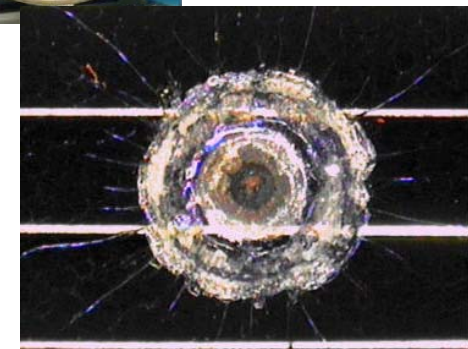
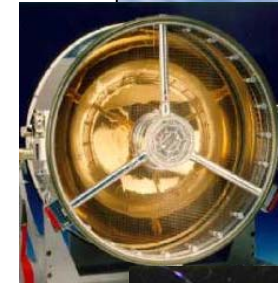
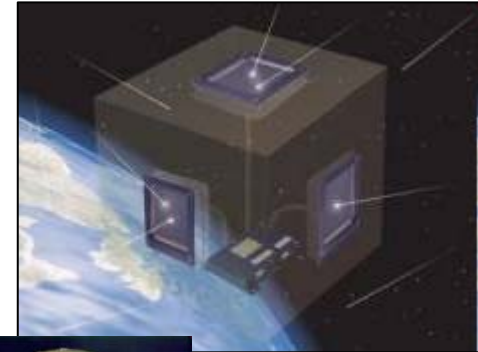
- SWE version will be an implementation of SPENVIS functionality “as-is”
- After re-deployment, SWE version will be accessible via the SSA Technical Web Portal (under development)
 - Centralised access to SSA services
 - User registration and account handling
 - Future work on harmonising the deployed applications
- Existing user accounts and information will remain at BISA, but can be incorporated to the SWE version at a later date depending on user needs
- SSA data policy and governance in discussion
- TEC-EES close involvement throughout ensures quality and consistency of redeployed version



- **Name: SEDAT**
- **Function:** Programmable application and space environment database allowing expert user environment analysis
- **User Domain:** Spacecraft designers, spacecraft operators

- **Name: EDID**
- **Function:** Resource for information on European impact detectors
- **Service Domain:** spacecraft design

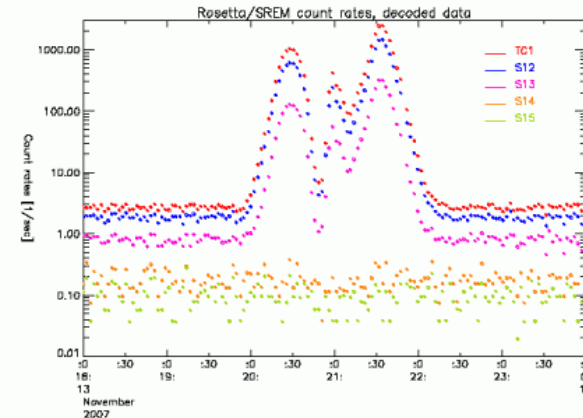
- **Name: ODI - Open Data Interface**
- **Function:** Database in MySQL common to SAAPS, SEDAT, and SPENVIS
- **Service Domain:** Spacecraft design



Initial Precursor Services



- **Name:** SREM in-flight sensors and database
- **Function:** Archive and latest data from SREM instruments
- **Service Domain:** spacecraft design & operation



- **Name:** SWENET Portal
- **Function:** Web based application including analysis tools, alerting functions and other services, database access. *Centralised access to distributed service network*
- **Service Domain:** data services

SWENET

Welcome to SWENET
Space Weather European Network

SWENET Contents

- Introduction
- SWENET Services
- Look for Services
- Latest Data
- Space Weather Data
- Data Browsing
- Data Analysis
- Index Quality
- FTP Mirror
- Latest SWPC Plots
- Latest Alerts
- Latest Indices
- Statistics
- Daily Reports
- Message of the Day
- Report Browsing
- Resources
- Documentation
- Tutorials
- Release Information
- Web Service
- User Area
- Login

SWENET Search

Latest Alerts

✓ No active alerts.

