

LA METEO DE L'ESPACE A L'ESA

ET AU CNES

Jean-Yves Prado

21 juin 2015

UNE BREVE HISTOIRE DE LA METEO DE L'ESPACE EN FRANCE ET EN EUROPE

Projets pilotes

- Parution en 1996 du SW Strategic Plan NASA/NOAA/DoD
- 1^{er} Groupe de travail du CNES 1997-1998: participer à des initiatives ESA
- Projets Pilotes ESA (RAL et ALCATEL/LPCE) 1999-2001
- Elaboration du SSA par le SWWT 2001-2009

Programme Space Situational Awareness de l'ESA

- Présenté à la ministérielle de décembre 2012 sur la base des travaux réalisés en 2009-2012 (période 1) à laquelle la France participait
- Programme facultatif avec 3 éléments SST/SWE et NEO
- Élément SST obligatoire, les 2 autres optionnels
- Pas de décision française de participer pour des raisons non liées au SWE
- Début de la Période 2 (2013-2016) à laquelle la France participe sans contribuer
- Préparation de la période 3 en cours pour adoption à la prochaine ministérielle de fin 2016

Introduction to the SSA Programme



CNES, 13th September 2013

N. Bobrinsky



SSA Programme Participants in Period 2

- ☐ 14 Participating States
- ☐ Focus on Space Weather
- ☐ Activities also in the areas of NEO and SST

