



Servicios de Clima Espacial de Apoyo Para Protección de Infraestructuras Críticas

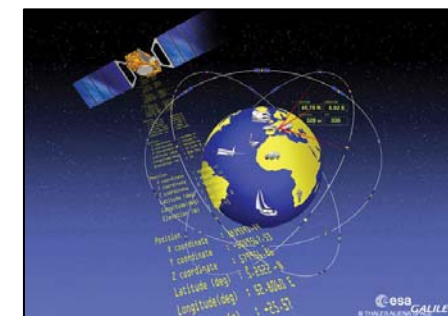
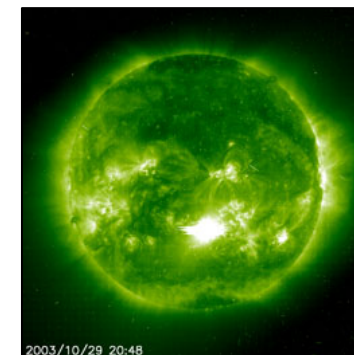
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SPACE WEATHER

Impact on Critical Infrastructures



- Space Weather occurs on a range of timescales and magnitudes throughout the ~11yr solar cycle
 - Solar max and solar min produce different challenges – extremes in each case can be challenging
- Severe Space Weather: Low frequency, potentially high impact events
- Technology advancement & increase dependence on space-based infrastructure means increased need to understand & mitigate for the risks associated with space weather
- Example affected critical infrastructures:
 - Communications
 - Navigation
 - Power systems

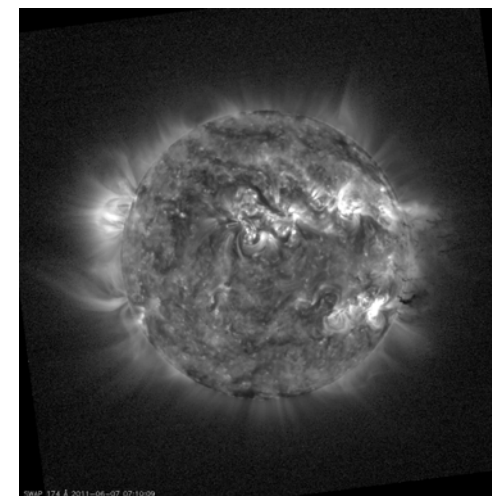
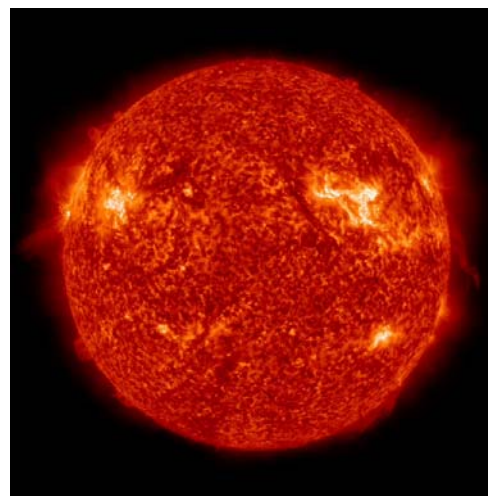
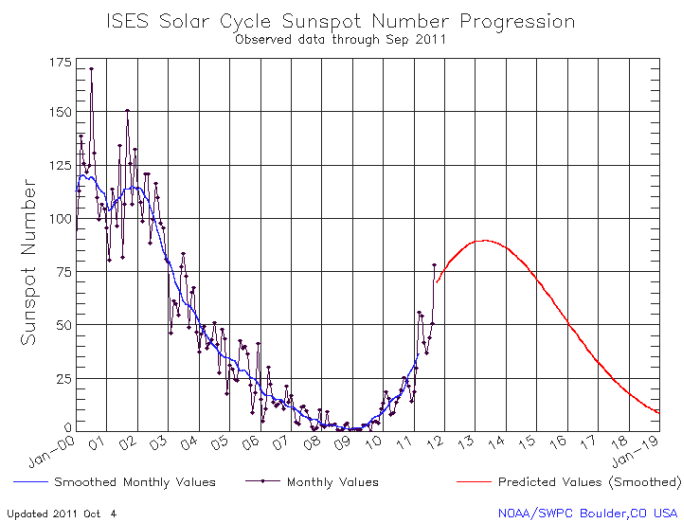
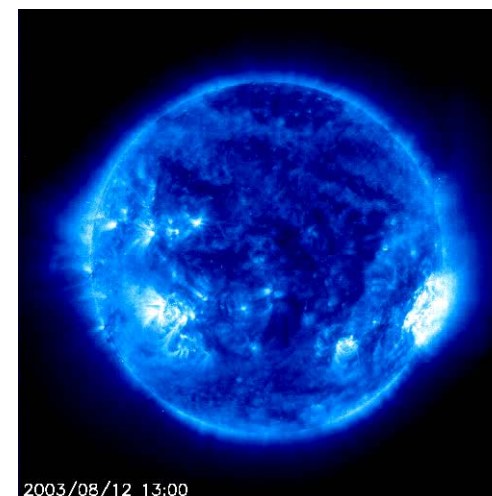


