



# Space Weather in the ESA SSA Programme

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SSA Programme Office, ESA-ESAC

**Space Weather Workshop**  
**16-19<sup>th</sup> April 2013**



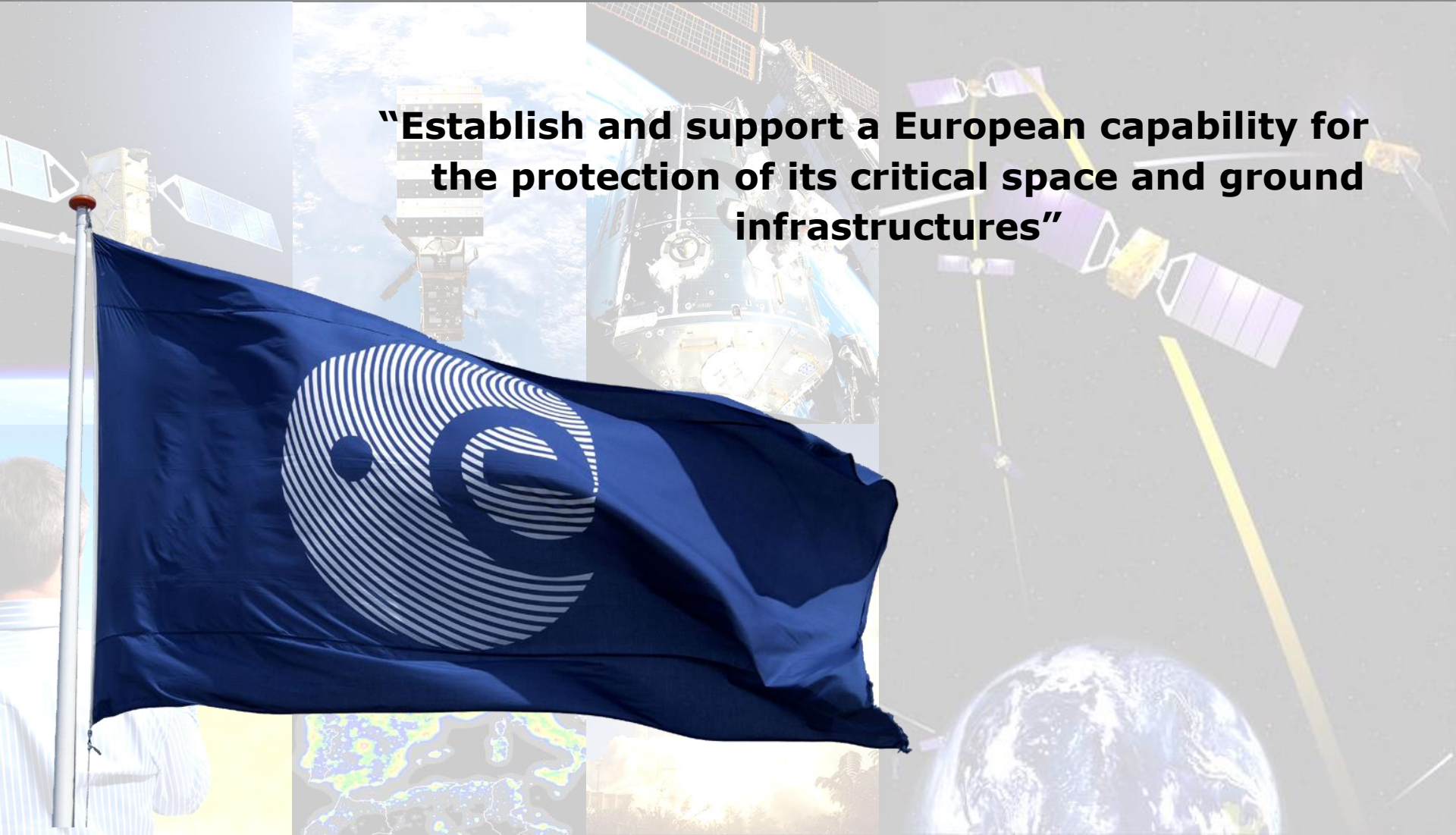
# Europe Depends on Space

- Communications
- Navigation
- Weather Forecasting (Space and Earth)
- Time Reference
- Climate Change Monitoring
- Disaster Management
- Earth Observation (Agriculture, Planning)