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

**Funding: 46.5 M€
(2012 e.c.)**

SSA Period 2

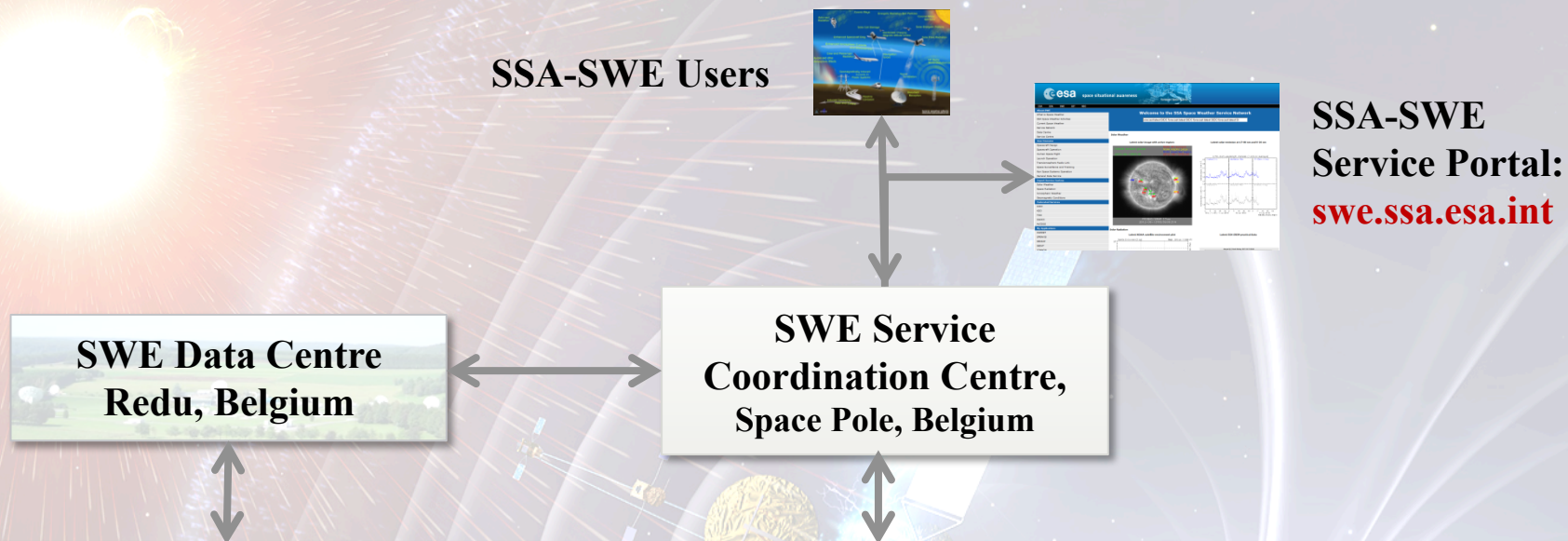
Participation, funding



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

1. **Networking of available national and European SWE assets** (sensors, data centres, service centres, service coordination, user support)
2. Continuation of the **preparation of SWE additional services**
3. Continuation of the **Proba-2** operations and exploitation
4. Implementation of the **first flight opportunities for hosted payload SWE instruments** and planning for the future HP missions
5. **Exploitation of SWE instruments**, as well as **data** and European centres of expertise
6. **Study** (phase A) of a **mission** to ensure availability of **solar wind, IMF and coronagraph data** from L1
7. **Studies** of mission concepts **for enhanced SWE monitoring and forecasting** with sensors away from the Sun-Earth line
8. SSA-SWE **technologies** development

SSA/SWE Precursor Service System in 2013



**SSA-SWE
Service Portal:
swe.ssa.esa.int**

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**

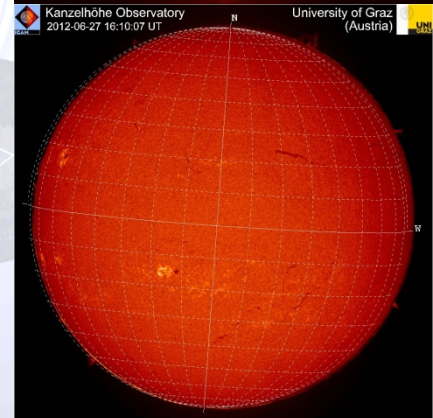
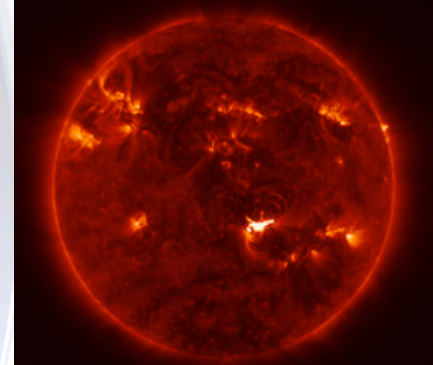
**Heliospheric
Weather**

TBD

Solar Weather ESC



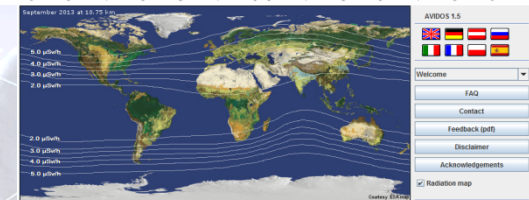
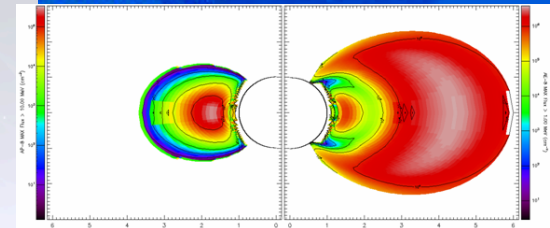
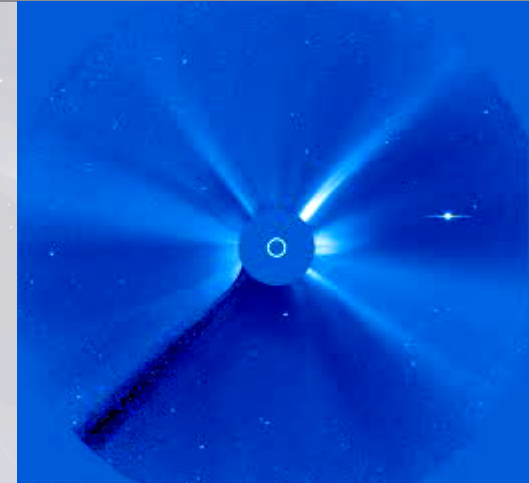
- Solar Weather ESC centralises the expertise on solar drivers of the space weather
- The expertise offered by the ESC includes
 - Long term solar cycle prediction
 - Solar flare monitoring and statistical prediction
 - Coronal Mass Ejection (CME) monitoring and geo-impact prediction
 - Coronal hole monitoring and geo-impact prediction
- Provides a large number of federated SSA-SWE services:
 - solar event alerts (automatic and forecaster triggered)
 - Solar weather predictions and forecasts
 - Latest and archived solar data
 - solar indexes
- Coordinator: **Royal Observatory of Belgium, Belgium**
- Participants: **University of Graz, Austria**



