

Solar Storms and Northern lights - how to predict Space Weather and the Aurora

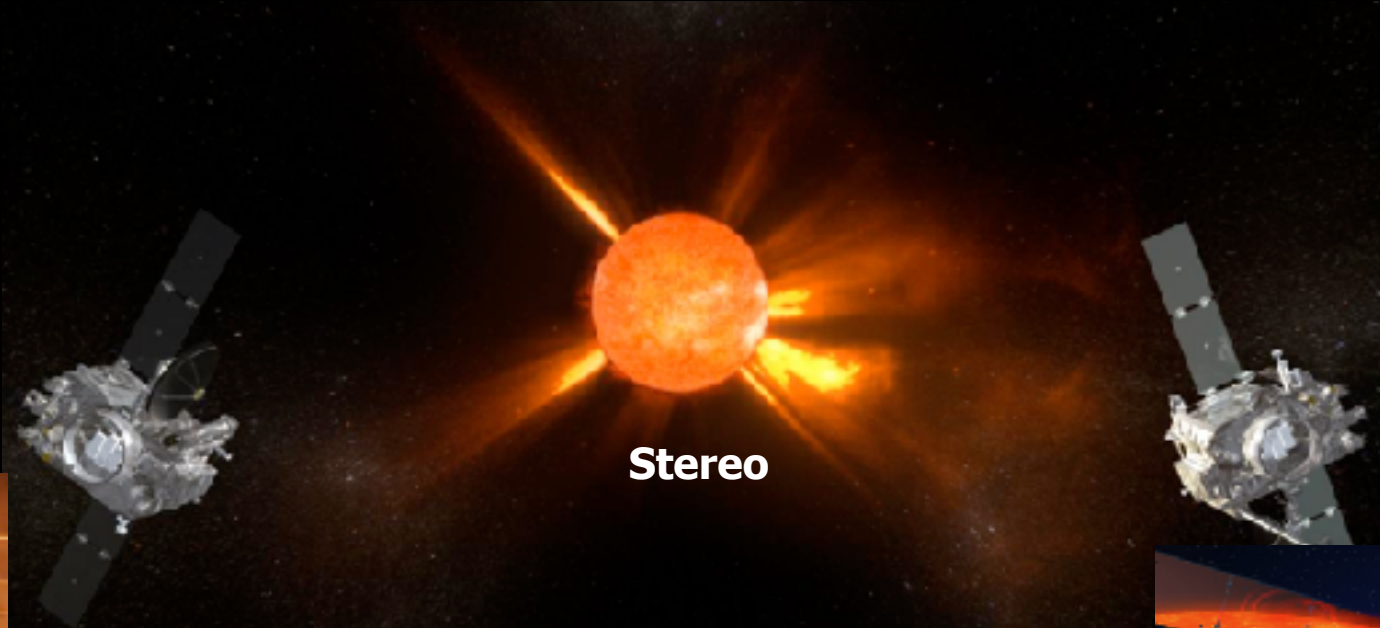
Pål Brekke
Norwegian Space Centre/UNIS



Fleet of satellites watching the Sun



SDO

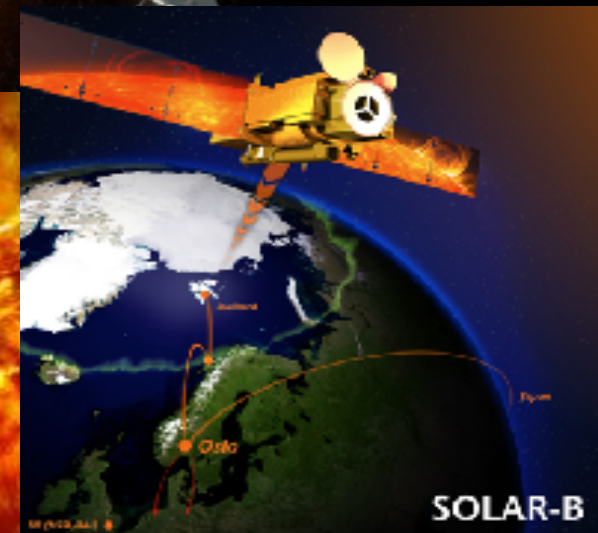
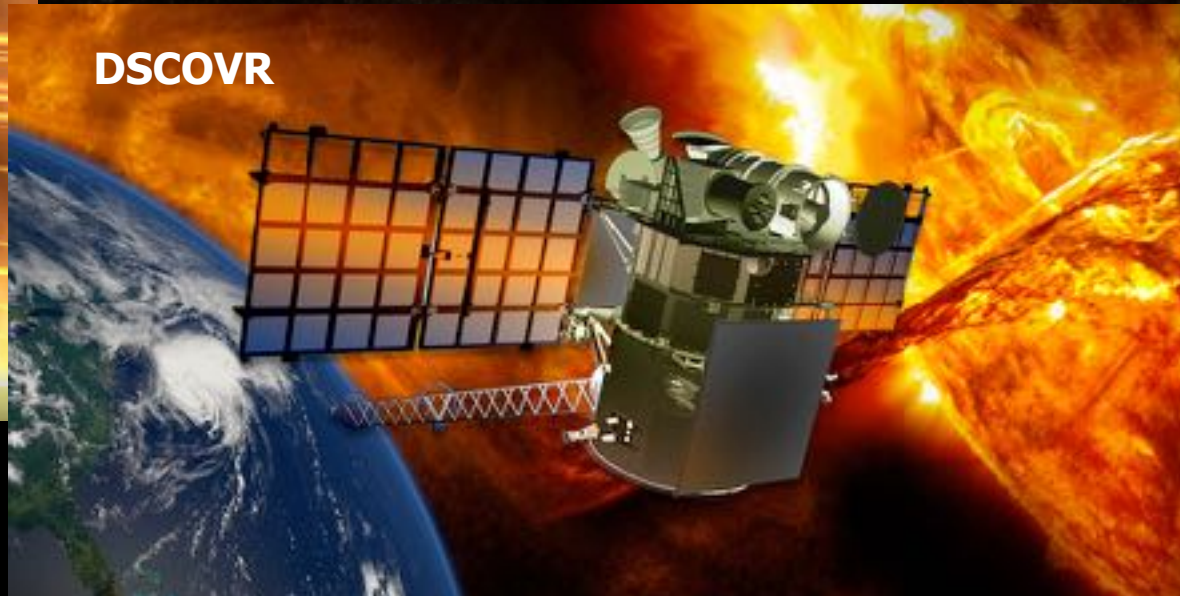


Stereo

Parker Solar Probe

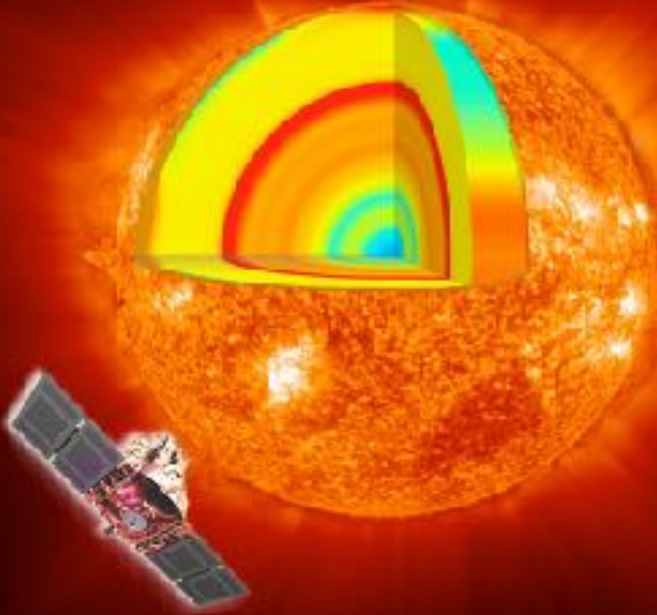


DSCOVR

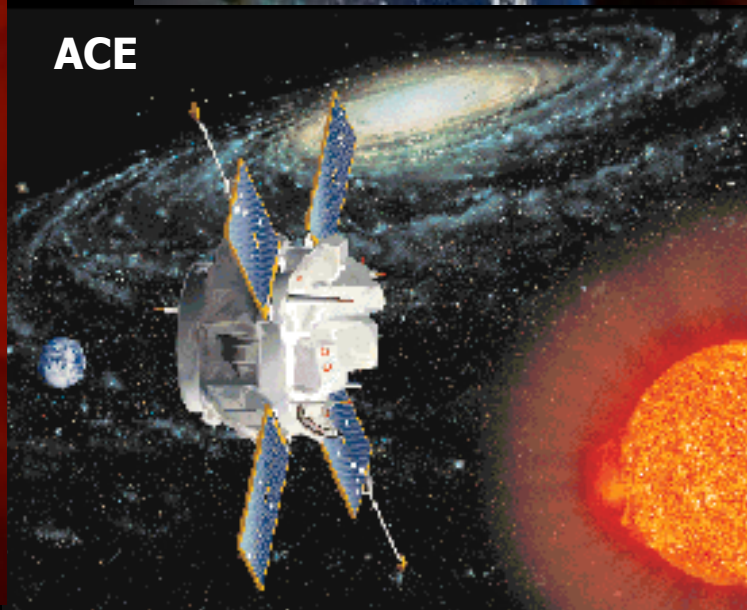


SOLAR-B

SOHO

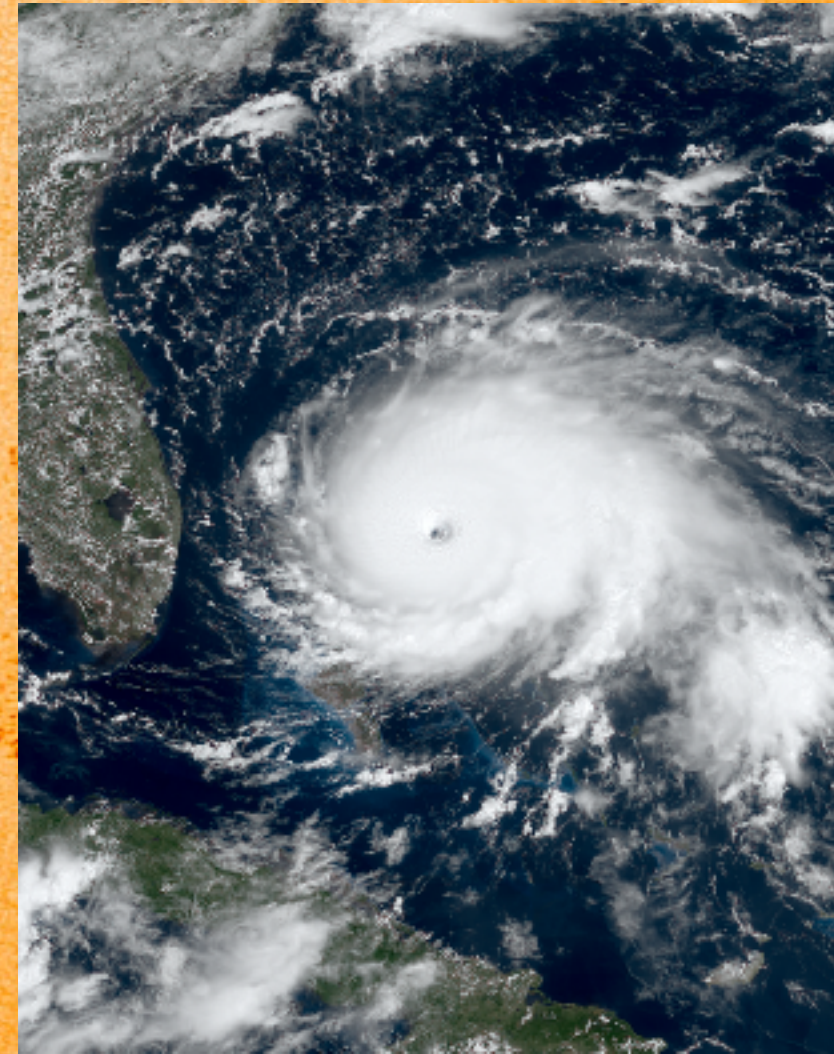
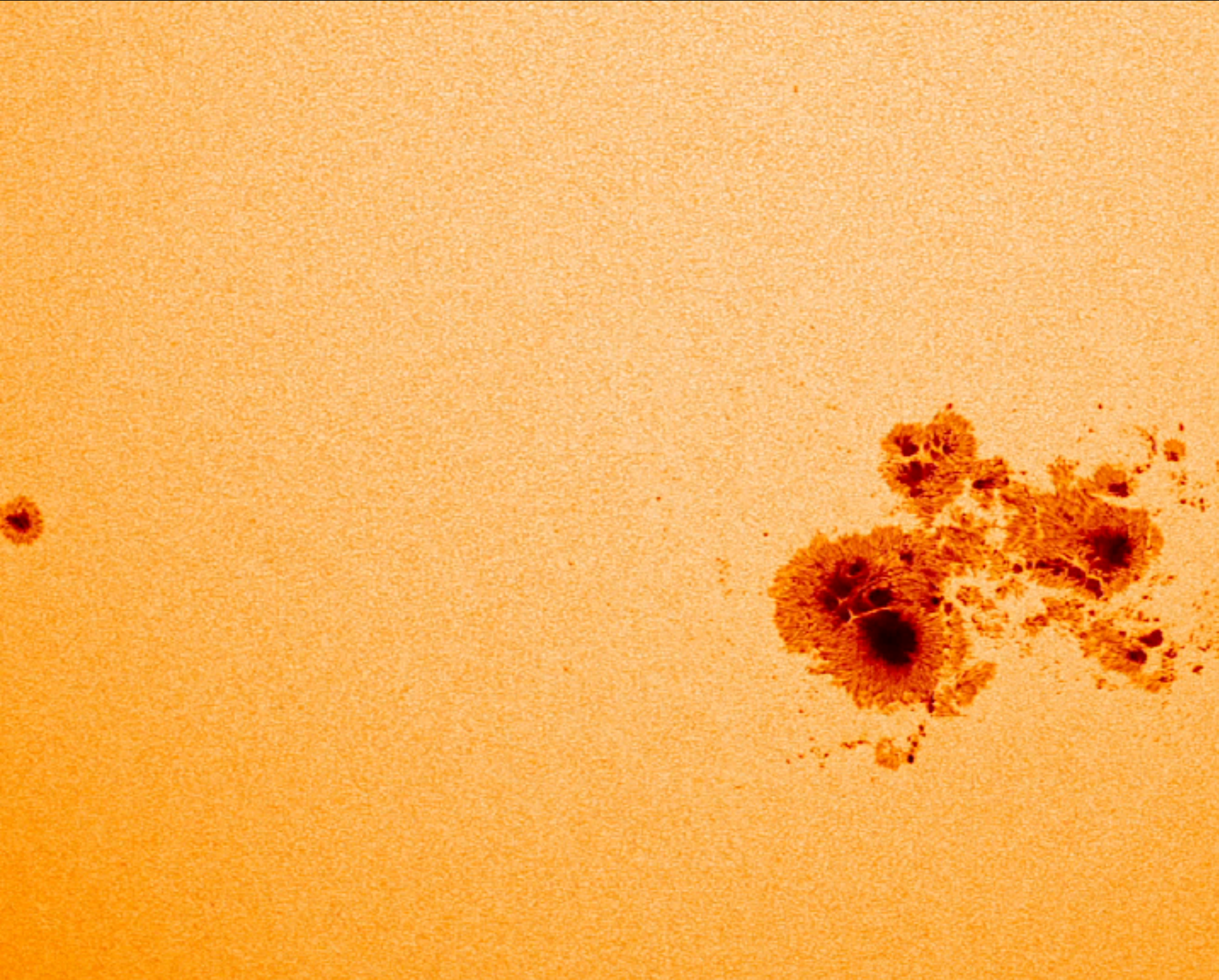


