

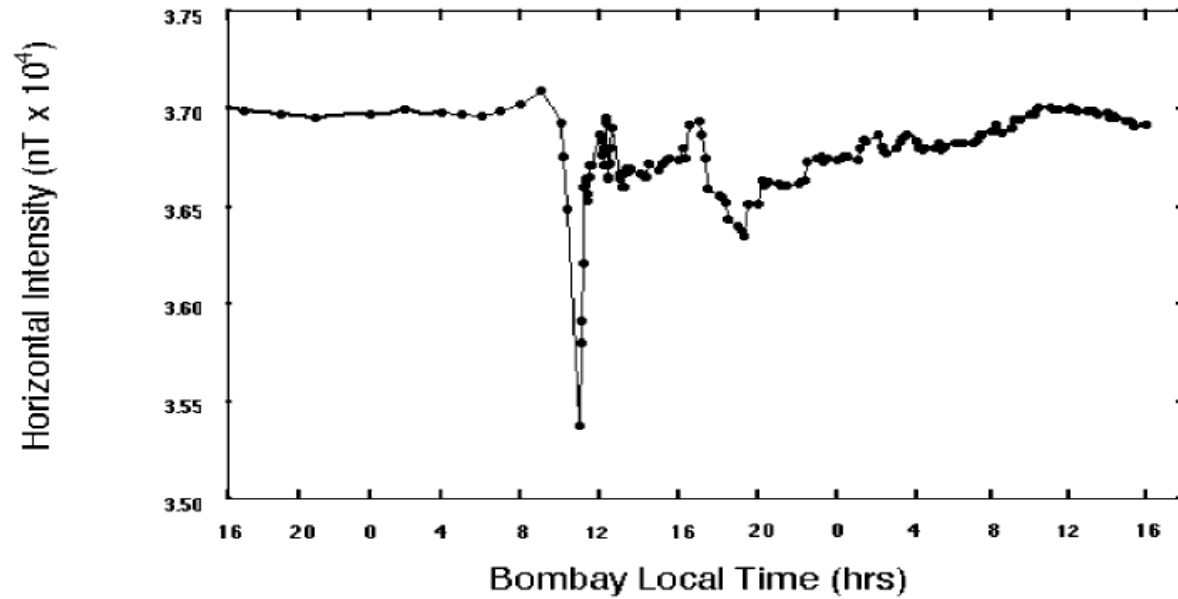
Meteorología Espacial: Sistemas de predicción y aviso

Consuelo Cid

SRG - Space Weather, Departamento de Física, Universidad de Alcalá
consuelo.cid@uah.es



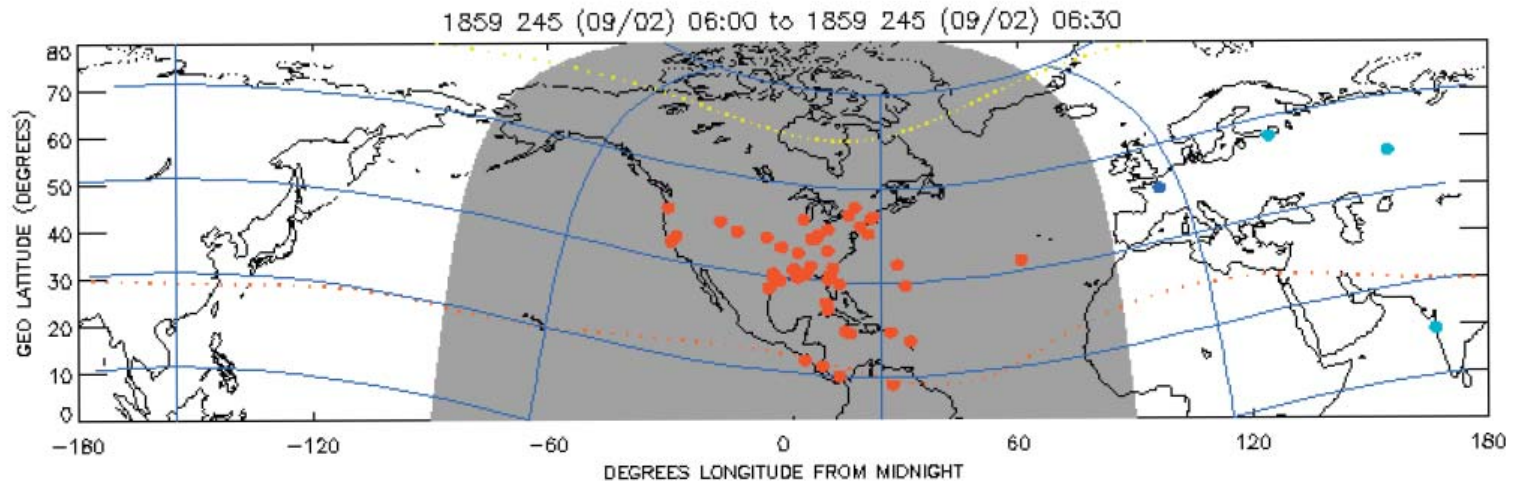
1859 Bombay Magnetic Storm



Sept. 1

Sept. 2

Sept. 3



Locations of reported auroral observations during the first ~1.5 hours of the September 2, 1859, magnetic storm
. Courtesy J.L. Green, NASA

- Problemas en el telégrafo (~8 horas)
- “Luces nocturnas” en todo el globo
- Carrington lo relaciona con dos emisiones brillantes en luz blanca seguidas procedentes de un grupo de manchas grande y complejo cerca del centro del disco (“One swallow does not make a summer”)

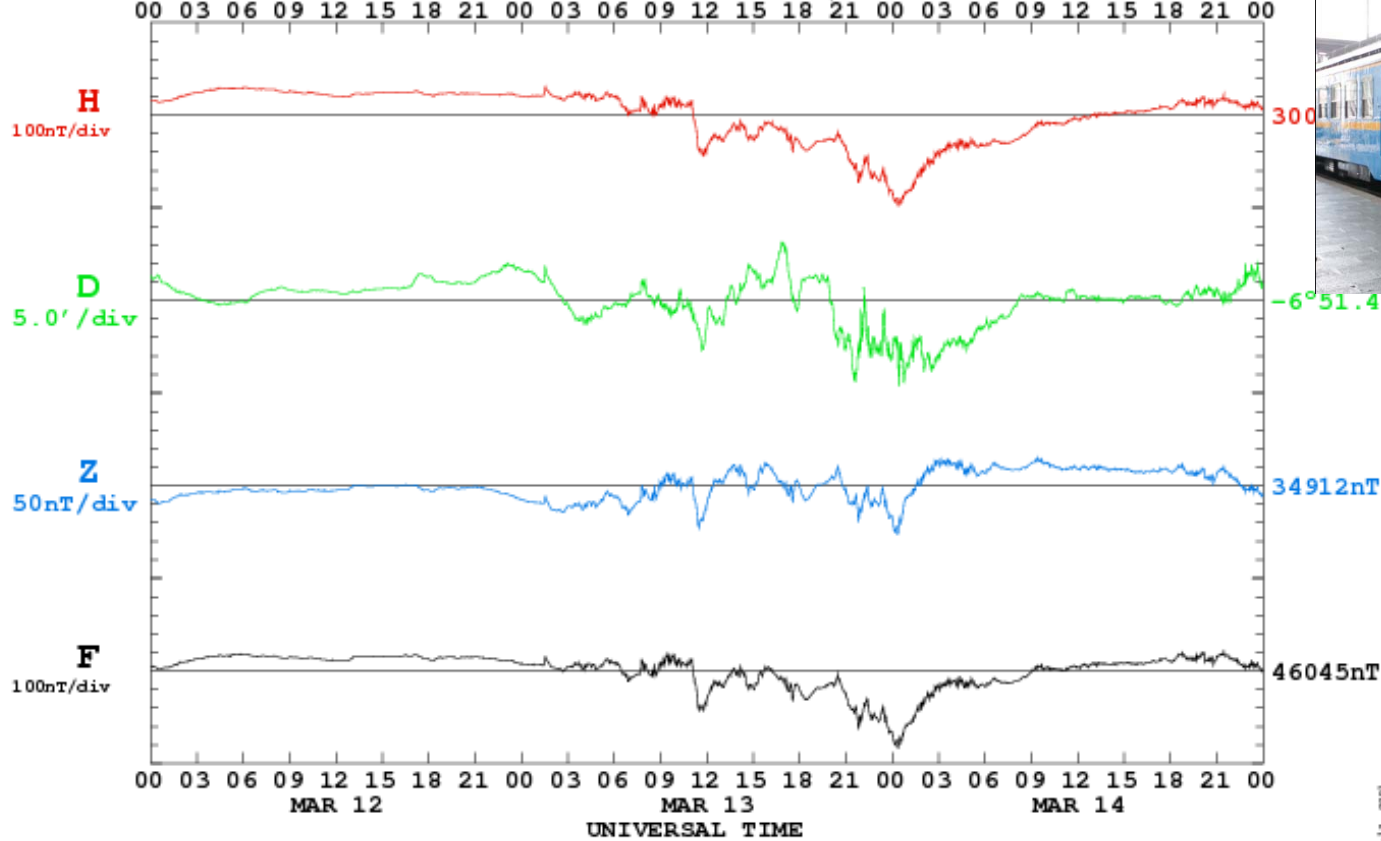


Thomas Alva Edison
(1847 -1931)



Julien Dupré (1859-1910)

KAK Kakioka GGLAT: 36.2 LONG: 140.2 START: MAR 12, 1989 00hUT
 PLOT FROM 1-MIN. VALUES SUPPLIED TO WDC, KYOTO FROM THE OBSERVATORY



111-93-20 04.22.12 0001



~ 1/3 menos intensa
 en la variación de
 campo magnético que
 el suceso de 1859

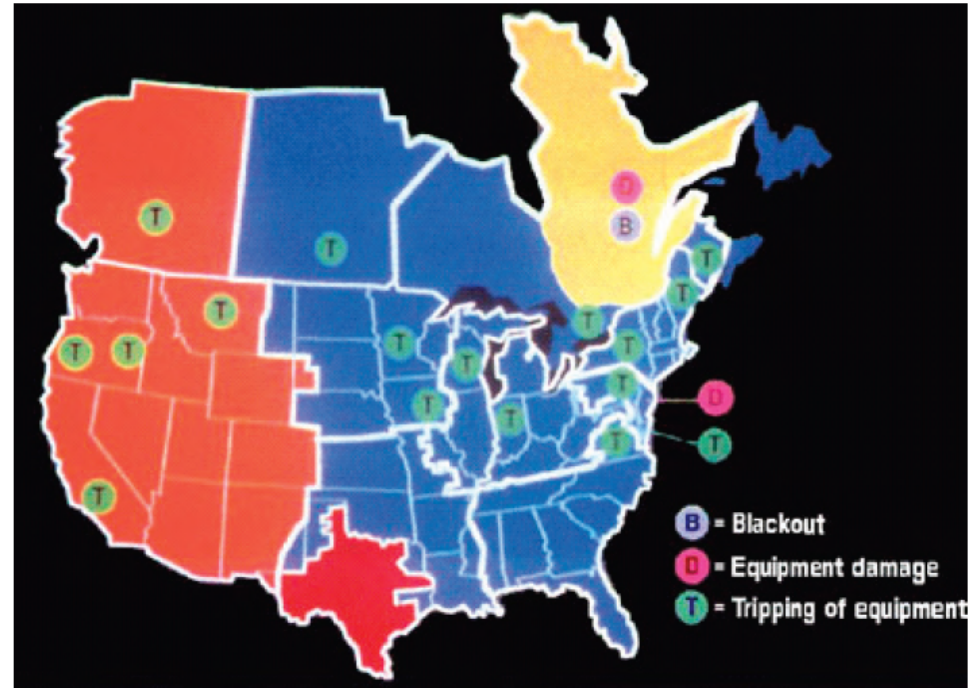
- El sistema eléctrico de Quebec sufrió un apagón de 9 horas
- Hubo problemas con numerosos satélites



