



AFFECTS

Advanced Forecast For Ensuring Communications Through Space

Solar storms are a consequence of sudden eruptions of magnetised gas in the Sun's outer atmosphere. Commonly such storms start with a sudden release of electromagnetic radiation – a solar flare, and by an eruption of a giant cloud of magnetised plasma – a coronal mass ejection (CME). A fast CME also accelerates solar particles to high energies – a solar energetic particle event.

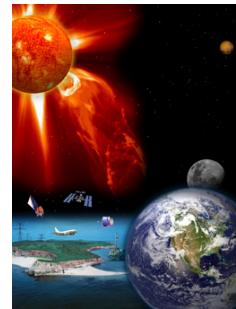
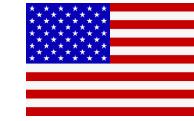
Solar storms affect the Earth environment from the magnetosphere down to the ionosphere, and even to the lower atmosphere climate system. The natural hazards of severe space weather have the potential to catastrophically disrupt the operations of technological systems, such as communication systems and power grids on Earth. Through the AFFECTS project funded by the European Union's 7th Framework Programme, European and US scientists develop an advanced prototype space weather warning system to safeguard the operation of telecommunication and navigation systems on Earth to the threat of solar storms. The project is led by the University of Göttingen's Institute for Astrophysics and comprises worldwide leading research and academic institutions and industrial enterprises from Germany, Belgium, Ukraine, Norway and the United States.

www.affects-fp7.eu

Funded by the European Union

Image Credits: University of Göttingen, NASA, ESA, Planetarium Hamburg

Official Media Partner



Advanced Forecast For Ensuring Communications Through Space (AFFECTS)

Volker Bothmer, Project Coordinator

FP7 Space Weather Meeting, 3 October 2013, REA, Brussels





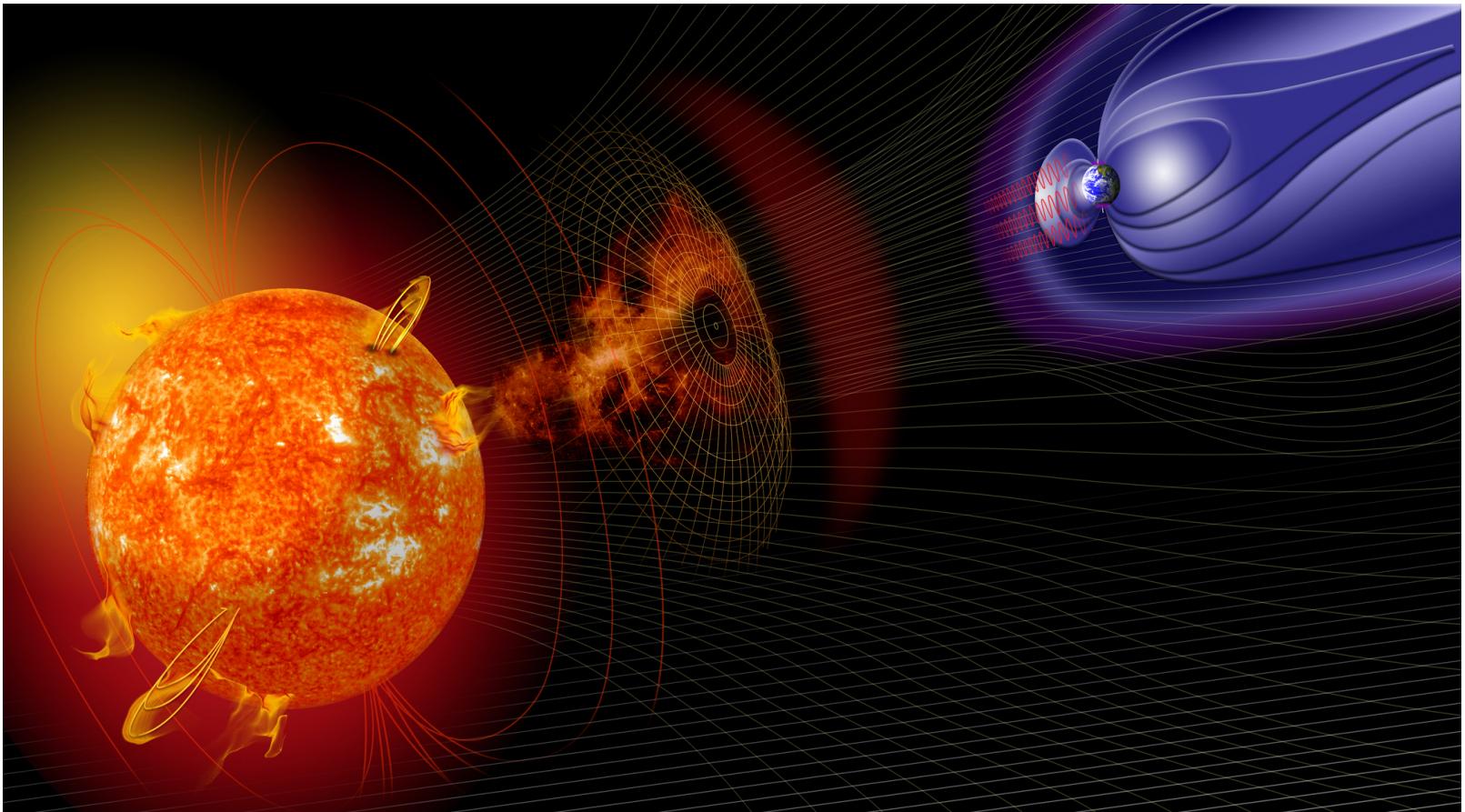
AFFECTS Project Objectives

- State-of-the-art analysis and modelling of the Sun-Earth chain of effects on the Earth's ionosphere and their subsequent impacts on communication systems based on multipoint space observations and complementary ground-based data.
- Development of a prototype space weather early warning system and reliable space weather forecasts, with specific emphasis on ionospheric applications.
- Dissemination of new space weather products and services to end users, the scientific community and general public.





Solar Storm - CME - heading towards Earth

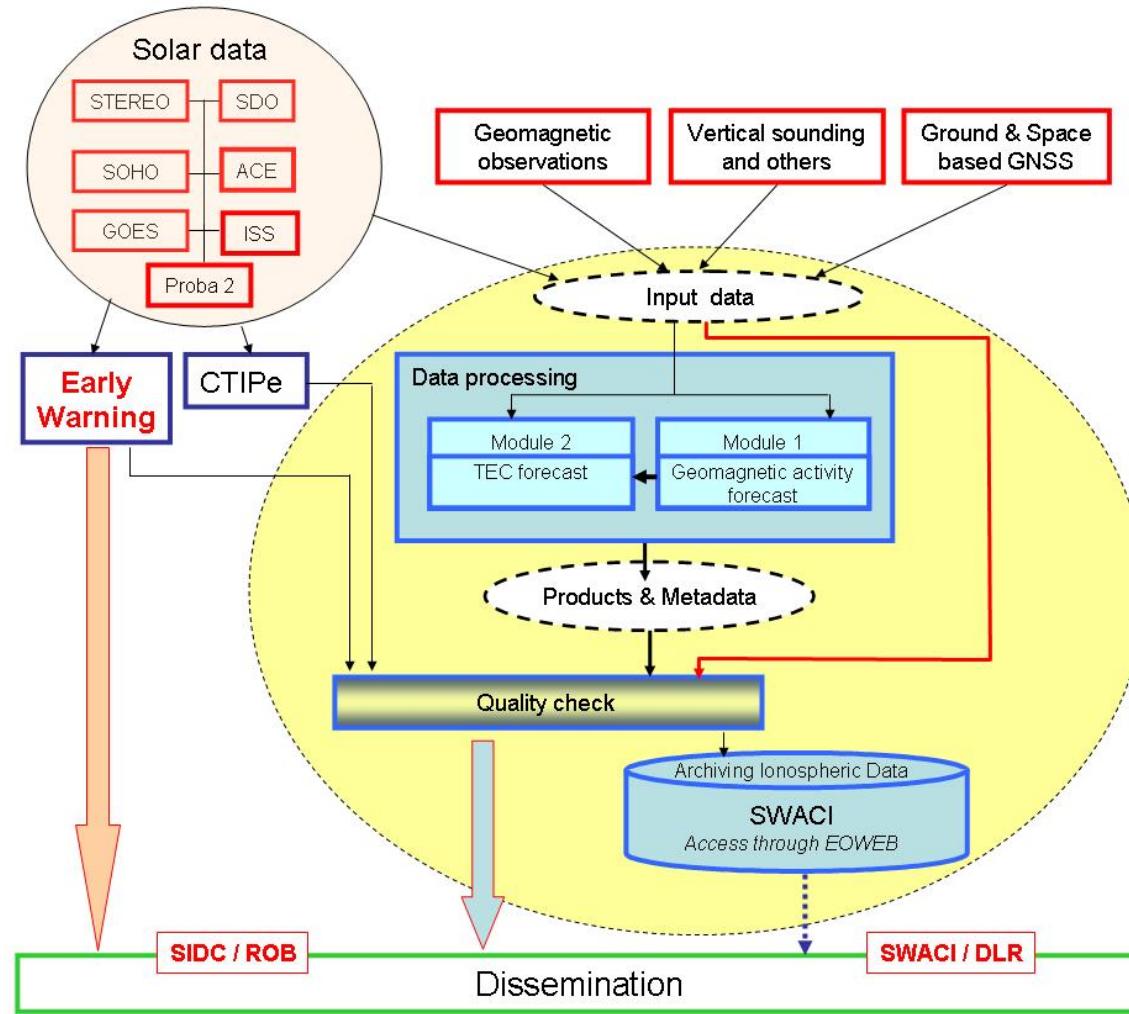


Courtesy: NASA.





AFFECTS Workflow





CME/flare Alerts – Subscription Services

UCMEO 93001 30723 1850/
30722 60624 81254 3062/ 305// 333// 41032
30722 60535 80705 ///// ///// 1112/
99999

PLAIN

SOHO/LASCO observed an asymmetric HALO CME on July 22, 2013. Event is first seen in C2 beginning 06:24 UT with a bright loop over the Northwest. The event expands with extensions to a full HALO with cavity and core by 07:12 UT. The event continues into the C3 field beginning 06:24-12:54 UT leaving the C3 field at 30Rsun in the Northwest.

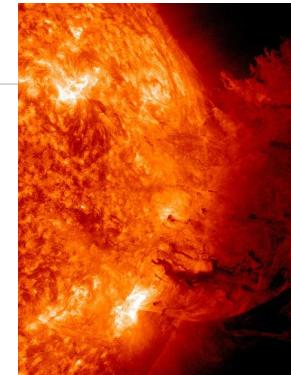
Time/height measurements were marked at 5 points in C2 with speeds of 972.3 Km/sec at pa 306 degrees. The event is marked to 8 points in C3. Speeds average through both fields to 1031.6 Km/sec at PA 306 degrees. Acceleration 39.81 m/sec².