ACE



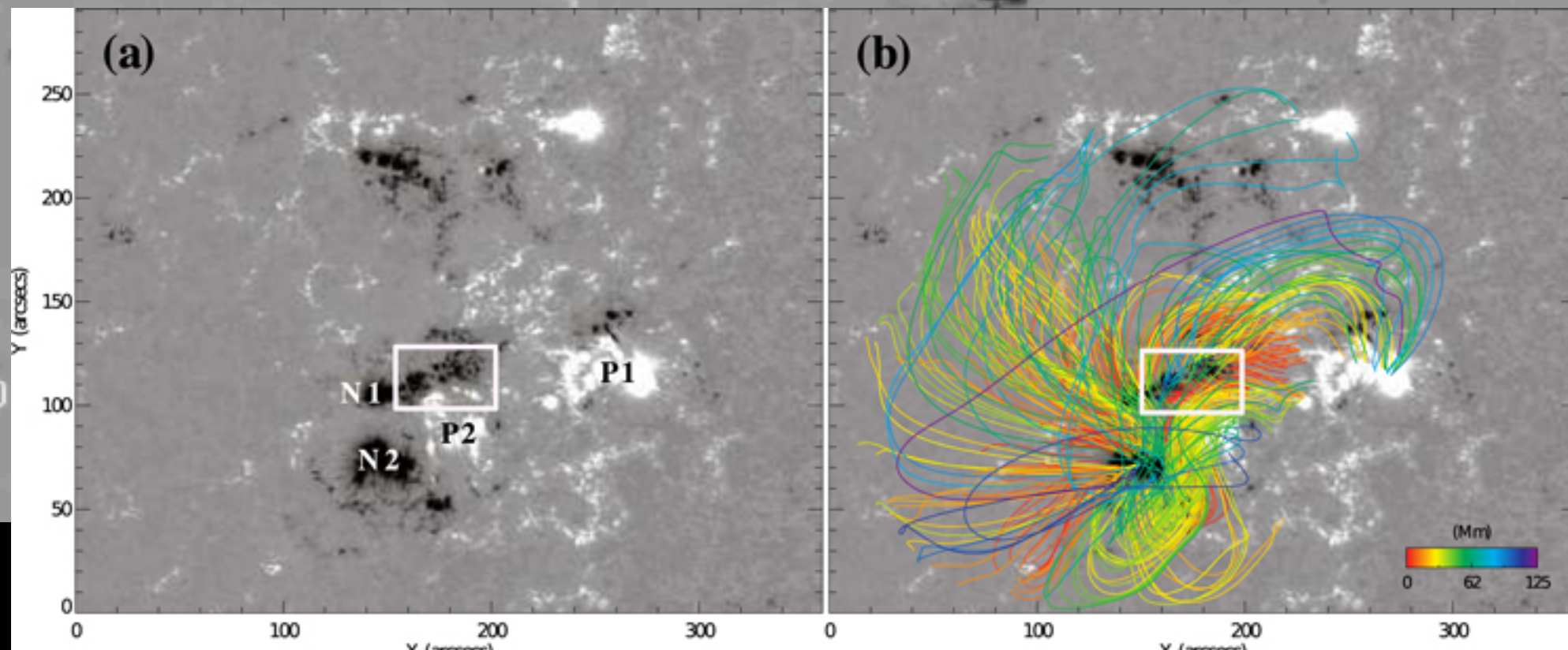
Solar Orbiter





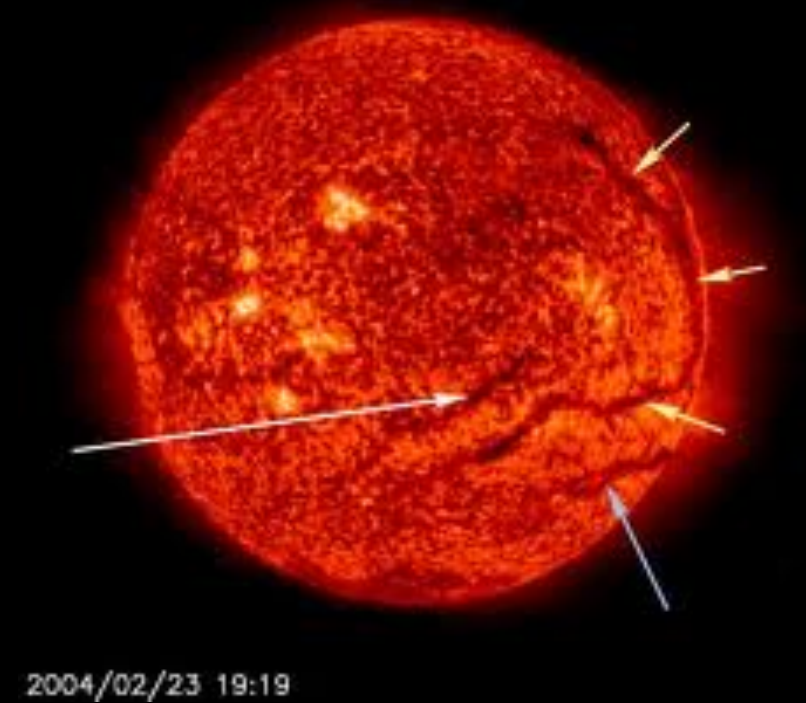
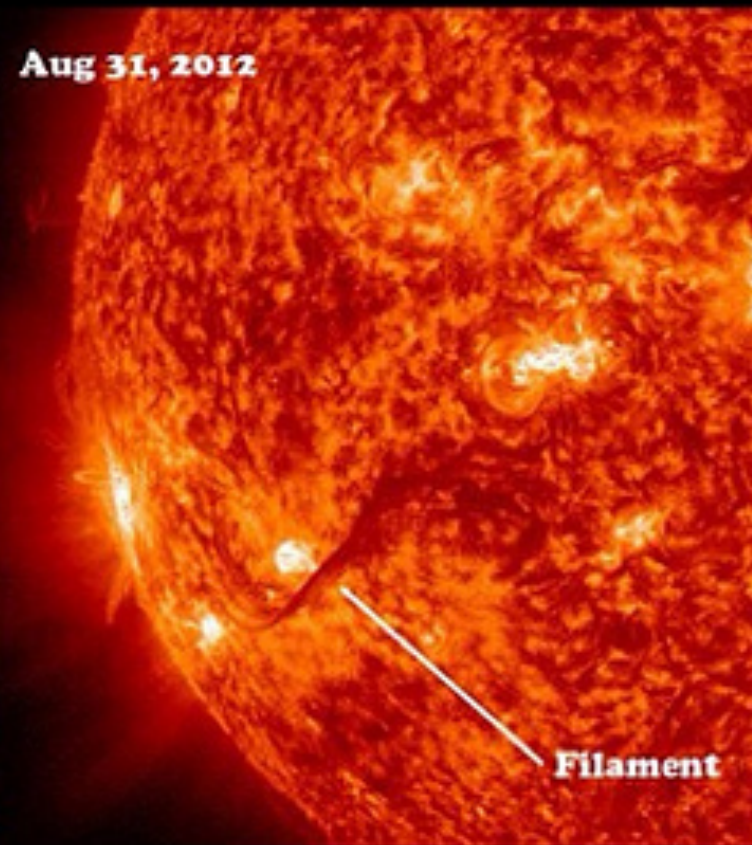
Monitoring the Sunspot magnetic field

As flares are powered from the stressed field rooted in the photosphere, a study of the photospheric magnetic complexity can be used to both predict activity and understand the physics of the magnetic field.



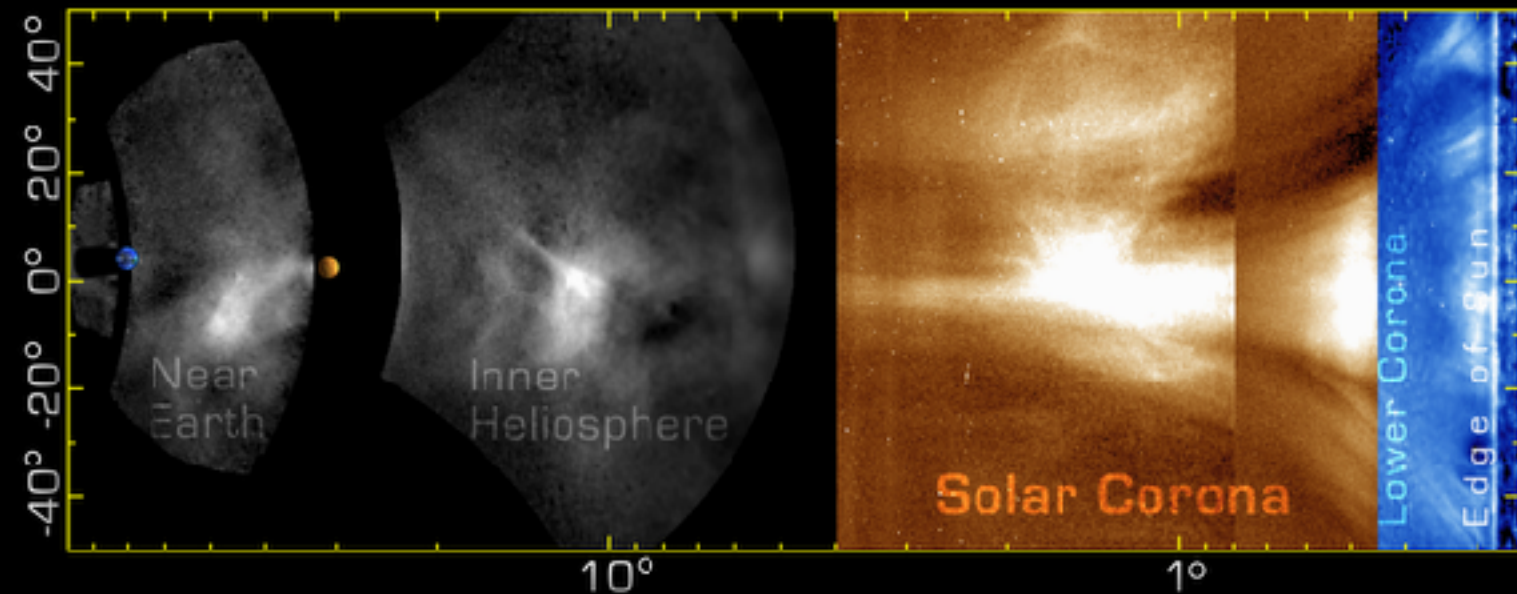
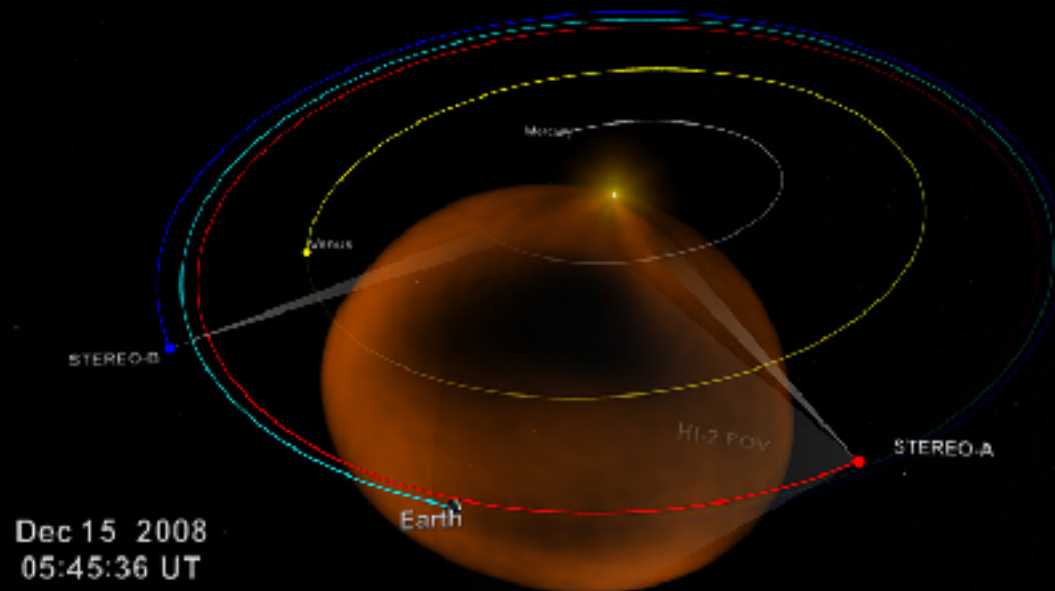
Look for filaments on the disk

When filaments get unstable they can erupt - so by monitoring filaments near the center of the disk can give some warning about possible eruptions.



Follow a CME from the Sun to the Earth

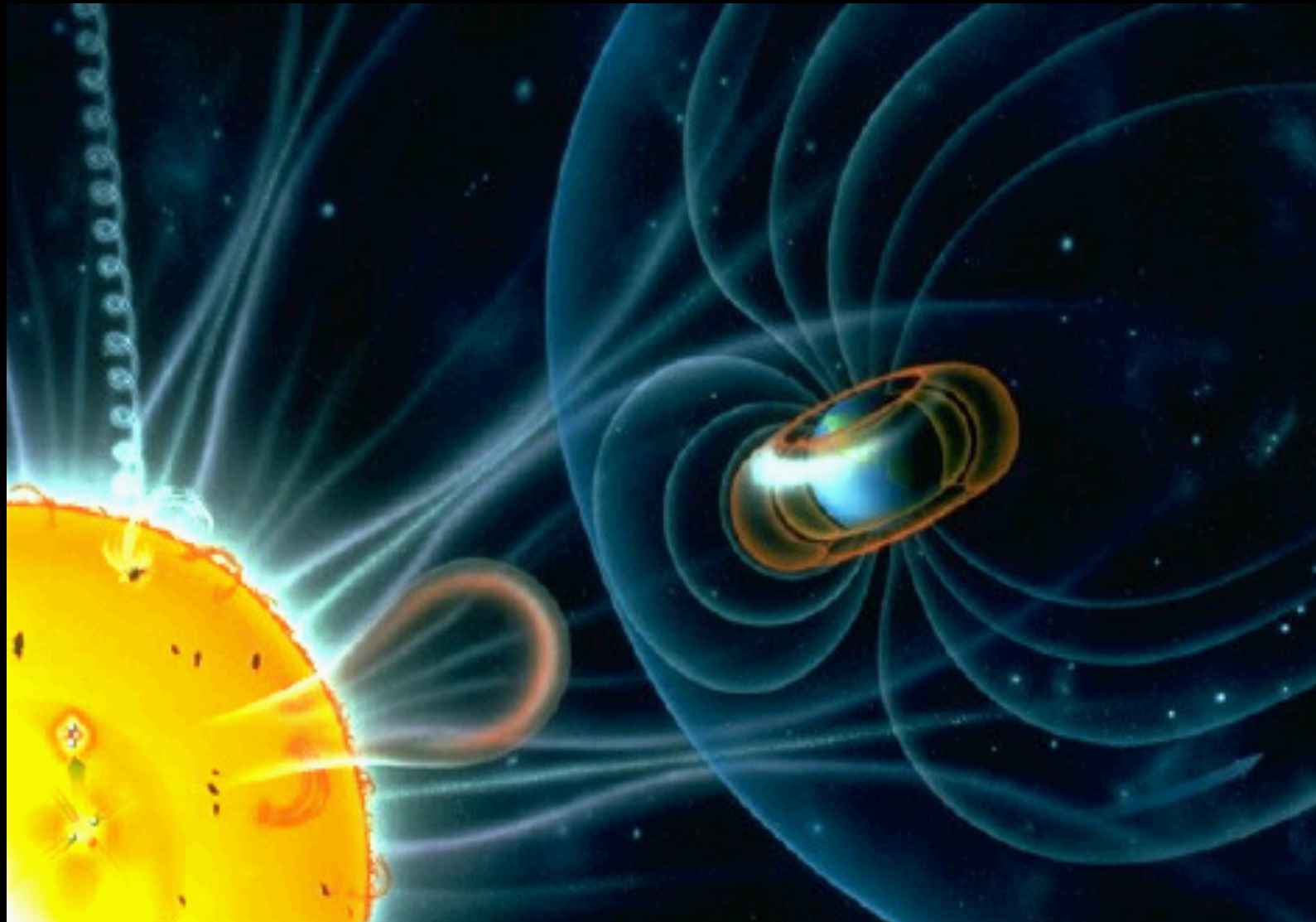
STEREO (Solar Terrestrial Relations Observatory) is a solar observation mission. Two nearly identical spacecraft were launched in 2006 into orbits around the Sun that cause them to respectively pull farther ahead of and fall gradually behind the Earth. This enables stereoscopic imaging of the Sun and solar phenomena, such as coronal mass ejections.



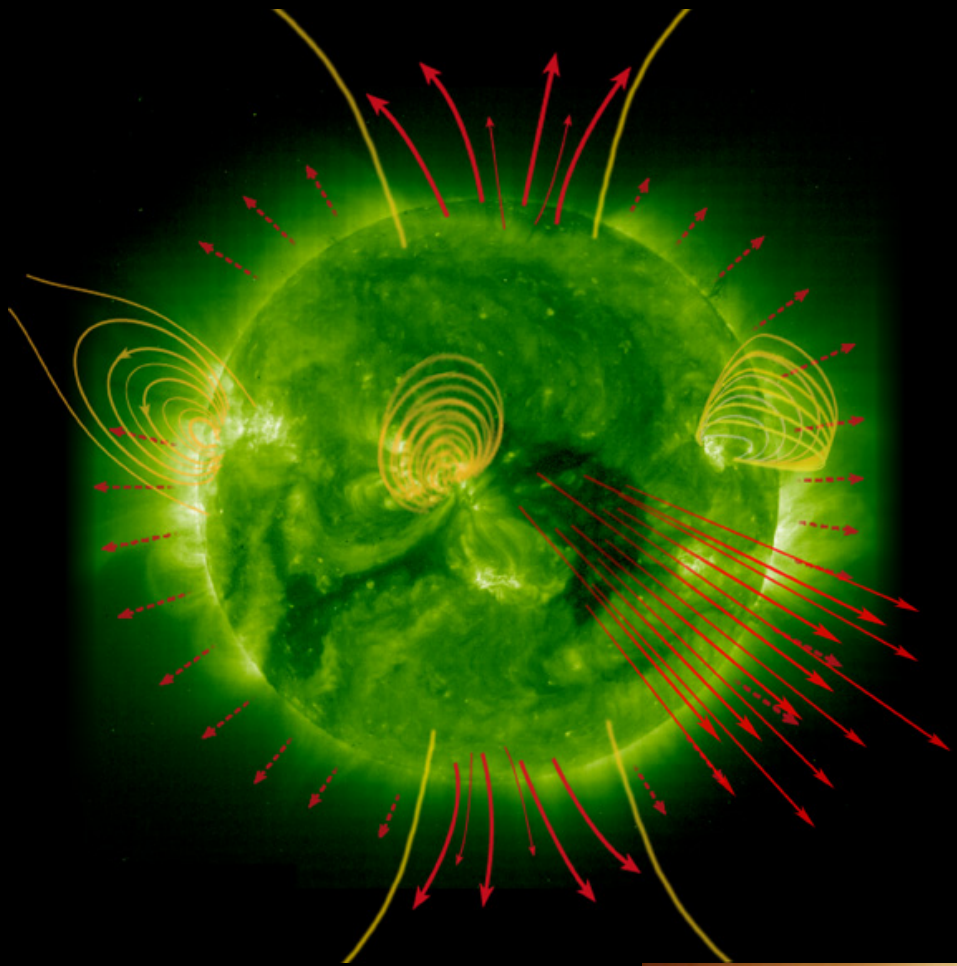
STEREO-A:12/12/08 12:04:00 PM

The Solar Wind also Creates Northern Lights

- A constant stream of particles flows from the Sun's corona, with a temperature of about a million degrees and with a velocity of about 1.5 million km/h.
- Gusts in the solar wind will buffet our magnetosphere and lead to a geomagnetic storm.