Daño en el transformador

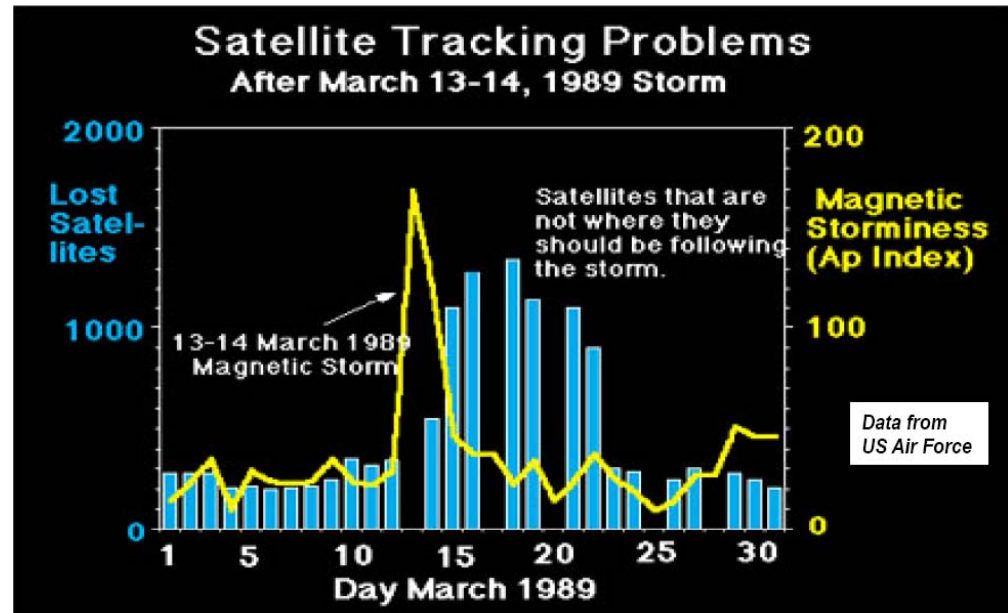


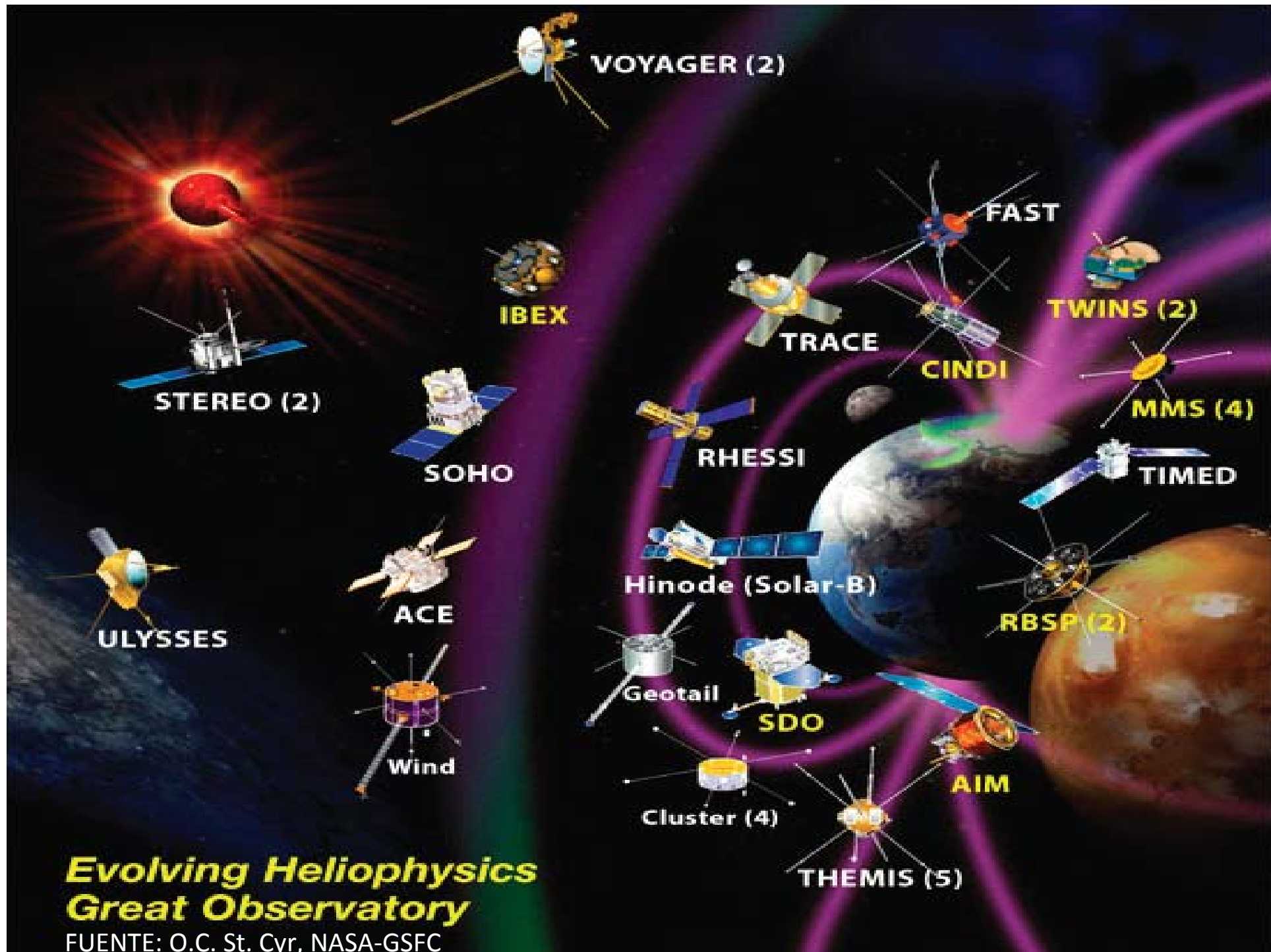
Sobrecalentamiento



Power system events due to the March 13, 1989, geomagnetic storm.

SOURCE: Electric Power Research Institute, Inc.



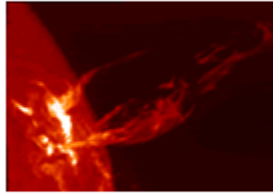


***Evolving Heliophysics
Great Observatory***

FUENTE: O.C. St. Cyr, NASA-GSFC

<http://www.swpc.noaa.gov/forecast.html>

NOAA / Space Weather Prediction Center



3-day Report of Solar and Geophysical Activity

[Last 75 Reports](#)

[Today's Space Weather](#)

[Space Weather Now](#)

Prepared jointly by the U.S. Dept. of Commerce, NOAA,
Space Weather Prediction Center and the U.S. Air Force.
Updated 2011 Mar 21 2200 UTC

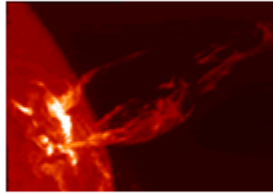
Joint USAF/NOAA Report of Solar and Geophysical Activity
SDF Number 080 Issued at 2200Z on 21 Mar 2011

IA. Analysis of Solar Active Regions and Activity from 20/2100Z to 21/2100Z: Solar activity increased to low levels. Isolated C-class flares were observed, the largest of which was a long-duration C4 at 21/1719Z from newly-numbered Region 1176 (S13E81). Region 1176 was the return of old Region 1165, which produced M-class flares during its previous rotation. SOHO/LASCO images showed a halo-CME, first visible in C2 images at 21/0236Z. The halo-CME was determined to be a backside event associated with a flare from old Region 1169 (N20, L=061).

IB. Solar Activity Forecast: Solar activity is expected to be low during days 1 - 3 (22 - 24 March) with a chance for an M-class flare from Region 1176.

<http://www.swpc.noaa.gov/forecast.html>

NOAA / Space Weather Prediction Center



3-day Report of Solar and Geophysical Activity

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[Today's Space Weather](#)

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Updated 2011 Mar 21 2200 UTC

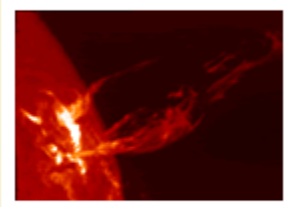
Joint USAF/NOAA Report of Solar and Geophysical Activity
SDF Number 080 Issued at 2200Z on 21 Mar 2011

IA. Analysis of Solar Active Regions and Activity from 20/2100Z
to 21/2100Z: Solar activity increased to low levels. Isolated
C-class flares were observed, the largest of which was a

IIA. Geophysical Activity Summary 20/2100Z to 21/2100Z:
Geomagnetic field activity was at quiet levels. A greater
than 10 MeV proton event at geosynchronous orbit began
at 21/1950Z and was in progress at the time of this report.
Stereo-A EUVI 195 images indicated the source for the
proton event was likely a flare from old Region 1169 which
also spawned the back sided halo-CME mentioned above.

IIB. Geophysical Activity
Forecast: Geomagnetic
activity is expected to be
at quiet levels during days
1 - 2 (22 - 23 March).
Geomagnetic activity is
expected to increase to
quiet to unsettled levels
on day 3 (24 March) as a
coronal hole high-speed
stream begins to disturb
the field. The greater than
10 MeV event at
geosynchronous orbit is
expected to end on day 1
(March 22).

NOAA / Space Weather Prediction Center



3-day Report of Solar and Geophysical Activity

[Last 75 Reports](#) [Today's Space Weather](#) [Space Weather Now](#)

Prepared jointly by the U.S. Dept. of Commerce, NOAA,
Space Weather Prediction Center and the U.S. Air Force.
Updated 2011 Mar 21 2200 UTC

Joint USAF/NOAA Report of Solar and Geophysical Activity
SDF Number 080 Issued at 2200Z on 21 Mar 2011

IA. Analysis of Solar Active Regions and Activity from
to 21/2100Z: Solar ac
C-class flares were ob
long-duration C4 at 21

III. Event
Probabilities
22 Mar-24 Mar
Class M 30/30/30
Class X 05/05/05
Proton 10/01/01
PCAF green

IV. Penticton 10.7 cm Flux
Observed 21 Mar 101
Predicted 22 Mar-24 Mar
115/125/135 90 Day Mea
21 Mar 094

V. Geomagnetic A Indices Observed
Afr/Ap 20 Mar 004/004
Estimated Afr/Ap 21 Mar 002/004
Predicted Afr/Ap 22 Mar-24 Mar
005/005-005/005-008/008

VI. Geomagnetic Activity Probabilities
22 Mar-24 Mar A.
Middle Latitudes Active 10/10/15 Minor storm
01/01/05 Major-severe storm 01/01/01 B.
High Latitudes Active 15/15/20 Minor storm
01/01/10 Major-severe storm 01/01/01

<http://www.esa-spaceweather.net/swenet/>

SWENET Contents

- Introduction
- SWENET Services
- Look for Services
- Latest Data
- Space Weather Data
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- Index Quality
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- Latest SWPC Plots
- Latest Alerts
- Latest Indices
- Statistics
- Daily Reports
- Message of the Day
- Report Browsing
- Resources
- Documentation
- Tutorials
- Release Information
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SWENET Search

Go

Latest Alerts

No active alerts.