Von Solar Influences Data analysis Center <sidc@oma.be>
Betreff: Halo CME detection alert from the SIDC/RWC Belgium
Antwort an: sidc@oma.be
An: RegisteredUsers@sidc.be

#: Issued: 2013 Jul 22 2206 UTC
#: Product documentation at <http://www.sidc.be/products/caactus> --#
#:-----#
#: HALO CME ALERTS from the SIDC (RWC-Belgium), generated by CACTUS #
#:-----#
#: A halo or partial-halo CME was detected with the following characteristics:
#:-----#
#: t0 | dt0| pa | da | v | dv | minv| maxv|
023|2013/07/22 06:12| 04 | 144| 360| 0844| 0326| 0309| 1420
Details can be found here: <http://www.sidc.oma.be/caactus/out/latestCMEs.html>
#:-----#
#: t0: onset time, earliest indication of lift-off
#: dt0: duration of lift-off (hours)
#: pa: principal angle, counterclockwise from North (degrees)
#: da: angular width of the CME (degrees),
#: v: median velocity (km/s)
#: dv: variation (1 sigma) of velocity over the width of the CME
#: minv: lowest velocity detected within the CME
#: maxv: highest velocity detected within the CME

This message is sent whenever a CME wider than 150 degrees is detected by cactus.
#:-----#
#: Solar Influences Data analysis Center - RWC Belgium
#: Royal Observatory of Belgium
#: Fax : 32 (0) 2 373 0 224
#: Tel.: 32 (0) 2 373 0 491
#: Email: sidc@oma.be
#: For more info see <http://www.sidc.be/caactus>. Please do not reply
#: directly to this message, but send comments and suggestions to
#: sidc@oma.be. If you are unable to use that address, use
#: rwclinden@sidc.oma.be instead.
#: To unsubscribe, visit <http://sidc.be/registration/unsub.php>
#:-----#

- ROB Presto - Flare and Cactus CME alerts
- NOAA-SWPC - PSS
- SOHO/LASCO halo CME alerts
- NRT generated messages



Von SWPC Product Subscription Service <SWPC.Products@noaa.gov>

Betreff: SUMMARY: X-Ray Event exceeded M5 (R2)

An Volker Bothmer

Space Weather Message Code: SUMXMS
Serial Number: 104
Issue Time: 2013 Jun 07 2326 UTC

SUMMARY: X-ray Event exceeded M5
Begin Time: 2013 Jun 07 2211 UTC
Maximum Time: 2013 Jun 07 2249 UTC
End Time: 2013 Jun 07 2304 UTC
X-ray Class: M5.9
Location: S28W73
NOAA Scale: R2 - Moderate

NOAA Space Weather Scale descriptions can be found at
www.swpc.noaa.gov/NOAA_scales

Potential Impacts: Area of impact centered primarily on sub-solar point on the sunlit side of Earth.
Radio - Limited blackout of HF (high frequency) radio communication for tens of minutes.



NRT GCS/CAT CME Modeling



GCS Tool

STEREO Cloud

- Position: 319,752
- Longitude: 2,23560
- Latitude: 29,5102
- Tilt Angle: 14,4285
- Height: 0,332029
- Ratio: 26,8527
- Half Angle:

Eruption Date: 2010-06-04T16:08:15,005

Carrington v Stonyhurst

Wire OFF

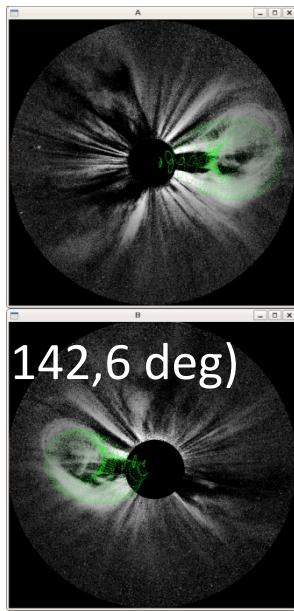
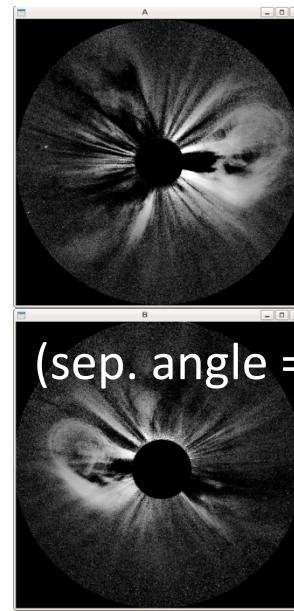
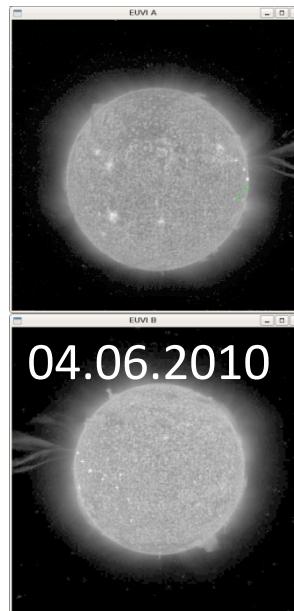
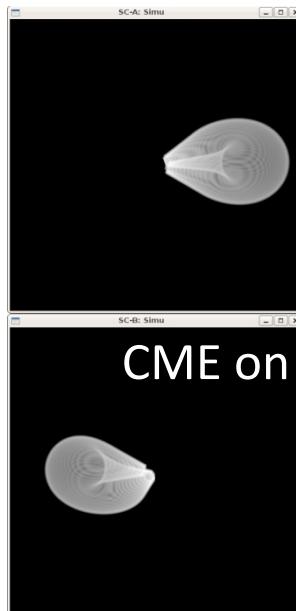
Eval, Fit

Fit z?

SC-A LON: 225,2 , LAT: 7,0
Date: Sat: 2010-06-04T16:08:15,005
SC-B LON: 82,9 , LAT: -7,0
Date: Sat: 2010-06-04T16:08:46,831

Generate View

Quit



CME on

04.06.2010

(sep. angle = 142,6 deg)

CAT Tool

STEREO B COR2

2010-04-13 12:24 UT

STEREO A COR2

2010-04-13 12:39 UT

ANIMATION CONTROLS

Start [Y M D H M] End [Y M D H M] Speed

Load Images

IMAGE ADJUST

L C R Stretch Bottom Stretch Top Gamma Correction image saturation value

CME CONTROLS

Latitude Longitude Regular Width (cone) Radial Distance (dist)

CME LEAVING EDGE (Rs) vs TIME (UT)

EMIL PARAMETERS

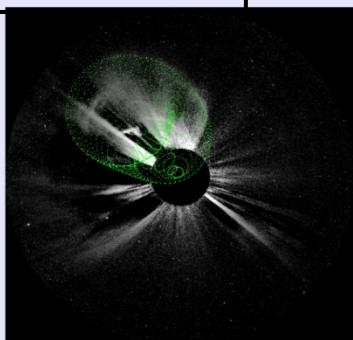
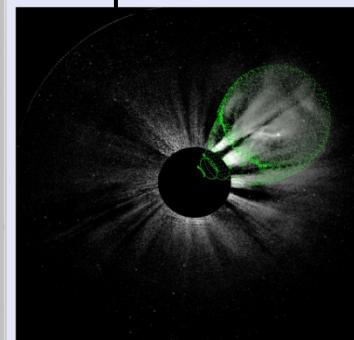
T 2010-04-13 18:20
lat: 15.9876
lon: 35.217
cone: 32
Vel: 464

Calculate Velocity Export Analysis Reset Analysis

CME Params

lat :	35.0
lon :	47.0
cone :	63.0
dist :	16.0

CME Database



COR2B white-light Coronagraph image with an overlay in green of the GCS wireframe

COR2A white-light Coronagraph image with an overlay in green of the GCS wireframe

With the GCS Forward-Modeling Code yields the following results.

GCS Fit-Parameter from Modeling:
Carrington Longitude: 159,876
Carrington Latitude: 35,217
Tilt Angle: -21,803
Height: 14,786
Ratio: 0,499
Half Angle: 17,888

Timestamp of used COR2-Images for Modeling:
2010-04-13 15:08:15
#formatting: yyyyymmdd hhmmss



Warning through AFFECTS Website and Mailing List

AFFECTS Space Weather Reports

Contents [hide]

- [1 May 15, 2013](#)
- [2 April 12, 2013](#)
- [3 March 16, 2013](#)
- [4 February 24, 2013 - Forecast Update](#)
- [5 February 22, 2013 - Forecast for AFFECTS GM and UW](#)
- [6 January 25, 2013 - General 10 day Forecast](#)
- [7 July 17, 2012 - Comparison of Forecast and Observations](#)
- [8 July 13, 2012 - Solar storm is heading towards Earth](#)
- [9 June 17, 2012 - Perfect match: CME has arrived as predicted](#)
- [10 June 15, 2012 - CME en route to Earth](#)
- [11 June 01, 2012 - Active region and coronal hole](#)
- [12 May 23, 2012 - Decaying active regions](#)
- [13 May 09, 2012 - Large sunspot region not likely to cause major storms at Earth](#)
- [14 May 07, 2012 - Coronal hole on visible solar disk and new active region](#)
- [15 May 03, 2012 - No major solar storms are expected the next days](#)
- [16 April 21, 2012 - Several Active Regions North and South of the Equator](#)
- [17 April 10, 2012 - Equatorial Coronal Holes](#)

May 15, 2013

Active region 1748 appeared at the Sun's East limb on May 13, 2013 when it caused on this, the following day and today three X-ray flares with peak intensities in the M to X-range. Three fast CMEs with speeds in the range 1400-2000 km/s were associated with these events. The first two ones are not expected to cause any impacts at Earth whilst a shock wave is expected to arrive between 06:30 and 12:30 local time (DST) tomorrow on May 16, 2013. The estimated speed at Earth is 1000 km/s. There are no indications that the CME main body will pass the Earth and there are no indicators for a major geomagnetic storm to be happening. The delayed and slow intensity increase in the >10 MeV proton flux is a typical signature for shock wave propagation East of central meridian. It is likely that the next days will be stormy too since besides AR 1748, AR 1745 closer to CM also has potential for causing major solar storms.

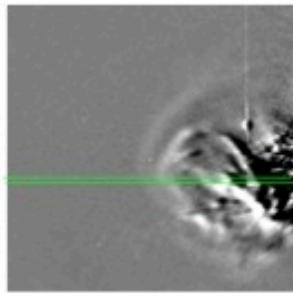
April 12, 2013

On April 11 around 07 UT SOHO and STEREO detected the onset of a CME near CM. The estimated speed of it is 603 km/s in the STEREO/COR2-B field of view. Using the BHV prediction method yields an arrival time of April 14, 03 UT with an in-situ speed of 500 km/s. Based on the B&S flux rope scheme the CME is predicted to be of ENW (SEN) type. A geomagnetic storm is forecasted for April 14, 03 - 15 UT, with a magnitude of about Kp 7+.