Space Radiation Environment ESC



- Expertise on radiation environment in space and for aviation
- End user support includes
 - Solar Energetic Particle (SEP) events: potentially harmful for manned spaceflight and airline crews/passengers
 - Trapped radiation particles: harmful for spacecraft electronics, electrical systems and solar cells
 - Cosmic rays: harmful for spacecraft electronics and cause for background radiation dose for aircraft crew/passengers
- Applications made available to end users:
 - SPENVIS (SPace ENVironment Information System)
 - AVIDOS (AVIation DOSimetry)
 - Neutron Monitor Service
- Coordinator: **Belgian Institute of Space Aeronomie, Belgium**
- Participants:
 - **Seibersdorf Laboratories GmbH, Austria**
 - **National and Kapodistrian University of Athens (UOA), Greece**



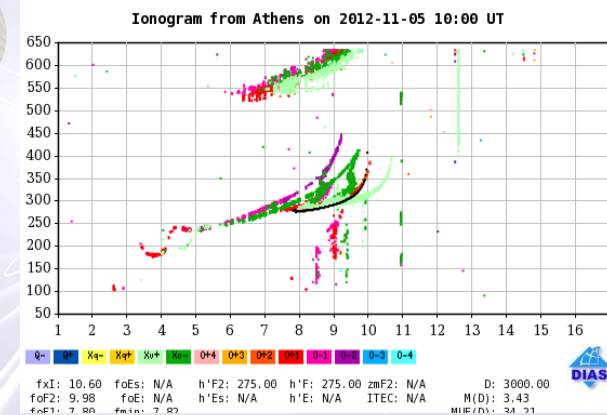
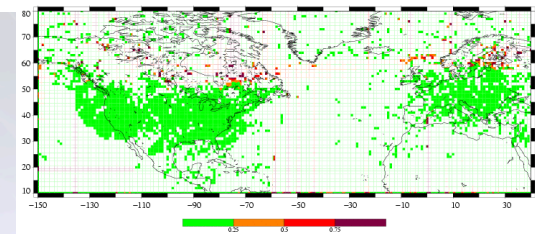
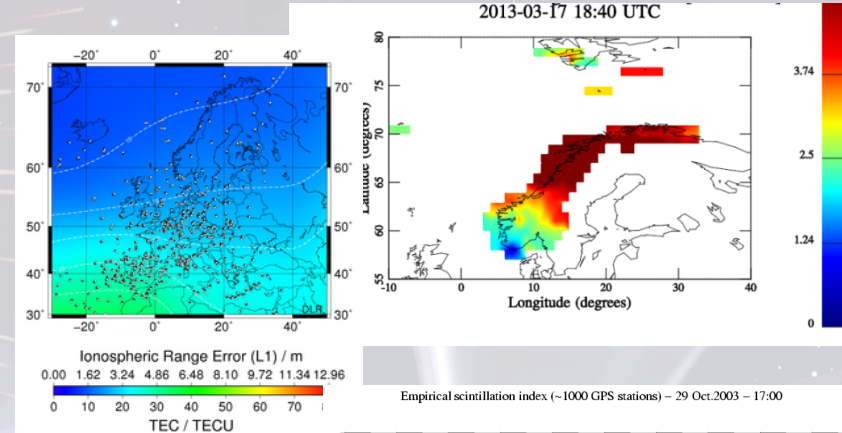
Welcome to AVIDOS
AVIDOS is an informational and educational software for the assessment of cosmic radiation exposure at flight altitudes.