# Objective of the SSA Programme



**“Establish and support a European capability for the protection of its critical space and ground infrastructures”**





# Customers for SSA Services



- **European Governments**
  - EU, EC
  - National
  - Regional
- **European Space Agencies**
  - ESA, EUMETSAT
  - National
- **Spacecraft Operators**
  - Commercial
  - Academic
  - Governmental
- **Space Insurance**
- **Space Industry**
- **Energy**
  - Surveying
  - Electrical Grid
  - Power Supply
- **Network Operations**
- **Telecommunications**
- **Air Traffic Control**
- **Search and Rescue Entities**
- **United Nations**
- **Defence**
- **Civil Protection**

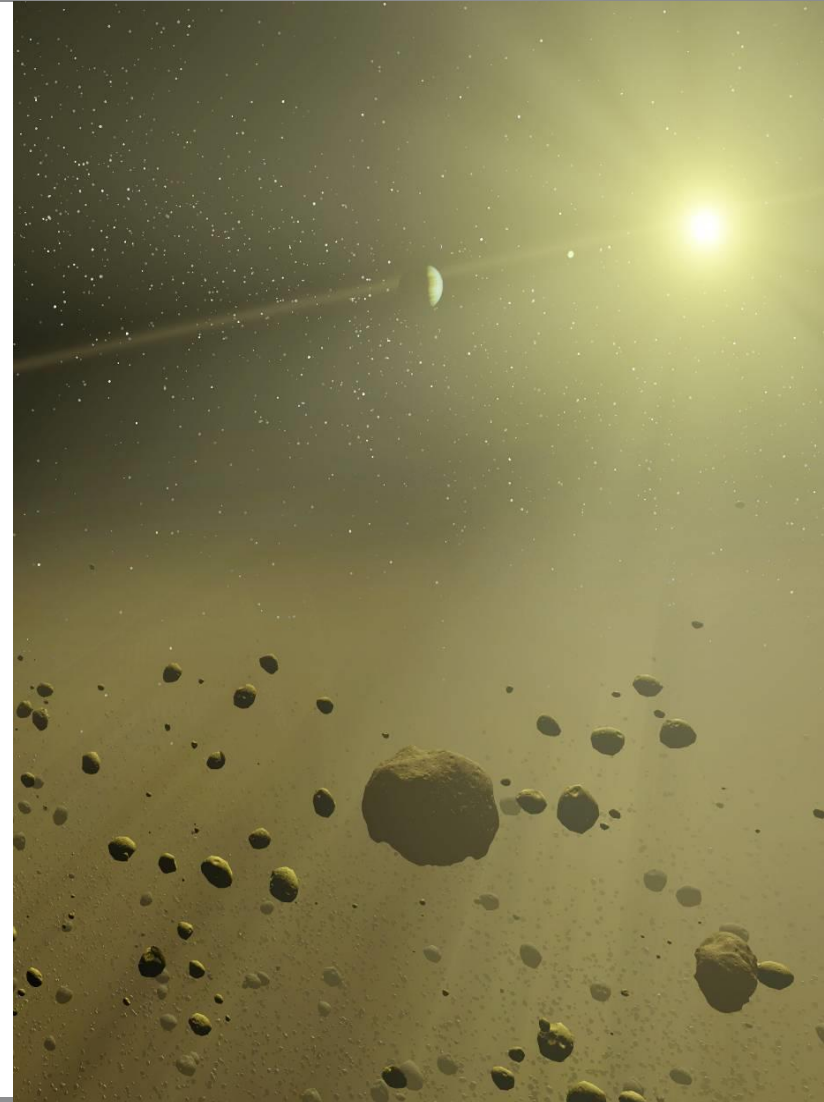


## **2009 – 2012: SSA Period 1 (Preparatory Programme)**

- Mission, customer and system requirements
- Governance Definition and Data Policy
- System Architecture
- Precursor Services
- Radar Breadboard
- Pilot Data Centres

## **2013 – 2016: SSA Period 2**

- Build on results of SSA PP
- Networking of European assets
- Testing & Validation
- Development of applications
- Establishment of selected new assets