SWENET Services

- Ground Effects
- Ionospheric Effects
- Spacecraft Effects

Latest Indices (14 days)

AP (MINCASTS)

sda-bincasts-drx-es-actual

Day	Index Value
1	5
2	10
3	20
4	35
5	25
6	15
7	10
8	5
9	5
10	5
11	5
12	5
13	5
14	5

Welcome to SWENET
Space Weather European Network

What is SWENET? **What is Spaceweather?** **What can I do on this site?** **Latest Upgrades**

The SWENET team is pleased to inform you about the latest features and functions upgrades as well as interface enhancements to the Space Weather European Network Portal, version 3.08.

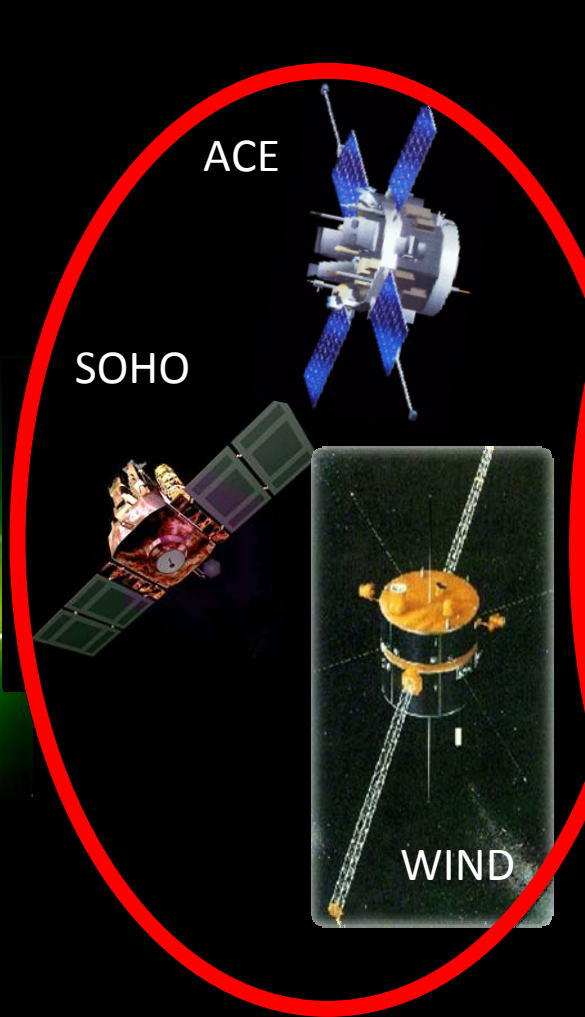
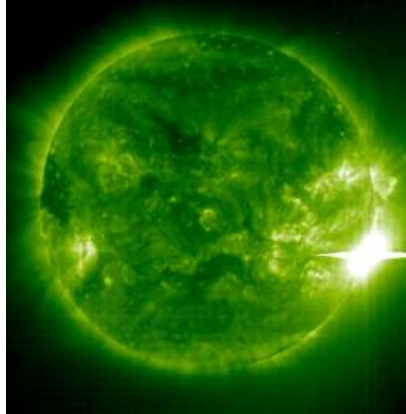
Upgrades:

- [Data Browsing Page](#)

The sec service has been renamed to swpc and the secdb service has been deactivated. As a consequence:

- All sec and secdb tables can now be found under the swpc section.
- The secdb tables

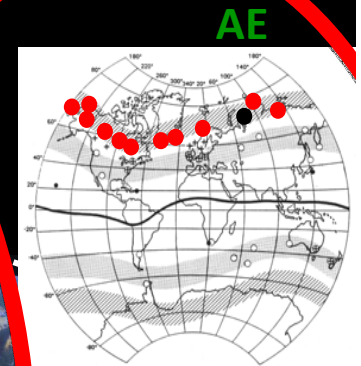
Los "centinelas"



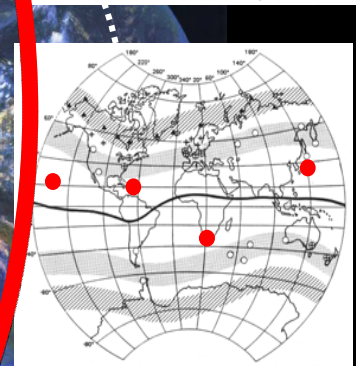
L1



geoestacionarios



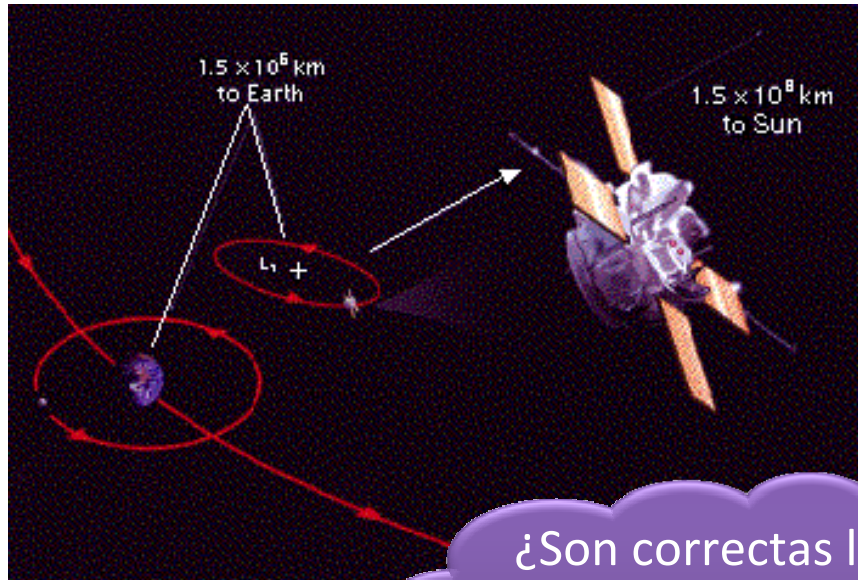
AE



Dst

en superficie

El tiempo de antelación



Observaciones solares (ej. SOHO) permiten predecir las tormentas con una antelación de 1 a 3 días

Observaciones del viento solar (ej. ACE) permiten predicciones más fiables, pero con una antelación entre 1 y 3 horas

¿Son correctas las afirmaciones anteriores?



¡Depende a qué fenómeno se refieran!

¿Qué fenómenos predecir o avisar?

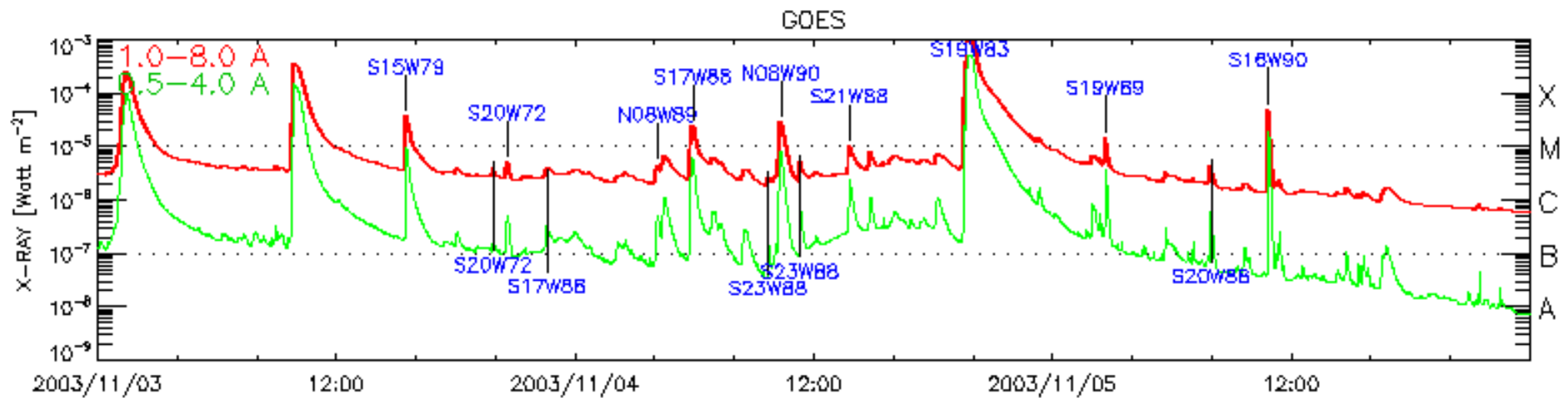
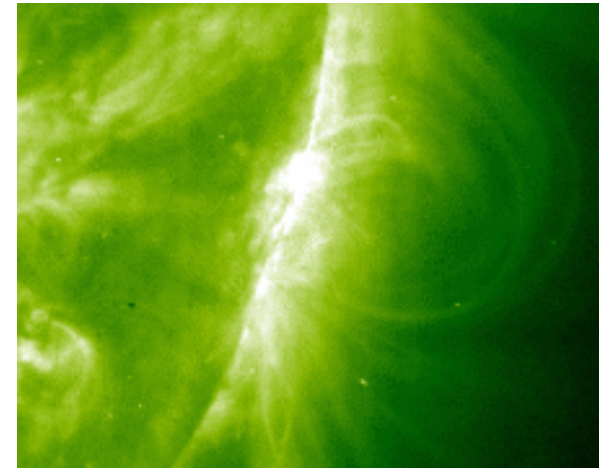
www.sec.noaa.gov

- **Tormentas geomagnéticas**
 - Redes de potencia eléctrica, conducciones de gas, ...
- **Tormentas de radiación solar**
 - Astronautas, naves espaciales, líneas aéreas
- **“Bloqueos” de radio**
 - Comunicaciones radio, navegadores

