

Space Weather Perspectives from the European Space Agency

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- 1. ESA look at Space Weather
- 2. Space Weather Programme

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1. European Space Agency

- Status: International organisation in Europe.
- Structure: 18 member states + Canada as associated state.
- Purpose: 'to provide for and to promote, for exclusively peaceful purposes, cooperation among European States in space research and technology and their space applications, with a view to their being used for scientific purposes and for operational space applications systems' [*Convention for the establishment of a European Agency, 1975*].

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Three ways to look at Space Weather

- Its effects on space systems and related assets.
- Its place in a European space programme.
- The corresponding programme elements to implement.

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Space weather effects

- Space systems are vulnerable to space weather.
- Even (maybe) the European ones!
- ESA performs TR&D activities and develops systems to assess risks and protect its assets.
- A number of offices are involved in different ESA directorates. Not a single structure.

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Definition of the European Space Programme

- ESA plays a key role in its definition.
- All member states as well.
- The European Union also.
- Many successful space weather observation research elements (e.g., SOHO, Cluster, etc...) have been accomplished by ESA and MS's.
- Many downstream applications.
- No space weather application programme before 2009.
- Now there is one starting.

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Definition of the European Space Programme

- ESA plays a role by elaborating and implementing a long-term European space policy, by recommending space objectives to the Member States, and by concerting the policies of the Member States with respect to other national and international organisations and institutions [1975];
- Examples: Science programme (horizon 2000, cosmic vision, etc...); Galileo; GMES (Kopernikus).
- A space weather application programme has been under discussion since 1996 and supported by several concept studies.

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Programme elements implementation

- ESA role [*Convention, 1975*]:
 - elaborating and implementing activities and programmes in the space field;
 - coordinating the European space programme and national programmes, and by integrating the latter progressively and as completely as possible into the European space programme, in particular as regards the development of applications satellites;
- Member states approved the start of a Space Situational Awareness programme with a Space Weather segment in Nov. 2008.

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3. Overview of the SSA programme

- Needs for SSA: comprehensive knowledge, understanding and maintained awareness of the (i) population of space objects, of the (ii) space environment, and of the (iii) existing threats/risks.
- High level service needs:
 - support safe and secured operation of space assets and related services.
 - support risk management (on orbit and during re-entry) and liability assessment
 - 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);
 - assess the status and basic characteristics of space objects (both human-made and natural).

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Overview of the SSA programme

- Long-term objective: To set-up an independent European SSA system in a 10 year-time scale.
- Phases:
 - Preparatory programme + TR&D: 2009-2011
 - Development phase: 2012-2019

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SSA programme: content

□ The general objective is the establishment of a reliable and coherent **European SSA System**. The first phase is called the “**SSA preparatory Programme**” and covers the period 2009 – 2011 (approved at MC 2008).

- 2009 - 2011: Governance, Data Policy, Customer and System, requirements, architecture of the future European SSA system (Space Surveillance, Space Weather, NEOs), delivery of precursor services, radar bread boarding, pilot Data Centres (exploiting synergies).

- Phase 2 (2012 – 2019): Implementation of a fully operational European SSA system
Transfer to operator.

□ The proposal for **SSA-Phase 2**, is planned to be submitted to ESA Member States for approval at the MC2011.

□ **R&D activities** are performed through GSP, TRP, GSP4&5, GEP and other.

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SSA preparatory programme: participants

- The following subscription level has been reached: 49.9 M€
- Participating countries:
Austria, Belgium, France, Germany, Greece, Italy, Norway, Portugal, Spain, Switzerland, UK.
- Additional possible participation may be considered: in-kind, new members, interface with other programmes, next phase.
- Additional budget is requested for TR&D.

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Space Weather Service Elements

- Spacecraft and payload operations’ support (radiation, drag, com).
- Launch operation support
- Human space flight radiation protection support
- Space environment modelling for spacecraft design
- Trans-ionospheric radio link support
- Space environment modelling for SSA survey and tracking
- Data service (NOAA SWPC type – including integrated numerical modelling element).

Services to ground system operators to be interfaced with data service through partnership.

For these services, a combination of ground based and space based sensors is foreseen.

First through federation of existing of assets.

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SW Development priorities

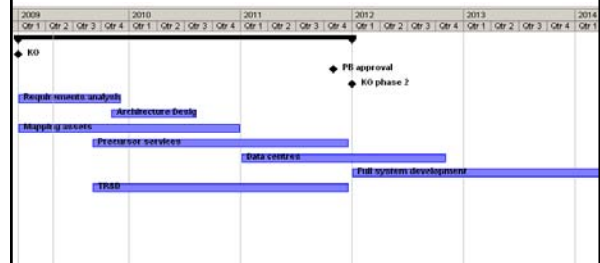
1. Instrumentation:
 - X-ray Flux Monitor (GSTP5 EIt3)
 - EUV Solar Imager and Flux Monitor (GSTP5 EIt3)
 - Compact Wide Angle Coronagraph (GSTP5 EIt3)
 - Ground-based H-alpha Solar Telescope Network (GSTP5 EIt3)
 - Radiation monitors
 - General purpose radiation monitors (GSTP5 EIt2)
 - High-Fidelity 3-D Energetic Electron Spectrometer (GSTP5 EIt3)
 - Plasma monitor:
 - 3-D solar wind plasma monitor (GSTP5 EIt3)
 - Plasma monitor (GSTP5 EIt2)
 - Magnetometer (GSTP5 EIt-3)
 - Particle Trajectory Analyzer Phase A/B (GSTP5-EIt-3)
 - Next Generation Micro Debris and Meteoroid Analyzer Prototype (GSTP5-EIt-3)
2. Carriers
 - Non-SSA European spacecraft as piggy-back payloads (FOC, MTG, METOP, Post-EPS, EDRS).
 - SSA dedicated elements: L1, PED (GSTP5 EIt 4, SSA)
 - Non-European elements
3. Data system
 - High Performance Distributed Solar Imaging and Processing Prototype (GSTP5, EIt3)
 - Next Generation Space Environment Information System (GSTP5, EIt3)
 - Distributed Environmental Data-Driven Analysis System (GSTP5, EIt3)
 - Virtual Space Weather Modelling Centre – Phase 1 (GSTP5, EIt3)
 - Data centres for Solar weather, ionosphere, radiation environment, geomagnetism (SSA)

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SSA PP Schedule



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Items for international collaboration

- applicable standards (data, services, models).
- data access.
- interface with service providers.
- interface with users.
- collaboration on space hardware (requirements, development, flight opportunities).

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Conclusion

- A framework exists now for the development of an ESA-EU space weather application programme.
- It is part of the overarching ESA SSA programme.
- Interaction with ISES and international partners is welcome and necessary.

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