# ESA SSA Programme Participants in Period 2



-  Austria
-  Belgium
-  Czech Republic
-  Denmark
-  Finland
-  Germany
-  Italy
-  Luxembourg
-  Norway
-  Poland
-  Romania
-  Sweden
-  Switzerland
-  United Kingdom

**Funding: 46.5 M€**  
(2012 e.c.)

# Participation by Programme Segments



	SWE	NEO	SST
<b>Austria</b>	X		X
<b>Belgium</b>	X	X	
<b>Czech Republic</b>	X	X	
<b>Denmark</b>	X		
<b>Finland</b>	X	X	X
<b>Germany</b>	X	X	
<b>Italy</b>	X	X	X
<b>Luxembourg</b>	X	X	X
<b>Norway</b>	X		X
<b>Poland</b>	X	X	X
<b>Romania</b>	X	X	X
<b>Sweden</b>	X		X
<b>Switzerland</b>	X	X	X
<b>UK</b>	X		



An artistic illustration of space weather. In the top left, a bright sun emits a powerful solar flare, with streams of red and orange particles (solar wind) flowing across the scene. In the center, a large satellite with two long, rectangular solar panel arrays is shown. It has a central body with gold-colored thermal blankets and two circular instruments. A bright blue and white energy discharge or lightning bolt is depicted striking the satellite. To the right, the Earth is visible, with its magnetic field lines represented by white arcs. Several smaller satellites are shown in orbit around the Earth. The background is a deep blue space filled with stars and streaks of light representing cosmic rays or particle showers.

# Space Weather (SWE) Segment

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

European Space Agency

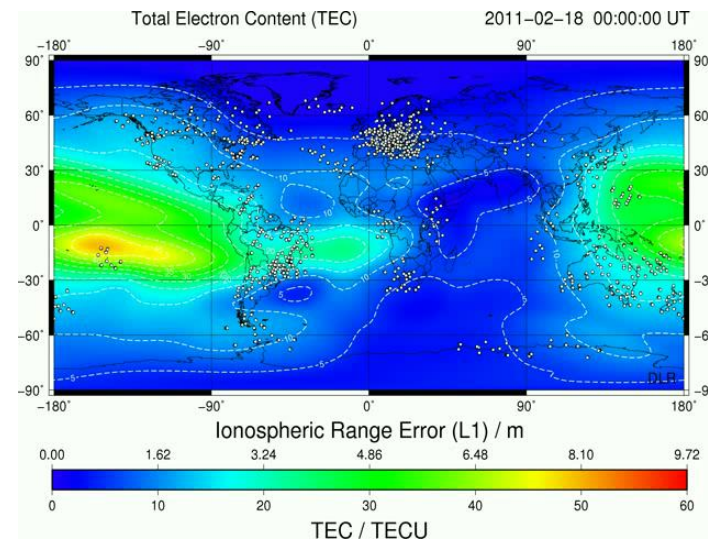
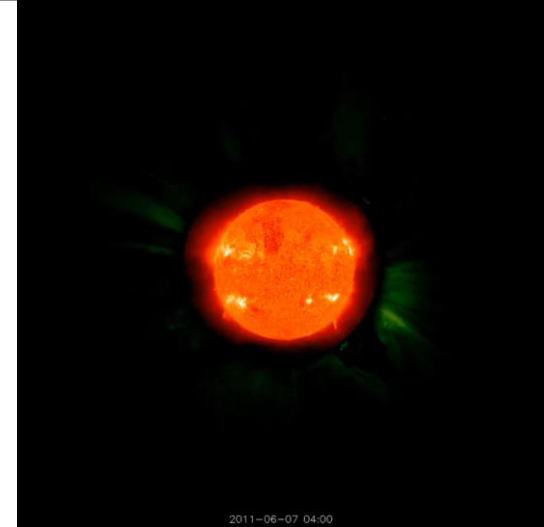


# SSA Space Weather System Objectives



**Detection** and **forecasting** of Space Weather events and the **effects** they may have on European space assets and ground based infrastructure:

- Provision of comprehensive knowledge, understanding and maintained awareness of the natural space environment
- Monitoring the Sun, the solar wind, the radiation belts, the magnetosphere and ionosphere to the extent that it supports SSA SWE services
  - Detection and forecasting of SWE and its effects
- Prediction and detection of permanent or temporary disruption of mission or service capabilities
- Provision of predicted local spacecraft and launcher radiation, plasma and electromagnetic environment data