Cada fenómeno puede producirse de forma aislada o acompañado de

“Bloqueos” radio

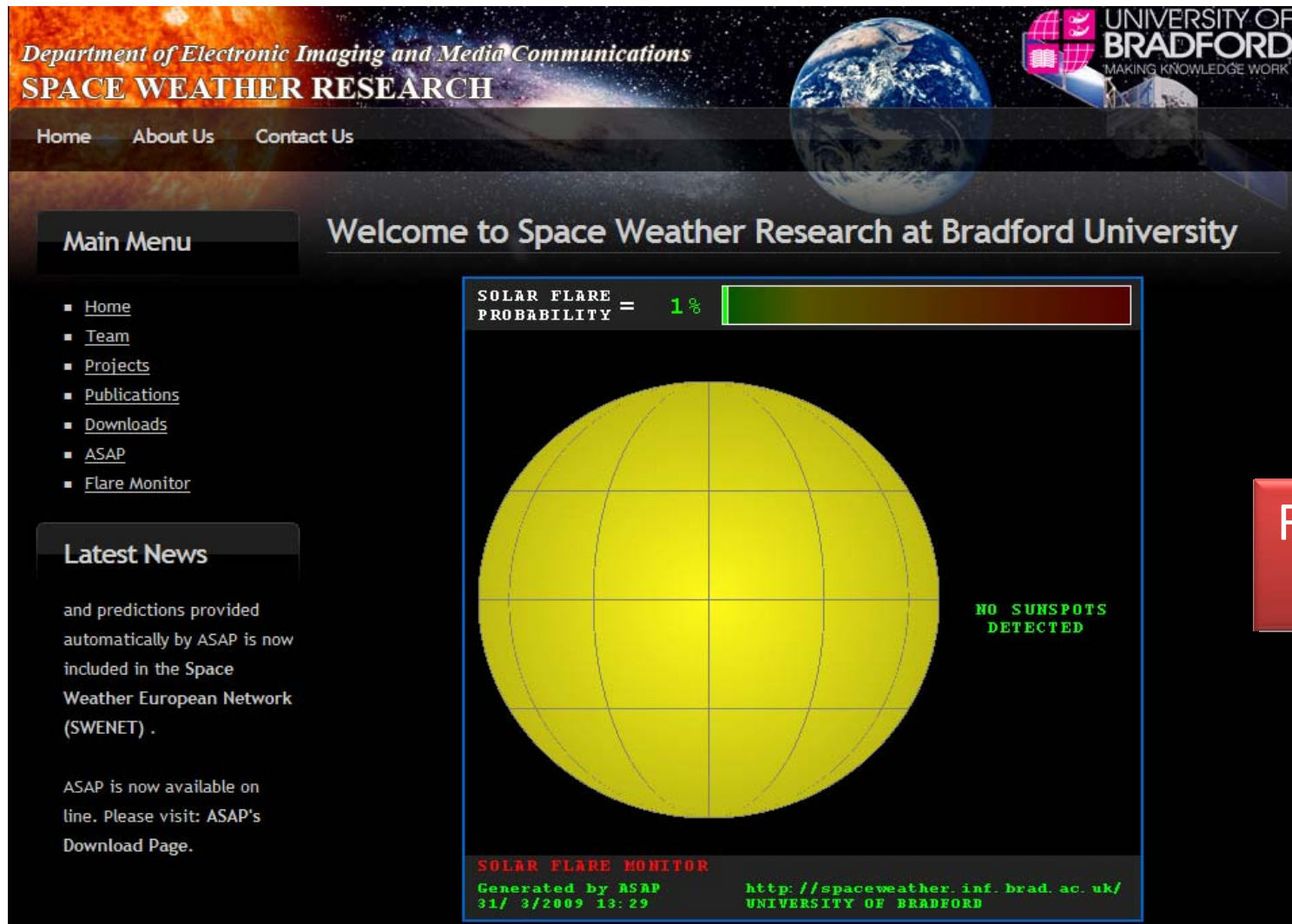
Los problemas se producen en el lado diurno por emisión solar en rayos X o EUV (*luz: 8 minutos*)



ASAP (As soon as possible)

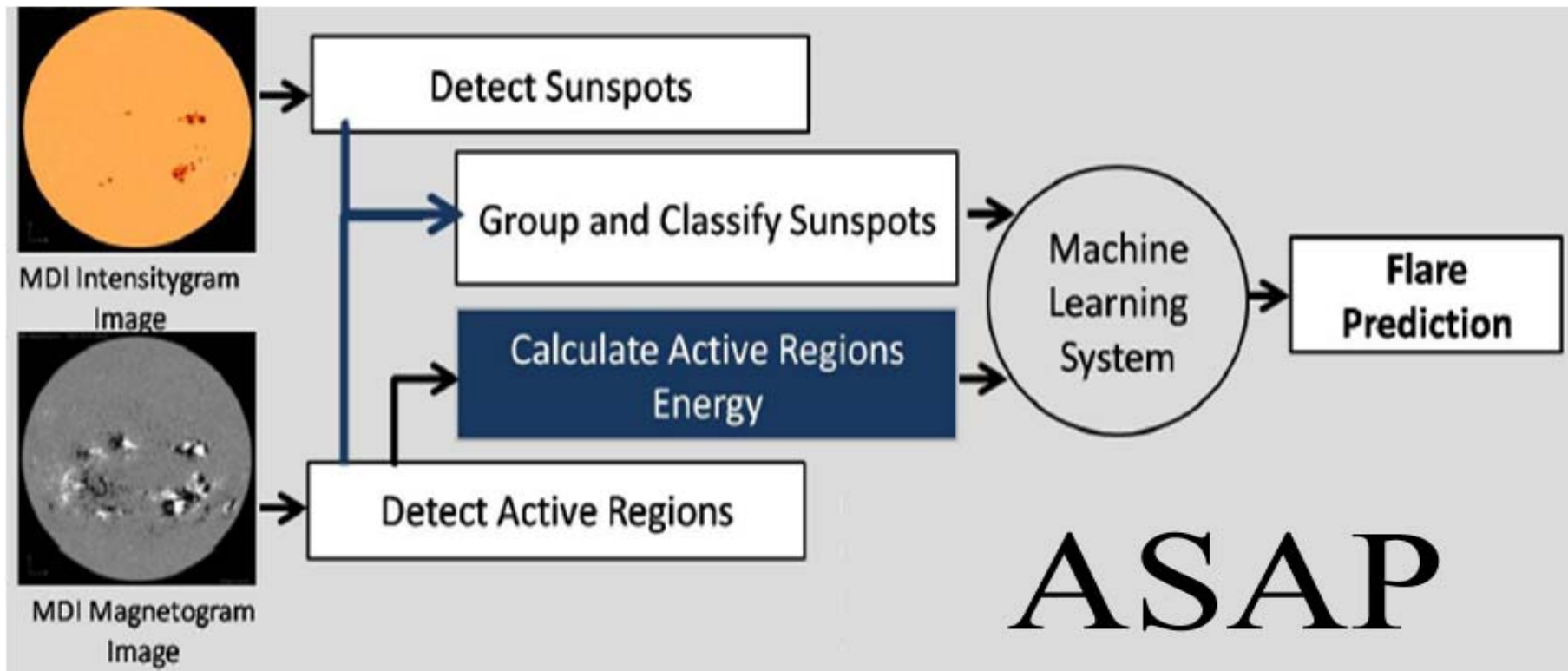
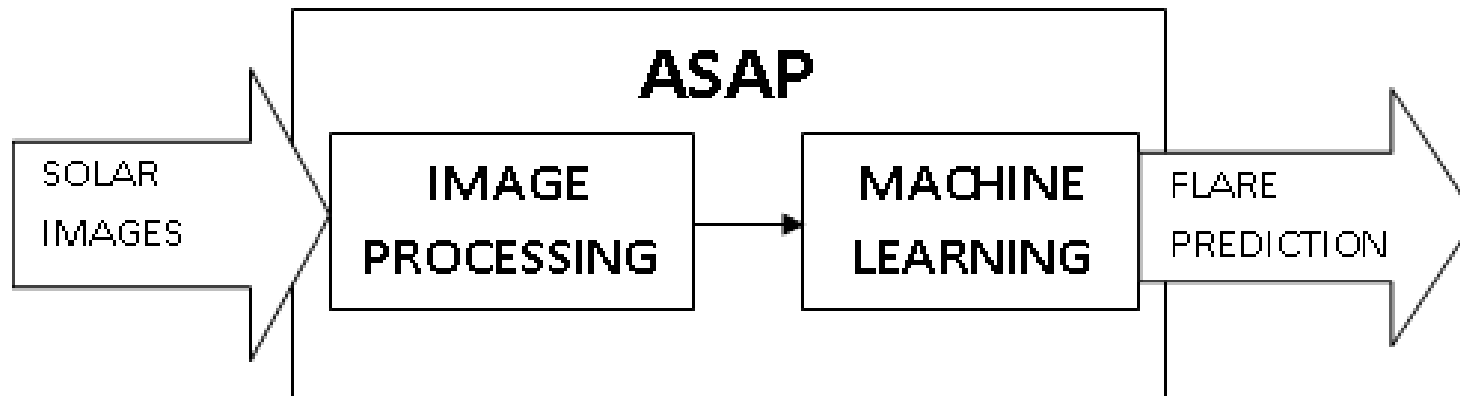
Predicciones automáticas de fulguraciones solares en la web

<http://spaceweather.inf.brad.ac.uk/>



The screenshot shows the website's header with the text "Department of Electronic Imaging and Media Communications" and "SPACE WEATHER RESEARCH". The University of Bradford logo is also visible. A navigation menu includes "Home", "About Us", and "Contact Us". The main content area features a "Main Menu" with links to "Home", "Team", "Projects", "Publications", "Downloads", "ASAP", and "Flare Monitor". A "Latest News" section contains text about predictions provided by ASAP and its availability on a website. The central focus is a "SOLAR FLARE MONITOR" section displaying a "SOLAR FLARE PROBABILITY = 1%" with a green progress bar. Below this is a large yellow sun icon with the text "NO SUNSPOTS DETECTED". At the bottom of the monitor, it says "Generated by ASAP 31/ 3/2009 13:29" and provides the URL "http://spaceweather.inf.brad.ac.uk/ UNIVERSITY OF BRADFORD".