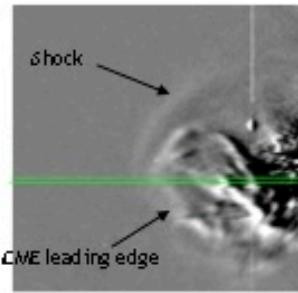




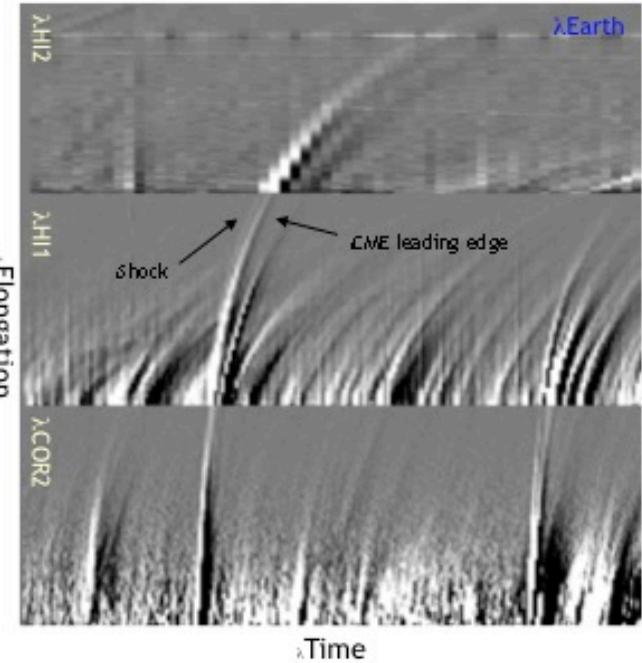
CME tracking with STEREO



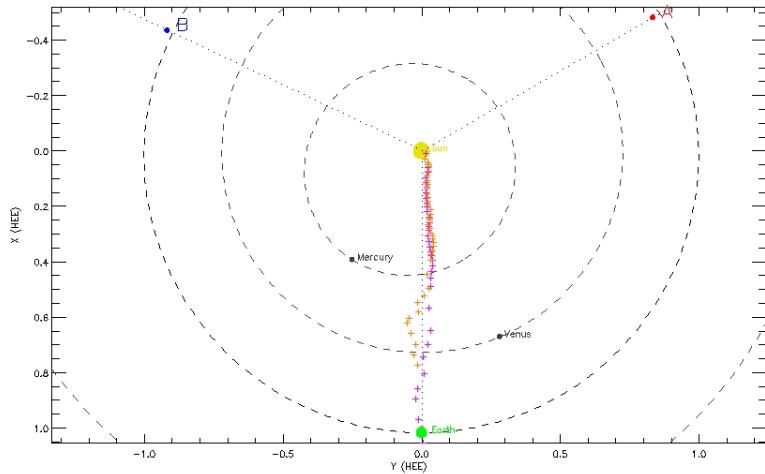
03/04/2010T19:29
Stereo A - HI1



03/04/2010T20:09
Stereo A - HI1

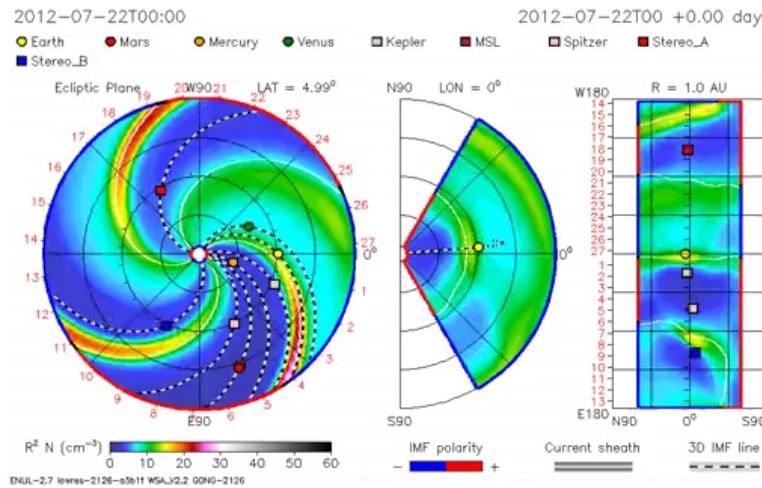
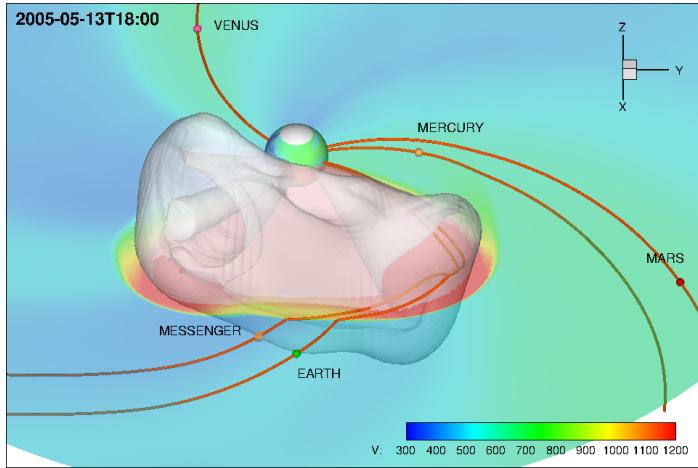


J-map technique;
Courtesy: L. Volpes





CME modeling to Earth - ENLIL

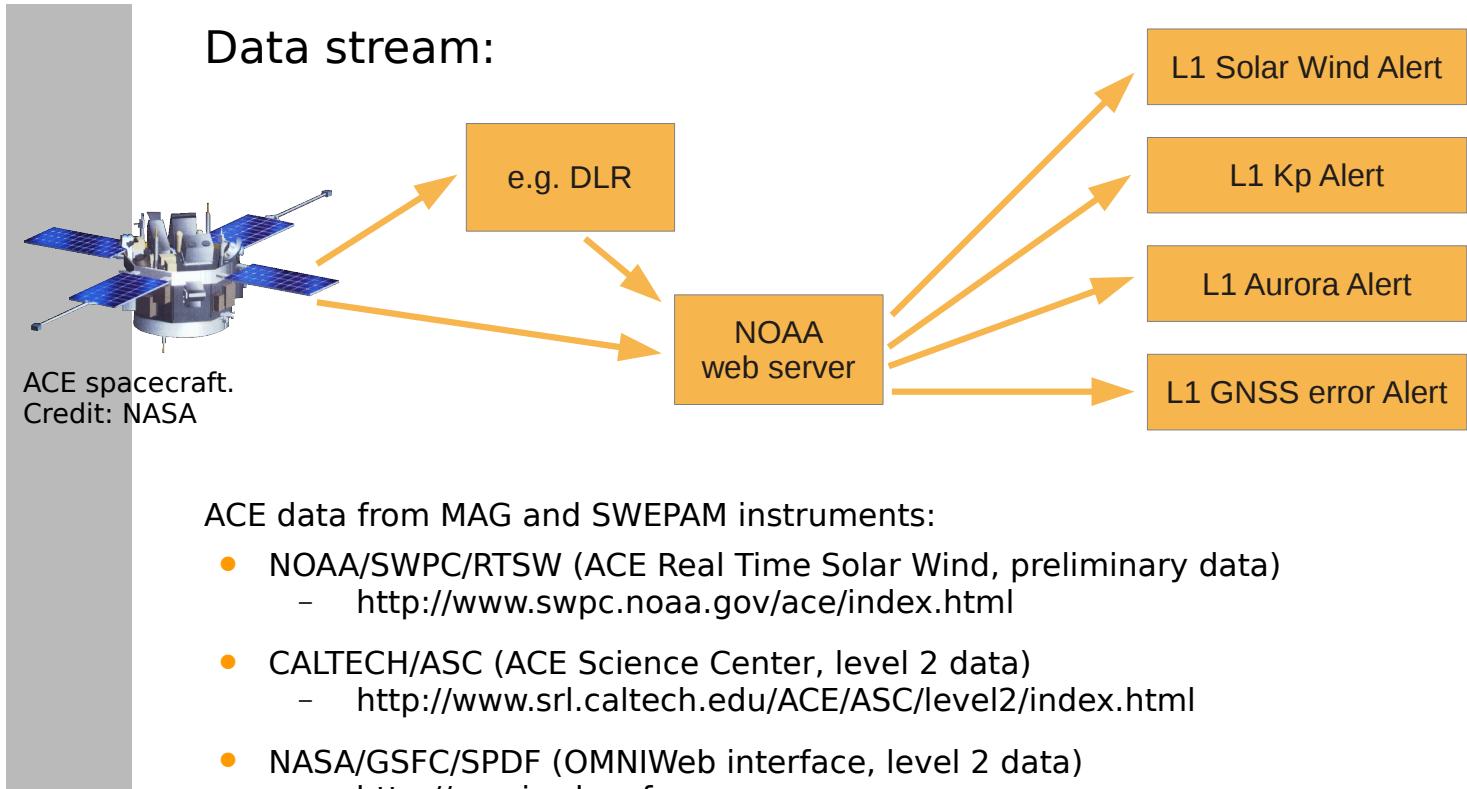


- Cooperation with NOAA-SWPC model
- Cooperation as partner of ILWS proposal (PI: D. Odstrcil)
- Input to ENLIL
 - CME parametrization (GCS, CAT)
 - CME magnetic field structure (B&S FR model)