Ionospheric Weather ESC



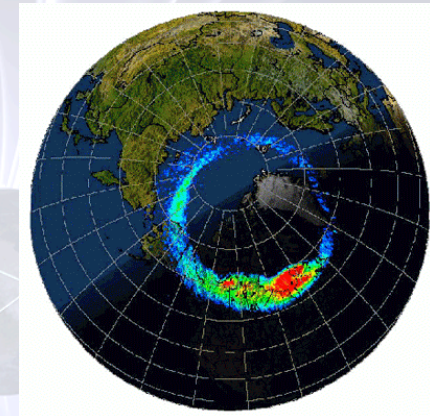
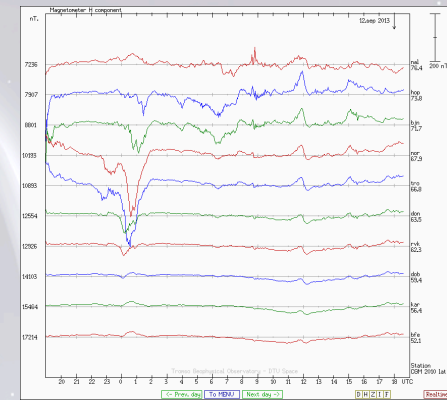
- Expertise on the ionized upper layers of the atmosphere
- Disturbances in the ionosphere impact satellite telecommunication, navigation and VHF/UHF radio communication
- Federated services offered by the Ionospheric Weather ESC include:
 - Regional and global maps and forecasts of Total Electron Content (TEC)
 - Ionospheric disturbance information and alerts
 - Ionospheric scintillation information
 - 2D electron density in the plasmasphere
- Coordinator: **Deutschen Zentrums für Luft- und Raumfahrt, Germany**
- Participants: **Norwegian Mapping Authority (NMA), Norway; National Observatory of Athens (NOA), Greece, CLS (France)**



Geomagnetic Conditions ESC



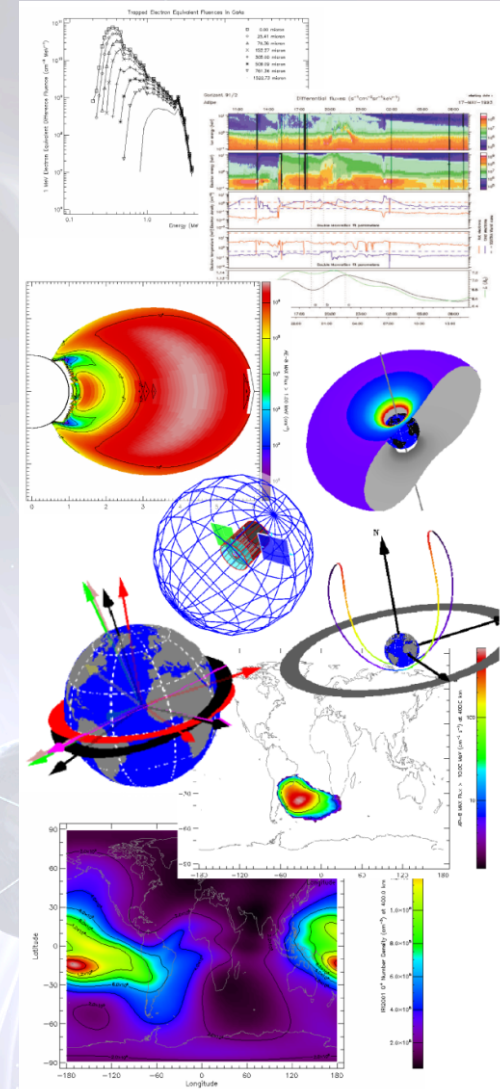
- Geomagnetic conditions ESC centralises expertise on variations in the Earth's magnetic field
- Geomagnetic storms can cause problems in traditional navigation systems, Geomagnetically Induced Currents (GIC) in power systems and pipelines and are related to ionospheric disturbances
- The end users of the Geomagnetic Conditions ESC services include:
 - Power grid and pipeline operators
 - Resource exploration and exploitation industry
 - Geomagnetic surveying companies
 - Auroral tourism sector
- Coordinator: **Tromsø Geophysical Observatory, Norway**
- Participants: **FMI, Finland**