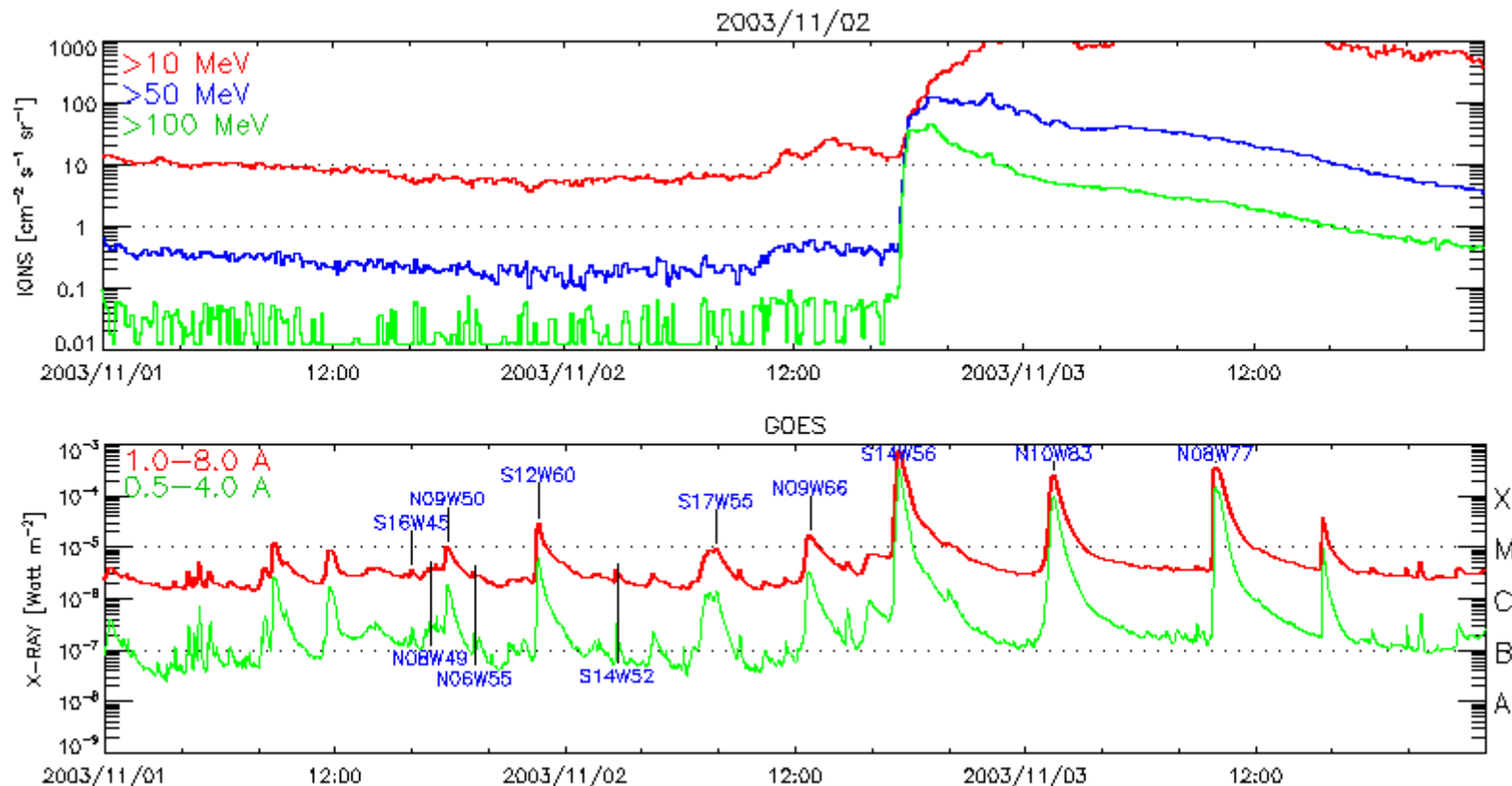
Fiabilidad 70%
(según web)



FUENTE: R. Qahwaji, Univ. Bradford, UK

Tormentas de radiación solar

Los problemas se producen fundamentalmente en las zonas polares y zona de noche (*partículas: 30 min-24 h*)



SOLPENCO

Predicciones flujo máximo y fluencia de sucesos de partículas energéticas **a partir de leyes físicas**

EUROPEAN SPACE WEATHER PORTAL
The European gateway to Space Weather resources

Home | Search | Log out

Consuelo Cid

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 - magnetospheric cutoffs
 - magnetospheric trajectories
 - plasmopause location
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Home » Services » Model Access

SOLPENCO

Submitted by Jan Wera on Tue, 03/04/2008 - 16:07.

Heliocentric distance: 0.4 AU
Initial pulse velocity: 750 km/s
Heliolongitude of parent solar activity: E 0
Mean free path: 0.2 AU
Existence of high turbulence: yes
Energy: 0.125 MeV

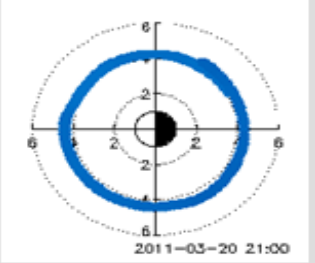
Run

UNIVERSITAT DE BARCELONA
Departament d'Astronomia i Meteorologia

An Engineering Model for Solar Energetic Particles in Interplanetary Space (SOLPENCO)

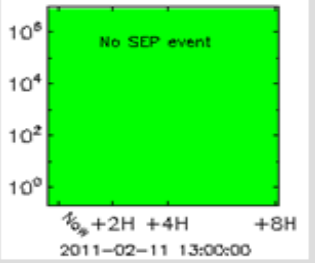
The code provides proton flux and cumulative fluence profiles at 0.125, 0.250, 0.5, 1, 2, 4, 8, 16, 32 and 64 MeV for a set of gradual SEP events, and for observers located at either 1.0 AU or 0.4 AU. The code also gives the transit time and velocity of the shock from the Sun to the observer, the maximum proton intensity (peak flux), and the total fluence of the SEP event computed from the onset of the event up to the arrival of the associated transient CME-driven shock.

Plasmopause location



2011-03-20 21:00

SEP event forecast



10⁶
10⁴
10²
10⁰

10⁰ +2H +4H +8H
2011-02-11 13:00:00

[Add your forecast]

Maintenance and hosting:

www.spaceweather.eu/es/solpenco

Consuelo Cid

About

- COST
- SOTERIA
- STCE
- SWENET
- SWWT

Services

Model Access

- exospheric solar wind model
- geomagnetic cutoff calculations
- magnetocosmics cutoffs
- magnetocosmics trajectories
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SOLPENCO

Submitted by Jan Wera on Tue, 03/04/2008 - 16:07.

Input parameters:

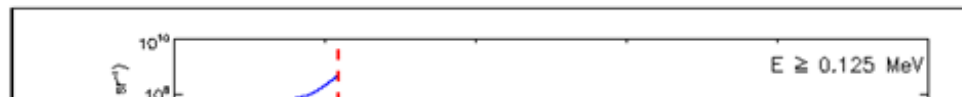
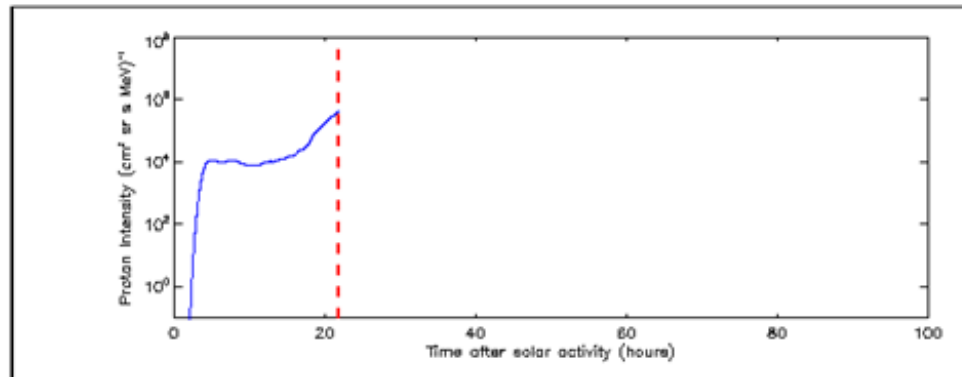
Radial distance (AU):	0.4
Angular position of the observer:	W00
Initial pulse velocity (km s ⁻¹):	750.0
Turbulent foreshock region:	Yes
Proton mean free path (AU):	0.2
Proton energy (MeV):	0.125

Shock arrival at spacecraft:

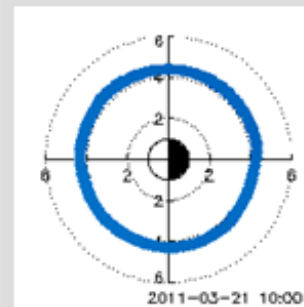
Transit time	= 21.89 hours
Transit velocity	= 760.7 km s ⁻¹
Total fluence	= 5.3e+08 cm ⁻² sr ⁻¹

Peak Intensity:

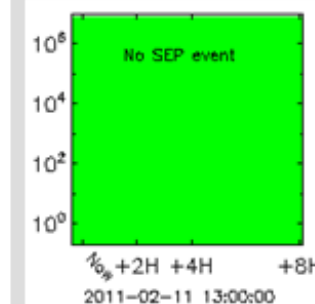
4.4e+05 cm⁻² sr⁻¹ s⁻¹ MeV⁻¹ at 21.89 hours



Plasmopause location

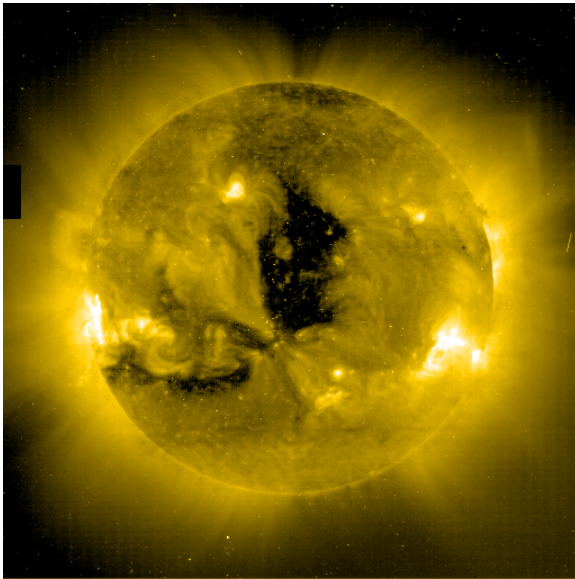


SEP event forecast

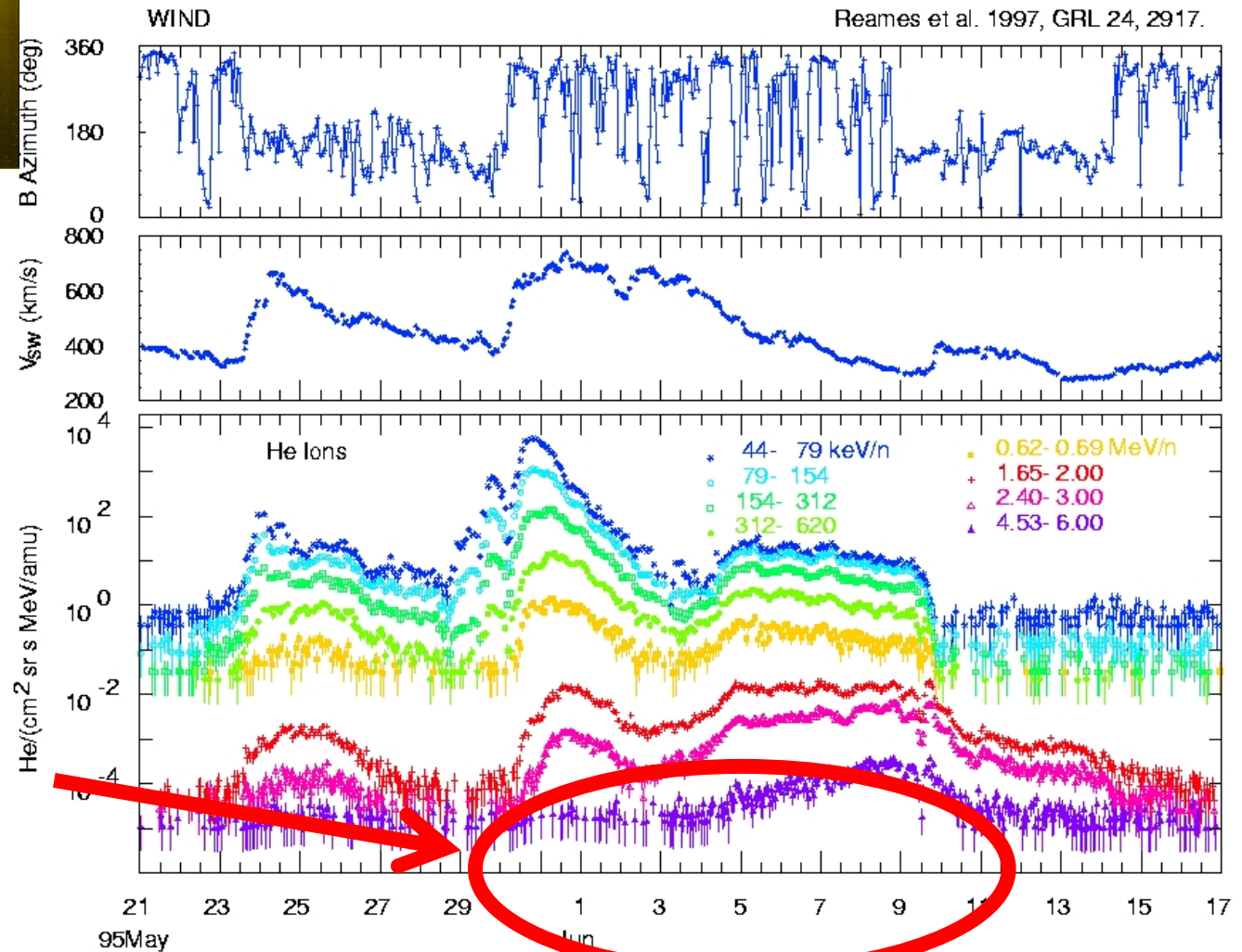


[\[Add your forecast\]](#)