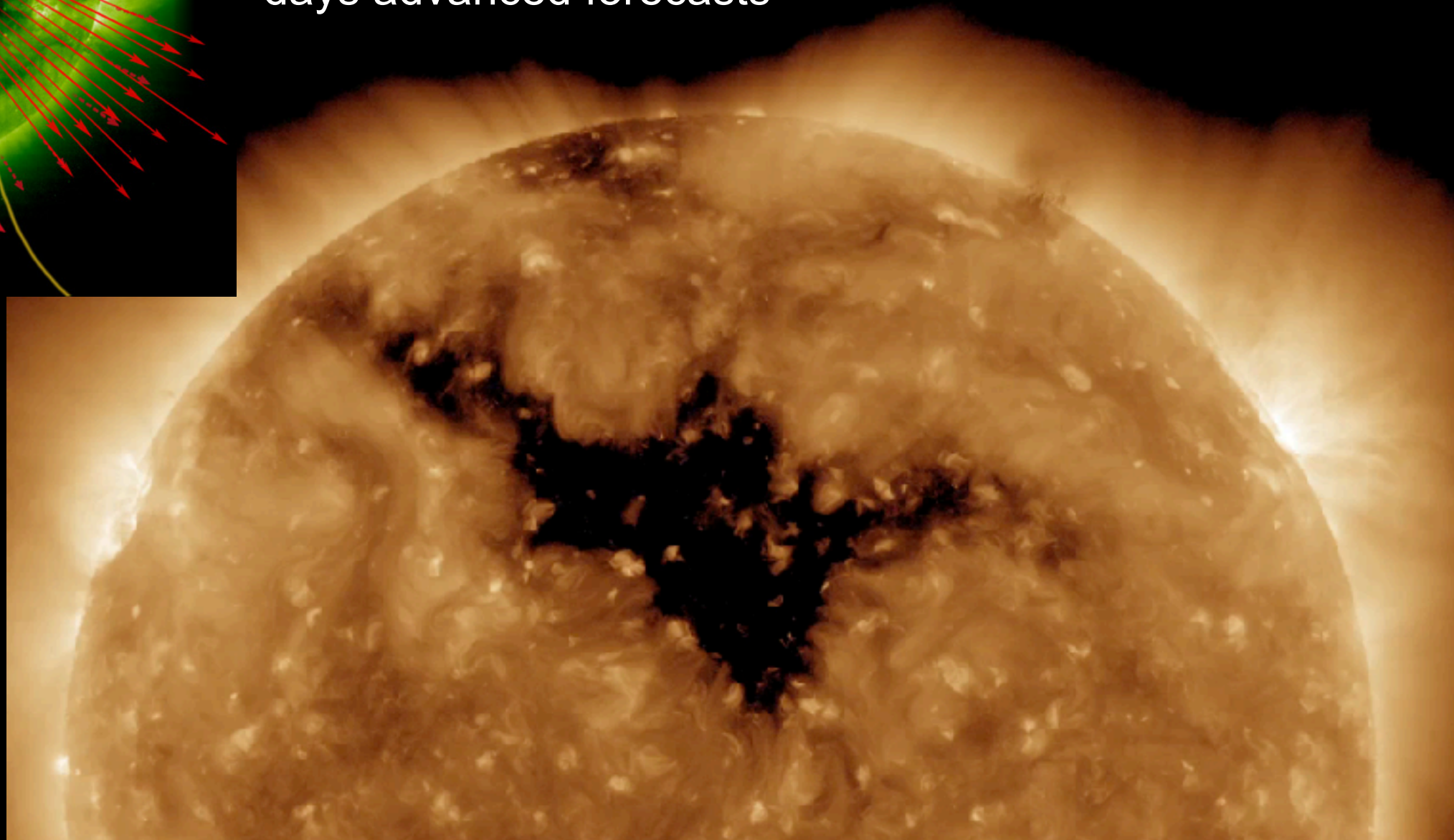


Predicting Auroras - Coronal Holes

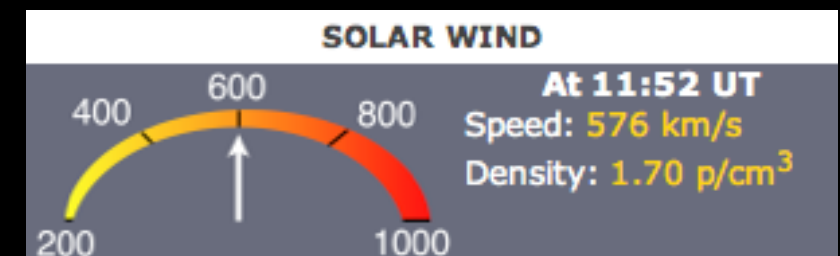
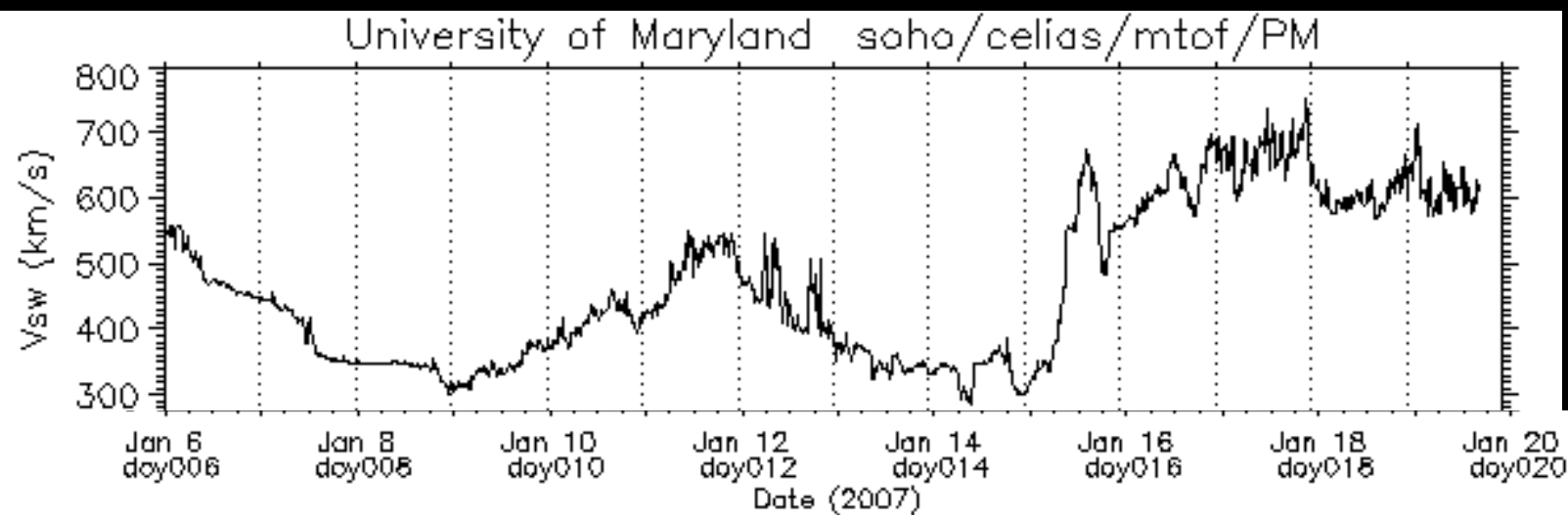
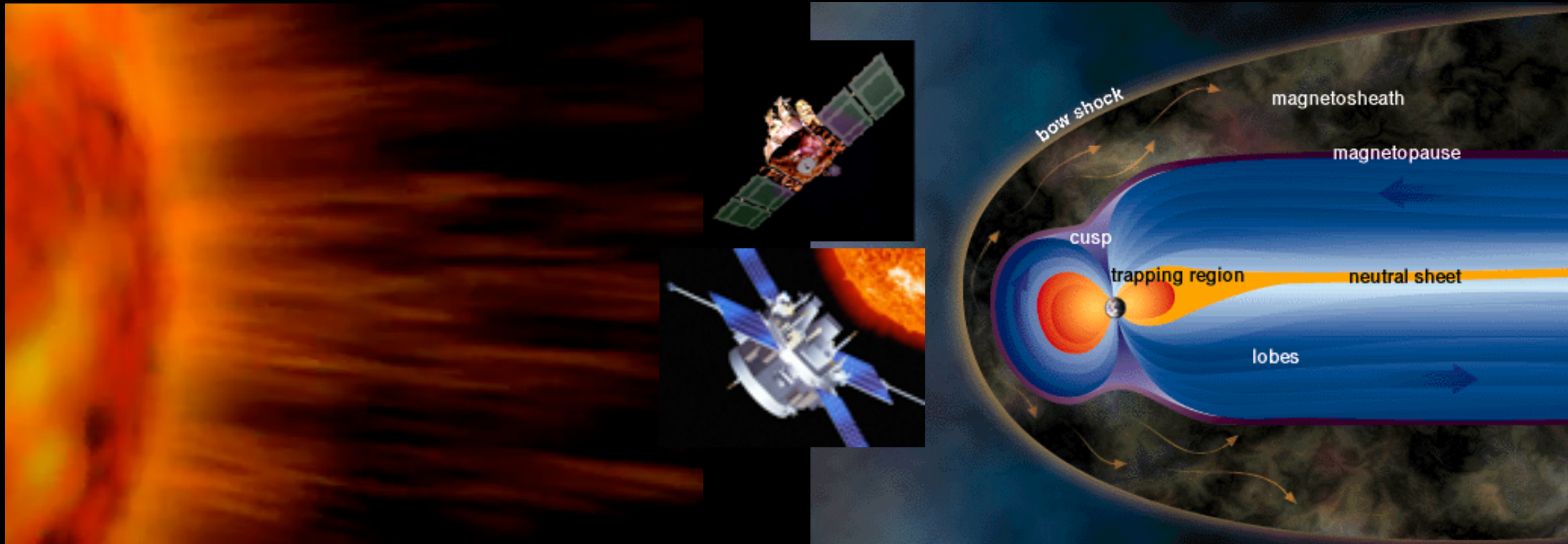


The fastest solar wind originates from the dark areas on the image, called coronal holes. Such holes often occur close to the polar regions, but can sometimes also be observed close to the equator.

By tracking coronal holes one can provide several days advanced forecasts

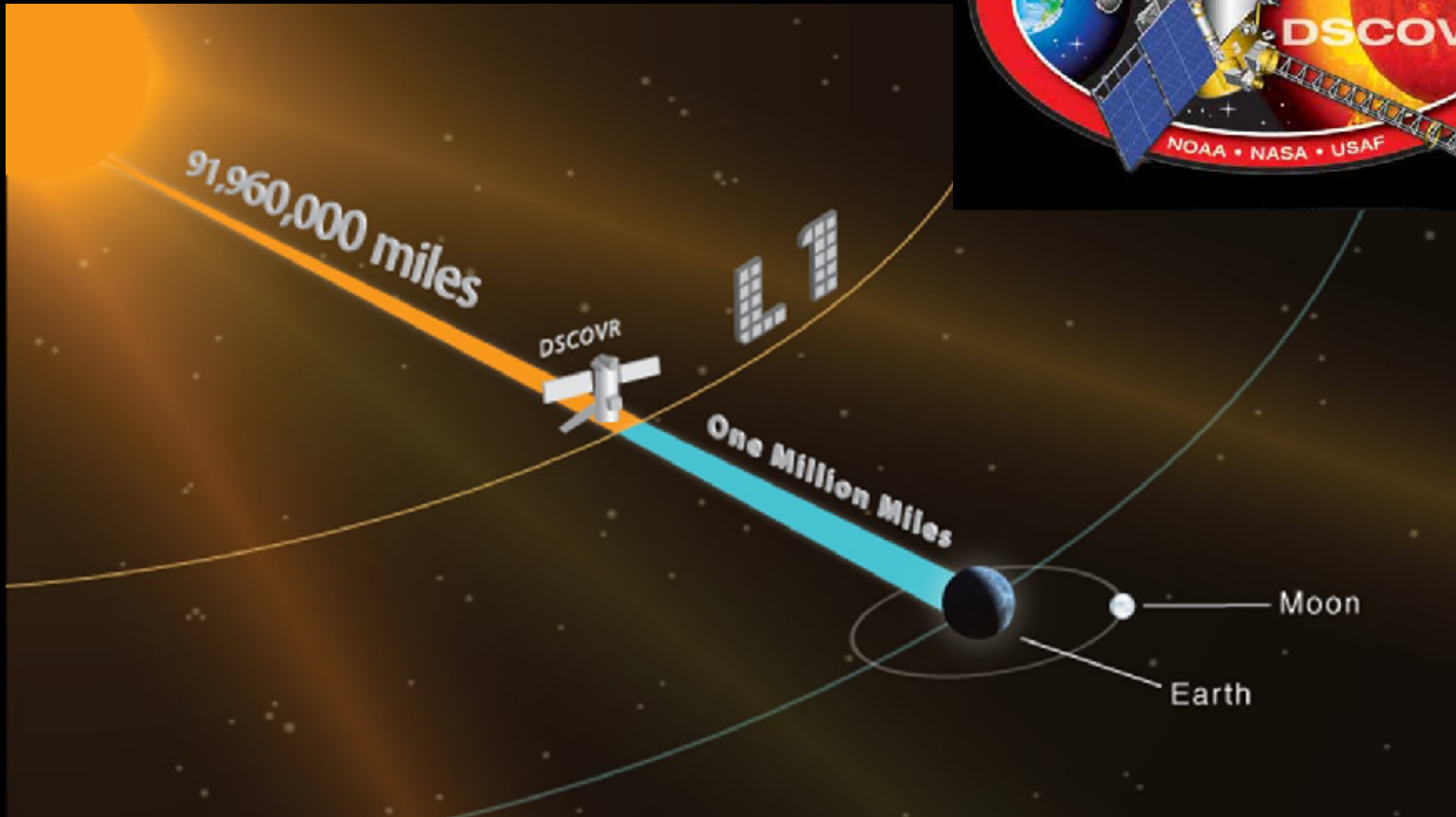


Monitoring the Solar Wind and IMF



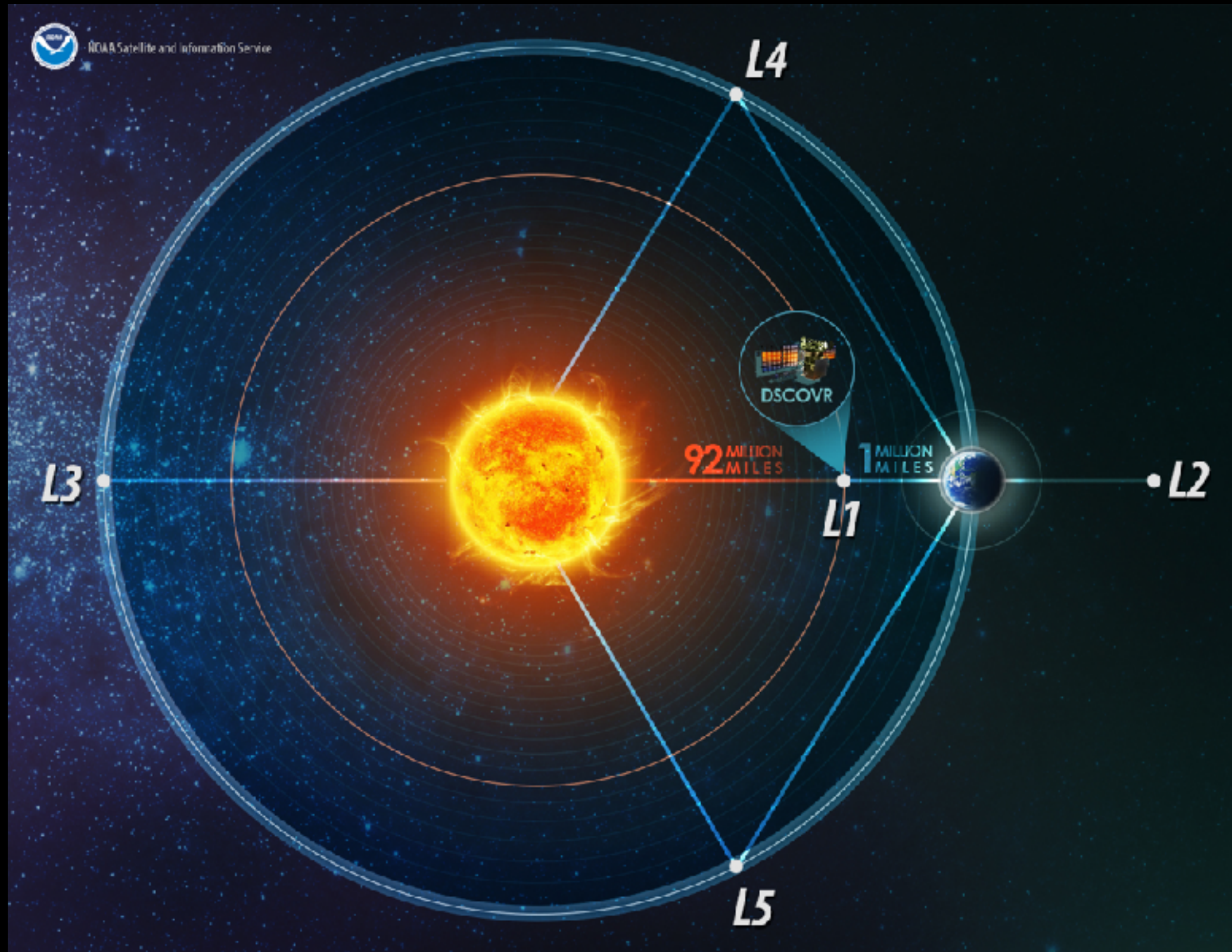
DSCOVR

Deep Space Climate Observatory



DSCOV

Deep Space Climate Observatory



DSCOV

Deep Space Climate Observatory



epic.gsfc.nasa.gov




Nyheter start Klima Intranet Hjelp og tips NRS NRS s-news KLIMA2 Storm UIT Radar CONTA Book TV Roland forum

ikke åpne siden The Polar Cusp - Googl... AGF216 - Dropbox Kunne ikke åpne siden DSCOV:EPIC:Earth P... point_of_Lagrangef1_big... Kunne ikke åpne siden