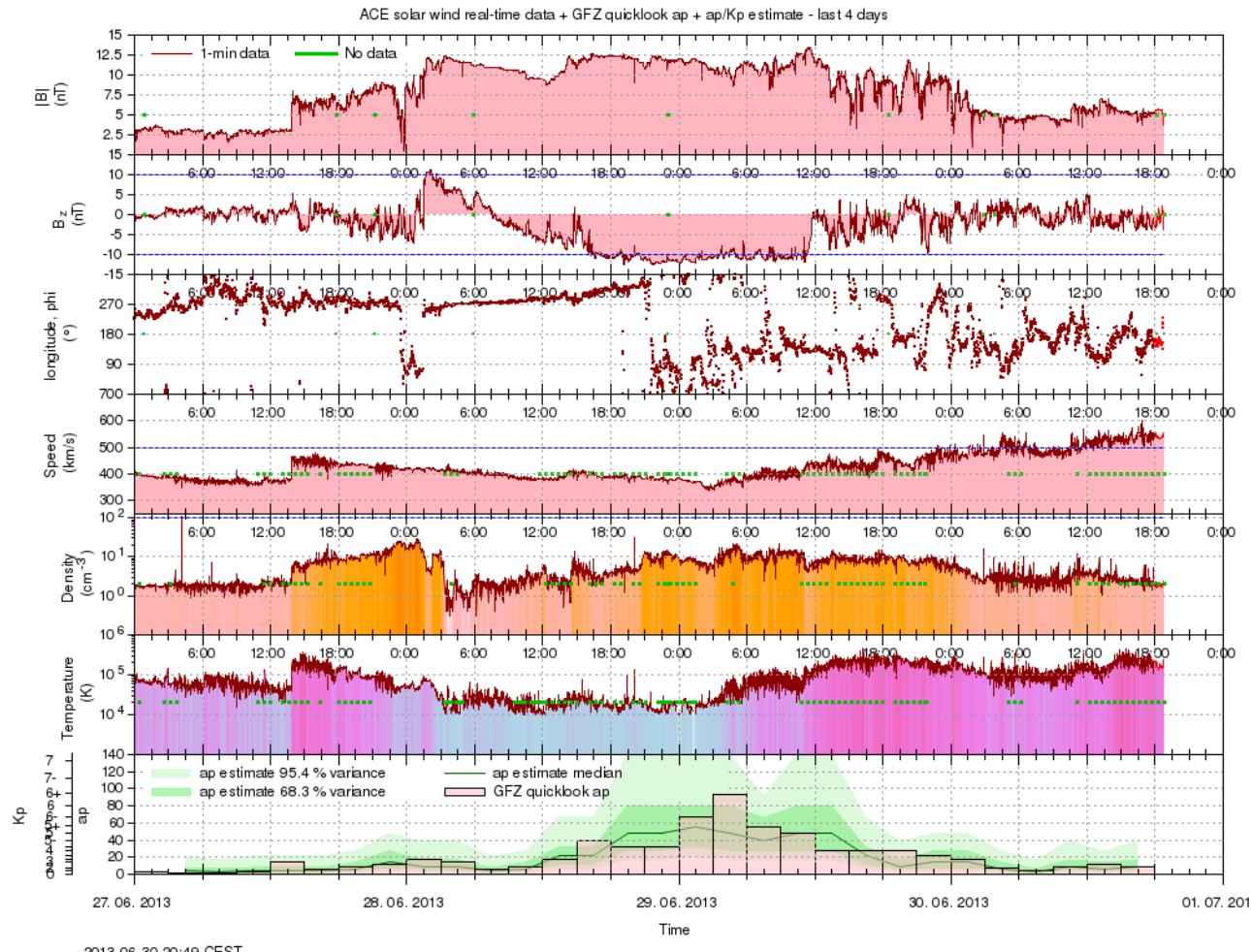


L1 Alerts – Provided as RSS-Feeds



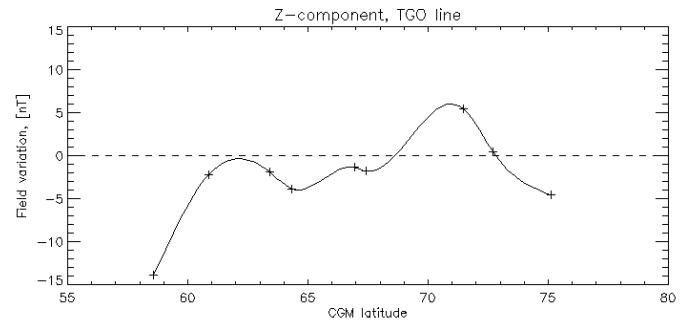
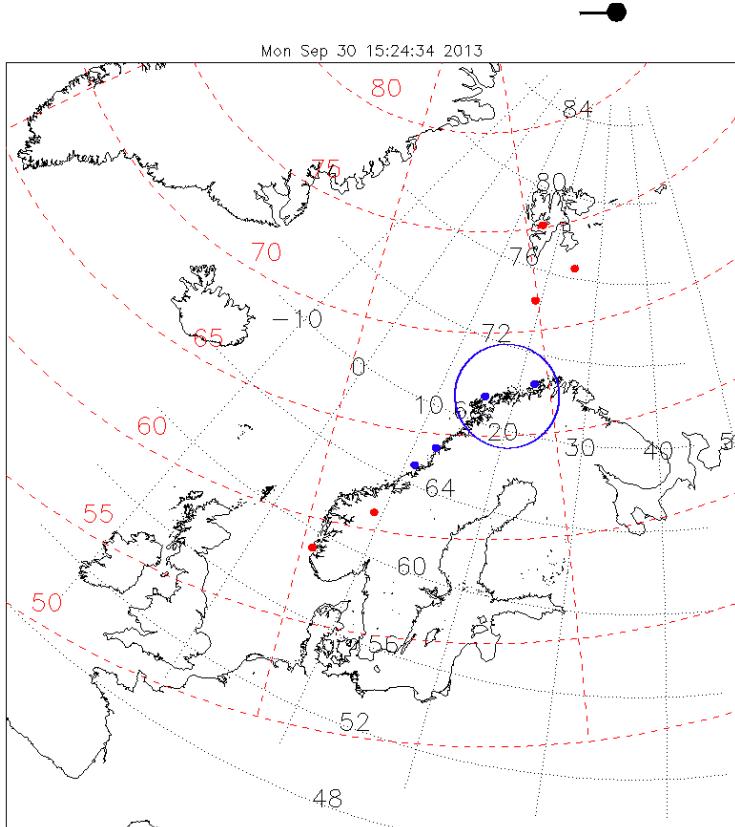


NRT L1 Solar Wind Plot (A Sample)

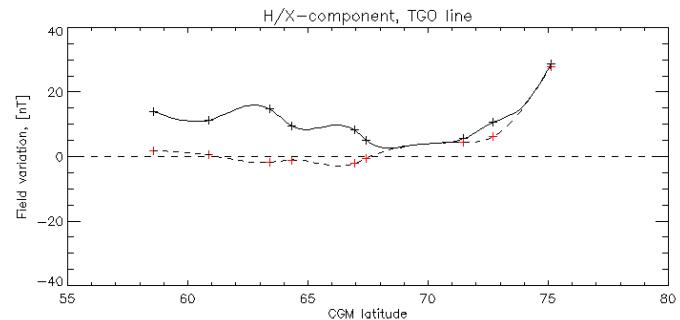




Auroral tracker



Oval ambiguous, variation less than 40 nT



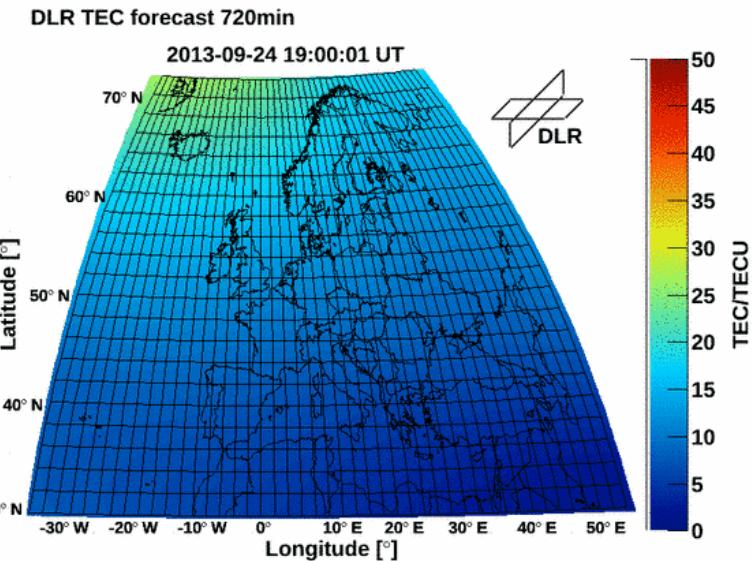
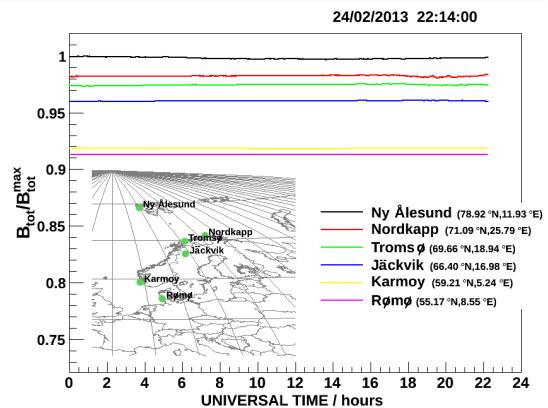
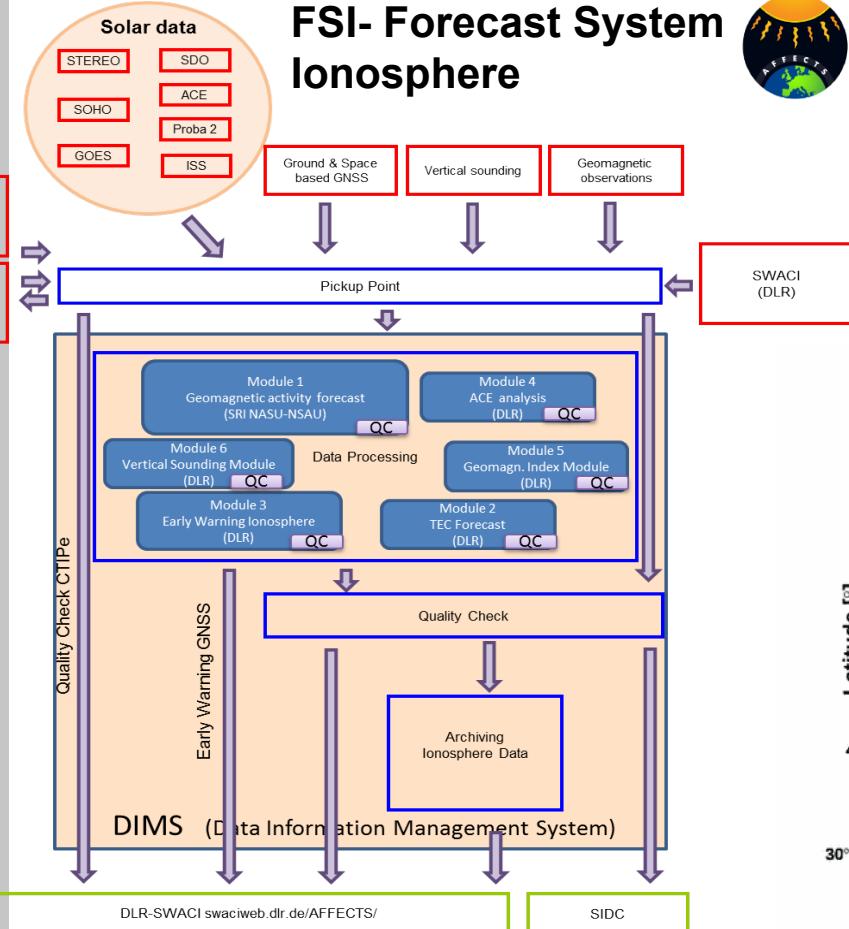
Data time stamp: 30/09/2013 15:23:00



Forecast of „Ionospheric Storms“ and prediction of Total Electron Content (TEC) / „GPS error“



Early Warning Sun (ROB)
Quality Check CTIipe (NOAA)



TEC 24 hrs forecast, taking space weather events into account in NRT.





Main Achievements (1/3)

- Subscription services for ROB and NOAA-SWPC space weather alerts established, including AFFECTS developments (e.g., RSS-alerts).
- Generation of early warnings established – messages sent to DLR and from DLR to GNSS beta testers.
- Near real time data analysis routines (e.g., GCS, CAT, Solar Daemon, STAFF) designed and implemented for CME and flare analysis (source region, topology, direction of propagation, mass estimate, speed, flare intensity).
- CME evolution and forecast routines (BHV method, Cactus) developed/implemented
 - to use derived CME parameters as input to calculate arrival time of CME (and shock) at Earth.
 - to forecast based on dedicated solar wind, geomagnetic and GNSS data analysis the space weather impacts (K_p , GNSS error are generated, CME speed, B_z).





Main Achievements (2/2)

- Updated warning message for CME arrival time at Earth and expected impact parameters (K_p , GNSS error, aurora) is generated for major events to subscribed users within 1-2 hours after storm onset and posted at AFFECTS website.
- CME tracked to Earth with STEREO based on jmap-technique developments.
- ENLIL modeling (cooperation with NOAA-SWPC, <http://www.swpc.noaa.gov/wsa-enlil/>, and NASA/GSFC).
- CME arrival at L1 and its key parameters are measured by ACE in NRT. RSS-alerts based on solar wind changes, latitude of auroral oval, K_p values and GNSS errors are distributed on average 1-2 minutes later. Can be received by mobile devices. See AFFECTS “Services”.





Main Achievements (3/3)

- Geomagnetic forecast implemented in FSI.
- TEC forecast is provided by DLR through the SWACI website, available through “Services” at AFFECTS website.
- Auroral Electrojet Tracker established, available through “Services” at AFFECTS website.
- “STAFF Viewer” developed and implemented.
- Definition of an EUV-TEC index for use in the FSI system.
- Joint CTIPe modeling development, comparison and validation by DLR, NOAA-SWPC.





Expected Final Result

- Europe's first prototype space weather warning system with specific focus on telecommunication and navigation systems





AFFECTS Dissemination activities

- Logo, available as sticker
- Trailer (2 min. HD Video)
- Flyer
- YouTube Video (EU)
- Planetarium Hamburg Show “Flammender Himmel” featuring AFFECTS
- Widespread Media coverage (TV, GEO, Radio, WWW, newspaper)
- Collaboration with infoNetwork
- International User Workshop at ROB (28 February 2013)
- Poster (2 versions)
- Website services incl. RSS-feeds
- Dedicated E/PO events (e.g., “Nacht des Wissens” @ UGOE)
- Space Weather Apps (e.g., 3D Sun, Sun Viewer,
- DVD, bluray, memory sticks
- Presentations at major meetings (EGU, ESWWT, national meetings)
- Joint publication (e.g. for JSWSC, AGU Space Journal)





AFFECTS Website - www.affects-fp7.eu

AFFECTS - ADVANCED FORECAST FOR ENSURING COMMUNICATIONS THROUGH SPACE -

is a space research project under the 7th Framework Programme of the European Union

AFFECTS will provide advanced early space weather warning to protect communication systems.

This website is set up by the AFFECTS consortium and informs you about the project's details and progress. We hope you enjoy your stroll through the pages...