Expert Service Centre (ESC) Evolution

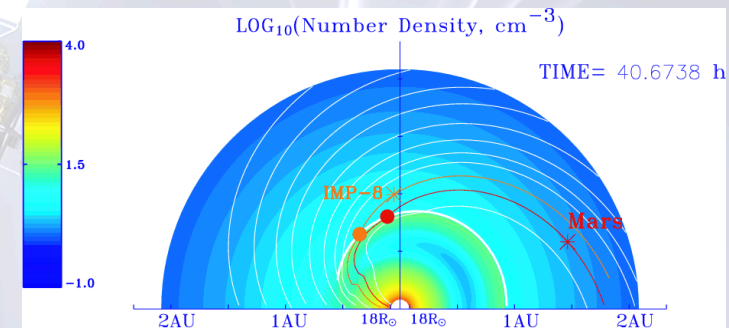
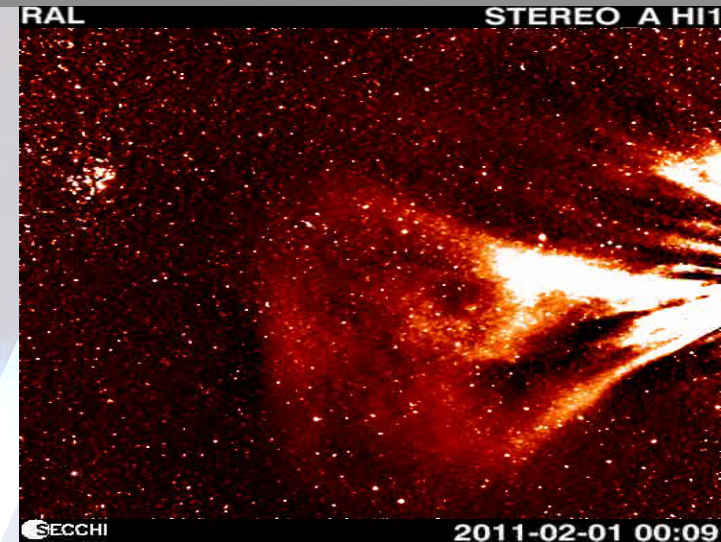


- ESC profile to be further elaborated during Period 2
 - Focussing on their role as thematic centres of expertise
 - Provision of 2nd line expert support to SWE users
 - Evaluation of new applications/products through targeted campaigns run together with the users.
 - Organisation of regular workshops 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) starting from Heliospheric Weather



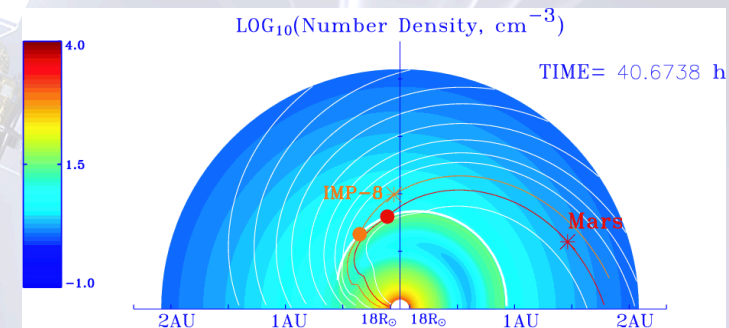
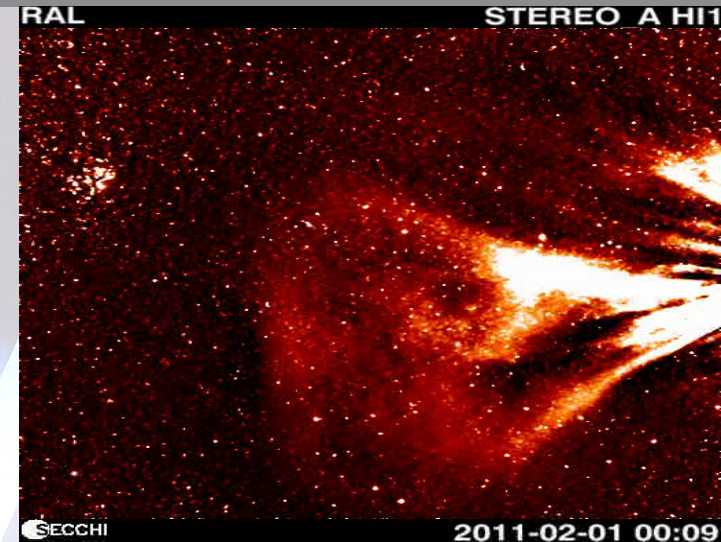
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- New ESC to be established at the beginning of Period 2
- Focus on magnetospheric response to solar wind disturbances
 - Multi-point remote sensing of heliospheric phenomena
 - Physical modelling of solar wind/CME initiation and evolution, Interaction solar wind/IP CMEs
 - SEP event modelling
 - Nowcast & forecast techniques to be prototyped and tested
- Heliospheric and Solar Weather ESC outputs will form key inputs to the ESC network