DSCOV:EPIC

Earth Polychromatic Imaging Camera

 [epic_1b_20160207055552_00](#)  ABOUT


2016-02-07 05:55:52 GMT
Distance: 964,914 miles  
SEV Angle 8.4° 

1 of 4


Europe Asia Africa Australia Antarctica

DSCOV(L1)
964,914 miles

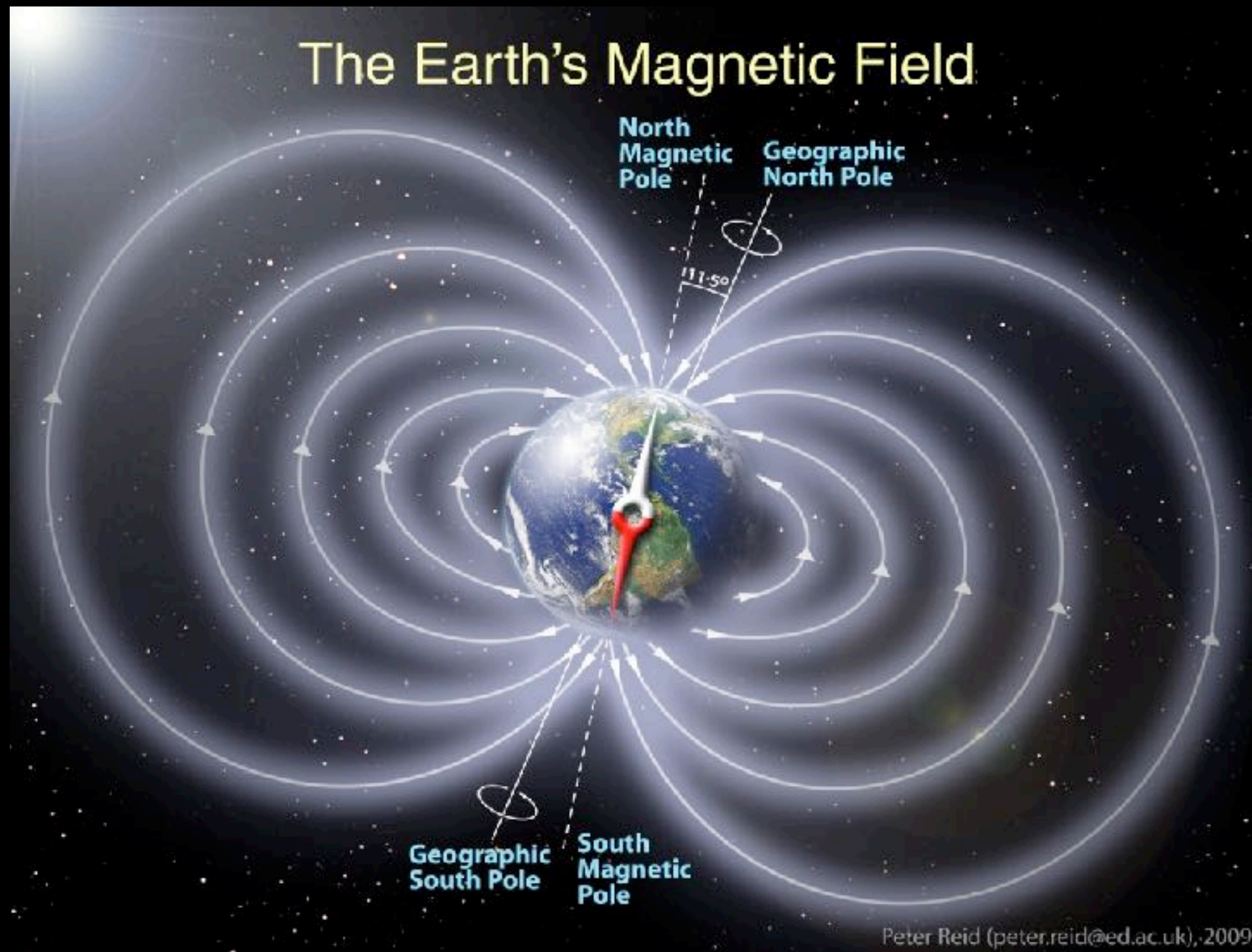
Sun 91,652,996 miles Earth SEV Angle: 8.4°



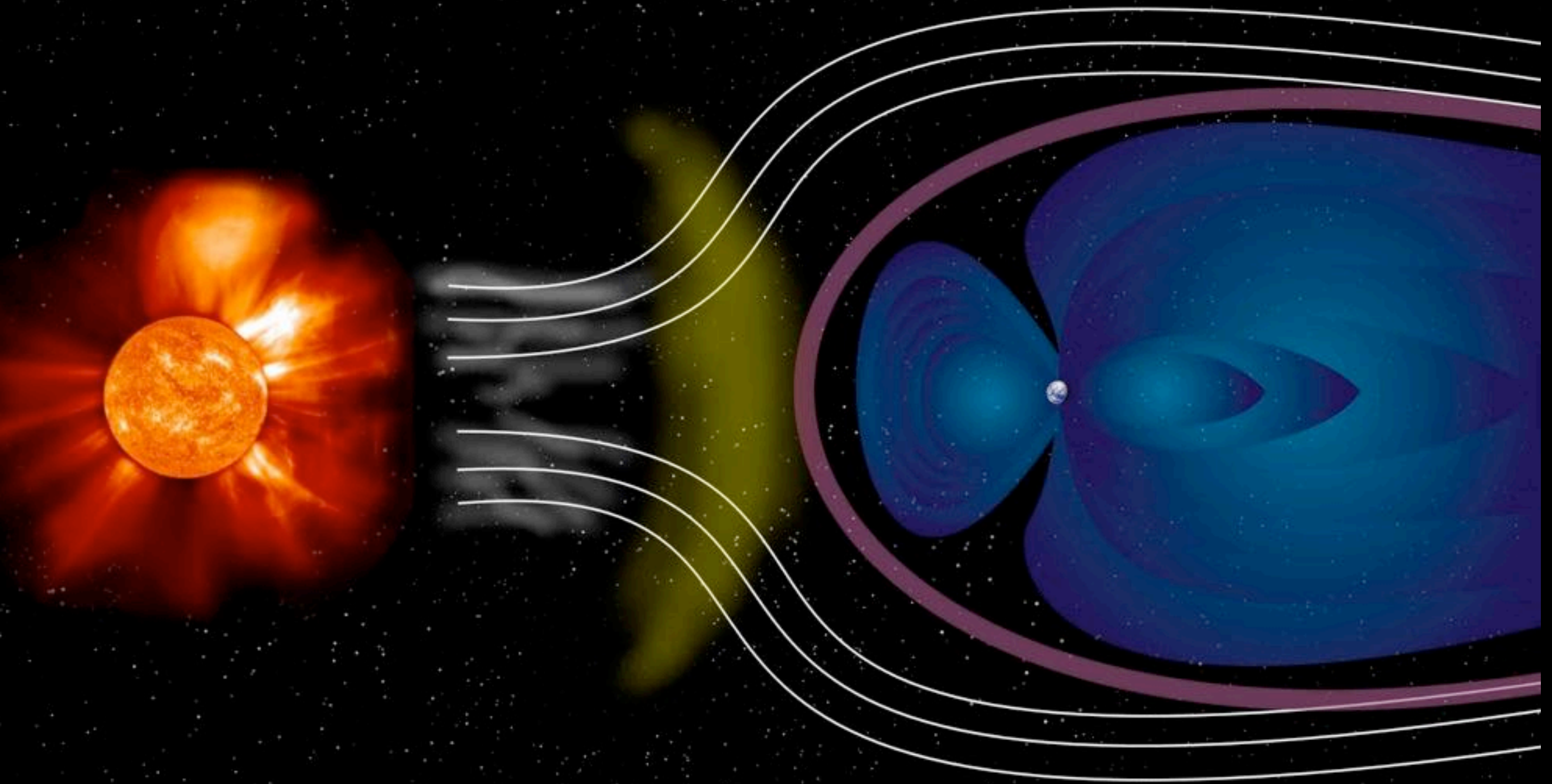
NASA Official: Alexander Marshak
Webmaster: Susannah Pearce
Curator: Karin Blank
[Privacy Policy & Important Notes](#)



The magnetosphere

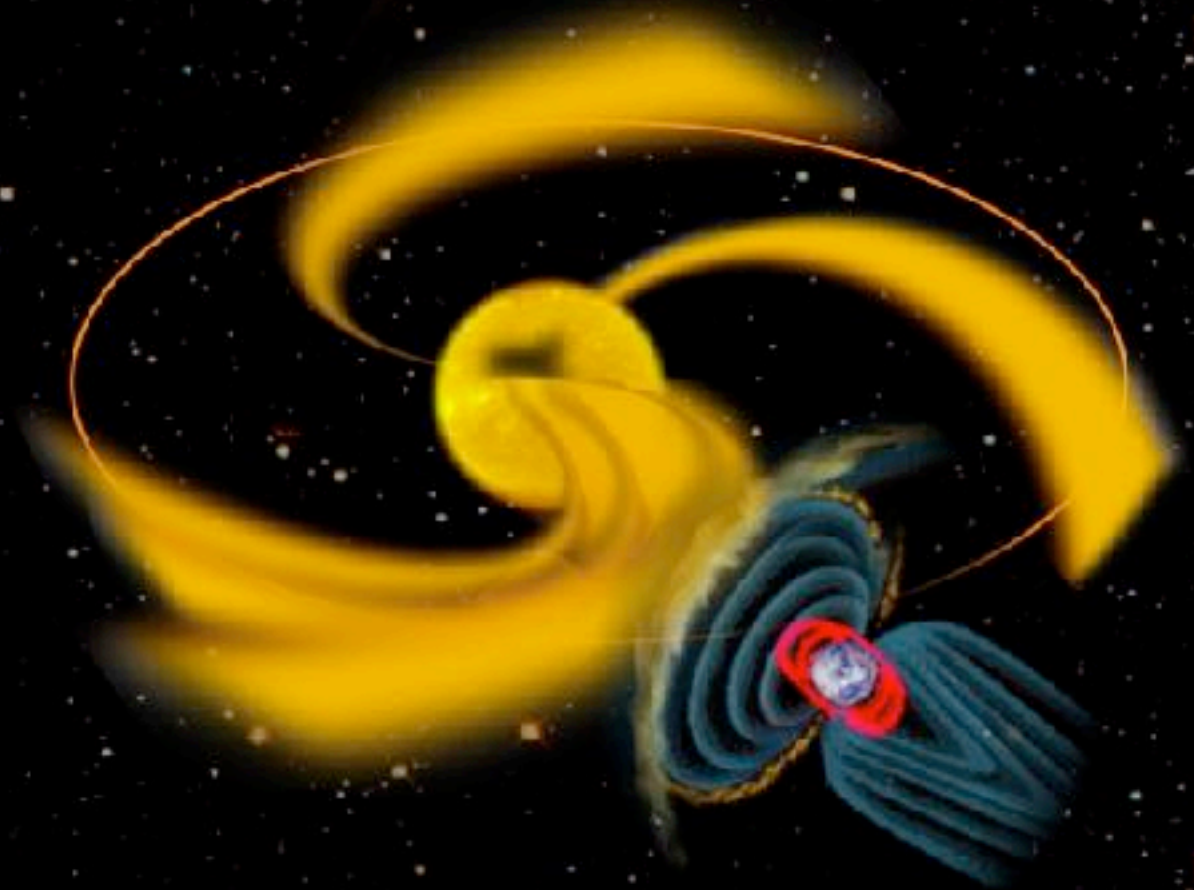
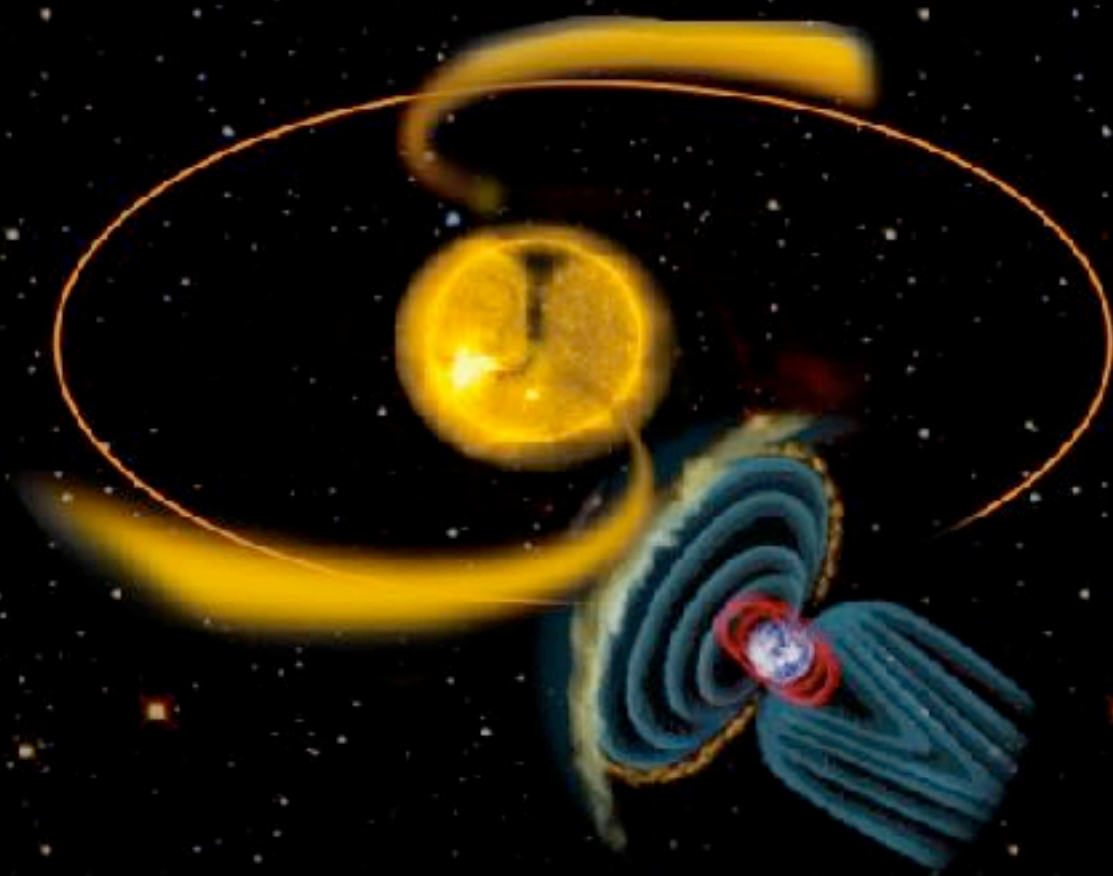