SWENET Services

- Ground Effects
- Ionospheric Effects
- Spacecraft Effects

Latest Indices (14 days)

Ap (BINCASTS)

sda-bincasts-drx-es-actual

9
8
7
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0

05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31

1. The SWENET team is pleased to inform you about the latest features and functions upgrades as well as interface enhancements to the Space Weather European Network Portal, version 3.08.

Upgrades:

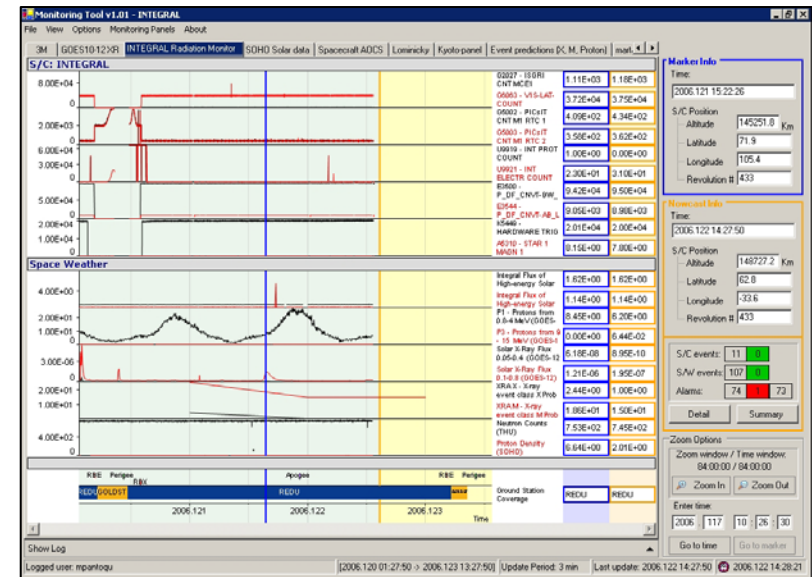
1. **Index Quality Statistics** made easier by introducing compact vs. full view functionality, and by adding an explanatory section on space weather indices.
2. The service **DIAS** (European Digital Upper Atmosphere Server) has been added with the following data:
 - foF2 maps over Europe
 - Daily sunspot numbers plots
3. The service **SWACI** was introduced. Update 2009-03: Hourly TEC maps over Europe added to database.
4. The service **BINCASTS** added smoothed monthly sunspot data, a

Initial Precursor Services



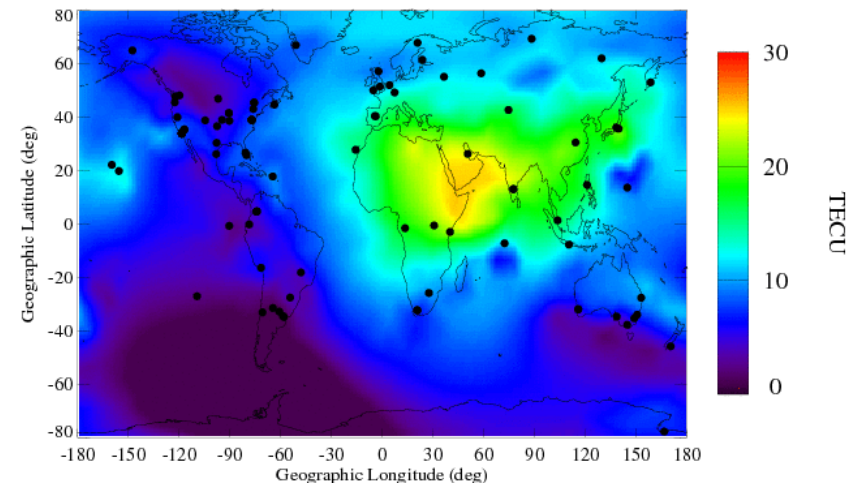
- **Name: SEISOP**
- **Function:** Application providing access to space environment and spacecraft housekeeping data in near-real time
- **Service Domain:** spacecraft operation