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Challenges for Space Weather Services



- Approaching peak of solar cycle 24
 - expected ~Mid 2013
- Comparatively small solar cycle observed so far
 - Activity picking up in 2012
 - Large events aren't excluded
- Predicting long term trends and individual events also a scientific challenge!



Updated 2011 Oct 4

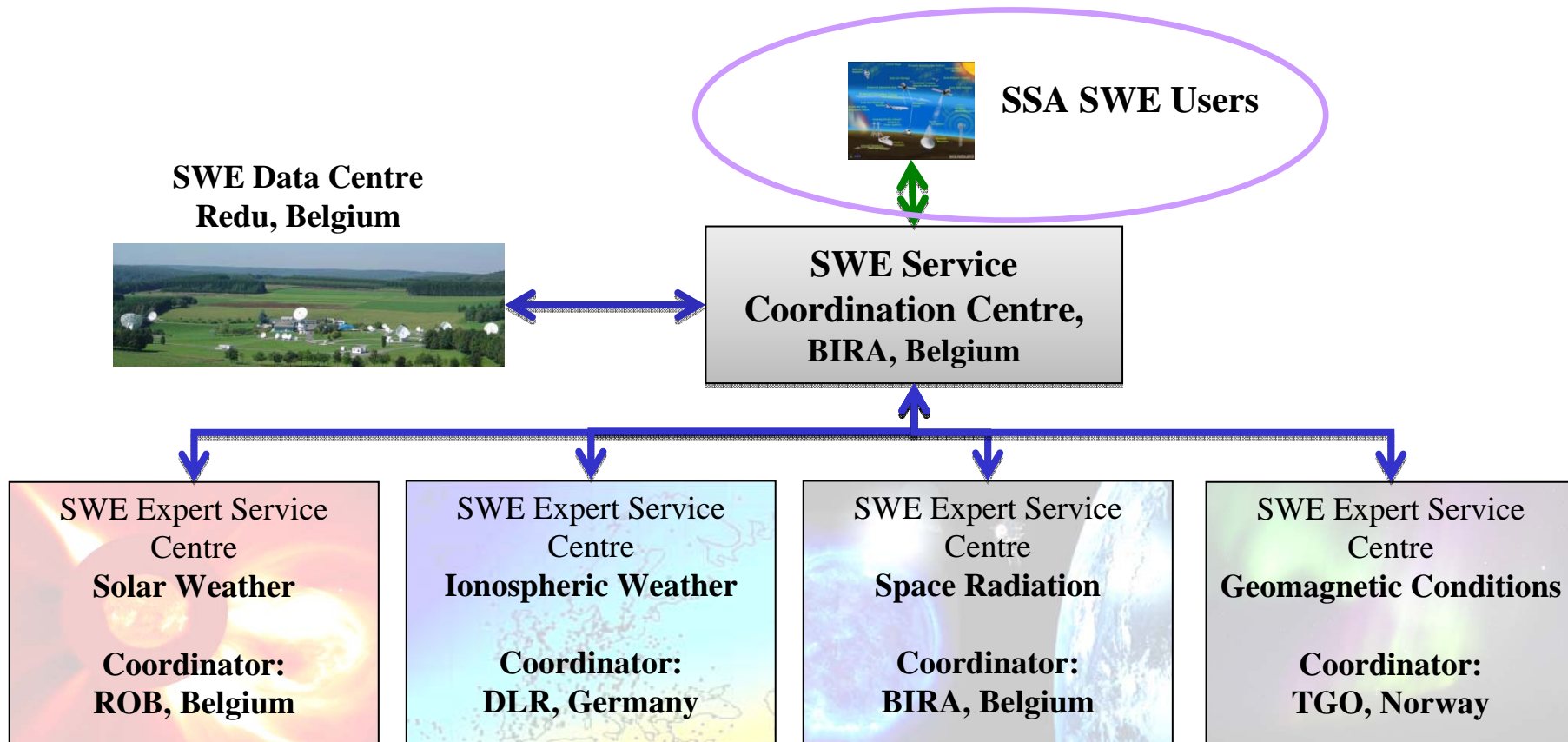
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SSA SWE Service Requirements