The magnetosphere

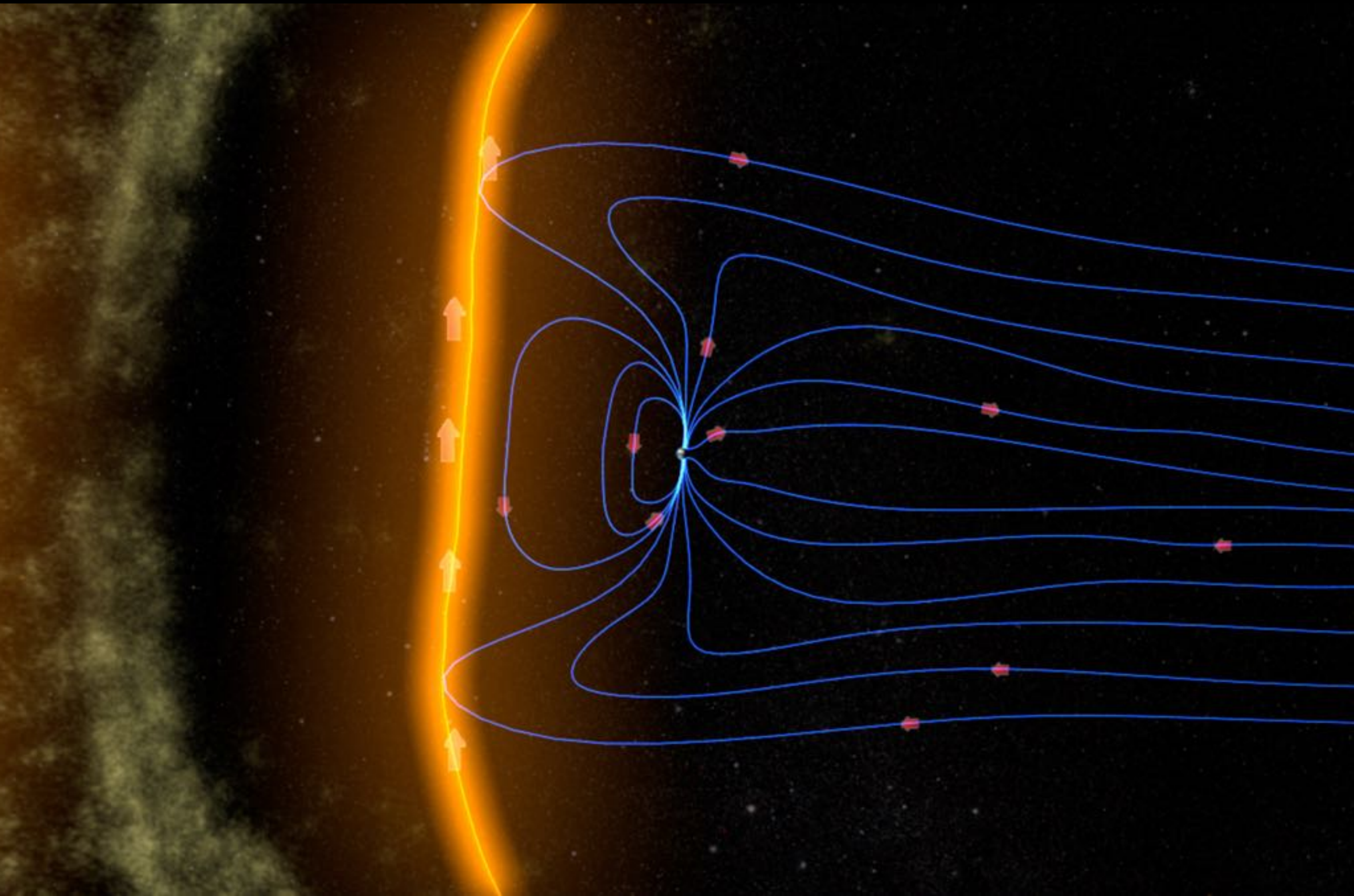


Interplanetary Magnetic Field

The **interplanetary magnetic field (IMF)**, now more commonly referred to as the heliospheric magnetic field (HMF), is the component of the solar magnetic field which is dragged out from the solar corona by the solar wind flow to fill the Solar System.



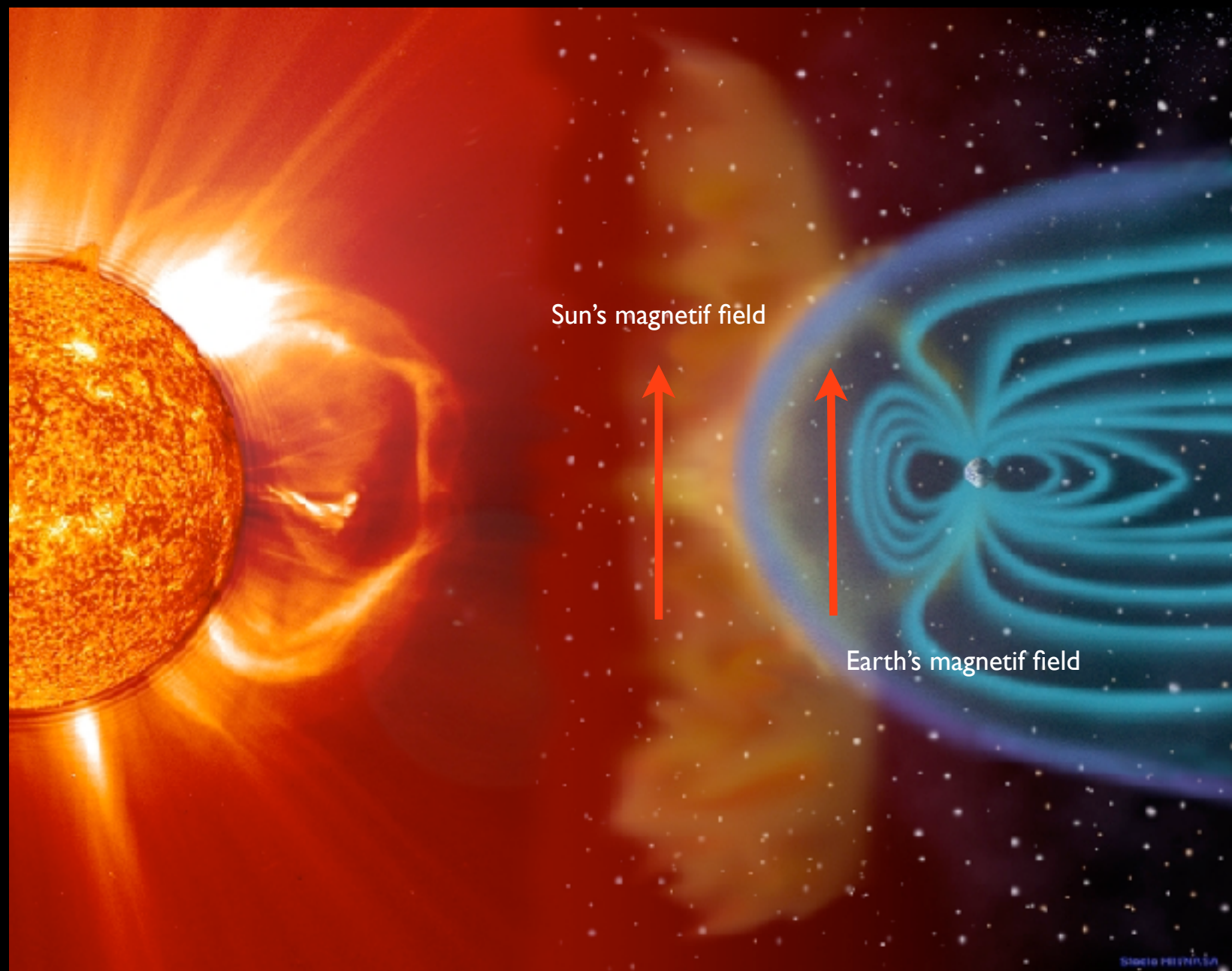
When do strong storms occure?



How effective will the storm be?

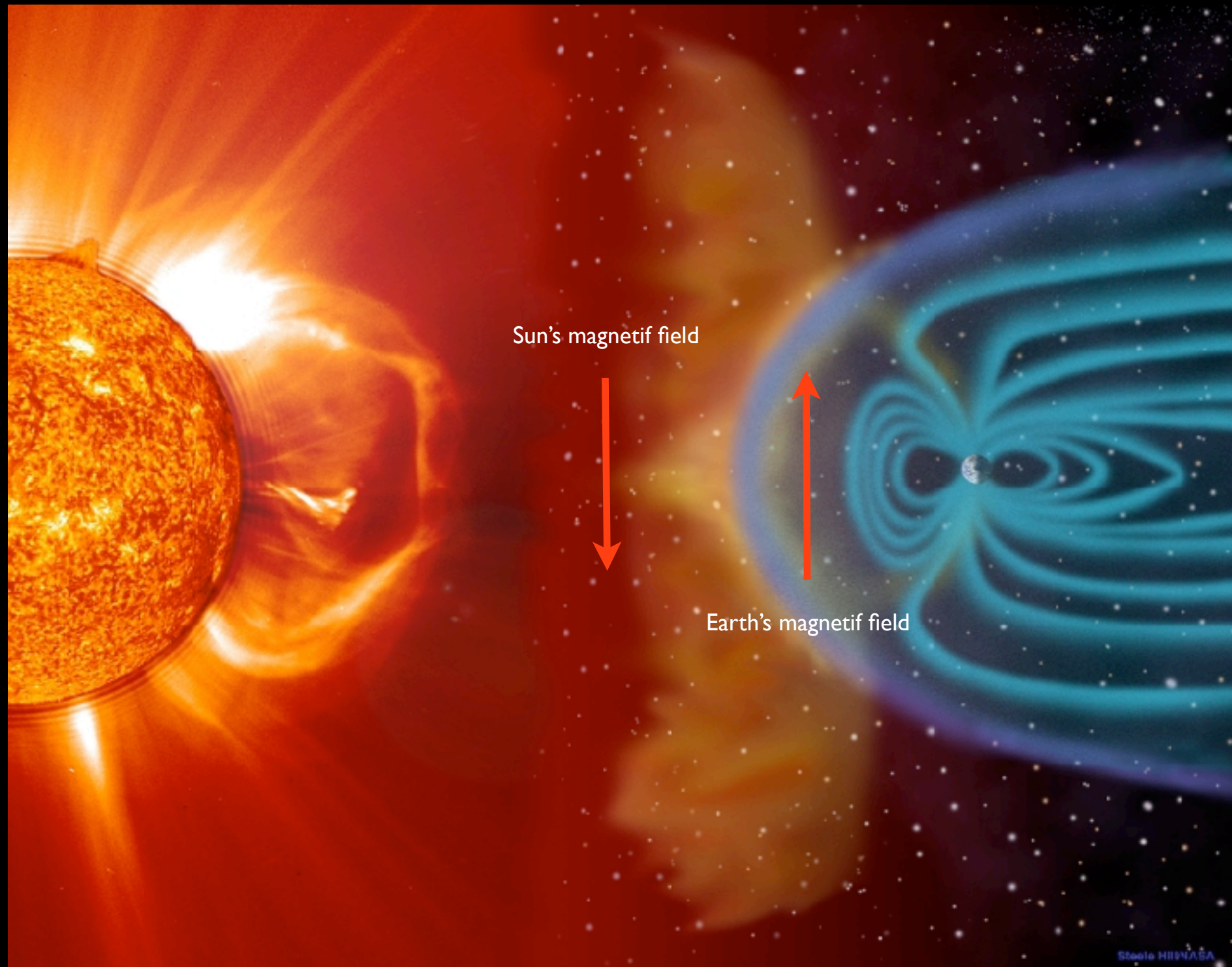
The solar wind also carries with it the magnetic field of the Sun. This field will have either a North or South orientation. If the solar wind has energetic bursts, contracting and expanding the magnetosphere, or if the solar wind takes a southward polarization, geomagnetic storms can be expected. The southward field causes magnetic reconnection of the dayside magnetopause, rapidly injecting magnetic and particle energy into the Earth's magnetosphere

Same direction - weak interaction - CME «glides by»

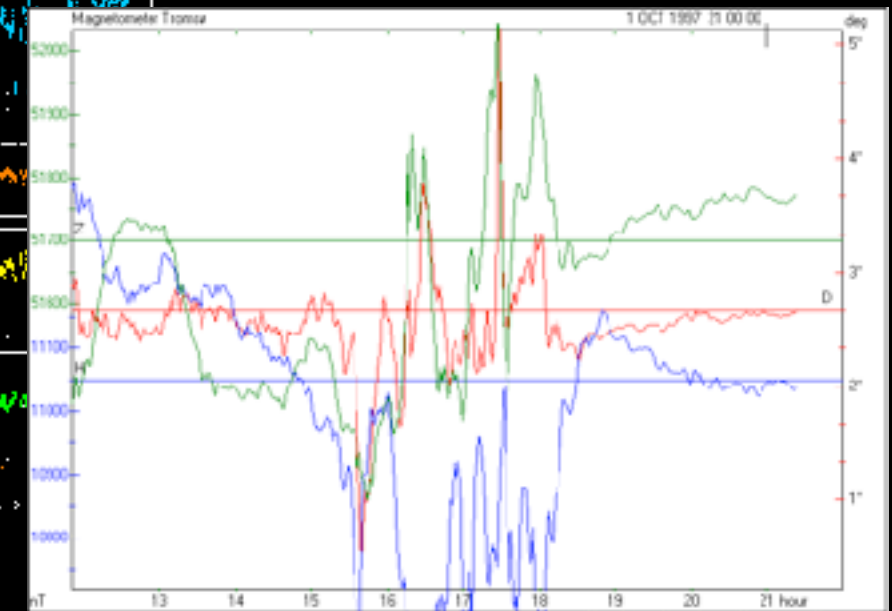
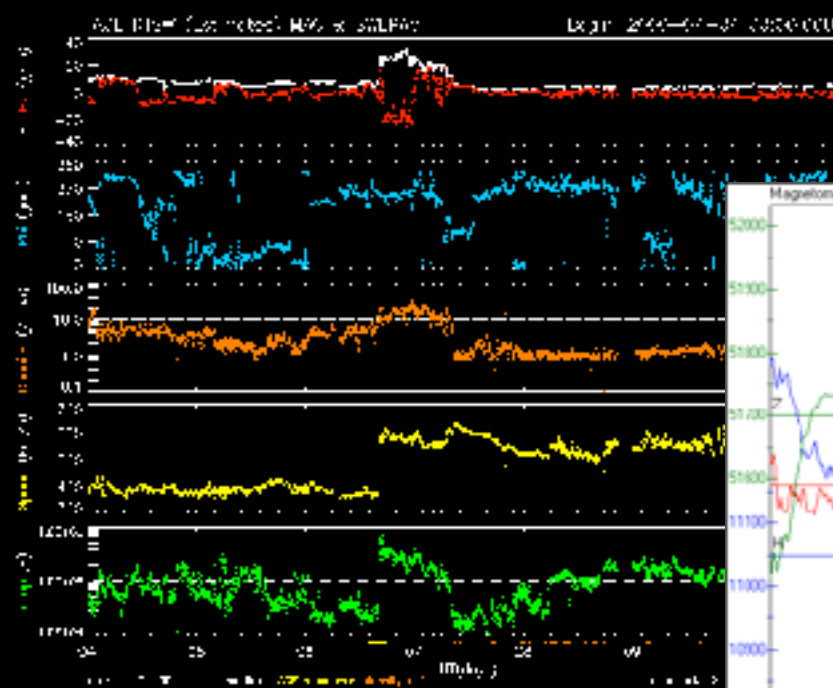
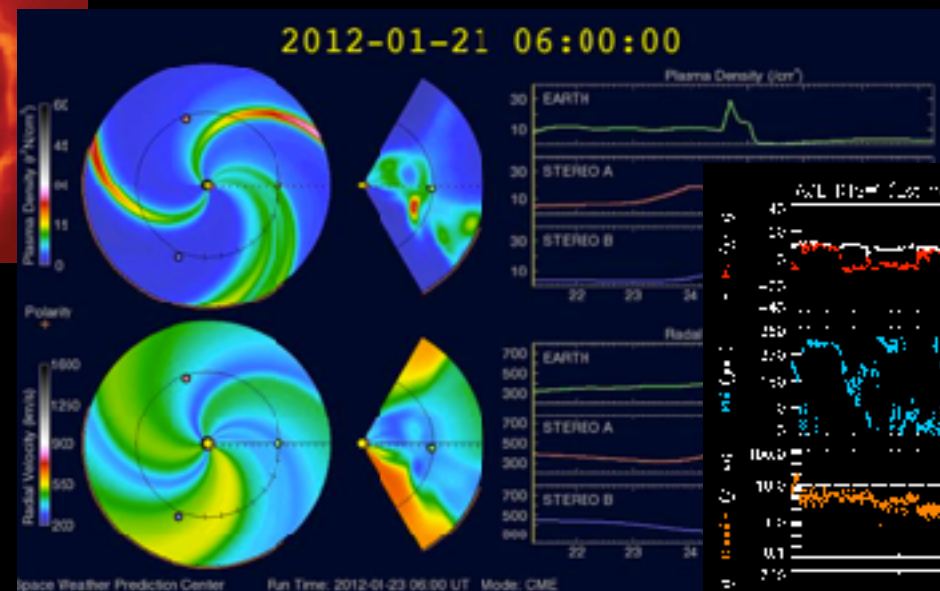
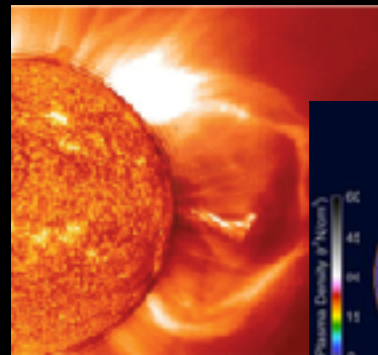


How effective wil the storm be?