THE FOLLOWING INSTITUTIONS ARE INVOLVED IN AFFECTS:

Beneficiary No.	Country	Institution	Short Name	Scientific Contact	Link to Institutions' website
1	Germany	Georg-August University Göttingen	UGOE	Dr. Volker Bothmer, project coordinator	www.uni-goettingen.de/en/1.html
2	Belgium	Royal Observatory of Belgium	ROB	Dr. Ronald Van der Linden, Dr. Francis Verbeeck	www.astro.oma.be/EN/hotnews/index.php
3	Ukraine	Space Research Institute SRI NSAU-NSAU	SRI NSAU-NSAU	Dr. Aleksei Pamowski	www.iid.kiev.ua
4	Germany	Fraunhofer FHG	FHG	Dr. Raimund Brunner	www.ipm.fraunhofer.de/en.html
5	Norway	University of Tromsø UoT	UoT	Prof. Chris Hall	www2.uib.no/ibViewer/page/inenglish
6	Germany	German Aerospace Center DLR	DLR	Dr. Norbert Jakowelski, Dr. Claudia Bonnes	www.dlr.de/ln/en/desktopdefault.aspx/
7	Germany	Astrium GmbH ST	ASTRIUM ST	Mr. Wilfried Pfeffer	www.astrium.eads.net/en/
8	U.S.A.	Space Weather Prediction Center of NOAA	NOAA-SWPC	Dr. Rodney Verreck	www.swpc.noaa.gov
9	Germany	Planetarium Hamburg		Mr. Thomas Kraupe	www.planetarium-hamburg.de/service/information-for-our-english-speaking-visitors/

Copyright © 2011 - 2012, AFFECTS Consortium. All Rights Reserved.

[IMPRINT](#) | [SITEMAP](#)

- Website includes Wiki engine

Provides

- 3 monthly AFFECTS Newsletter
- PR Material (Trailer, press releases, meeting reports)
- Weather reports and alerts
- Space Weather services
- Links to partner sites and other useful resources





NASA Space Weather Apps

Datei Bearbeiten Anzeige Steuerung Store Erweitert ?

iTunes

MEDIATHEK Sprache: Englisch Entwickler: NASA © 2011 National Aeronautics and Space Administration

Kennzeichnung: 4+

Voraussetzungen: Kompatibel mit iPhone, iPod touch und iPad. Erfordert iOS 4.0 oder neuer.

Weitere iPhone Apps von NASA

NASA Lunar Electric Rover Simulator
AstroApp: Space Shuttle Crew
NASA Television
NASA Desert RATS Virtual Test Site

iPhone Screenshots

SDO - AIA Composite (211, 193, 171) 2011-02-16 16:31:53.0

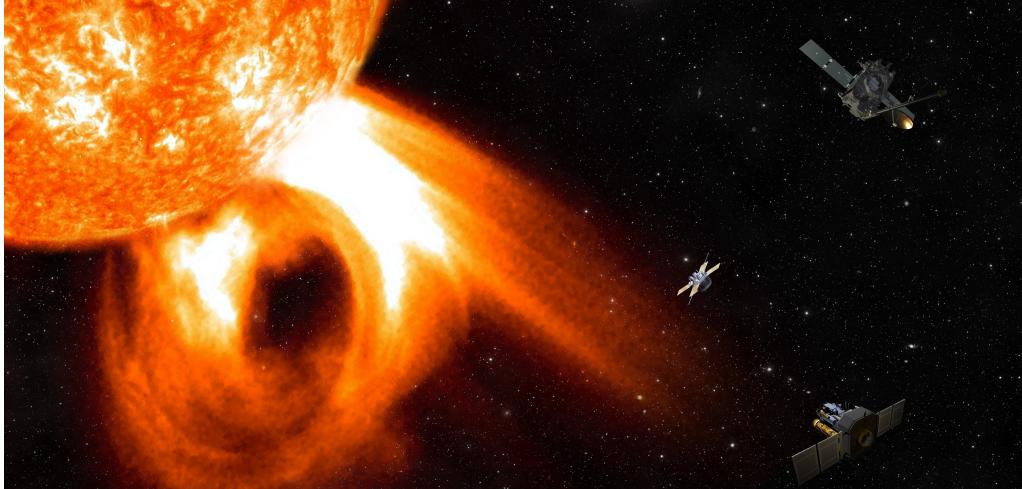
SWACI TEC Map 2011-02-16 16:00:00.0

Total Electron Content (TEC)
Ionospheric Range Error (L1)
TEC / TECU





AFFECTS International User Workshop



AFFECTS User Workshop
Royal Observatory of Belgium,
February 28, 2013

Demonstration of AFFECTS
space weather products:

- Near real time dimming and EIT wave detection
- 3D CME analysis tool
- Coronal analysis tool
- CME & solar wind arrival and impact forecast tool
- Flare, CME, geomagnetic, auroral, ionospheric forecasts & alerts
- Forecast of perturbed TEC
- Solar activity and space weather timelines viewer



L1 Alert Poster



AFFECTS FP7 REA



**L1 Solar Wind, Kp, Aurora
and GNSS Error Alerts**

Venzmer, Malte¹; Bothmer, Volker¹;
Hesemann, Jonas¹; Bosman, Eckhard¹

[1] Institute for Astrophysics, University of Göttingen, GERMANY



INSTITUT FÜR
ASTROPHYSIK
GÖTTINGEN

0 Overview

Short-time warnings of severe space weather effects are provided via RSS feeds. Panel 1 covers the used solar wind data, panel 2 explains RSS feeds and the other four handle the different RSS feed alerts:

- L1 Solar Wind Alert (established)
- L1 Kp Alert (preliminary)
- L1 Aurora Alert (preliminary)
- L1 GNSS Error Alert (in progress)

3 L1 Solar Wind Alert

RSS feed: L1 Solar Wind Alert

This feed creates a new alert if thresholds of specified solar wind parameters are exceeded. It uses like all L1 alerts 1-minute real-time data from ACE.

With the actual threshold values $|B| = 15 \text{ nT}$, $B_z = 10 \text{ nT}$ and $V = 600 \text{ km/s}$ 31 warnings were triggered since September 2012.

Example warning:


4 L1 Kp Alert

RSS feed: L1 Kp Alert

Extreme solar wind affects the Earth's magnetosphere. Kp is a geomagnetic disturbance index, introduced by Bartels in 1948 at the Institute for Geophysics, Göttingen University.

Kp scale ranges from 0 to 9 with 1+ additional.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10+

This feed provides warnings of possible strong Kp conditions. It creates a new alert if the estimated Kp exceeds a specified threshold.

Since October 2012 there were no alerts (threshold: Kp = 7).

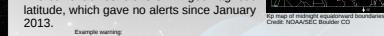
Example warning:


5 L1 Aurora Alert

RSS feed: L1 Aurora Alert

The equatorward auroral boundary position correlates with the Kp index. The auroral position is derived via an estimated Kp index from L1 solar wind data.

The current threshold is 52.2° geomagnetic latitude, which gave no alerts since January 2013.

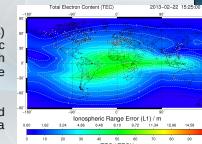
Example warning:


6 L1 GNSS Error Alert

RSS feed: L1 GNSS Error Alert

Global navigation satellite systems (GNSS) have positioning errors. The ionospheric part of this error (up to ~30 m) scales with the Total Electron Content (TEC) of the ionosphere.

TEC data of strong Kp storms is provided by DLR and data evaluation that leads to RSS alert is in progress.



Links to RSS alerts

- [L1 Solar Wind Alert](#)
- [L1 Kp Alert](#)
- [L1 Aurora Alert](#)

Contact details

Malte Venzmer
Institute for Astrophysics
University of Göttingen, Germany
Phone: 0049 551 39 5062
mvenzmer@astro.physik.uni-goettingen.de

Acknowledgement

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 263506 (AFFECTS).

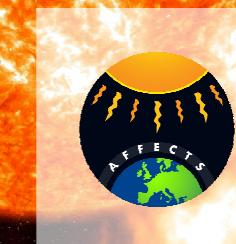




CME Parametrization Poster



AFFECTS FP7 REA



How to parametrize a CME with the GCS Model

*E. Bosman, V. Bothmer,
J. Hesemann, M. Venzmer*
University of Göttingen, GERMANY



Introduction

Since launch of the STEREO twin spacecraft in October 2006, 1071 large-scale flux-rope like CMEs were identified in STEREO/SECCHI/COR2 observations between January 2007 and December 2011. This presentation illustrates how the 3D structure of typical flux-rope like CMEs can be parametrized in real-time based on STEREO/SECCHI/COR2 beacon and/or science data with the GCS Forward-Modeling Technique developed by Thernisien et al. for flux-rope CMEs.

The results are used as input for the forecast of space storms at Earth's orbit by ENLIL and other models.

Software Installation

1. IDL (www.exelisvis.com) Installation on Linux 32/64bit
2. Installation of SolarSoft
[SSW: www.lmsal.com/solarsoft/sws_install_howto.html](http://www.lmsal.com/solarsoft/sws_install_howto.html) [*]
3. Installation of SolarSoft Database
[SSWDB: www.lmsal.com/solarsoft/sswdbb_install.html](http://www.lmsal.com/solarsoft/sswdbb_install.html)
4. Setting SSW Environment for IDL (described here [*])
5. Start IDL with SSW:
\$ swidil
\$ rtscguicloud/demodemo

CME Detection

1. Detection of CME on 12.03.2011 in COR2 synoptic movies at: <http://secchi.nrl.navy.mil>
2. UTC Time t_0 without CME:
2011-03-11 @ 20:08:15
3. UTC Time t_1 with CME:
2011-03-12 @ 05:08:15
(for Beacon-Data)
4. Required Data:
 t_0 : 3x COR2A, 3x COR2B FTS files 1x EUVI-A, 1x EUVI-B FTS file
 t_1 : 3x COR2A, 3x COR2B FTS files 1x EUVI-A, 1x EUVI-B FTS file

Data Acquisition



GCS Model

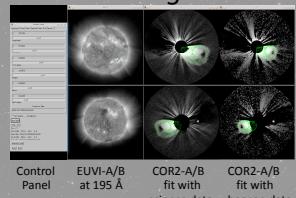
Model Parameter and Electron density distribution:



Data Processing - Overview



GCS Modeling with Science/Beacon data



1. Set all Parameters to Zero and Height to $\approx 10 r_{\text{sun}}$
2. Adjust Longitude, Latitude and Height until a good visual match is achieved.
3. Fit Aspect Ratio to describe the spatial extension of the CME.
4. Then adjust the Half Angle and Tilt Angle to complete the Fit.

Getting Results

GCS-Parameter	Value*
Carrington Lon. [deg]	177.8
Heliosph. Lat. [deg]	-17.3
Tilt Angle [deg]	8.4
Height [r_sun]	14.4
Aspect Ratio [-]	0.3
Half Angle [deg]	20.4

Generating several fits in a time sequence allows speed determination and CME evolution for a better CME forecast.
*Since the fits are done by hand they exhibit the modeler's subjective understanding of the CME and depend on his experience.

Acknowledgement

The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n°263506 (AFFECTS).

References:

- IDL: www.exelisvis.com
- SSW: <http://www.lmsal.com/solarsoft/>
- DOBO: http://secchi.nrl.navy.mil/cgi-bin/dobo/secchi_right/img_short/form
- GCS-Tutorial:
<http://secchi.nrl.navy.mil/synopsis/scraytrace/dobo/examples.html#rtscguicloud>
- Thernisien,Vourlidas,Howard: Forward Modeling of CMEs using STEREO/SECCHI Data, *Solar Phys.* (2009), 256:111-130

Contact details:

Eckhard Bosman
Institut für Astrophysik, Göttingen, Germany
Phone: +49551395062
Email: ebosman@astro.phys.uni-goettingen.de





CME Parametrization Poster



AFFECTS FP7 REA



How to parametrize a CME with the GCS Model

*E. Bosman, V. Bothmer,
J. Hesemann, M. Venzmer*
University of Göttingen, GERMANY

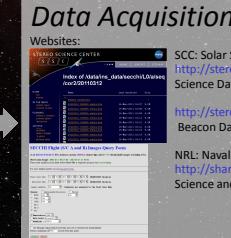
Introduction

Since launch of the STEREO twin spacecraft in October 2006, 1071 large-scale flux-rope like CMEs were identified in STEREO/SECCHI/COR2 observations between January 2007 and December 2011. This presentation illustrates how the 3D structure of typical flux-rope like CMEs can be parametrized in real-time based on STEREO/SECCHI/COR2 beacon and/or science data with the GCS Forward-Modeling Technique developed by Thernisien et al. for flux-rope CMEs.
The results are used as input for the forecast of space storms at Earth's orbit by ENLL and other models.