- **SSA Preparatory Programme established in 2009**
- **Overall SSA SWE Aim:** *Knowledge, understanding and maintained awareness of the natural space environment and space weather*
 - *Detection and forecasting of space weather and its effects*
- **End users perspective a key driver:**
 - **Understanding disturbances & what constitutes a realistic worst case event**
 - **Statistical information**
 - **Reliable monitoring and individual forecasts tailored to sector needs**



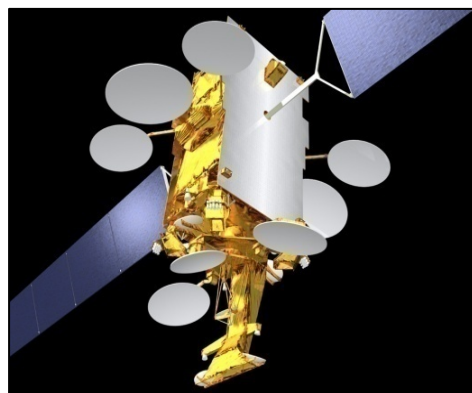
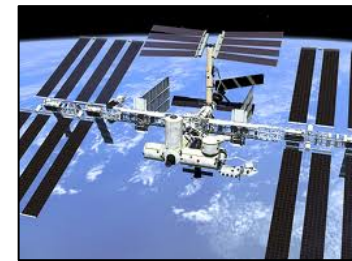