# SWE Segment objectives in SSA Period 2



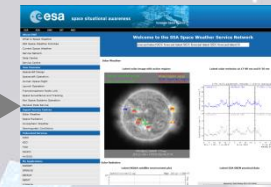
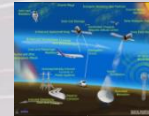
- **Networking of available national and European SWE assets**
  - PP catalogued sensors, data, data centres, applications & service centres
  - P2 will also enhance service coordination, user support
- Continuation of the **preparation of SWE additional services** building on achievements of the Preparatory Programme
- Continuation of the **Proba-2** operations and exploitation
- Implementation of the **first flight opportunities for hosted payload SWE instruments** and planning for the future HP missions
- **Exploitation of SWE instruments**, as well as **data** and European centres of expertise
- **Study** (phase A) of a **mission** to ensure availability of **solar wind, IMF and coronagraph data** from L1
- **Studies** of mission concepts **for enhanced SWE monitoring and forecasting** with sensors away from the Sun-Earth line
- SSA-SWE **technologies** development



# SSA/SWE Precursor System 2013



SSA-SWE Users



**SSA-SWE  
Service Portal:**  
**[swe.ssa.esa.int](http://swe.ssa.esa.int)**

**SWE Data Centre  
Redu, Belgium**

**SSA Space Weather  
Coordination Centre  
Space Pole, Belgium**

## SWE Expert Service Centres

**Solar  
Weather**

**ROB, Belgium  
(coord.)  
Uni. Graz, Austria**

**Ionospheric  
Weather**

**DLR, Germany  
(coord.)  
NMA, Norway  
NOA, Greece  
CLS, France**

**Space  
Radiation**

**BIRA, Belgium  
(coord.)  
AIT, Austria  
UOA, Greece**

**Geomagnetic  
Conditions**

**TGO, Norway  
(coord.)  
FMI, Finland**

**Heliospheric  
Weather**

**TBD**

# SSA Space Weather Coordination Centre (SSCC)

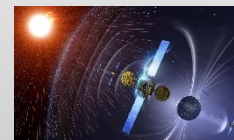


- Established in Space Pole, Brussels
- SSCC is the first point of contact for SSA-SWE help and information:
  - Operates the SWE Helpdesk
  - operates and maintains the SSA-SWE Data Centre
  - monitors the availability and accessibility of the SSA-SWE services
  - coordinates the second level user support through ESCs
- SSCC is operated by
  - Belgian Institute of Space Aeronomy
  - Royal Observatory of Belgium
  - Space Application Services
  - Spacebel S.A.



## SSA SWE Coordination Centre

Space Pole  
Avenue Circulaire, 3 - Ringlaan  
1180 Uccle - Ukkel (Brussels)  
BELGIUM



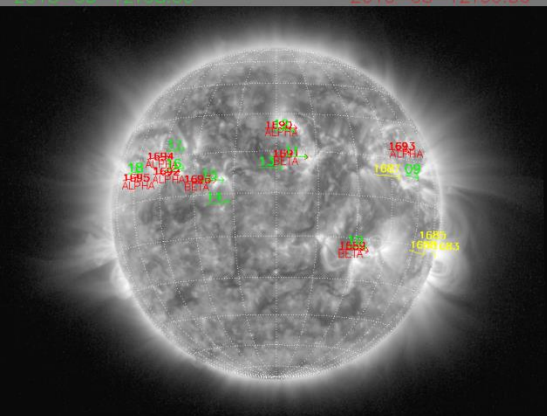
Tel: +32-2-7903-913  
Email: [helpdesk.swe@ssa.esa.int](mailto:helpdesk.swe@ssa.esa.int)