Opposite direction - strong interaction - strong geomagnetic storm



Sequence of events for Geomagnetic Forecast



Analysis and Prediction
(Geomagnetic Storm
Watch Products Issued)



ACE
Observation
(Geomagnetic Storm
Warning Issued)



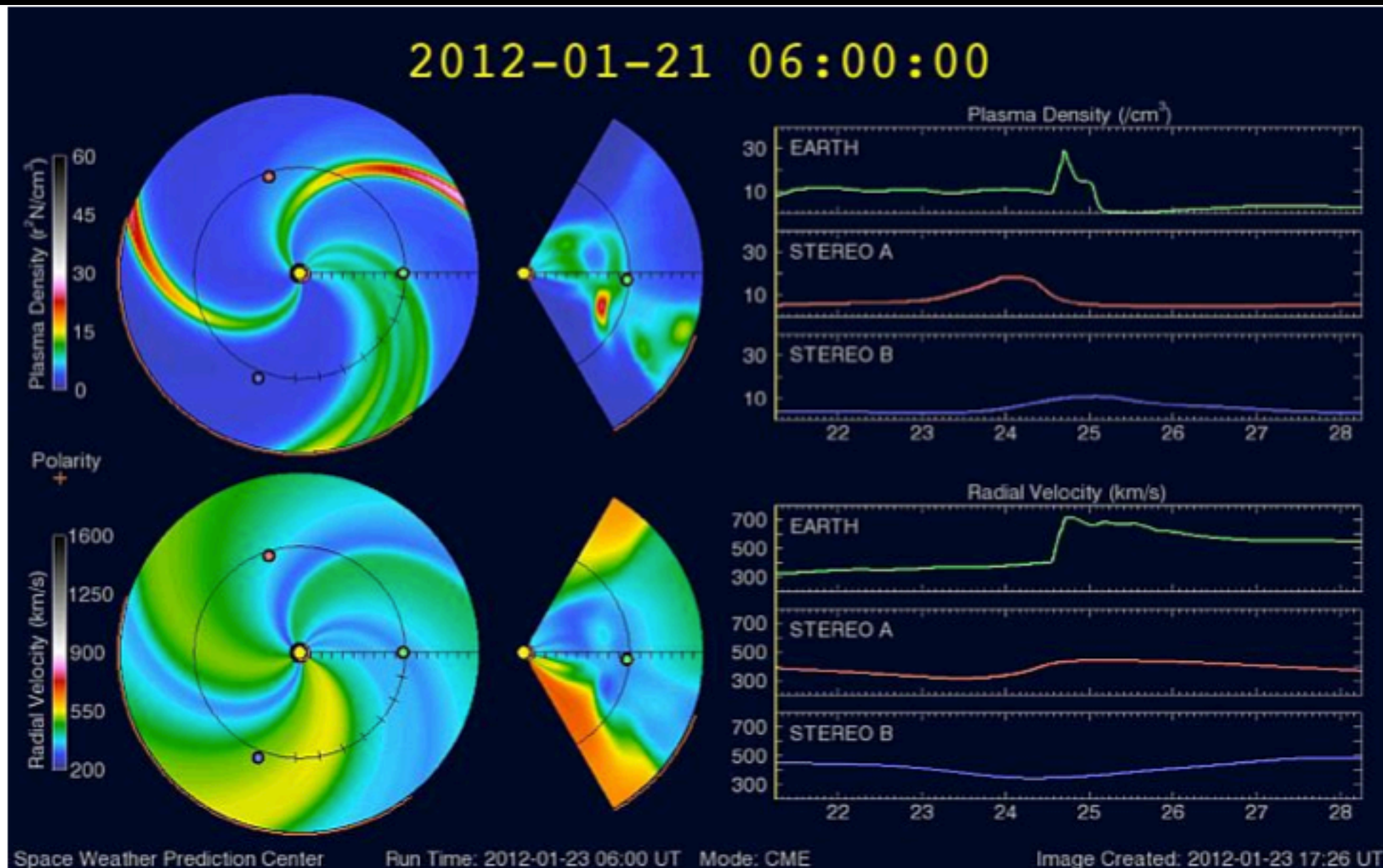
Event Onset/
Ground-Based Observation
(Geomagnetic Storm Alert
Issued)

Watches: The
conditions are favorable
for occurrence
(1-4 days)

Warnings: Disturbances that
are imminent, expected in the
near future with high probability
(Minutes to a few hours)

Alerts: Observed
conditions meeting or
exceeding thresholds

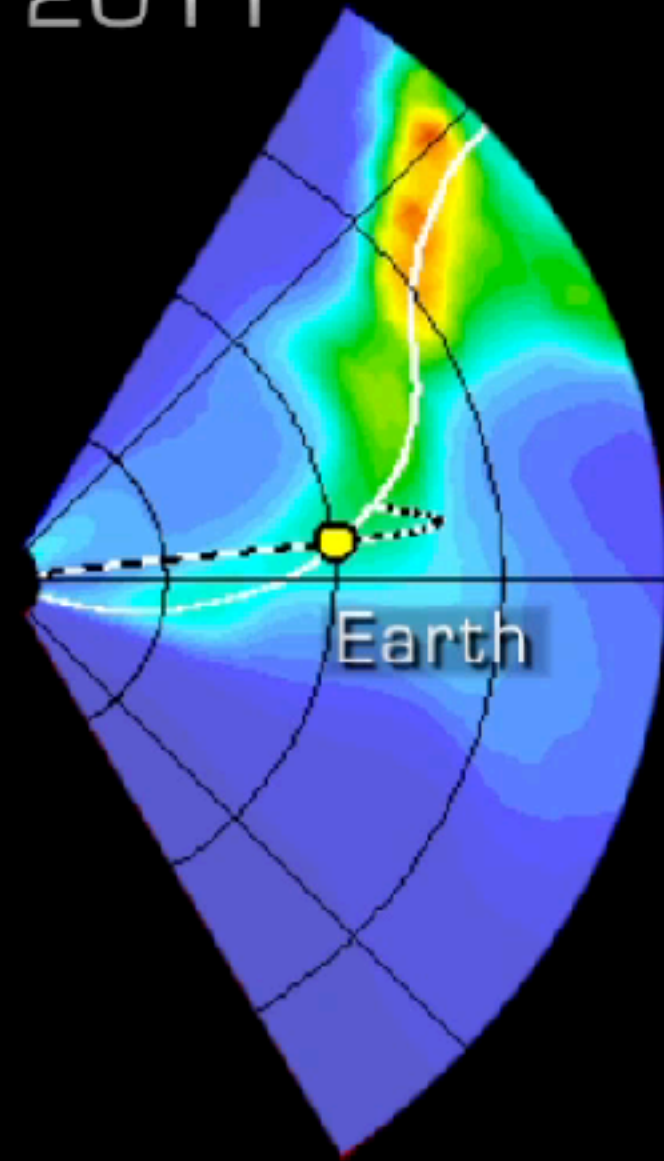
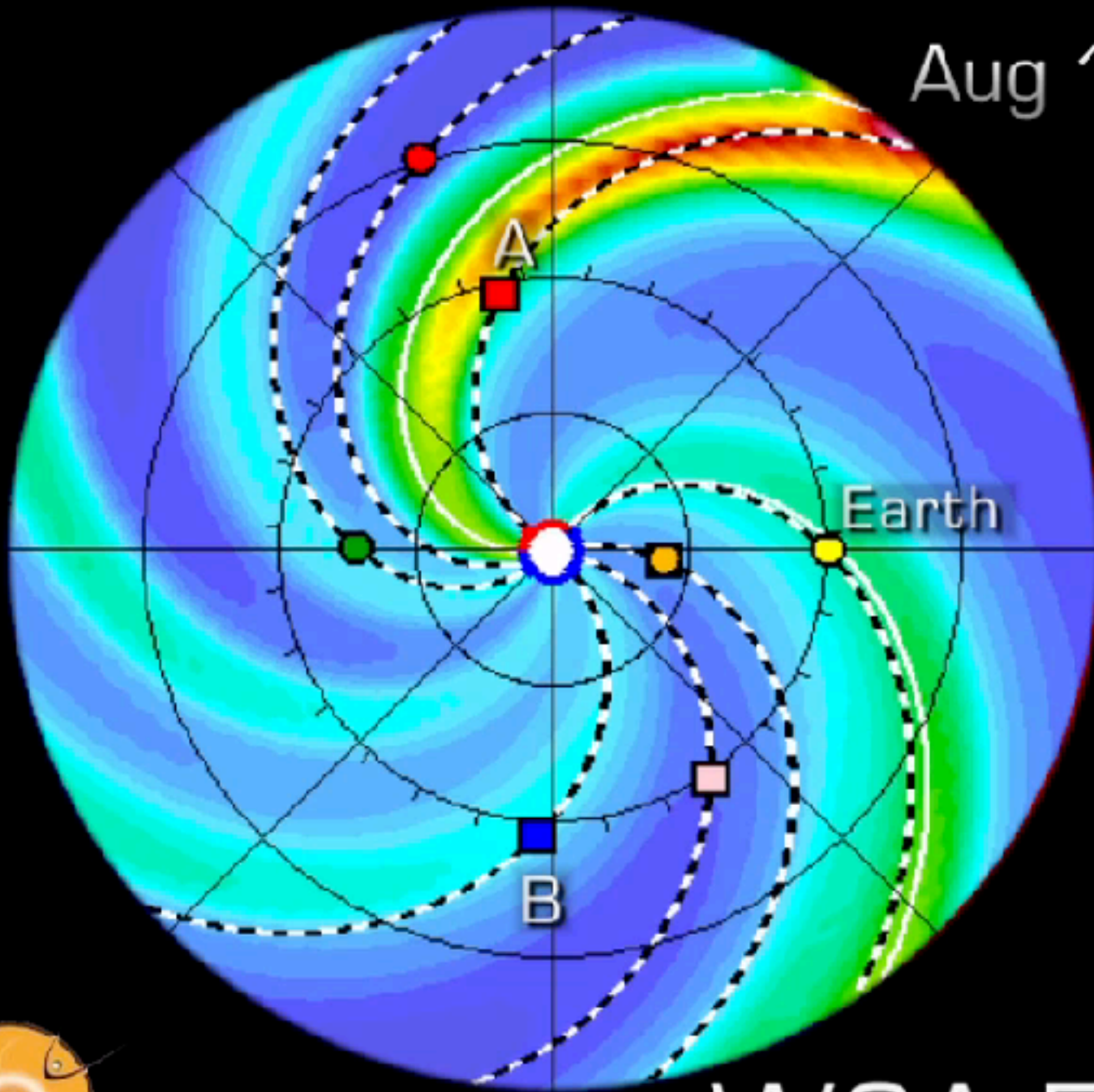
Space Weather Forecasts



- Watch the trajectory of CMEs
- www.swpc.noaa.gov/wsa-enlil/
- This gives 2-3 days warning

Space Weather Forecasts

Aug 1-10, 2011



WSA-Enlil CME Model



Space Weather Forecasts

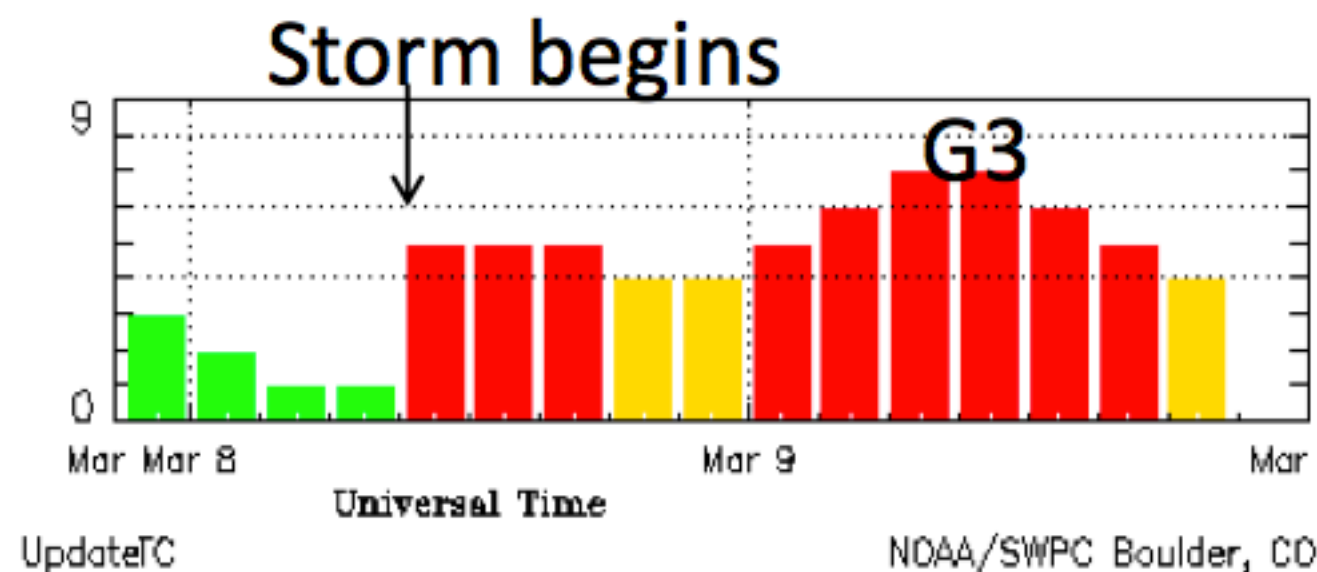
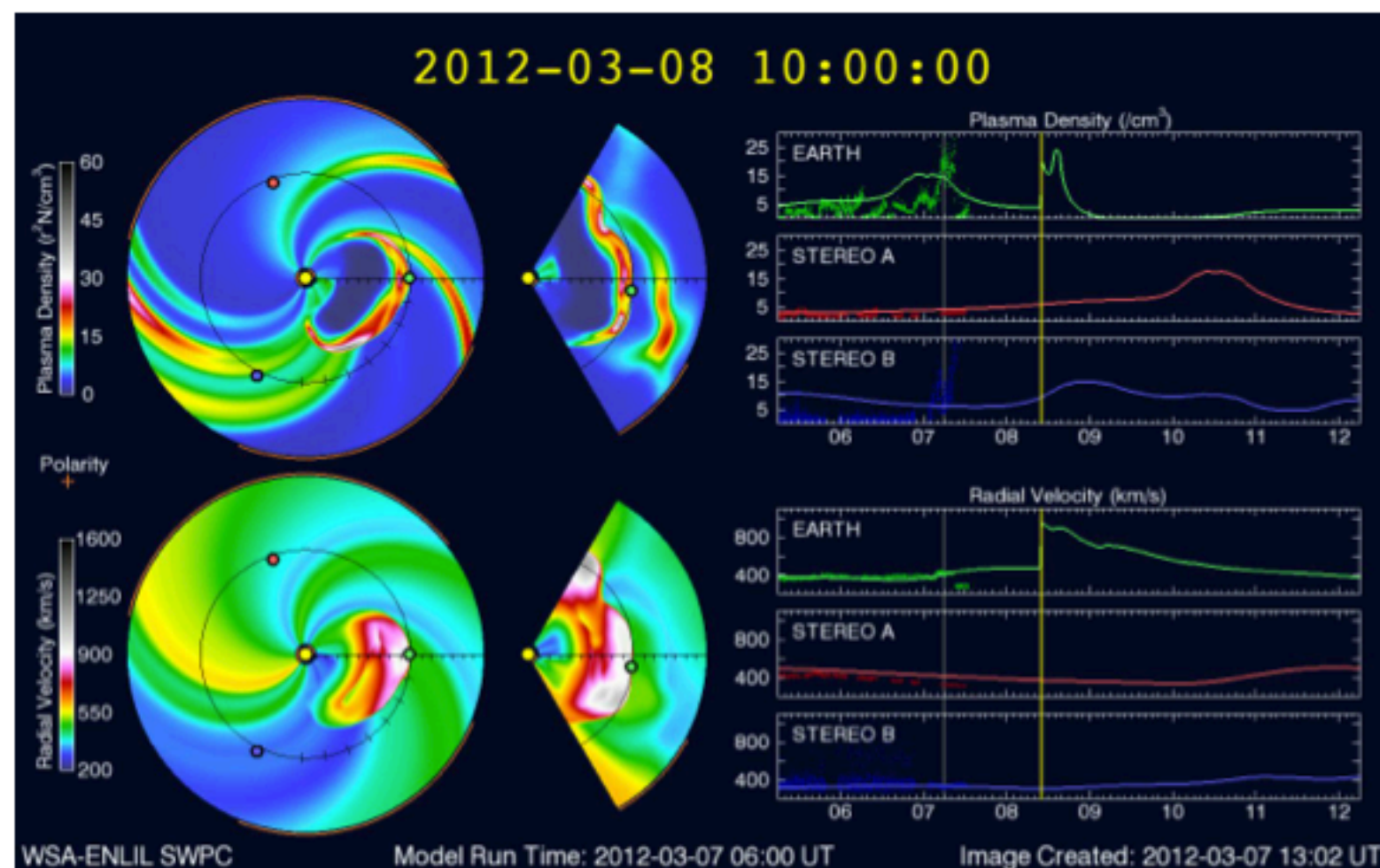
- WSA/Enlil model indicated Mar 8, 10UTC arrival at Earth.
- A “G3 Watch” was issued Mar 7 at 17:42UTC...17 hours before the storm onset.
- Stronger storming was expected on Mar 8, but solar wind not suitable for stronger storming until Mar 9.

Geomagnetic Storm Forecast:

“The arrival time is estimated to be Mar 8 at 06:00-10:00UTC.”