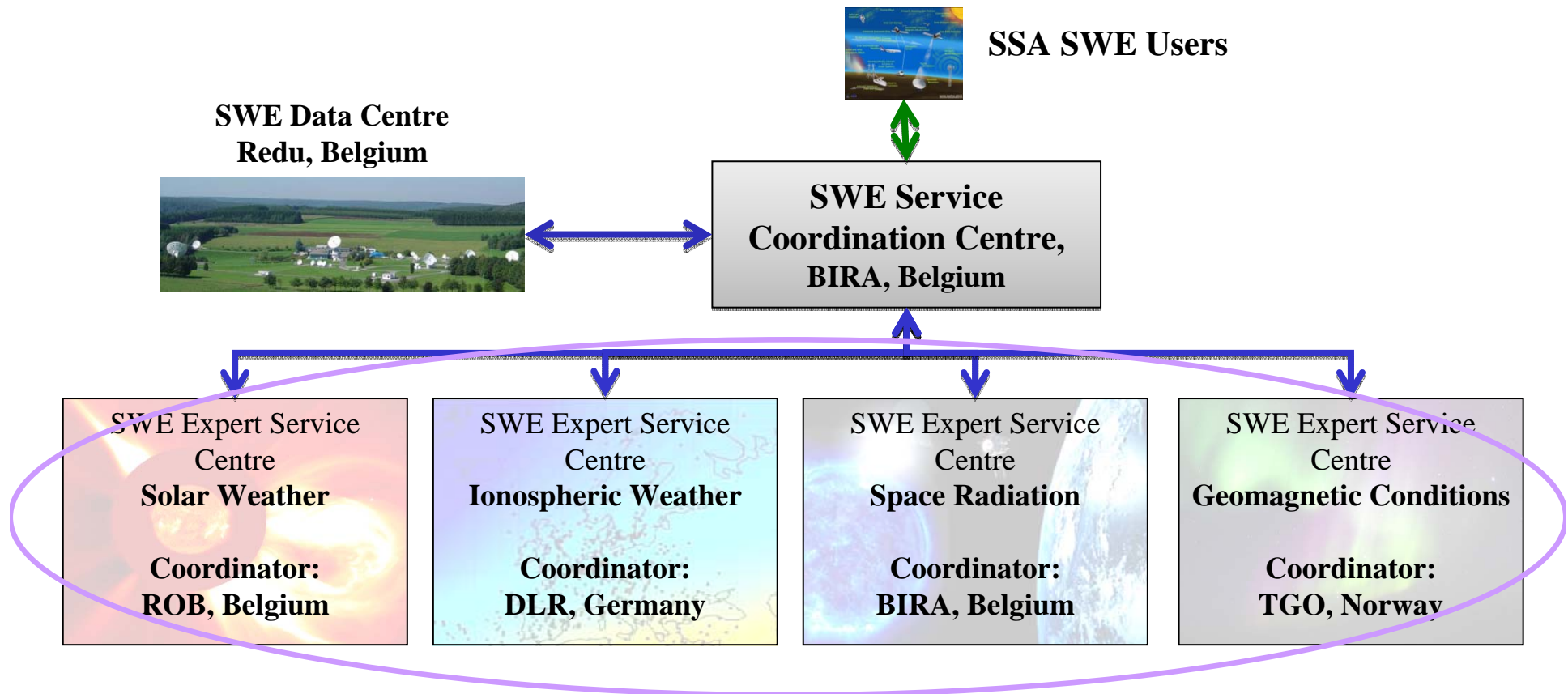
SPACE WEATHER

Example End Users



- **Spacecraft designers & operators**
- **Launch operators**
- **Transionospheric radio link users**
 - **Communication**
 - **Navigation**
- **Non-space system operation**
 - **Aviation**
 - **power and pipeline network operators**





- Core of the SWE precursor service network
- Distributed centres based on existing national expertise
 - Coordinating group
 - (N)*expert groups
- New Expert Groups added to the ESC framework in SSA PP in 2012
- Next phase (2013+):
 - New ESCs are foreseen
 - Network of Expert Groups to expand



SWE Expert Service Centre
Space Radiation

Coordinator:
BIRA, Belgium

Expert Groups:
AIT (A)



SWE Expert Service Centre
Geomagnetic Conditions

Coordinator:
TGO, Norway



SWE Expert Service Centre
Solar Weather

Coordinator:
ROB, Belgium

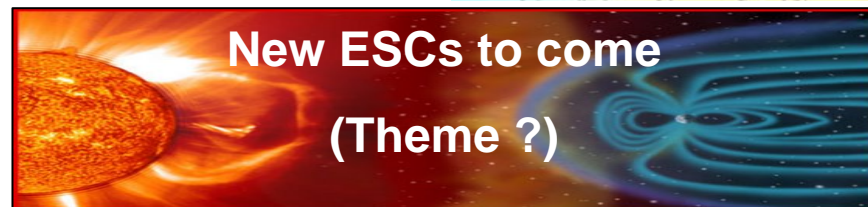
Expert Groups:
Univ Graz (A)