# Examples of Space Weather Data & Applications Already Available

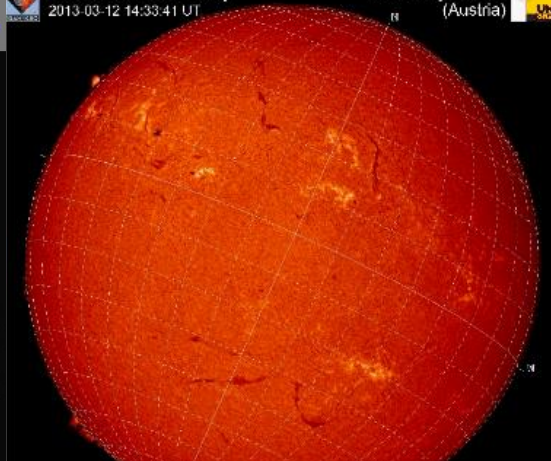


Solar wind groups  
2013-03-12T08:00  
NOAA AR/sunspot  
NOAA Alpha plage  
NOAA expected region  
2013-03-12T00:30

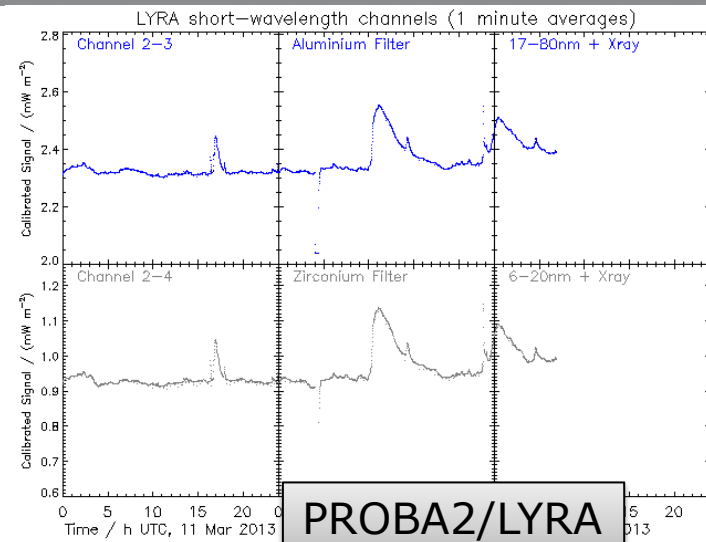


SIDC/SOTERIA

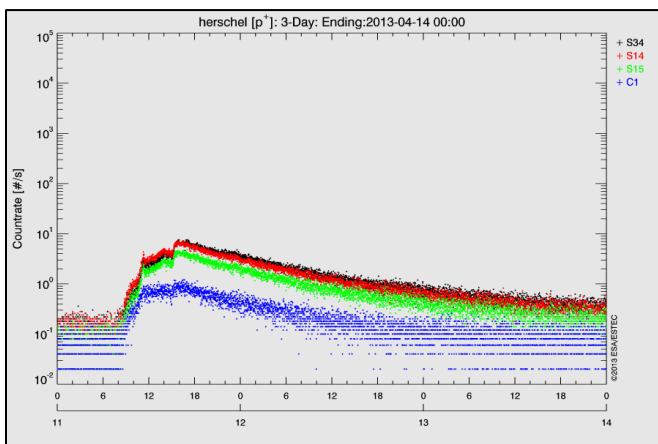
Kanzelhöhe Observatory  
2013-03-12 14:33:41 UT  
University of Graz  
(Austria)



