Belgian Space Weather services by SIDC

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What is the space weather and why is it important?

The eruptive phenomena on the Sun and the solar wind can impact the Earth’s magnetosphere and influence the performance of space-based and ground-based technology.

Space weather research are efforts to study generation and propagation of the solar (solar storms) and non-solar (galactic cosmic rays) phenomena and their impact to the Earth with the aim to understand and forecast the phenomena.

European Space WEather Portal  http://www.spaceweather.eu/
Space Weather in Europe & wider

Regional Warning Centers within ISES (International Space Environment Service) in Europe and wider (http://www.spaceweather.org/)
→ provide services to the scientific and user communities within their regions

- **SIDC** – Solar Influences Data Analysis Center, Royal Observatory of Belgium, Belgium
- **MOSWOC** – Met Office Space Weather Operations Center, United Kingdom
- **KSO** – Kanzelhöhe Observatory for Solar and Environmental Research, Austria
- **IAP** – Institute of Atmospheric Physics, Czech Republic
- **LSWC** – Lund Space Weather Center, Sweden
- **SRC** – Space Research Center, Poland
- **SWPC** – Space Weather Prediction Center/World Warning Agency, USA

- IPS, Australia,
- EMBRACE, Brazil,
- CSWFS, Canada,
- SAPC, SEPC, China,
- NPL, India,
- NICT, Japan,
- KSWC, Republic of Korea,
- IAG, Russia,
- SANSA, South Africa,
- SCIESMEX, Mexico
Space weather Expert Service Centers – SWE ESCs

- SWE ESCs are well-focused groups in the framework of ESA Space Situational Awareness (SSA) program.
- Each Center comprises a distributed set of expert groups contributing particular data, products and/or expertise.

European expert groups and centres of excellence
SWE Expert Service Centres (ESCs)

European expert groups and centres of excellence

- SIDC, Belgium
  - KSO, Austria
  - RCAAM, Greece
  - INAF, Italy
  - FHNW, Switzerland
- DLR, Germany
  - IMPC, Germany
  - NMA Norway
  - NOA, Greece
  - FMI, Finland
  - IAP, Czech Republic
  - INVG, Italy
  - CLS, France
  - SRC PAS, Poland
  - DTU, Denmark
- BIRA-IASB, Belgium
  - RAS, Austria
  - ANeMoS, Greece
  - CSR, Belgium
  - DLR Rad Bio, Germany
  - SRL, Finland
  - SGO, Finland
  - MSSL, UK
  - CSDRad C.Ltd, UK
  - IAP, Czech Republic
- TGO/NOSWE, Norway
  - SIDC, Belgium
  - DTU Space, Denmark
  - FMI, Finland
  - IRF Lund, Sweden
  - GFZ, Germany
  - NMA, Norway
- RAL, UK
  - MOSWOC, UK
  - UNIGRAZ, Austria
  - DTU, Denmark
  - CDPP, France
  - KUL, Belgium
  - DHC, Belgium
  - UGOE, Germany
The **SSCC** = **Space Situation Awareness (SSA)**

**Space Weather**
**Coordination**
**Centre** is placed at the Space Pole in Brussels.

- The SSCC provides the 1st European Space Weather Helpdesk.
- The SSCC coordinates the provision of Space Weather services available either at the SWE Data Centre or at federated sites.

[http://swe.ssa.esa.int/web/guest/contact & helpdesk.swe@ssa.esa.int](http://swe.ssa.esa.int/web/guest/contact & helpdesk.swe@ssa.esa.int)
Solar Weather Expert Service Centre

ESC tools and products

**ROB/SIDC**

- PROBA2 / SWAP - EUV 17.4 nm
- PROBA2 / LYRA
- USET / H-alpha full disk
- USET / White-Light
- HUMAIN / Radiospectrogram
- SDO / AIA
- International Sunspot Index
- F10.7 index forecast
- Daily SWE bulletin
- CACTus Automated CME detection
- Automated alerts (GOES-flare, CACTus-CME)
- S IDC all quiet alert
- HUMAIN / Automated Radio burst detection
- F10.7 forecast
- Solar flare forecast
- Operator moderated alerting service
- USET / Sunspot group characterisation
Regularity & sporadically (defined by the needs):

- **Daily space weather forecast** (issued at 14:30 UT)
- **Weekly bulletin**
- **Weekly space weather briefings** (webex) (Monday 11:30 Belgian time)
- **Presto** (shock at 1AU, K index >5, proton event, X-class flare, halo CME)
- **All quiet alert** (bellow C-class flares & Kp < 5 & proton flux bellow the event threshold)
- **CME arrival alert** (Earth directed CMEs)
- **CACTUS alerts** (halo CMEs)
Space Weather Products in Support of ESA Missions

**Tailored space weather products in support of GAIA**
The launch window (2013 Dec 16-20) and the L2 insertion maneuver (2014 Jan 6-14) were supported with daily forecasts and alerts on flaring activity and particle storms.

**Tailored space weather products in support of VENUS EXPRESS**
The Venus Express Aerobraking campaign (2014 May 18 – Jul 11) was supported by monitoring energetic particles and irradiance variations that affect atmospheric density at aerobraking altitudes.

**Tailored space weather products in support of ROSETTA**
The Space Weather Bulletins for ROSETTA operations.
Software Tools: www.sidc.be

• **SoFAST** autonomously detects EUV flares in image sequences from PROBA2/SWAP.
  • Catalogued events since May 2012.

• **CACTUS** is automatic CME tracking tool (LASCO and COR2).
  • Catalog since 1997; Halo Alert service.

• **CACTUS for HI data** was recently developed in the framework of HELCATS project.

• **CME Speed Calculator** provides real time CME speeds obtained using J-maps (STEREO coronograph observations), and estimation of the CME arrival time.

• **SOLAR DEMON** is the automatic flare, dimming & EUV waves detection tool.
  • It is running in real time on SDO/AIA 94 QKL data of 3 minute cadence with the typical delay of 15 minutes.

• **STAFF - Solar Timelines viewer**

• **JHelioviewer** is an advanced visualization program for Solar data, it allows zooming, making movies and combining (overlay) solar images.

• New model **EUHFORIA** (EUropean Heliospheric FORecasting Information Asset) developed by KU Leuven & University of Helsinki, is being tested at ROB to be used for the purposes of space weather forecasting.
Space weather observational infrastructure & products

Ground-based Solar Observations:

- Visible domain:
  - USSET/ white light,
  - USSET/ Hα full disc,
  - USSET/ Ca II K,
  - International sunspot index.

- Radio domain:
  - HUMAIN/ radiospectrogram in the frequency range of 45-1490 MHz (since 2008/2015 up to now).
  - Automated radio burst detection.

Space-based Solar Observations:

- PROBA 2:
Thank you for your attention.

SSCC: http://swe.ssa.esa.int/web/guest/contact & helpdesk.swe@ssa.esa.int
Where: Royal Observatory of Belgium, Avenue Circulaire 3, 1180 Brussels