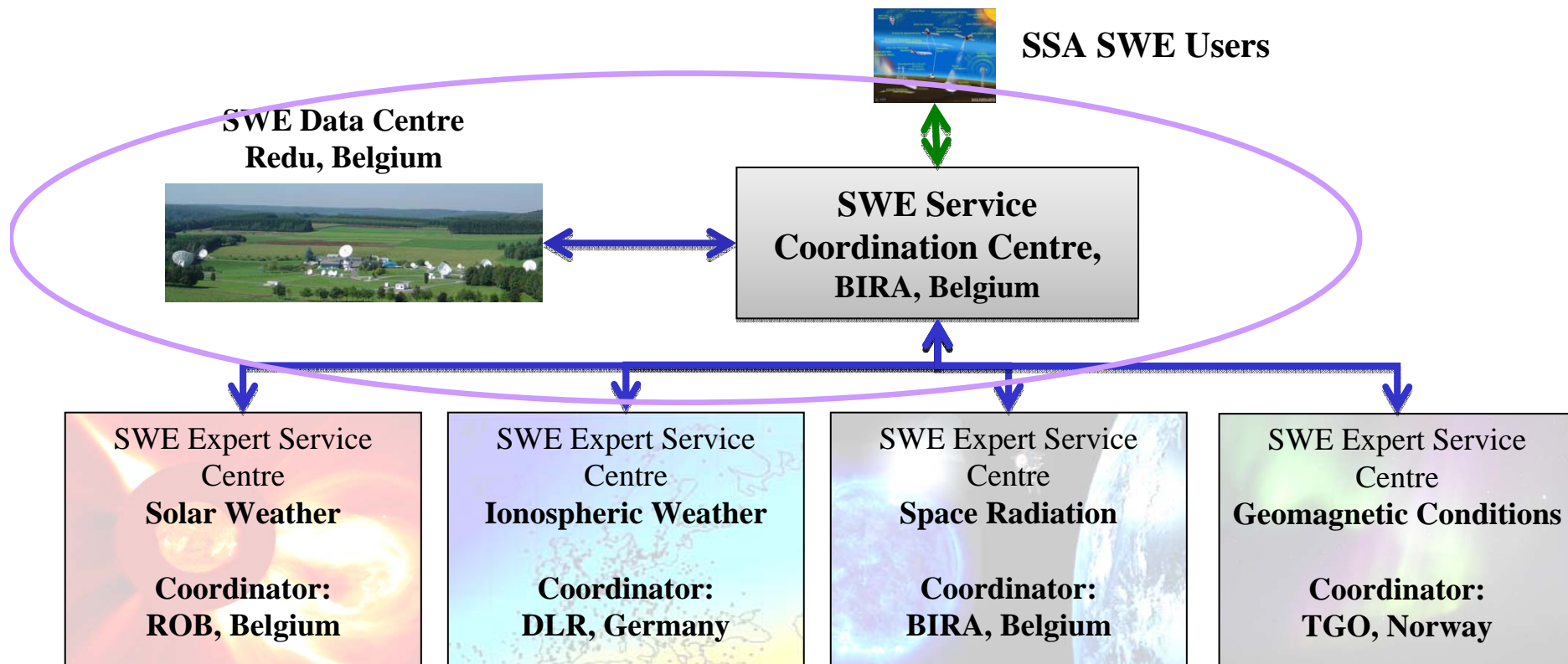
SWE Expert Service Centre
Ionospheric Weather

Coordinator:
DLR, Germany

Expert Groups:
NOA (Gr), NMA (N)



New ESCs to come
(Theme ?)