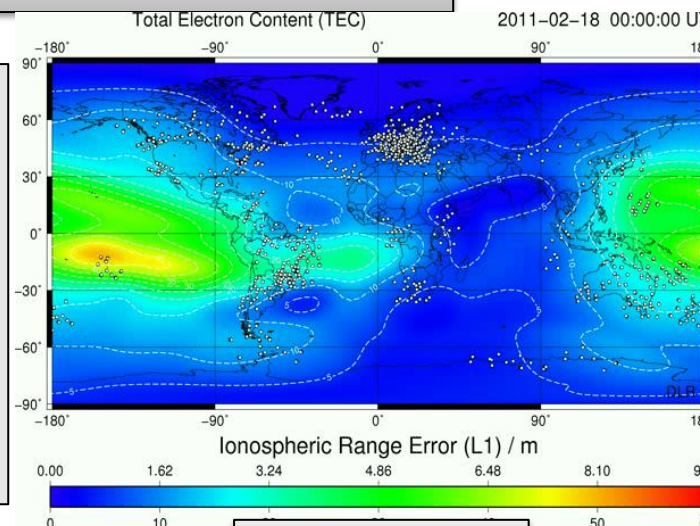
Uni Graz-Kanzelhoehe



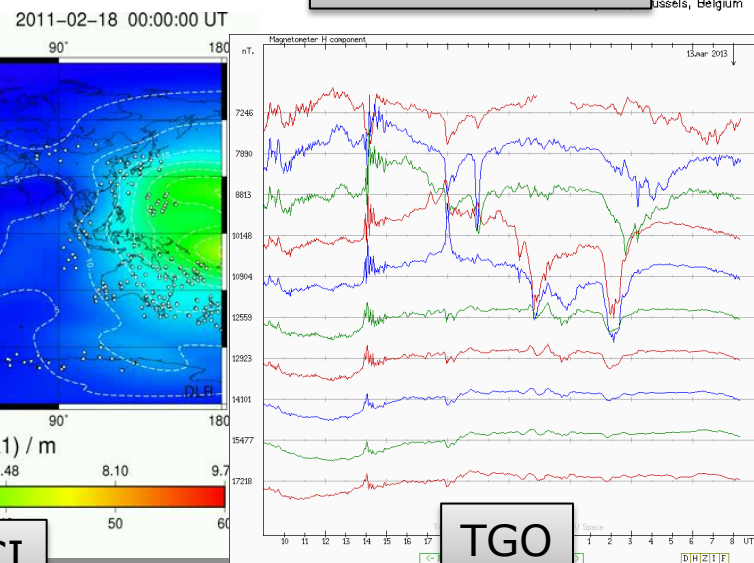
PROBA2/LYRA



SREM (Herschel)



DLR/SWACI

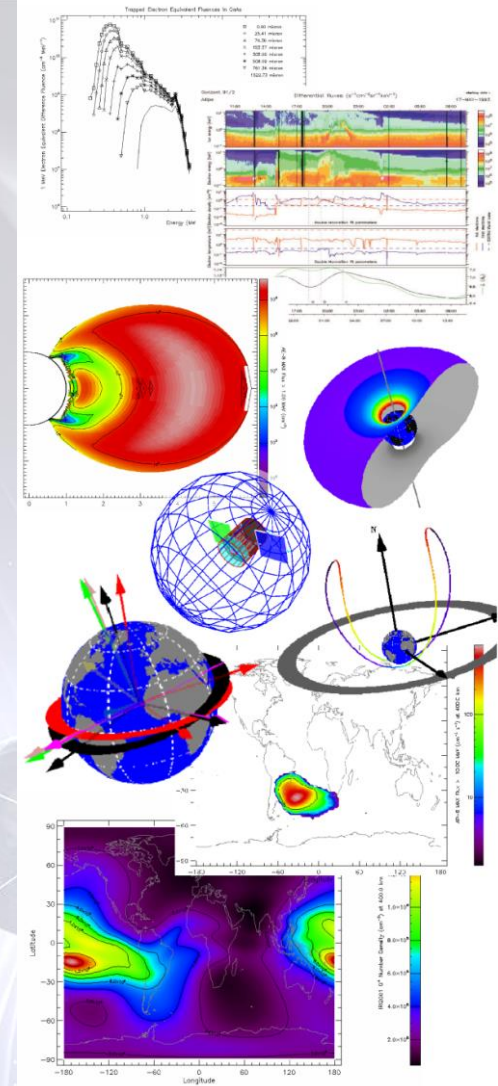


TGO

# Expert Service Centre (ESC) Evolution



- ESC profile to be further elaborated during Period 2
  - Focussing on their role as thematic centres of expertise
  - Provision of 2<sup>nd</sup> line expert support to SWE users
  - Evaluation of new applications/products through targeted campaigns run together with the users.
  - Organisation of regular workshops with users
  - Targeted development of services
  - Service performance metrics and monitoring
  - Recommendation for updates of service roadmaps
- ESC network will expand to
  - Existing ESCs will include new Expert Groups
  - Include new ESC(s)