CME Detection

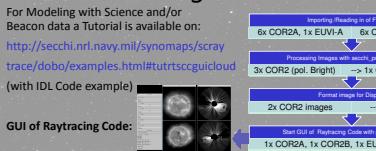
1. Detection of CME on 12.03.2011 in COR2 synoptic movies at:
<http://secchi.nrl.navy.mil>
2. UTC Time t_0 without CME:
2011-03-11 @ 20:08:15
UTC Time t_1 with CME:
2011-03-12 @ 05:08:15
(for Beacon-Data)
3. Required Data:
 t_0 : 3x COR2A, 3x COR2B FTS files 1x EUVI-A, 1x EUVI-B FTS file
 t_1 : 3x COR2A, 3x COR2B FTS files 1x EUVI-A, 1x EUVI-B FTS file

Data Acquisition

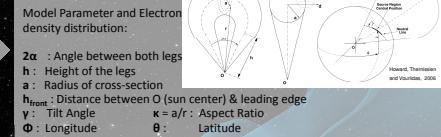


NRL: Naval Research Laboratory, STEREO - Payload Operation Center
http://sharp.nrl.navy.mil/cgi-bin/swdb/secchi_flight/img_short/form
Science and Beacon Data

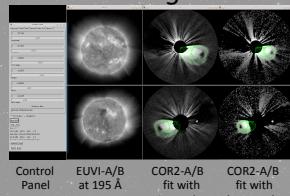
Data Processing - Overview



GCS Model

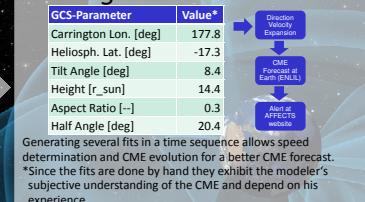


GCS Modeling with Science/Beacon data



1. Set all Parameters to Zero and Height to $=10 r_{\text{sun}}$
2. Adjust *Longitude*, *Latitude* and *Height* until a good visual match is achieved.
3. Fit *Aspect Ratio* to describe the spatial extension of the CME.
4. Then adjust the *Half Angle* and *Tilt Angle* to complete the Fit.

Getting Results



References:

- IDL: www.exelisvis.com
- SSW: www.lmsal.com/odcsoft/ssw_install_howto.html
- NRL: <http://sharp.nrl.navy.mil/synmaps/scraytrace/dlbo/examples.html#tutrtscguicloud>
- Thernisien,Vourlidas,Howard: Forward Modeling of CMEs using STEREO/SECCHI Data, *Solar Phys.* (2009), 256: 111-130

Contact details:

Eckhard Bosman
Institut für Astrophysik, Göttingen, Germany
Phone: +49511395062
Email: ebosman@astro.physik.uni-goettingen.de



Acknowledgement
The research leading to these results has received funding from the European Union's Seventh Framework Programme (FP7/2007-2013) under the grant agreement n° 263506 (AFFECTS).





AFFECTS FP7 REA

Space Weather App Poster





Live-Apps für Sonne und Weltraumwetter

AFFECTS-Koordinator: Dr. Volker Bothmer

AFFECTS-Team:
Eckhard Bosman, Malte Venzmer, Jonas Hesemann,
Dörte Dannemann, Dr. Jens Rodmann, Laura Volpes



**INSTITUT FÜR
ASTROPHYSIK
GÖTTINGEN**

Sonnenaktivität und Weltraumwetter

Die Sonnenkorona ist die Quelle eines kontinuierlichen Stroms ionisierter Wasserstoff- und Heliumteilchen mit den zugehörigen Elektronen. Dieser „Sonnenwind“ transportiert das Magnetfeld der Sonne in den Weltraum und erzeugt elektrische Felder gegenüber den um die Sonne kreisenden Kometen und Planeten. Die Veränderlichkeit dieses Sonnenwindes prägt das Weltraumwetter. Besonders heftige Störungen entstehen bei starken Gasausbrüchen in der Sonnenatmosphäre. Solche heftigen koronalen Materieausschüsse (Coronal Mass Ejections, CMEs) treten im Allgemeinen zusammen mit solaren Strahlungsbilzen (Flares) auf und können mit Geschwindigkeiten von bis zu zehn Millionen Kilometern pro Stunde die 150 Millionen Kilometer entfernte Erde in weniger als einem Tag erreichen. CMEs führen zu starken „Stürmen“ im Weltall. Neben den Polarlichtern können sie auf der Erde und im erdnahen Raum eine Vielzahl unerwünschter Effekte auslösen wie zum Beispiel Störungen des Funkverkehrs sowie der Satellitenavigation und -kommunikation (z.B. GPS), Korrosion in Öl-Leitungen und mitunter auch Stromausfälle.

Durch die aktuellen NASA/ESA Weltraummissionen STEREO, SOHO, SDO und ACE können die Sonnenaktivität und das Weltraumwetter kontinuierlich verfolgt werden. Mit speziell entwickelten kostenfreien Software-Applikationen können diese Beobachtungen per Smartphone live abgerufen werden.

3D Sun

Aktuelle Meldungen über das Weltraumwetter und 3D Ansicht der Sonne



Verschiedene Weltraumwettermeldungen

Quelle: NASA (3dsun.org)



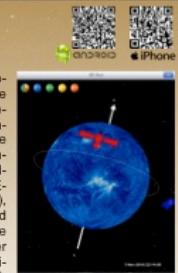
Eine Sonneneruption bricht 150 Mio. km entfernt auf der Sonne aus! Ihr Smartphone informiert Sie innerhalb kurzer Zeit über das aktuelle Weltraumwetterereignis!

Links ist ein Beispiel von Weltraumwettermeldungen zu sehen. Erfahren Sie wann und wo auf der Sonne Röntgenstrahlungsbilze und Sonneneruptionen entstehen oder schnelle Teilchen und Sonnenstürme ausbrechen und sich in den Weltraum ausbreiten.



Ausbruch von Plasmamaterie auf der Sonne

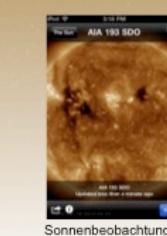
Spektakuläre Bilder und Videoaufnahmen sind in einer Galerie zusammengefasst. Eine Hilfe-funktion erklärt diese Aufnahmen in verständlicher Form. Eine vollständige 3D Ansicht der Sonne, rekonstruiert aus den Bildern der beiden NASA STEREO-Satelliten (rechtes Bild), zeigt eine komplett 360 Grad Darstellung der Sonne. Aktuelle Daten zur Sonne und unserer Erde, wie Sonnenfleckendichte, Sonnenwindgeschwindigkeit, Schwankungen des Erdmagnetfeldes und Polarlichtaktivität komplementieren das Smartphone-Observatorium.



3D Ansicht der Sonne mit den beiden STEREO-Satelliten

NASA Space Weather Media Viewer

Sonnenbilder in Echtzeit mit Zusatzinformationen



Sonnebeobachtung im extremen UV-Licht

Quelle: SDO/NASA



Machen Sie sich ein umfassendes Bild des aktuellen Weltraumwetters anhand der Bild- und Videodateien der verschiedenen Sonnenbeobachtungssatelliten (mittleres Bild).

Links ist eine Sonnenaufnahme zu sehen, aufgenommen im extrem ultravioletten Licht bei einer Wellenlänge von 19.3 nm vom NASA Solar Dynamics Observatory (SDO).



Videointerviews mit Weltraumwetter-Experten vermitteln verständliche Hintergrundwissen zu Themen wie Sonnenwind, Erdmagnetosphäre und weiteren Phänomenen des Weltraumwetters. Diese werden auch in Animationen anschaulich dargestellt.

Auf dem rechten Bild ist eine Aufnahme der Sonne im ultravioletten Licht bei 30.4 nm dargestellt.



weiterführende Informationen

www.3dsun.org
www.spaceweather.com
www.affects-fp7.eu
sunearth.gsfc.nasa.gov/spaceweather

Kontakt

Dr. Volker Bothmer
 Institut für Astrophysik
 Georg-August Universität Göttingen
 e-mail: bothmer@astro.physik.uni-goettingen.de
www.affects-fp7.eu





Sample Forecast for Individuals

infoNetwork
FORUM FOR ENVIRONMENTAL INFORMATION

UdK Berlin/Göttingen/Potsdam | 030/904000
Dipl. Meteorologe Albrecht
Cofounder of AFFECTS
Redaktion Wetter
Tel. +49 30 904000-100
cofounder.albrecht@infonetwork.de

Dr. Volker Bothmer
AWI/WCR/UNESCO Chair
Institute for Astrophysics
Technische Universität Berlin
D-10707 Berlin

Dear Mr. Bothmer,

Thank you for offering the collaboration of infoNetwork with the Institute for Astrophysics at the Georg-August University Göttingen, RTI, Germany and at the weather department we provide information on the RTV, RBB, RTL2 and 6+7. Next to weather information we also take care about weather relevant scientific topics. Because of the increasing interest of space weather particularly solar activity and sun eruptions we are dependent on substantiated information.

We are glad to find in AFFECTS the leading experts about solar activity and effects to the entire Earth environment from the magnetosphere down to ionosphere. The interpretation of solar storm warnings into our overall alert system of hazardous events, such as earthquakes, avalanches or tsunamis, is a challenging but highly important subject.

We look forward a good collaboration.

Sincerely yours,
Constance Ahlers
Chefin von Dienst (CvD)

11.2. 2013

Hallo Herr Bothmer!

Als Dankaktion für Ihre Polarlicht - Vorträge, die ja Super eingetragen sind, schicke ich Ihnen eine Foto - CD.

Es sind einige private Fotos, die einen Schatz aus dem nördlichsten Dorf Europas geben sollen. Die Fotos von der Polarlichtshow sind sehr wunderschön und unvergesslich. Danach - als "Bonus" - ist einmal meine Frau und einmal mein Sohn im Vordergrund.

Abermals habe ich in der letzten Nacht (Mitternacht von 3. & 4. Feb.) ein Foto zur Verfügung. Ich habe eine Folge von 36 Fotos gemacht, ein Zeitraum von Nekermann (hier viele Stör- und Streulicht). Jedes Bild wurde 6sec belichtet, dann 1 sec Pause. Es ist ein Zeitraffer über ca 3 min entstanden. Wenn man diese Bilder etwa in 1 sec - Abstand ablaufen lässt, sieht man sehr schön die Dynamik. Ich bin davon recht begeistert. (Ob ich recht��k ist, dass in Nekermann (von unserer Unterstutzung aus gesehen) das Polarlicht immer in einem Staffel oder die Art des Himmels entzündet und sich bewegen, der klappt)



13:44 85 %

Nachricht... +49 172 90... Bearbeiten

am 31.1. kurz vor Mitternacht gab es wohl schwaches polarlicht. ein freund hat es gesagt, wir haben verpennt. na vielleicht diese nacht, bei klarem himmel.