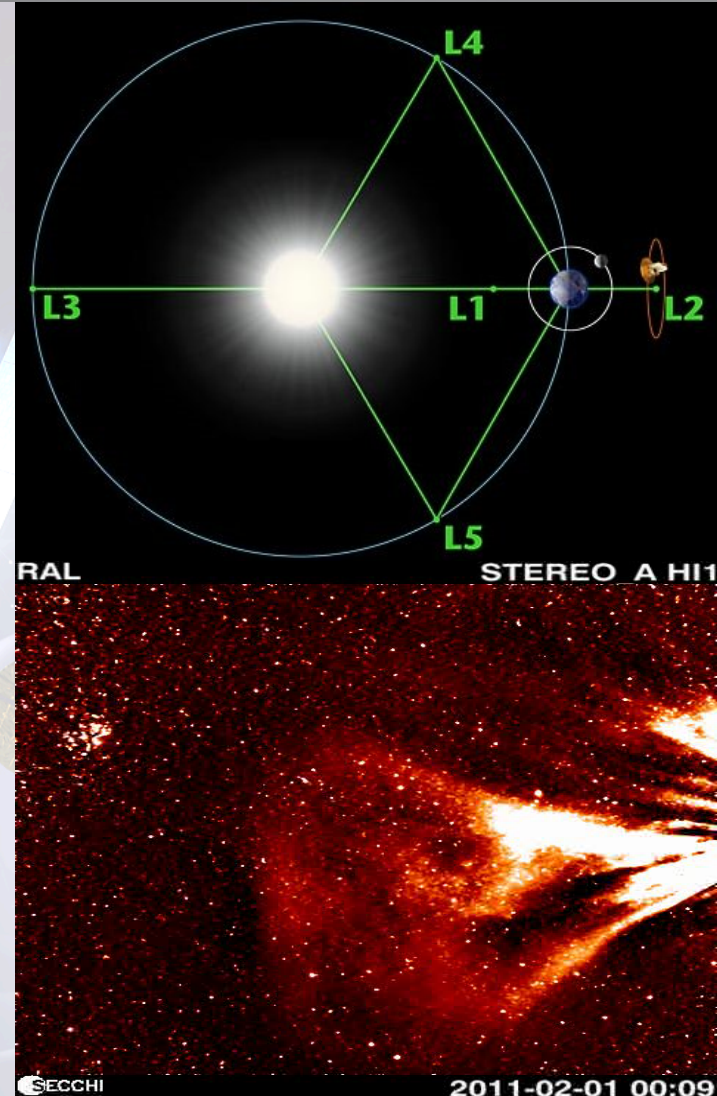
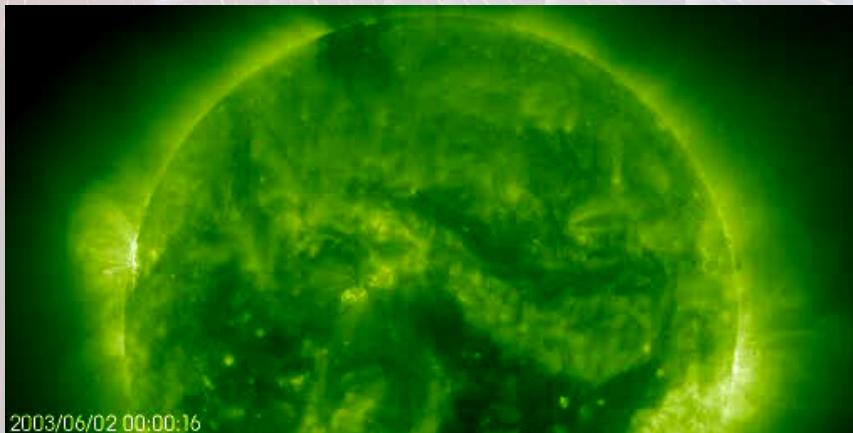
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Concepts for enhanced SWE monitoring