“Periods reaching the G3 (Strong) Level Likely”

Actual: Arrival: Mar 8, 11:05UTC
Intensity: G3 storm



Space Weather Scales



NOAA Space Weather Scales



Category	Effect	Physical measure	Average Frequency (1 cycle = 1 year)
Sub-Describe	Duration of event and influence on systems and effects	Key system determined every 1 hour	Number of times event when Kp level was met (number of storm days)
Geomagnetic Storms			
G 5 Extreme	Power systems: widespread voltage control problems and protective system problems can occur some and serious loss of service possible within minutes. Transformer may experience damage. Spacecraft operations: may experience extensive surface charging, problems with orientation, uplink/downlink and tracking satellites. Other systems: pipeline currents can reach hundreds of amps, HF (high frequency) radio propagation may be impossible in many areas for entire day, satellite navigation may be degraded for days, low-frequency radio navigation can be out for hours, and aurora has been seen as low as Florida and southern Texas (typically 40° geomagnetic lat.).**	Kp=9	4 per cycle (1 storm per cycle)
G 4 Severe	Power systems: possible widespread voltage control problems and some protective systems will mistakenly trip out key areas from the grid. Spacecraft operations: may experience surface charging and tracking problems, corrections may be needed for orientation problems. Other systems: induced pipeline currents affect protective measures, HF radio propagation sporadic, satellite navigation degraded for hours, low-frequency radio navigation degraded, and aurora has been seen as low as Massachusetts and New California (typically 50° geomagnetic lat.).**	Kp=8	100 per cycle (50 days per cycle)
G 3 Strong	Power systems: voltage corrections may be required, false alarms triggered on some protection devices. Spacecraft operations: surface charging may occur on satellite components, drag may increase or low Earth orbit satellites, and corrections may be needed for orientation problems. Other systems: intermittent satellite navigation and low-frequency radio navigation problems may occur, HF radio may be unreliable, and aurora has been seen as low as Illinois and Quebec (typically 50° geomagnetic lat.).**	Kp=7	200 per cycle (150 days per cycle)
G 2 Moderate	Power systems: high latitude power system may experience voltage drops, long-distance storms may cause transformer damage. Spacecraft operations: corrective actions re orientation may be required by ground control; possible changes in drag affect orbit predictions. Other systems: HF radio propagation can face at higher latitudes, and aurora has been seen as low as New York and Idaho (typically 50° geomagnetic lat.).**	Kp=6	600 per cycle (250 days per cycle)
G 1 Minor	Power systems: weak power grid fluctuations are common. Spacecraft operations: minor impact on satellite operations possible. Other systems: magnetic storms are affected at this and higher levels, aurora is commonly visible at high latitudes, increases in aurora and aurora.**	Kp=5	1700 per cycle (200 days per cycle)

* Based on 100 storms, but other physical measures are also considered.

** For specific locations around the globe, see geomagnetic field to determine their sighting (see www.noaa.gov/geomag).

Category	Effect	Physical measure	Average Frequency (1 cycle = 1 year)
Sub-Describe	Duration of event and influence on systems and effects	Key system determined every 1 hour	Number of times event when Kp level was met (number of storm days)
Solar Radiation Storms			
S 5 Extreme	Biological: considerable high solar radiation hazard to astronauts on EVA (extra-vehicular activity); passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: satellites may be rendered useless, memory impacts can cause loss of control, they cause serious noise in image data, star-trackers may be unable to locate sources; permanent damage to solar panels possible. Other systems: complete shutdown of HF (high frequency) communications possible through the polar regions, and protection measures navigation, navigation extremely difficult.	10 ¹⁰ protons/cm ² > 10 MeV	Fewer than 1 per cycle
S 4 Severe	Biological: considerable radiation hazard to astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: may experience memory device problems and noise in image systems, star-trackers problems may cause orientation problems, and solar panel efficiency can be degraded. Other systems: shutdown of HF radio communications through the polar regions and increased navigation errors over several days are likely.	10 ⁹	1 per cycle
S 3 Strong	Biological: radiation hazard avoidance recommended for astronauts on EVA; passengers and crew in high-flying aircraft at high latitudes may be exposed to radiation risk.*** Satellite operations: degradation of image systems, and slight reduction of efficiency in solar panel and battery. Other systems: degraded HF radio propagation through the polar regions and navigation errors on several days are likely.	10 ⁸	10 per cycle
S 2 Moderate	Biological: passengers and crew in high-flying aircraft at high latitudes may be exposed to elevated radiation risk.*** Satellite operations: intermittent data errors are possible. Other systems: degradation of HF radio propagation through the polar regions and navigation errors on several days are likely.	10 ⁷	25 per cycle
S 1 Minor	Biological: none. Satellite operations: none. Other systems: minor impacts on HF radio in the polar regions.	10 ⁶	50 per cycle

* Flux levels are 1 minute averages. Flux particles/cm²/sec/cm² based on this measure, but other physical measures are also considered.

** These events are based on the 100.

*** High energy protons (>10 MeV) are a radiation risk to passengers and crew. Protons are particularly susceptible.

Category	Effect	Physical measure	Average Frequency (1 cycle = 1 year)
Sub-Describe	Duration of event and influence on systems and effects	Key system determined every 1 hour	Number of times event when Kp level was met (number of storm days)
Radio Blackouts			
R 5 Extreme	HF Radio: Complete HF (high frequency) radio blackout on the entire sunlit side of the Earth lasting for a number of hours. This results in no HF radio contact with aircraft and no radio aviation in this sector. Navigation: Low frequency navigation signals used by maritime and general aviation systems experience outages on the sunlit side of the Earth for many hours, causing loss in positioning. Increased satellite navigation errors in positioning for several hours on the sunlit side of Earth, which may gradually be the night side.	10 ¹⁰ (10 ¹⁰)	Fewer than 1 per cycle
R 4 Severe	HF Radio: HF radio communication on the entire sunlit side of the Earth for two to three hours. HF radio contact lost during this time. Navigation: Degradation of low-frequency navigation signals causes loss in positioning for one to two hours. Minor degradation of satellite navigation possible on the sunlit side of Earth.	10 ⁹ (10 ⁹)	8 per cycle (5 days per cycle)
R 3 Strong	HF Radio: Wide area blackout of HF radio communication, loss of radio contact for about an hour on sunlit side of Earth. Navigation: Low-frequency navigation signals degraded for about an hour.	10 ⁸ (10 ⁸)	175 per cycle (140 days per cycle)
R 2 Moderate	HF Radio: Limited blackout of HF radio communication on sunlit side of the Earth, loss of radio contact for about 10 minutes. Navigation: Degradation of low-frequency navigation signals for about 10 minutes.	10 ⁷ (10 ⁷)	400 per cycle (300 days per cycle)
R 1 Minor	HF Radio: Weak or minor degradation of HF radio communication on sunlit side of the Earth, occasional loss of radio contact. Navigation: Low-frequency navigation signals degraded for brief intervals.	10 ⁶ (10 ⁶)	2000 per cycle (250 days per cycle)

* Flux measured in the 0.1-30 MHz range in V/m². Based on 100 storms, but other physical measures are also considered.

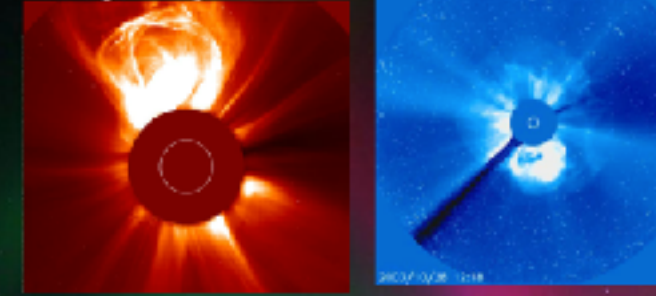
** Other frequencies may be affected by these conditions.

URL: www.noaa.gov/NOAA/SpaceWeather

April 7, 2011

Geomagnetic Storms (G Scale)

Coronal Mass Ejections (CMEs) create geomagnetic storms

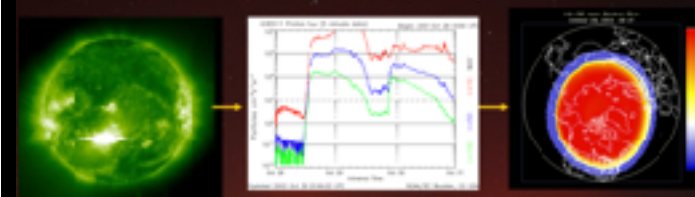


Arrival: 20 - 90 hours
Duration: hours to a day

IMPACTS:

- Power grid operations
- Satellite operation
- Aircraft operations
- GPS
- Pipelines

Solar Radiation Storms (S Scale)

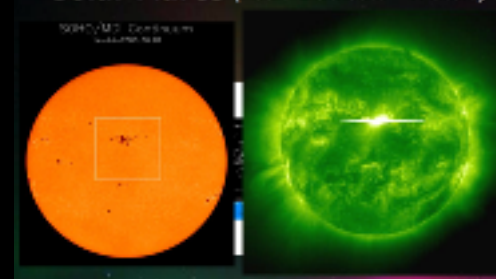


Arrival: 30 min to several hours
Duration: hours to days

IMPACTS:

- Satellite operation/loss
- Aviation (comm/exposures)
- HF outage (polar regions)
- Manned spaceflight

Solar Flares (Radio Blackouts - R Scale)





Arrival: 8 min 20 s
Duration: minutes to 3 hours

IMPACTS:

- GPS network
- Communication (ground/Space)
- Radar
- Manned spaceflight

Space weather warnings

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



SPACE WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Tuesday, November 08, 2016 07:03:07 UTC

HOME ABOUT SPACE WEATHER PRODUCTS AND DATA DASHBOARDS MEDIA AND RESOURCES SUBSCRIBE ANNUAL MEETING FEEDBACK

Search

SPACE WEATHER CONDITIONS on NOAA Scales

24-Hour Observed Maximums

R

none

S

none

G

none

Latest Observed

R

none

S

none

G

none

Predicted 2016-11-08 UTC

R1-R2

1%

R3-R5

1%

G1 or greater

1%



G1

minor

Solar Wind Speed: **295** km/sec

Solar Wind Magnetic Fields: B1 **5** nT, Bz **4** nT

Noon 10.7cm Radio Flux: **77** sfu



THE NATION'S OFFICIAL SOURCE OF SPACE WEATHER ALERTS AND WARNINGS

NOAA
National Weather Service
Space Weather Prediction Center

G1 (Minor) Watch In Effect for the 8 November UTC-day

published: Monday, November 07, 2016 17:58 UTC
A G1 (Minor) geomagnetic storm watch is in effect for the 8 November, 2016 UTC-day.

Executive Order to Prepare Nation for Space Weather Events

published: Monday, November 07, 2016 16:51 UTC
An Executive Order to coordinate efforts to prepare the nation for space weather events was signed by President Obama on 13 Oct. Read the full order

NWS Fall Safety Campaign is On

published: Monday, November 07, 2016 16:50 UTC
As the days get shorter and temperatures fall, a new round of weather hazards are on the rise.

New Experimental Regional Geomagnetic Products Available

published: Monday, November 07, 2016 14:22 UTC
SWPC deployed experimental products from the new operational Geospace model on Oct 5th.

SERVING ESSENTIAL SPACE WEATHER COMMUNITIES

Aviation
Radio Communications

Electric Power
Satellites

Emergency Management
Space Weather Enthusiasts

Global Positioning System (GPS)

Space Weather Forecasts

- Subscribe to email alerts, warnings, and watches
- Suggest a Geomagnetic Storm Scale threshold of G2 or greater

The screenshot shows a web browser window titled "Product Subscription Service - Mozilla Firefox". The address bar displays the URL: <https://ps.swpc.noaa.gov/LoginWebForm.aspx?ReturnUrl=%2fproductsubscriptionserv>. The browser's toolbar includes various icons and tabs, with the active tab showing "Product 5".

The main content area of the page is titled "NOAA SWPC Product Subscription Service". Below the title, there is a "SWPC Help" link. A welcome message states: "Welcome to the Space Weather Prediction Center's Product Subscription Service. Registered users can sign in below. Forgot your password? Click [here](#)."

The page is divided into two main sections: "General Information" and "Sign In".

General Information

Receive alerts, warnings, watches, forecasts, and summaries via email within moments of issue.

To sign up: register, select products of interest from various categories, then review your choices.

Note: data, plots, and images are available for you to download [here](#).

Questions? Contact us [here](#).

Sign In

email address

password


New user? Register [here](#).

Notice

Privacy Statement: Addresses are used to send alerts, respond to questions, and send information that SWPC considers of interest to our customers. The information provided on the registration form may be used by SWPC for statistical analysis of users. U.S. Government regulations restrict the distribution of user information. No user information is made available to customers, organizations, vendors, or other government agencies. See the NOAA privacy policy [here](#).

Disclaimer: SWPC makes a concerted effort to distribute products, but this delivery method is not guaranteed. For more information, go [here](#).

SWPC-Home

 powered by VeriSign

Space Weather Forecasts

- Go to SWPC web site
www.swpc.noaa.gov
- Focus on NOAA Scale
- If G2 or greater, possible impact to GNSS operations



ESA SSA Space Weather

<http://sidc.oma.be/>



space situational awareness



ESA SSA SWE NEO SST

About SWE

What is Space Weather
SSA Space Weather Activities
Current Space Weather
Contact

Service Domains

Spacecraft Design
Spacecraft Operation
Human Space Flight
Launch Operation
Transionospheric Radio Link
Space Surveillance and Tracking
Power Systems Operation
Airlines
Resource Exploitation System Operation
General Data Service

Expert Service Centres

ESC Solar Weather
ESC Space Radiation
ESC Ionospheric Weather
ESC Geomagnetic Conditions
ESC Heliospheric Weather

Other Resources

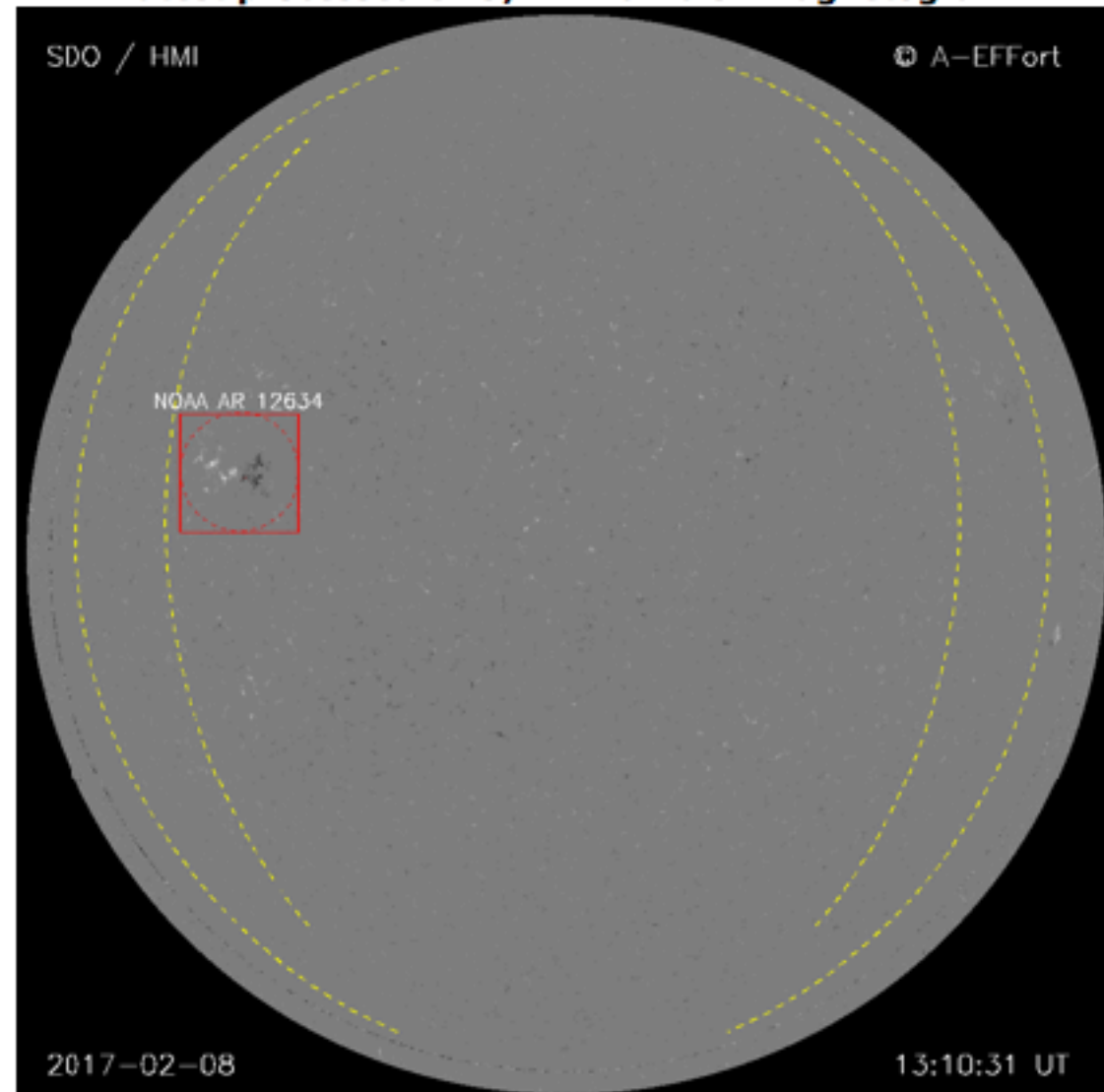
Documents
SWWT
SWEN NewsLetter
Upcoming Events

Welcome to the SSA Space Weather Service Network

Please note that all SSA-SWE Services are under review/construction

WC-Belgium forecast of 08 Feb 2017, Flares: Quiet, Geomagnetism: Active,

Latest processed SDO/HMI full-disk magnetogram



Norwegian Center for Space Weather

<http://site.uit.no/spaceweather/>



Norwegian Center for Space Weather

Search this website...