02.02.2013 23:36

wow , hatten heute von 19.15 bis 20 Uhr tolles polarlicht einmal längs über den himmel in mehamn und auch in gamvik. perfekte vorher sage. danke heinz wüppen

03.02.2013 01:17

Freut mich sehr Herr Wüppen ! Alles gute für Ihre Reise. Hatte letzte Woche einen tollen Tag.

Nachricht Senden

13:44 85 %

Nachricht... +49 172 90... Bearbeiten

Nachricht 31.01.2013 12:16

Evt. erhöhte Polarlichtaktivität in den Abenden 2. auf 3. und 3. auf 4. Feb. wegen eines entstandenen kleinen Koronalochs. Viel Glück und guten Aufenthalt. Volker Bothmer

hallo herr bothmer, na dann schauen wir mal!!! herzliche grüße vom slettnes leuchtturm, alles dunkel, verschneit und leider bewölkt. wir genießen die einsamkeit

01.02.2013 19:28

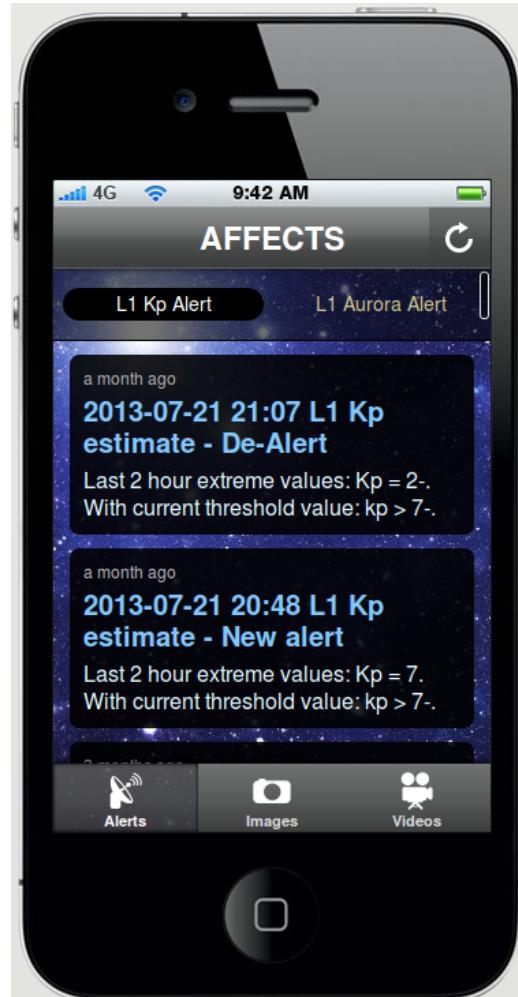
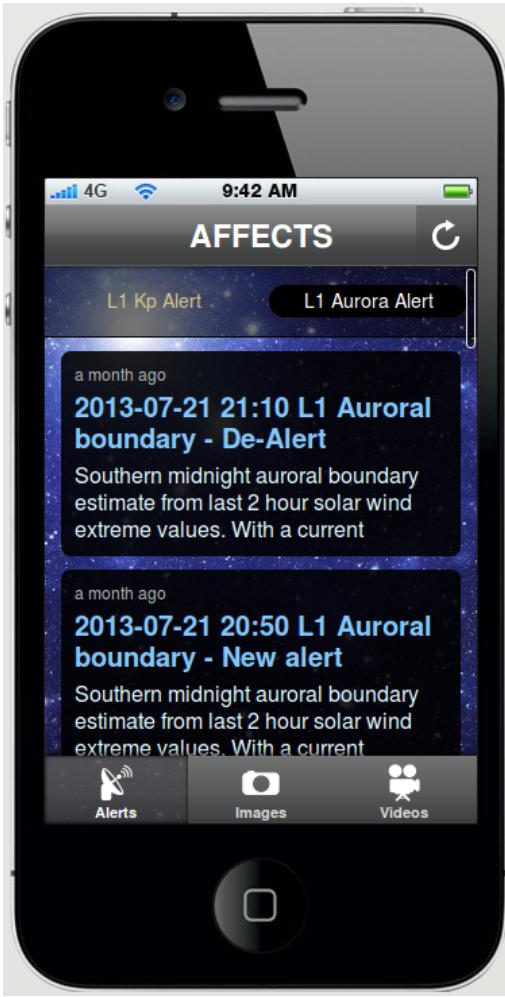
am 31.1. kurz vor Mitternacht gab es wohl

Nachricht Senden

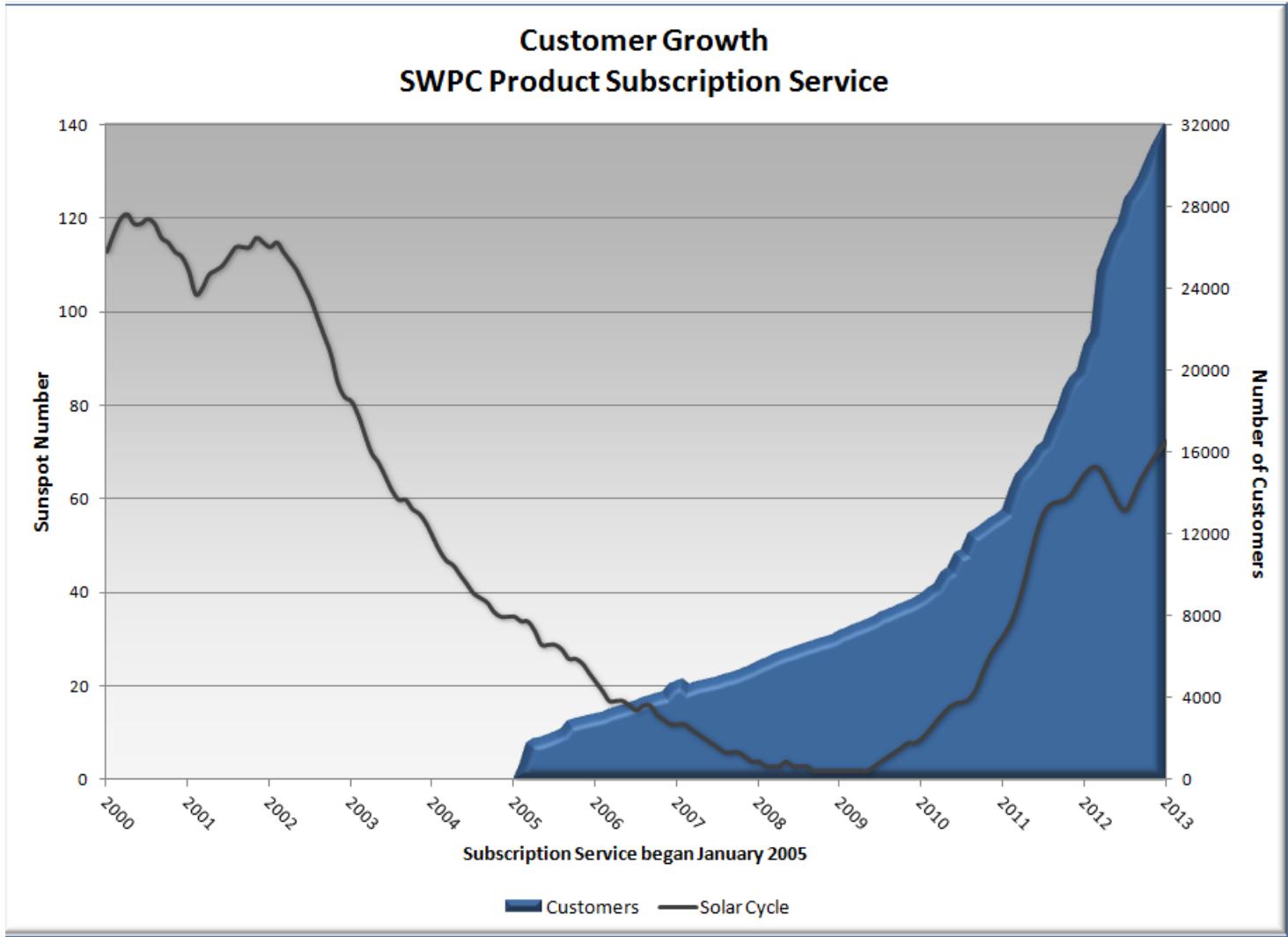




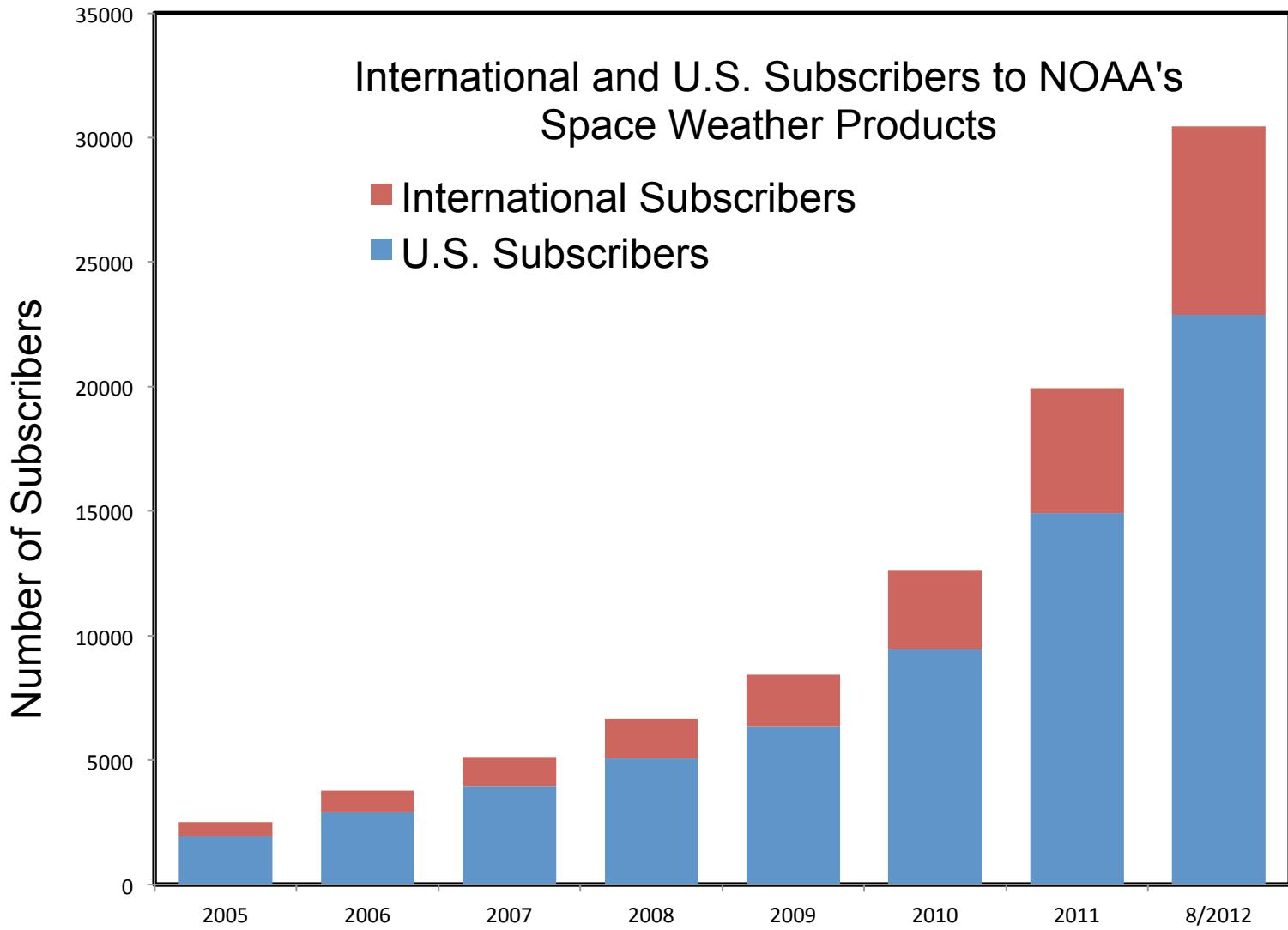
Space Weather App - Demo



Growing Number of End Users (e.g., NMA, Axio-Net, Fugro, etc.) and feedback (e.g., AFFECTS User WS)