- In-situ L1 observations are critical for consolidating the CME warnings and geoeffect predictions
- 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)



Activities for 2014 - 2016

- The activities to maintain and develop the SWE Segment will continue in the work plans 2014 and onwards
- Foreseen activities in 2014-2016 will include
 - Addition of new space weather services
 - Further enhancement of the SWE ground segment
 - Maintenance and enhancement of the SSCC
 - Phase C/D development of selected new SWE sensors with identified hosted payload flight opportunities
 - Phase B1 of the enhanced space weather monitoring system study
 - Continuation of the hosted payload flight opportunity assessments for new missions and new instruments



Roadmap to Council at Ministerial level 2016 for the SSA programme

Clare Mattok
HSO Coordination Office

Preparing for SSA Period 3



SSA programme currently in Period 2, to be completed at end 2016.

Next phase, Period 3 (2017-2020), to be decided at CMIN planned to be held at end 2016.

Decisions required on continuation of activities in all three segments as well as longer-term strategy for overall programme.

Preparation of proposal to involve Member States, industry.

Consideration to also be given to SSA Advisory Group recommendations on activities and plans of European and international partners.

Key dates in 2015 and early 2016



9 Sept 2015

Workshop with Industry (at ESOC)

To seek recommendations from industry on opportunities and how they could be implemented.
To obtain their engagement in future SSA activities.

28 Sept 2015

Workshop with Delegations (at HQ)

To understand MS' interests and affordability constraints.

> Draft of Programme Proposal

13 Jan 2016

Workshop with Delegations (at HQ)

To introduce the draft Programme Proposal and seek MS' reactions.

> 1st Programme Proposal to PB-SSA in Feb 2016

ET AU CNES

Activités

- Soutien au service de l'Observatoire (P. Lantos) depuis les années '70s jusque vers 2000
- Reprise par CLS d'une partie des activités
- Réduction progressive jusqu'à disparition de ce support
- Recommandation de rejoindre le SSA/SWE soutenue par le CERES lors du séminaire de prospective scientifique de mars 2014
- Mise en avant des pôles thématiques CDPD et MEDOOC comme éléments de contribution française au SSA/SWE
 - ◆ Eléments actuellement absents dans l'architecture SSA
 - ◆ Pas de contrainte de service opérationnel 24/7
 - ◆ Transversalité

Groupe de travail Météo de l'Espace :

- Créé en début 2015 en réponse à un courrier de la DGAC
- 4 sous groupes
 - ◆ Science et produits
 - ◆ Défense
 - ◆ Opérateurs de satellites
 - ◆ Aviation civile, Réseaux électriques, Transport et Communications
- Première version du rapport final prévue en septembre

..... LK/JYP
PF/GM (EMA/CIE)
GG

Mise en place d'une nouvelle organisation

- Rapport d'évaluation du HCERES avril 2015
- ... *développer une vision prospective des usages sociétaux et commerciaux des données spatiales...*
- Mise en place d'une nouvelle Direction (de l'Innovation et des Applications)
- Les thématiciens et responsables de programme y seront intégrés
- Mise en place au 1^{er} octobre

Forum de l'Académie Nationale de l'Air et l'Espace sur la Météo de l'Espace et l'Aéronautique le 17 mars 2016 à Paris