Maintenance and hosting:



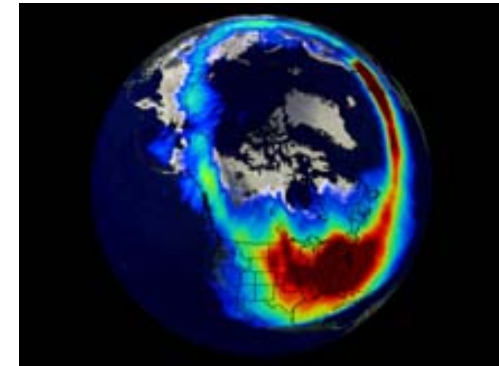
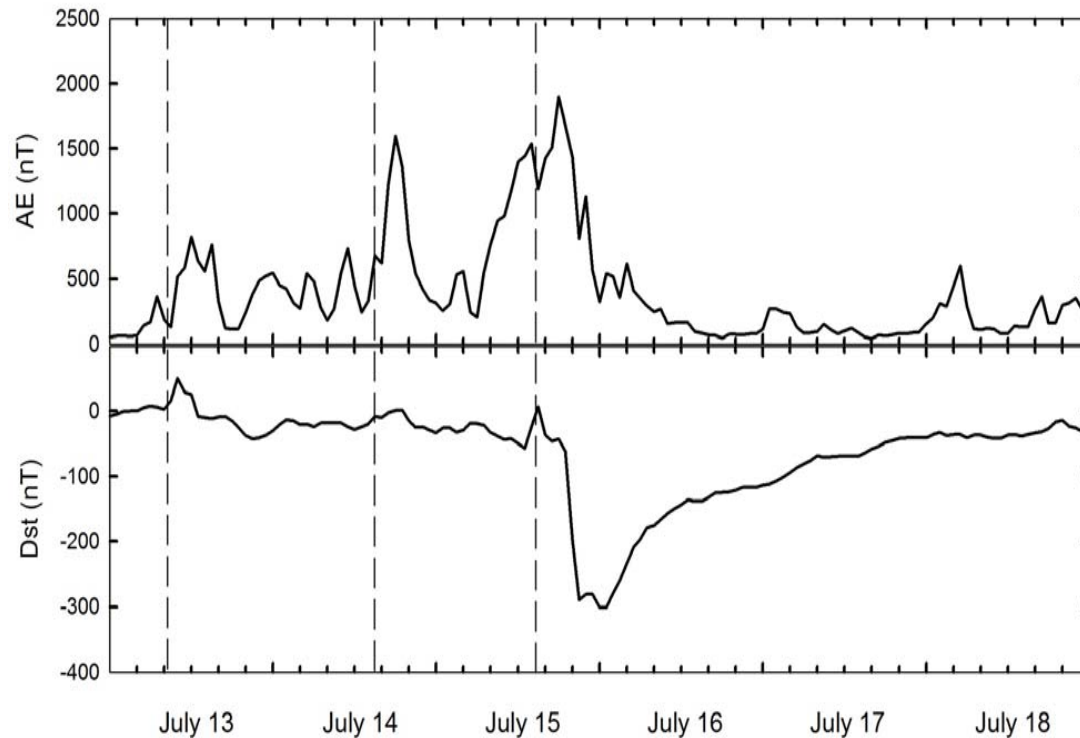
Los agujeros coronales también generan partículas relativistas



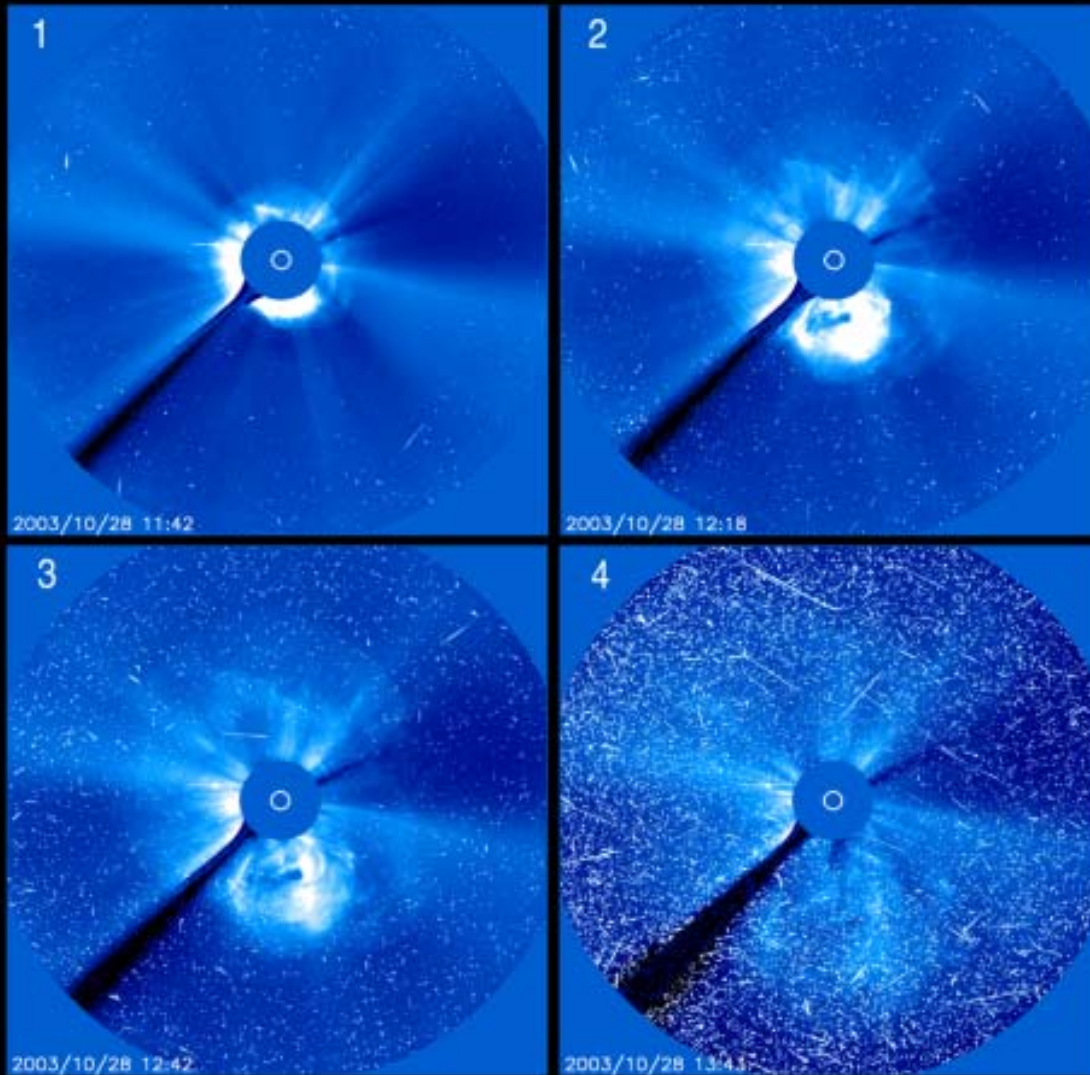
¡varios días!

Tormentas geomagnéticas

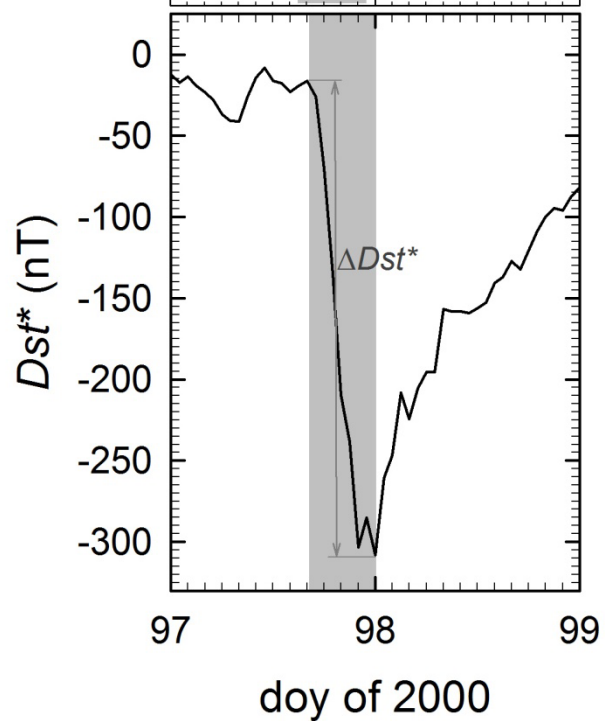
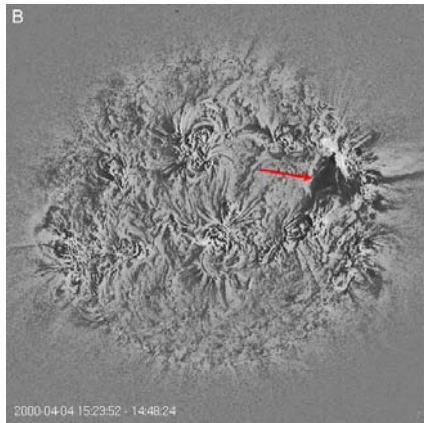
Implican un aumento en las corrientes de la magnetosfera, fundamentalmente en el anillo de corriente (*plasma 1-4 días*)



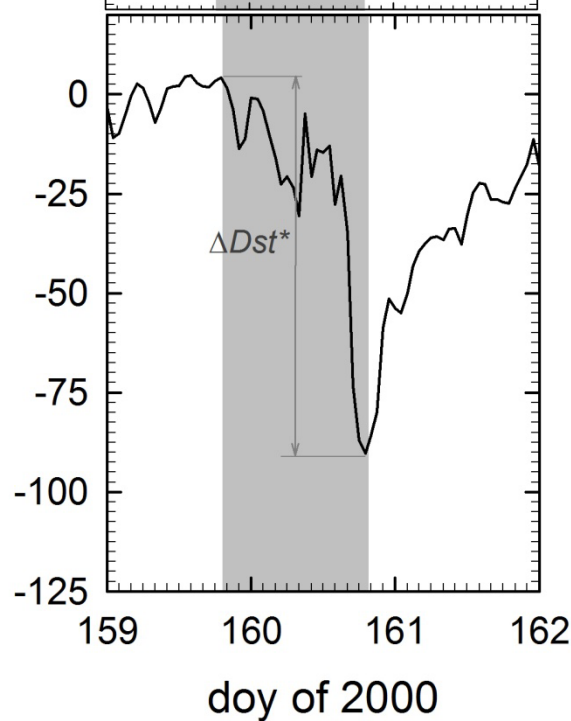
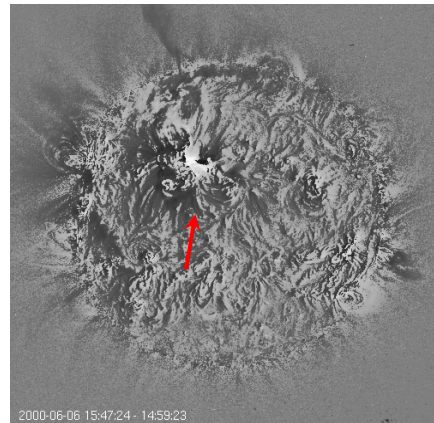
¿Es posible
saber si el
plasma de
una CME
llegará a la
Tierra?