Subscribers



SWx Customers (A Sample)



Airlines	Surveying and Mapping	Electric Power	Satellites
Aer Lingus	AE & E Trucking, Etc., LLC	Allegheny Power	Lucent Technologies
Air Canada	AEI-CASE Engineering	Ameren Corporation	AeroMap U.S.
Air China	Airmag Surveys	Bechtel Nevada	Aerospace Corporation
Air Europa	Associated Engineers, Inc	Bonneville Power Administration	Alcatel Space
Air Line Pilots Association	Athens Group (oil & gas)	Central Maine Power	American Space Culture Foundation
Air New Zealand	Baker Hughes (drilling)	Cleco Power LLC	AMSAT-France
AirMed Inc.	Banks		
Airservices Australia	Barr E		
Alaska Airlines	Benne		
Allied Pilots Association	Black		
ALPA Japan	Carve		
American Airlines	Christo		
American Eagle Airlines	Clarida		
American Trans Air	Consu		
Boeing / Flight Test	DGR C		
British Airways	Diamo		
Bushmail	Earth I		
Cathay Pacific Airway	Easter		
Continental Airlines	Excel		
Emirates	Geoco		
FedEx	GeoLoc		
German ALPA	Global		
Icelandic ALPA	GRW J		
Irish Aviation Authority	Halcyo		
Jet Aviation Business Jets	J. D. B		
Korean air	Johnso		
Lufthansa	Jones		
Lufthansa Cargo	marine R/D Survey	Puget Sound Energy	North Star Data
Northwest Airlines	NC Geodetic Survey	Soreq NRC	Northrop Grumman
Oslo Lufthavn AS	Nexen Inc. (oil)	Swedish Geological Survey	Oceaneering Space Systems
Qantas Airways	NOVA Engineering & Consulting, Int'l.	Texas-New Mexico Power	Omnistar, Inc.
Raytheon Aircraft Co.	NYS Professional Engineer	Transpower NZ Ltd	ORBCOMM
SCTA	Old Dominion Freight Lines	US NRC	Orbital Sciences Corp
SkyWest Airlines	Olson Trucking	We Energies	PT Asia Cellular Satellite
Sun Country Airlines	Oxy (oil & gas)	Western Area Power Admin.	Raytheon
Sundt air (Norway)	Pape-Dawson Engineering		Rockwell Collins, Inc.
Swales Aerospace	PGS Onshore		SES Americom
United Airlines	Planning Consultants, Inc.		SES ASTRA
APLA, Argentina	Portland Natural Gas Transmission		Sirius Satellite Radio
ATA Airlines	Raymac Surveys		Skyway, Inc.
NetJets	Schlumberger Drilling & Measurements		Space Engineering Development
North American Airlines	Seelye		Space Imaging

- Every Major Airline (world wide)
- Every Major US Power Company
- Every Major Satellite Company (world wide)
- US Federal Agencies
 - Department of Defense.
 - NASA
 - Department of Energy
 - Department of Homeland Security
 - Federal Aviation Administration
- 32,000 Specific Customers
- 15 – 20 Million Web Hits a day





Cooperation with other projects (1/3)

- Forecast of solar wind speed and geomagnetic activity (UGOE with UGraz COMESEP team (M. Temmer, A. Veronig).
- ESA SN-II study – Implementation Design Study of Space Weather Instruments (UGOE, Astrium Satellites).
- ILWS (UGOE with D. Odstrcil as PI, ENLIL data driven modeling).
- NRI NASU-NSAU in “Resonance” (Russia) project through forecast of ULF geomagnetic pulsations and in “Ionosat” project (Ukraine).





Cooperation with other projects (2/3)

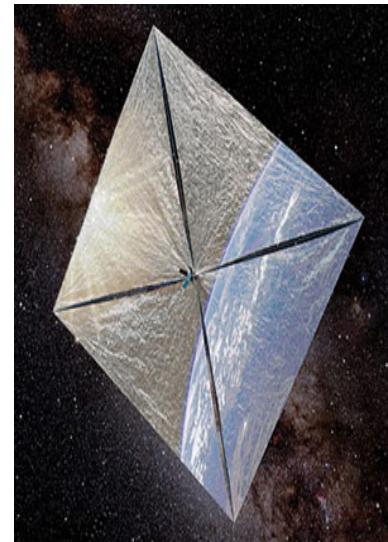
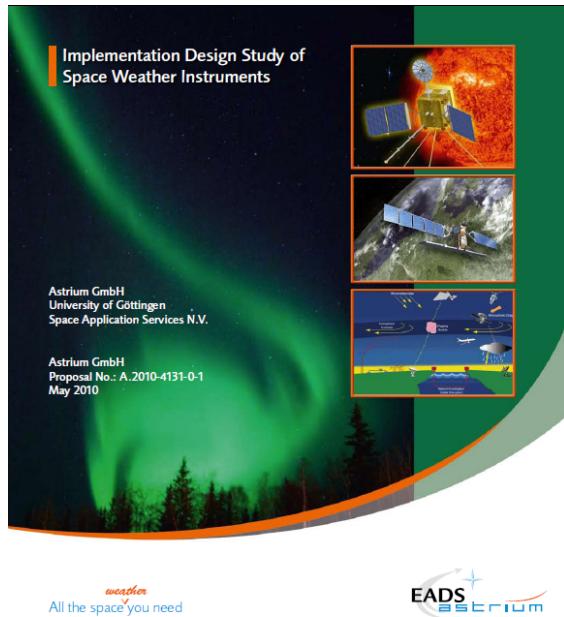
- Partners follow internationally shared data and model strategy (ESA-ESTEC, Korean RRA, Rosh Hydromet, UK Met Office, RWC Tokyo, UK Met Office, Australia IPS).
- Definition of an EUV-TEC index for use in the FSI (FHG with University of Leipzig).
- Analysis of EUV data products (FHG with LASP, Boulder - Space Environment: SDO, California, UCL: SOHO/SEM - PMOD, CH), LATMOS.
- Investigation of magnetic connection oinfluence on SEPn events (UGOE in eHEROES consortium).





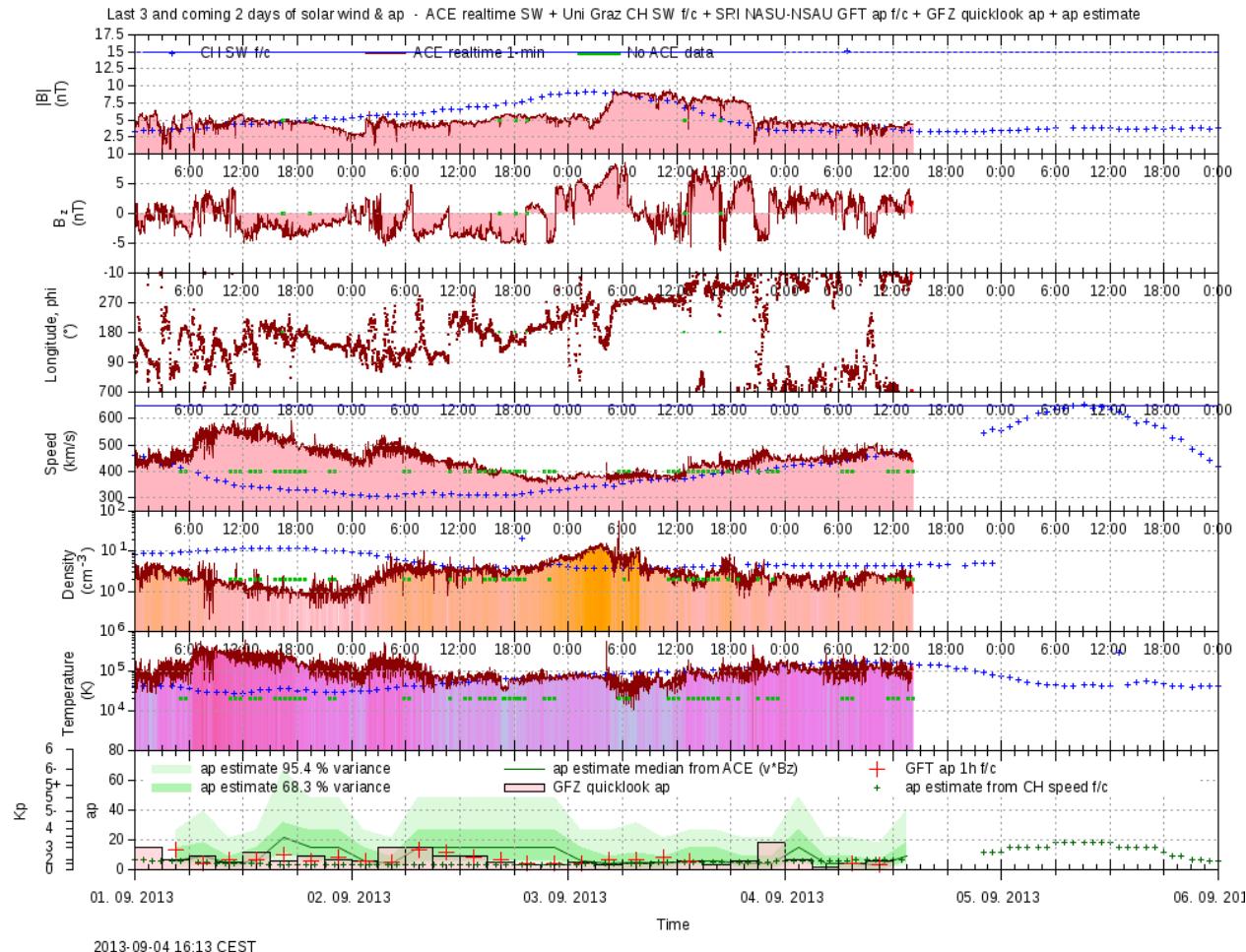
Cooperation with other projects (3/3)

- Increase of storm warning time and impact mitigation (UGOE in DLR, ESA Solar Sail WG).





NRT Forecast





Ideas for exploitation and way forward

Space weather is global and therefore, requires global participation and coordination to address the growing needs of customers and the services they require. Future projects shall therefore address:

- Test-bed studies to improve and further validate the developed space weather early warning system and its services and products with emphasis on data-driven modelling.
- Development of the prototype space weather early warning system into a long-term operational facility and support of the ESA SSA program, including international collaborations.
- Optimisation of the services and products for the end users, scientific community and general public and for use in future space weather projects and missions.





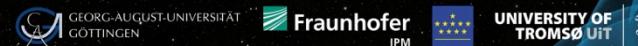
DON'T LET THE SUN GO DOWN ON YOU WATCH OUT FOR SOLAR STORMS

AFFECTS

Advanced Forecast For Ensuring Communications Through Space

Solar storms affect the Earth environment from the magnetosphere down to the ionosphere, and even to the lower atmosphere climate system. The natural hazards of severe space weather have the potential to catastrophically disrupt the operations of technological systems, such as communication systems and power grids on Earth. Through the AFFECTS project funded by the European Union's 7th Framework Programme, European and US scientists develop an advanced prototype space weather warning system to safeguard the operation of telecommunication and navigation systems on Earth to the threat of solar storms.

The project is led by the University of Göttingen's Institute for Astrophysics and comprises world-wide leading research and academic institutions and industrial enterprises from Germany, Belgium, Ukraine, Norway and the United States.



www.affects-fp7.eu

Funded by the European Union

Image Credits: University of Göttingen, NASA, ESA, Planetarium Hamburg

infoNetwork

Official Media Partner