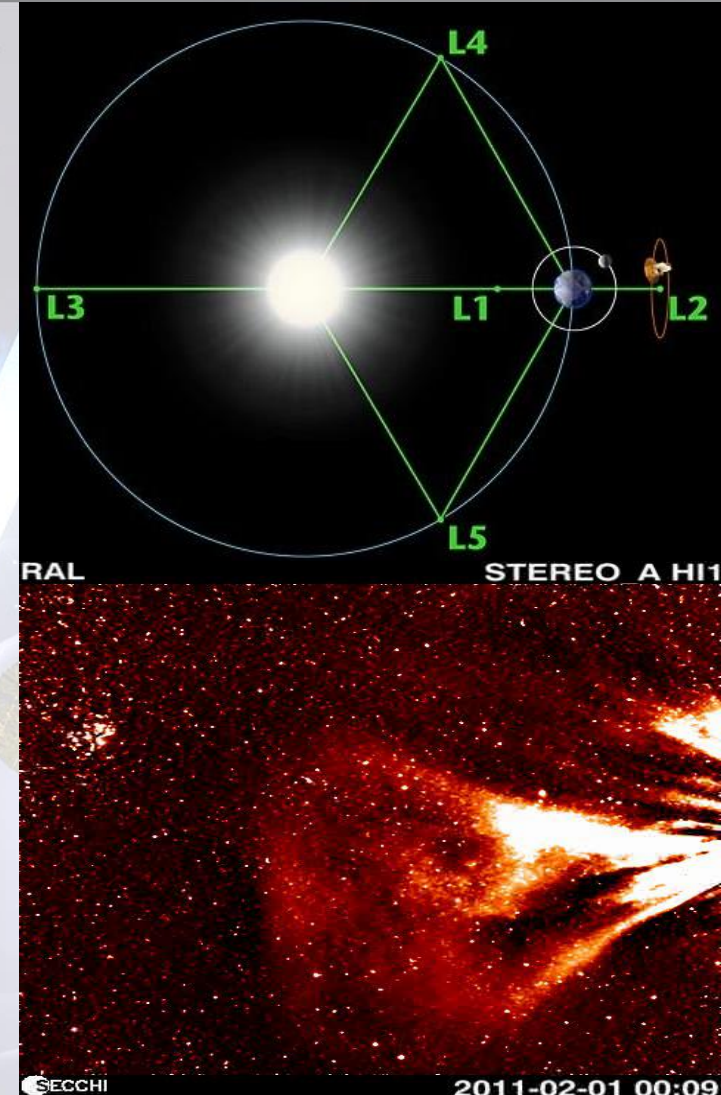
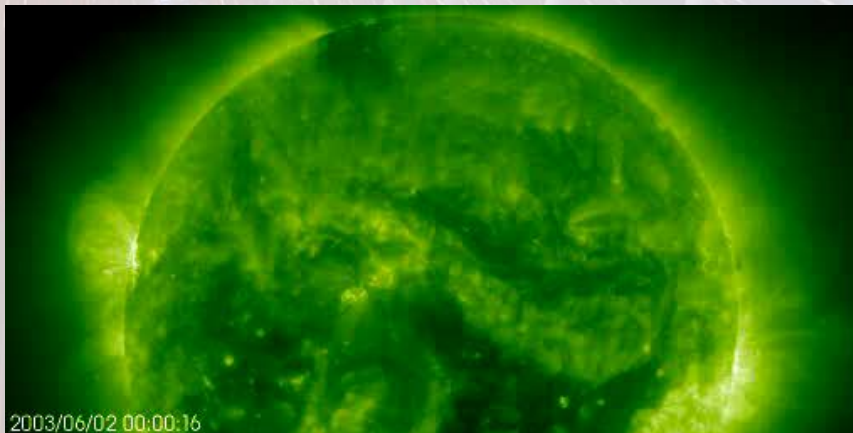


# Concepts for enhanced SWE monitoring



In-situ L1 observations are critical for forecasting  
EUV imaging of the solar disc from L5 point gives an  
opportunity for early detection of potentially  
hazardous active regions