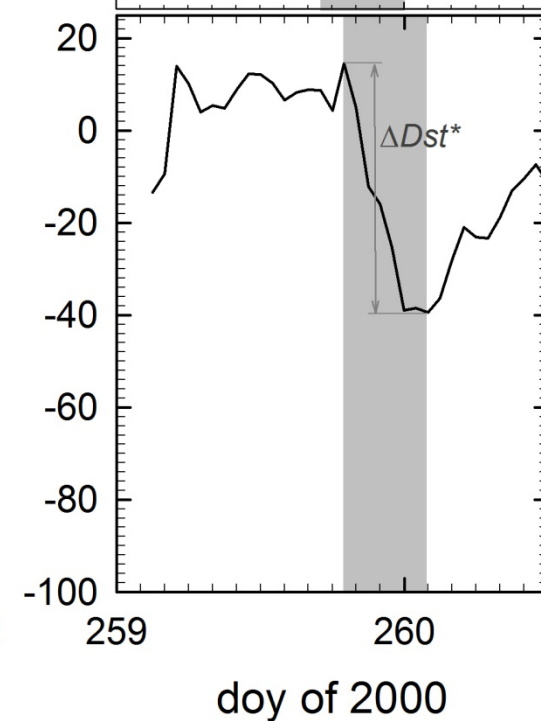
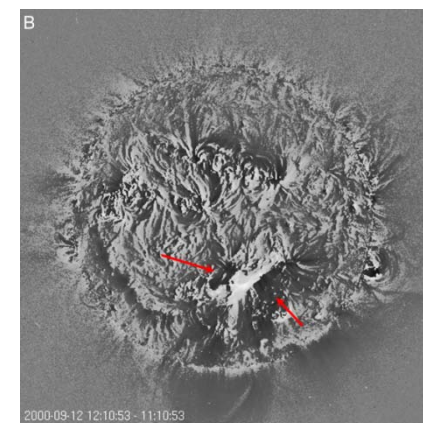
Fuente solar: N16W66
 $v=1188$ km/s

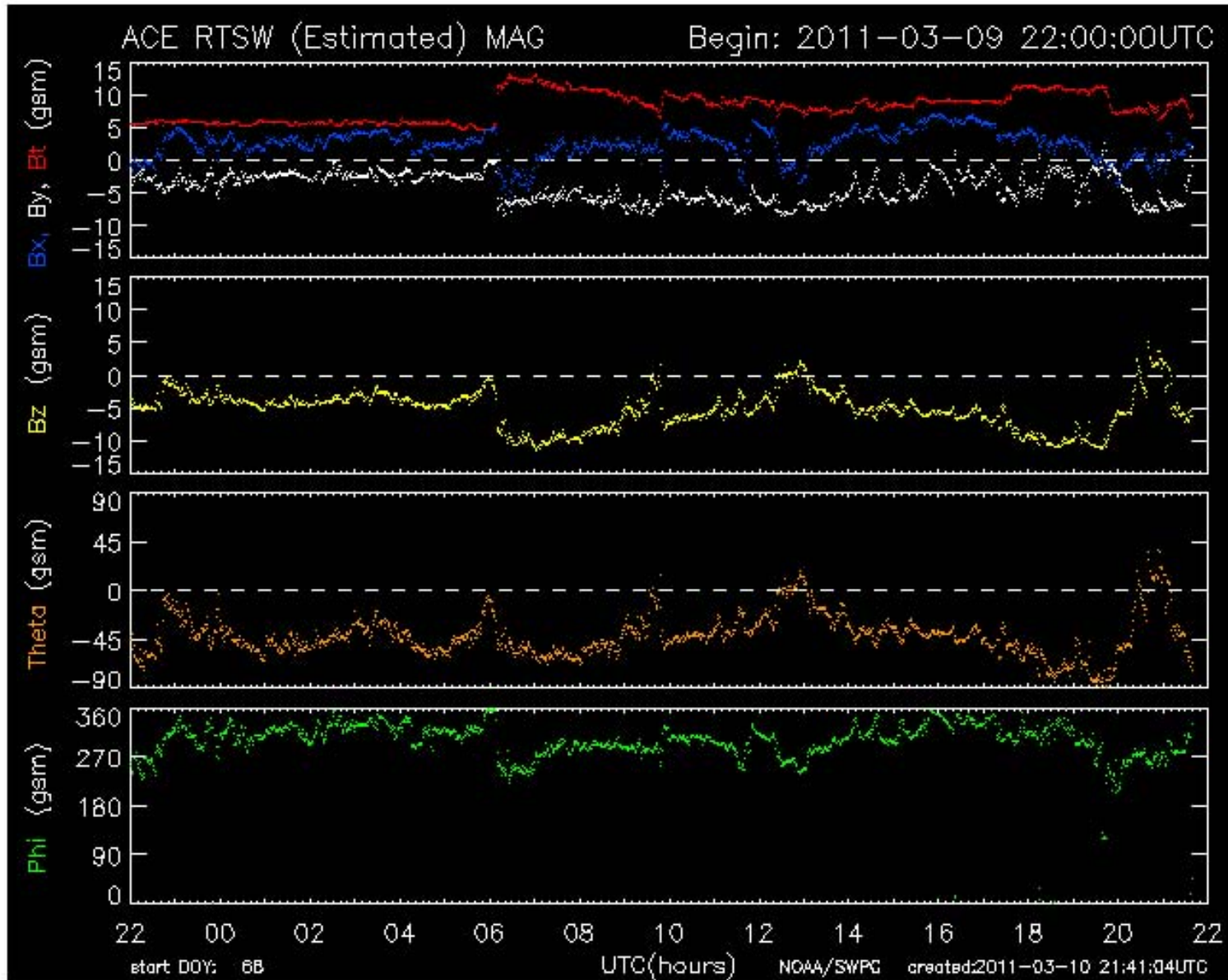


Fuente solar: N20E18
 $v=1119$ km/s



Fuente solar: S17W09
 $v=1188$ km/s



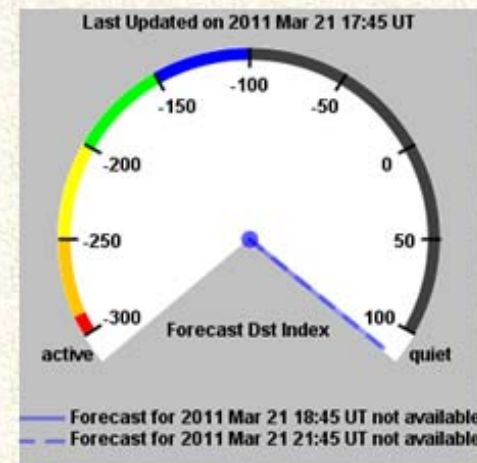
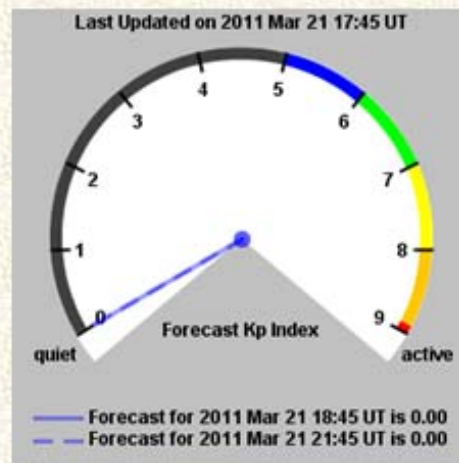


University Partnering for Operational Support

JHU/APL - University of Alaska)

Predicting Geomagnetic Activity and Storms

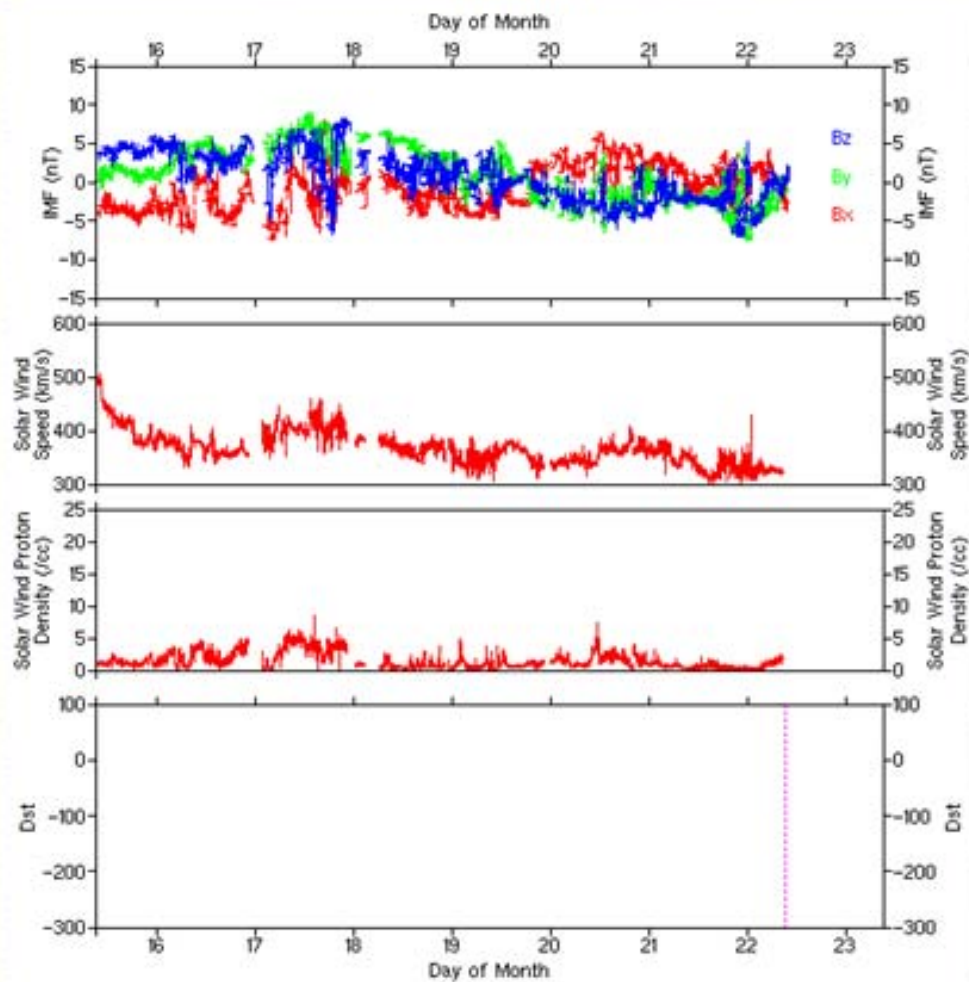
As technology advances, space weather prediction has become increasingly important to many human activities, e.g., communications, navigation systems, satellites, power grid, space travel, etc. Kp and Dst are two of the most common indices used to indicate the severity of disturbances in near-Earth space. For the past few years, [the ACE spacecraft](#), located at [the L1 point](#), has been reliably providing solar wind measurements up to approximately 45-60 minutes in advance of its arrival at Earth. Kp and Dst models based on solar wind input can use ACE observations to make short-term forecasts of these two indices.