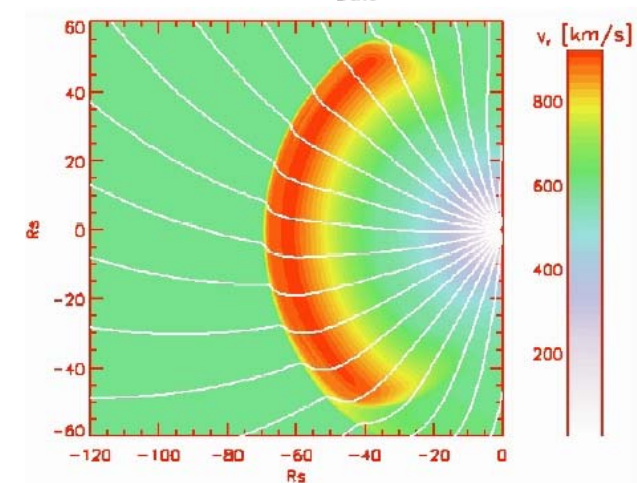
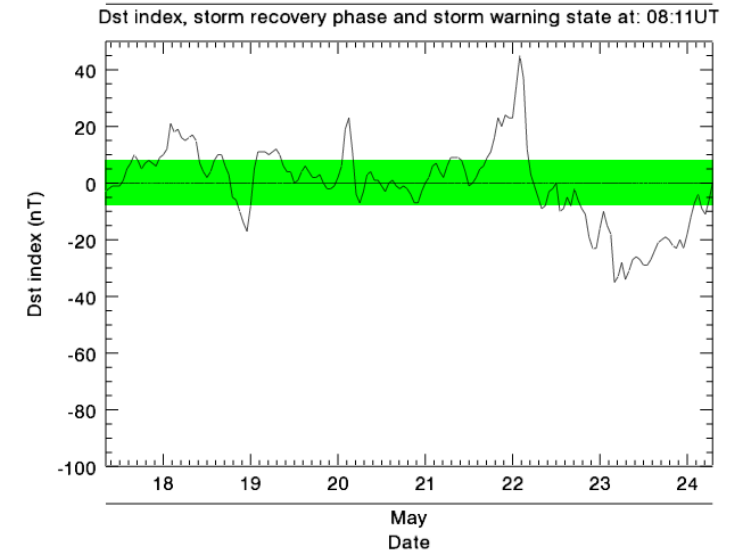
SPACE WEATHER Coordination Elements



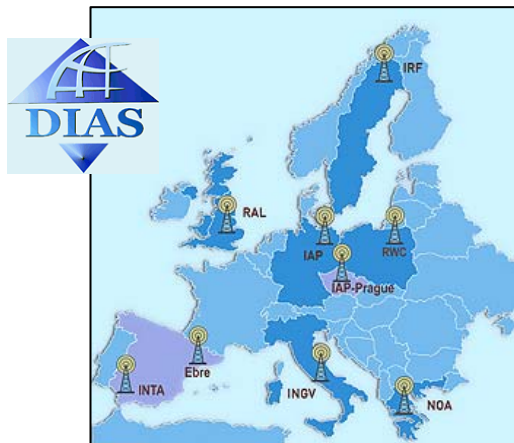
- SSA SWE access web portal currently being finalised
- SSCC: Space Weather Service Coordination Centre: **SSA SWE front desk** being established
 - First line user support
- SWE Data Centre at Redu
 - Several applications redeployed
 - Incl. SEISOP, SWENET, SEDAT, SPENVIS...
 - Further development of enhanced portal to follow



- Initial review of assets >200 SWE assets in database including several Spanish
- Scientific expertise in SWE science, ground based monitoring and instrumentation.
- Some examples in interplanetary propagation:
 - **UAH Space Weather Service**
 - Real-time warning of severe geomagnetic disturbances
 - **SOLPENCO**
 - Engineering model allows statistical analysis of SEP events including helio-radial variation
 - Univ. Barcelona STP and Space Weather group
 - **UMASEP forecaster**
 - SEP forecast using neural network techniques provides complementary approach
 - Univ Malaga