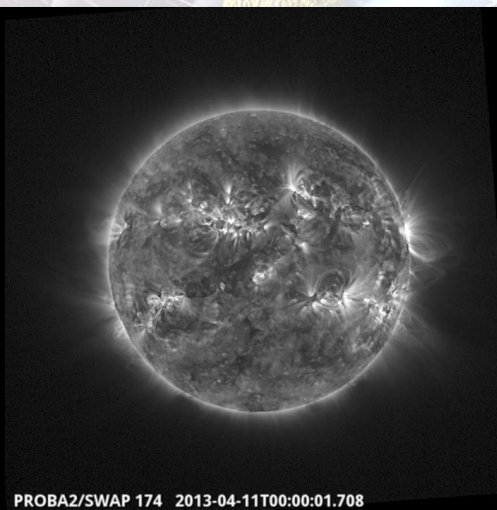
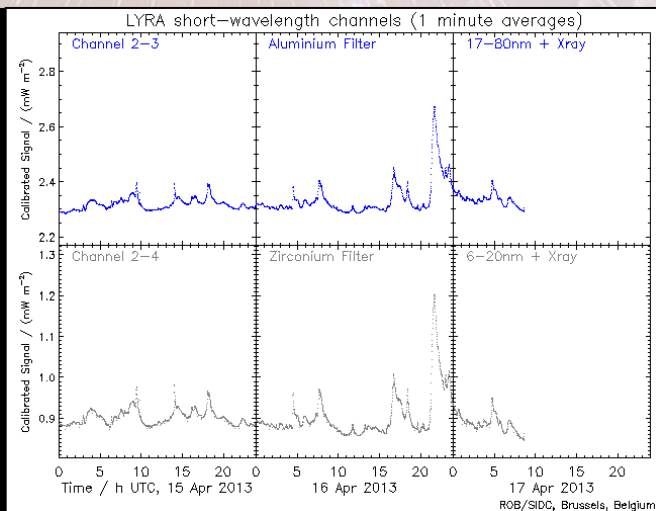
In-situ observations of particles and fields in L4  
gives ahead information about well connected  
particle events (SEPs)



# Proba2 mission extension



- Responsibility of Proba2 mission management is transferred from SRE to SSA on 1st July 2013
- Mission Operations Centre (MOC) is funded by the SSA Programme for 18 months from 1st July
- Science Operations Centre (SOC) funding by SRE until December 2014 is assumed
- If s/c remains healthy, funding of the MOC and SOC may be continued until December 2016



PROBA2/SWAP 174 2013-04-11T00:00:01.708





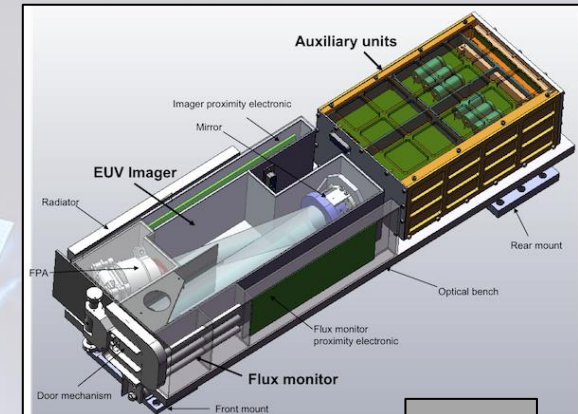
# SSA-SWE hosted payload missions



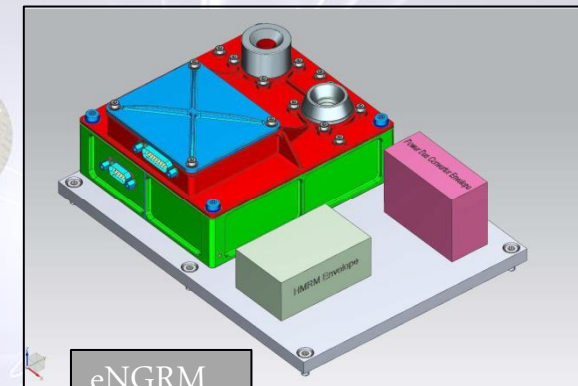
- Opportunities for SWE hosted payload missions have been analysed in SN-II activity lead by Astrium GmbH
- Analysis included
  - 40 European SWE instruments
  - 10 candidate host missions
  - Ground segment configurations
- Analysis for each mission included a detailed mission implementation design plans
- First mission to be implemented is NGRM onboard EDRS-C platform
- Other investigated missions included e.g. MetOp-C, Galileo FOC, Jason-CS...



SEPS-LEED



ESIO



eNGRM





**THANK YOU!**

**For more information:**  
<http://www.esa.int>  
<http://swe.ssa.esa.int>  
<http://sst.ssa.esa.int>  
<http://neo.ssa.esa.int>

European Space Agency