Utilizando redes neuronales y datos de viento solar

[Forecasting Dst](#)
[Home](#) [UPOS home](#)

Dst 1-Hour Forecast 7 Day Display



Plots most recently generated on Tue Mar 22 09:00:17 UT 2011

<http://sd-www.jhuapl.edu/UPOS/ForecastingDST/index.html>

<http://rwc.lund.irf.se/rwc/dst/models/dstdoc/index.html>

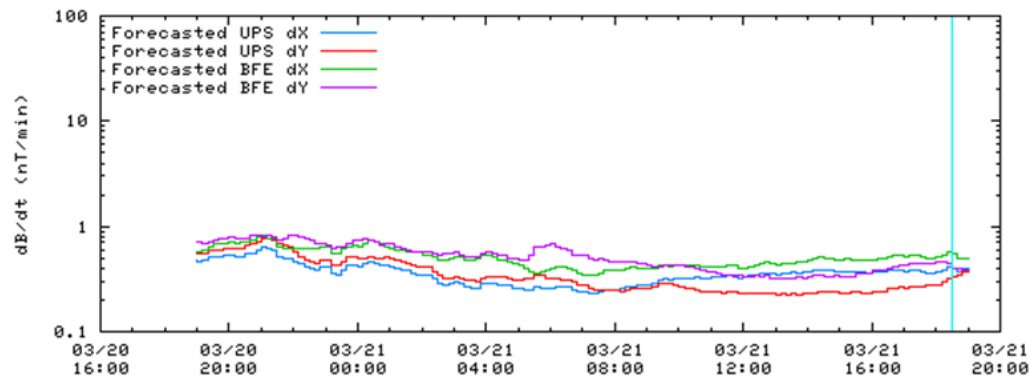
Swedish Institute of Space Physics

Real time RMS ΔB forecast for Uppsala and Brorfelde

[Last 24 hours](#) [Last 4 hours](#) [Archive](#) [Models](#) [Changes](#)

Forecast issued 2011-03-21 18:31:12 CET.

30 minute forecast of local 10 minute RMS dB.

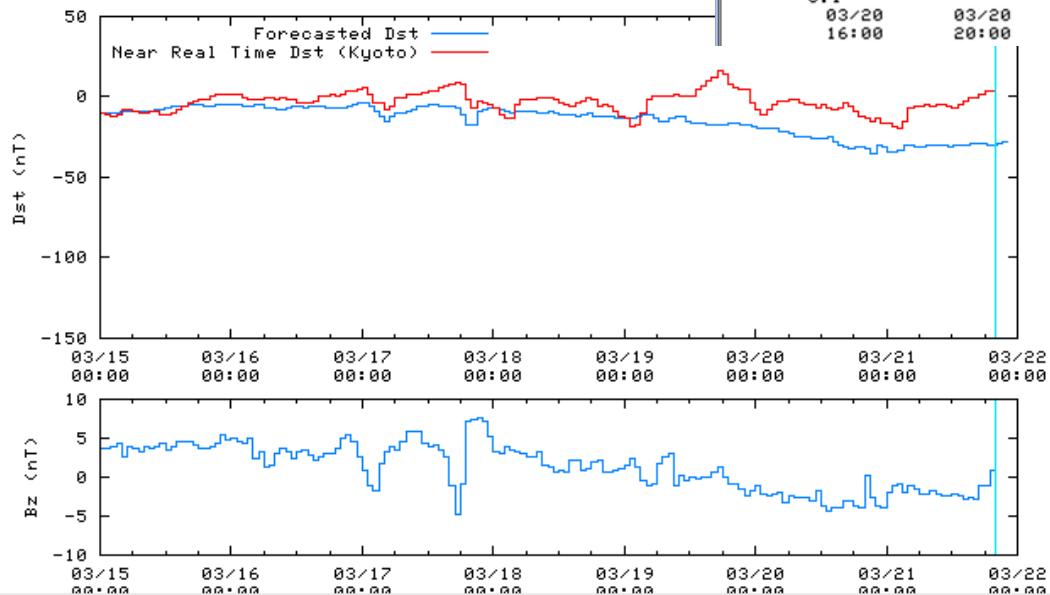


Real time Dst forecast

[Last 7 days](#) [Last 24 hours](#) [Archive](#)

Forecast issued 2011-03-21 21:03:14 CET.

Forecast of hourly Dst.



- Datos de viento solar
- Basado en redes neuronales

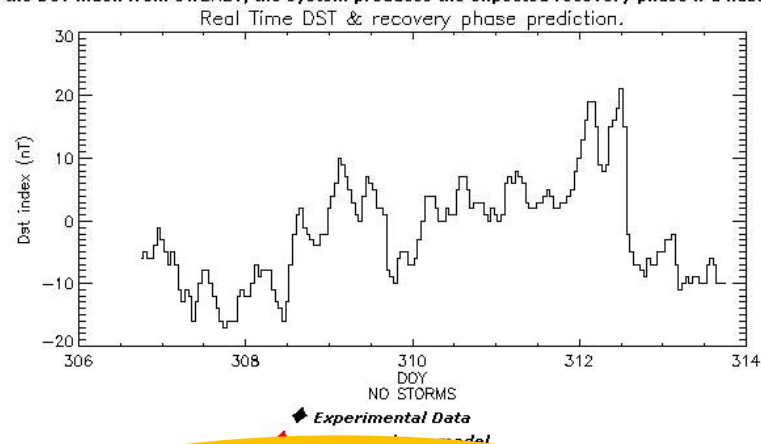
UAH Space Weather Monitor

Using high resolution real-time magnetic field data from MAG on board ACE spacecraft, the UAH monitor produces an alert when a significant magnetic perturbation is going to take place at the terrestrial surface at low-mid latitudes, as measured by Dst index.

LAST DATA FROM MAG/ACE: 09 Nov 2010 at 18:26 (UT)



Using real-time data of the DST index from SWENET, the system produces the expected recovery phase if a hazard warning take place.



Información por e-mail

TO RECEIVE REAL-TIME ALERTS FILL IN THE INFORMATION BELLOW.

Name:

Institution Name:

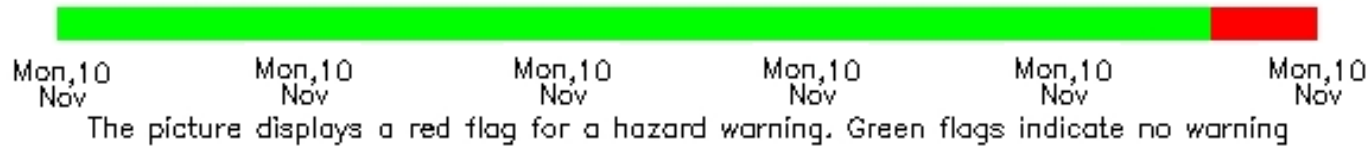
Mail:

www.spaceweather.es

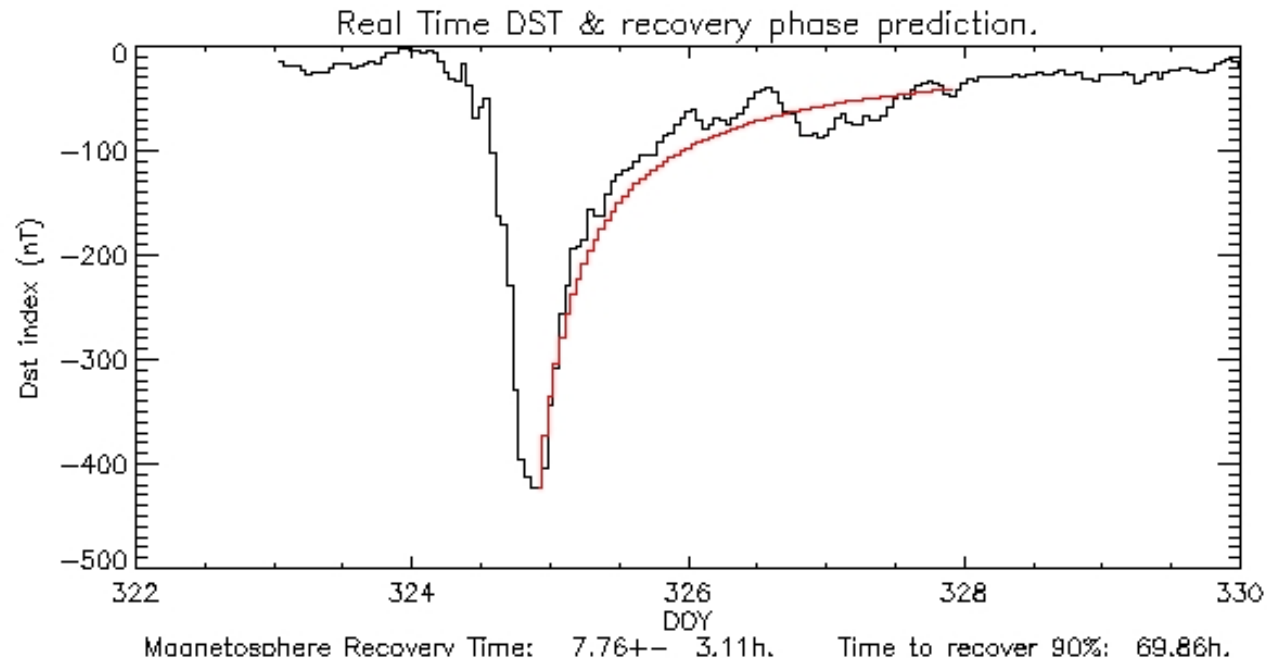


Universidad
de Alcalá

LAST DATA FROM MAG/ACE: 10 Nov 2003 at 07:11 (UT)



Sólo datos de B_z y basado en leyes físicas



CONCLUSIONES

- Es necesario avanzar en el conocimiento de la Ciencia que hay en la interacción entre el Sol y la Tierra para mejorar los sistemas de predicción
- Debe existir un programa de seguridad en el ámbito de la Meteorología Espacial a nivel global para el planeta, tanto a nivel de modelos de predicción, como a nivel de suministro de datos. La colaboración internacional es imprescindible





Gracias por
su atención