- **Name: IONMON**
- **Function:** Software producing TEC (Total Electron Content) maps in near real-time and product archive based on dual-frequency GPS data collected from IGS ground stations.
- **Service Domain:** Transionospheric Radio link, Non-space system operators & General data service



05/28/10
11:00 UT

Ionospheric TEC Map

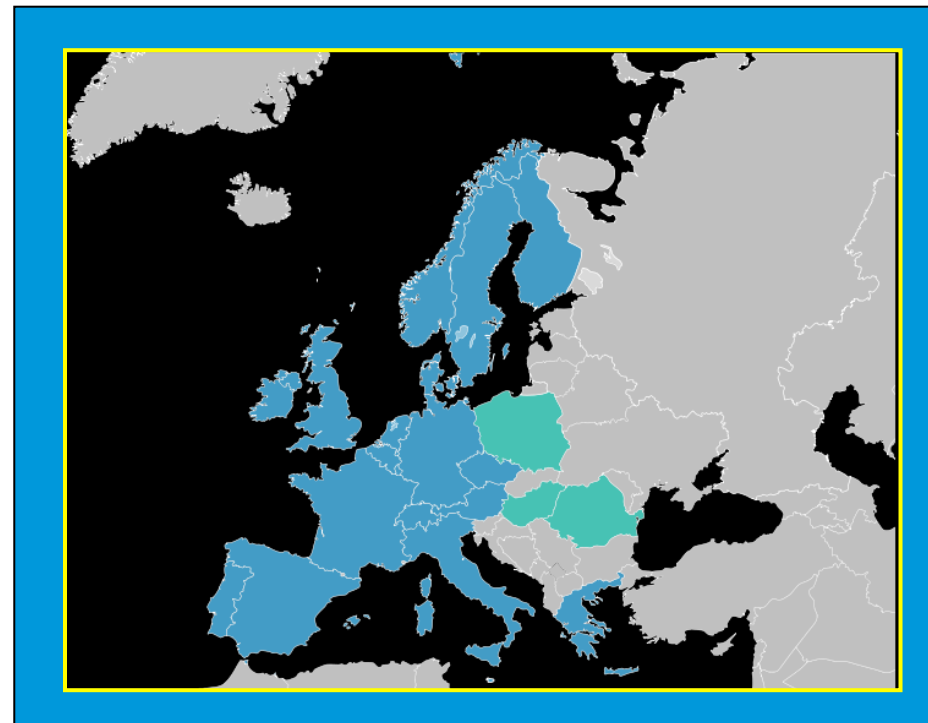


Survey of space-weather assets 2009 with support from SSA URG and ESA SWWT:

- Data and sensors
- Software and models
- Expertise in space-weather domain
- Already existing services

Assets from 19 countries, ESA member states and associated states (Canada, Hungary).

More than 300 assets identified.



International Collaboration

- EC: FP7, COST Actions
- European Space Weather Week
 - **15-19th November 2010**
 - <http://sidc.oma.be/esww7>
- ISES (&WMO)
 - TEC-EES collaborative expert centre
- ILWS
 - End Users Task Group
- NOAA
 - Data collaboration
- NASA
 - Data in discussion
- UN COPUOS
 - ISWI
- COSPAR PSW
- Other...



SSA preparatory programme:

- Preparatory activities for ICT infrastructure (on-going)
- Preparatory activities for service prototyping including initial redeployment of existing assets available by end 2010 (SN-1)
- Preparatory activities for identifying and securing flight opportunities for SWE instruments (SN-2).
- System requirements analysis and high level architecture (ongoing)

R&D for future development and upgrades:

- Instruments/tools to be developed as part of GSTP-5 (subscribed activities in preparation)
- Propose and undertake relevant R&D (GSTP5, TRP, GSP, ...)
- Next 3-year TRP plan in preparation