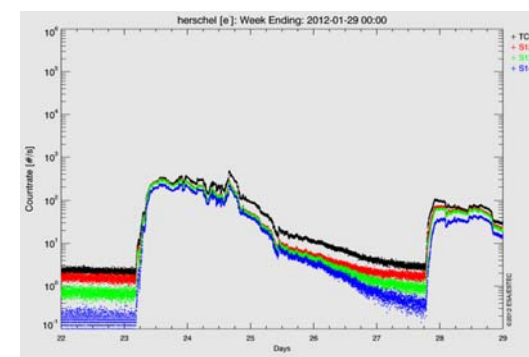
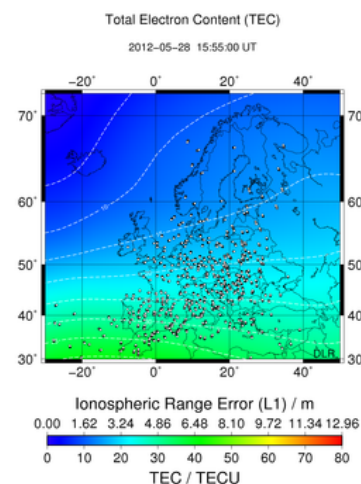
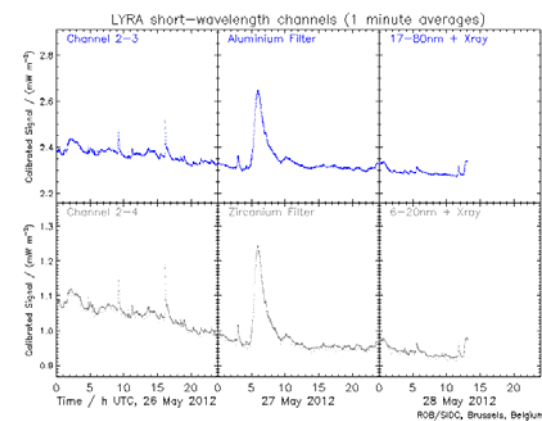
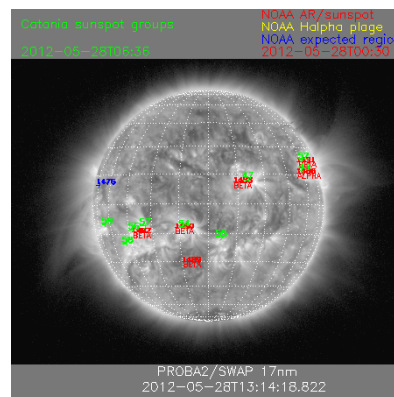
- Spanish institutes provide regular ionospheric monitoring:
 - Ebro observatory
 - INTA (El Arenosillo)
- ATMOP: FP7 project to develop an enhanced thermosphere model with operational applications
 - supports improved survey and precise tracking of objects in LEO



SPACE WEATHER *Data Requirements*



- Reliable services need reliable space and ground based data incl.:
 - L1 in-situ monitoring
 - Solar observation
 - Geospace monitoring
 - Upper atmosphere/ionosphere monitoring
 - Plus, good statistical information and archives
- SWE PP work on identifying potential hosted payloads and measurements requiring dedicated mission(s)
- International collaboration will be strengthened to ensure continued access to key datasets.



SPACE WEATHER *Summary*



- Space weather has the potential to significantly impact critical infrastructure
- SSA-SWE is currently establishing a range of precursor services based on existing European expertise & data
- Spain has substantial scientific expertise in SWE science and monitoring
- SSA SWE next phase to be decided at ESA C/MIN(2012)
 - Expanded precursor service network
 - Additional expert groups
- This presentation focuses on services, but also anticipated scope for instrumentation development and deployment supporting underlying data needs for reliable services





THANK YOU

For more information:

www.esa.int/ssa

Coming Soon:

<http://swe.ssa.esa.int/>

European Space Agency