HOME

DATA AND PRODUCTS

BLOG

LINKS

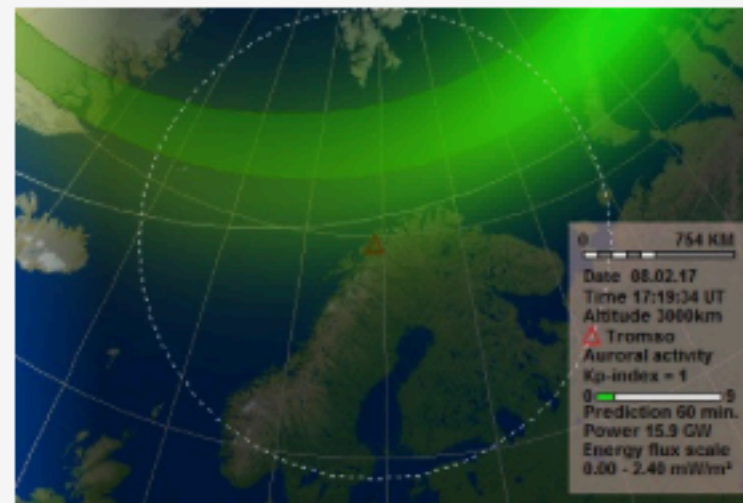
CONTACT

GEOMAGNETIC SUMMARY AND FORECAST

	Last 24-3 h	Last 3-1 h	Last 1h	Now	Next 1h
Auroral zone (Tromsø)	Moderate	quiet	quiet	quiet	quiet
Sub-Auroral zone (Dombås)	quiet	quiet	quiet	quiet	quiet

Updated Wed Feb 8 16:27:00 UTC 2017

NORTHERN LIGHTS IN THE NEXT HOUR



NOSWE
event analysis tool

Solar Wind conditions

V_x : 465.4 km/s
 B_z : 4.1 nT
X-Ray: $6.51 \times 10^{-8} \text{ W/m}^2$

[Ref. NOAA Space Weather Prediction Center]

-Last Updated: 2017-02-08 1615 UTC

<http://sidc.oma.be/>



SIDC - Solar Influences Data Analysis Center

netism: Quiet Protons: Warning Predicted 10CM Flux: 172

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Welcome to the Solar Influences Data Analysis Center (SIDC), which is the solar physics research department of the [Royal Observatory of Belgium](#). The SIDC includes the World Data Center for the sunspot index and the [ISES Regional Warning Center Brussels](#) for space weather forecasting.

INFO FROM SIDC - RWC BELGIUM 2014 Feb 12 12:50:44

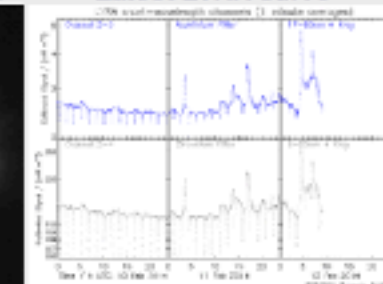
The solar flaring activity is increasing during past 24 hours with majority of activity originating from the Catania sunspot group 36 (NOAA AR 1974). The strongest of four reported M-class flares was observed this morning. The M3.7 flare peaked at 04:25 UT on February 12 and was associated with an EIT wave, coronal dimming and full halo CME first seen in the SOHO LASCO C2 field of view at 05:48 UT. From the currently available data we conclude that the CME is Earth directed.

The impulsive M1.7 flare which peaked at 03:31 UT on February 11 was accompanied by an EIT wave, coronal dimmings and type II radio burst (indicating the shock speed of about 870 km/s). The flare originated from the Catania sunspot group 36 (NOAA AR 1974) currently situated at the center of the solar disc. The full halo CME associated with this flare was first seen in the SOHO LASCO C2 field of view at 04:12 UT. The expected arrival of this halo CME is late February 16. We do not expect strongly disturbed geomagnetic conditions (K index maximum 4) due to its faint structure and slow speed of 300 km/s (as reported by the CACTUS software). A partial halo CME detected in the SOHO/LASCO C2 field of view at 09:24 UT on February 11 had angular width of about 200 degrees, and speed around 320

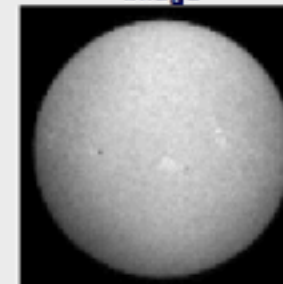
Latest SWAP image



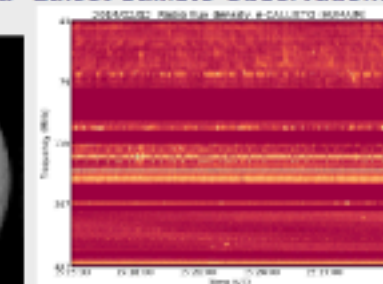
Latest LYRA curve



Latest USET H-alpha image



Latest Callisto Observations



ESWW11 call

Space weather warnings

<http://soho.nascom.nasa.gov/spaceweather/>

November 28, 2011 09:25:19 UT - Mission Day: 5841 - DOY: 332

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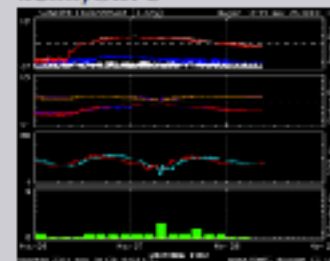
classroom

community

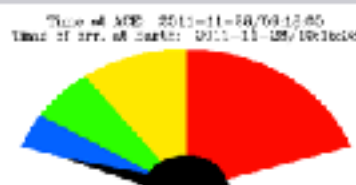
SPACE WEATHER

Space Weather

NOAA/SWPC

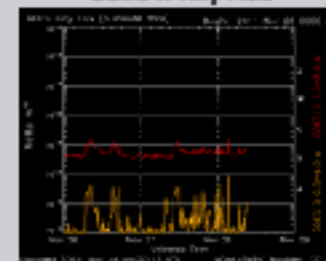


Dst Geomagnetic Index Estimate

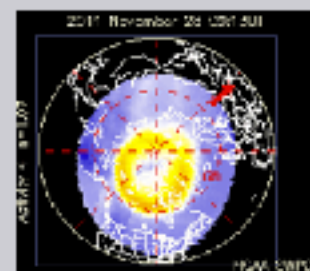


Low: Dst > -20 nT
Medium: -20 nT > Dst > -50 nT
High: -50 nT > Dst > -100 nT
Extreme: Dst < -100 nT

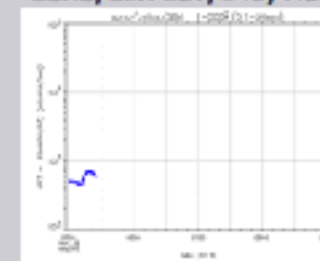
GOES X-Ray Flux



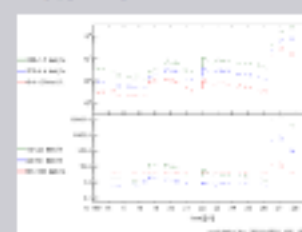
Auroral Activity Extrapolated from NOAA POES



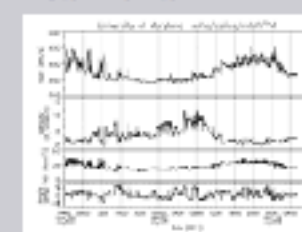
SOHO/SEM EUV/X-ray Flux



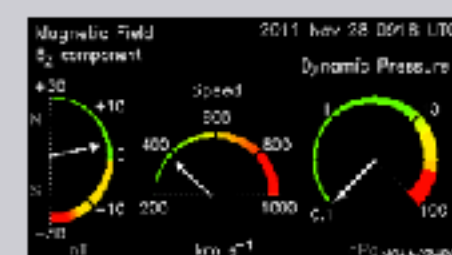
SOHO/ERNE High Energy Proton Flux



SOHO CELIAS/HTOP Proton Monitor




ACE Solar Wind Real-Time Data



Space weather warnings

www.spaceweather.com



spaceweather.com

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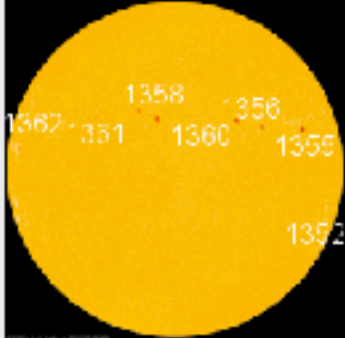
[AURORA ALERTS](#) | [SUBMIT YOUR PHOTOS!](#) | [3D SUN](#) | [CONTACT US](#) | [SUBSCRIBE](#) | [FLYBYS](#) | [SCIENCE@NASA](#)

Current Conditions

Solar wind
speed: 414.7 km/sec
density: 0.3 protons/cm³
[explanation](#) | [more data](#)
Updated: Today at 0916 UT

X-ray Solar Flares
6-hr max: C1 0311 UT Nov28
24-hr: C1 0311 UT Nov28
[explanation](#) | [more data](#)
Updated: Today at 0900 UT

Daily Sun: 28 Nov 11



None of these sunspots poses a threat for strong flares. Credit: SDO/HMI

Sunspot number: 123
[What is the sunspot number?](#)
Updated 27 Nov 2011

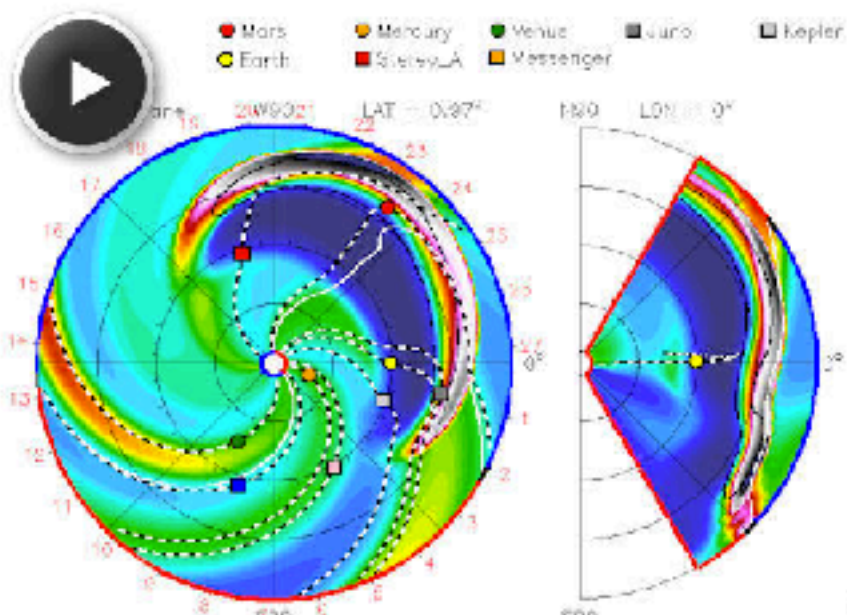
Spotless Days
Current Stretch: 0 days
2011 total: 2 days (<1%)
2010 total: 51 days (14%)
2009 total: 260 days (71%)
Since 2004: 521 days
Typical Solar Min: 455 days
Updated 27 Nov 2011

What's up in space

They came from outer space—and you can have one! Genuine meteorites are now on sale in the Space Weather Store.

AMATEUR ASTRONOMERS PHOTOGRAPH MARS ROCKET: NASA's super-sized Mars rover Curiosity is en route to the Red Planet after a successful [liftoff](#) from Cape Canaveral on Nov. 26th. Amateur astronomers are monitoring the mission's progress: Duncan Waldron of Brisbane, Australia, photographed Curiosity's spacecraft and its booster rocket shortly after a separation burn over the Indian Ocean ([image](#)) while Scott Ferguson of Titusville, Florida, caught the rover leaving the Earth-Moon system at a distance of 161,877 km ([image](#)). Curiosity is due to reach Mars in August 2012.

RADIATION STORM AND CME UPDATE: A radiation storm that began on Nov. 28th when a magnetic filament erupted on the sun is [subsiding](#). Nevertheless, the Earth-effects are just beginning. The same [explosion](#) that caused the radiation storm also hurled a [CME](#) into space at about 930 km/s (2 million mph). According to analysts at the Goddard Space Weather Lab, the CME will reach our planet on Nov. 28th at 17:21 UT (+/- 7 hours). Click to view an animated forecast track:



Legend: Mars, Mercury, Venus, Juno, Kepler, Earth, Svalley, A, Messenger

own your own METEORITE!

archives
November
29
2011
[view](#)

Solar Telescope
GREAT FOR SUNSPOTS!

Light Over Lapland PHOTO EXHIBITION
2 SPOTS LEFT BOOK NOW!
[LEARN MORE](#)

Averted Imagination
ASTROPHOTOGRAPHY

The aurora over North-America tonight

<http://www.gi.alaska.edu/AuroraForecast>



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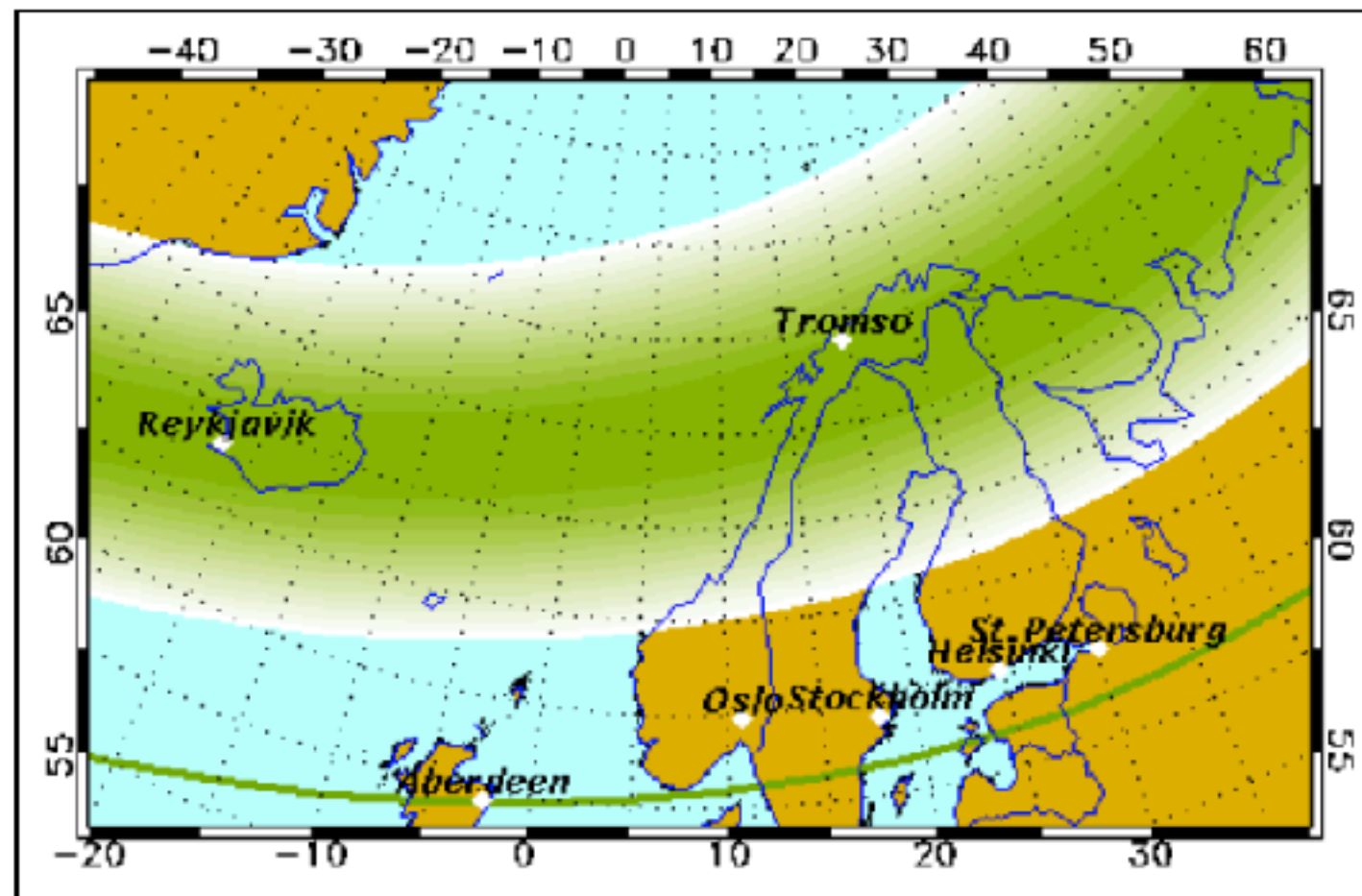
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Aurora Forecast for night of Wednesday, February 8, 2017



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Viewing Aurora in the Northern Summer

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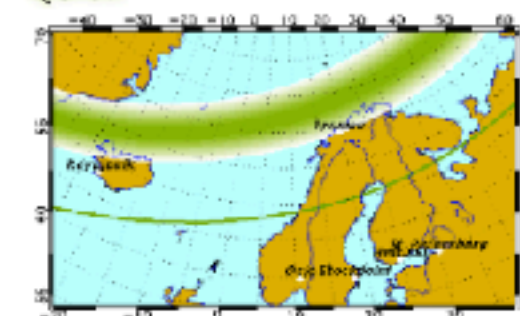
28 Day Forecast

Short-Term (1-hour) Forecast

Feb 08, 2017 / 16:15 GMT

(February 08, 2017 / 07:15 AST)

Quiet:




Active: 0 1 2 3 4 5 6 7 8 9


Forecast: Auroral activity will be active. Weather permitting, active auroral displays will be visible overhead from Tromsø, Norway to as far south as Umeå, Sweden and Trondheim, Norway, and visible low on the horizon in Oslo, Stockholm and Helsinki.

Aurora forecaster in Norway

<http://www.storm.no/nordlys/>

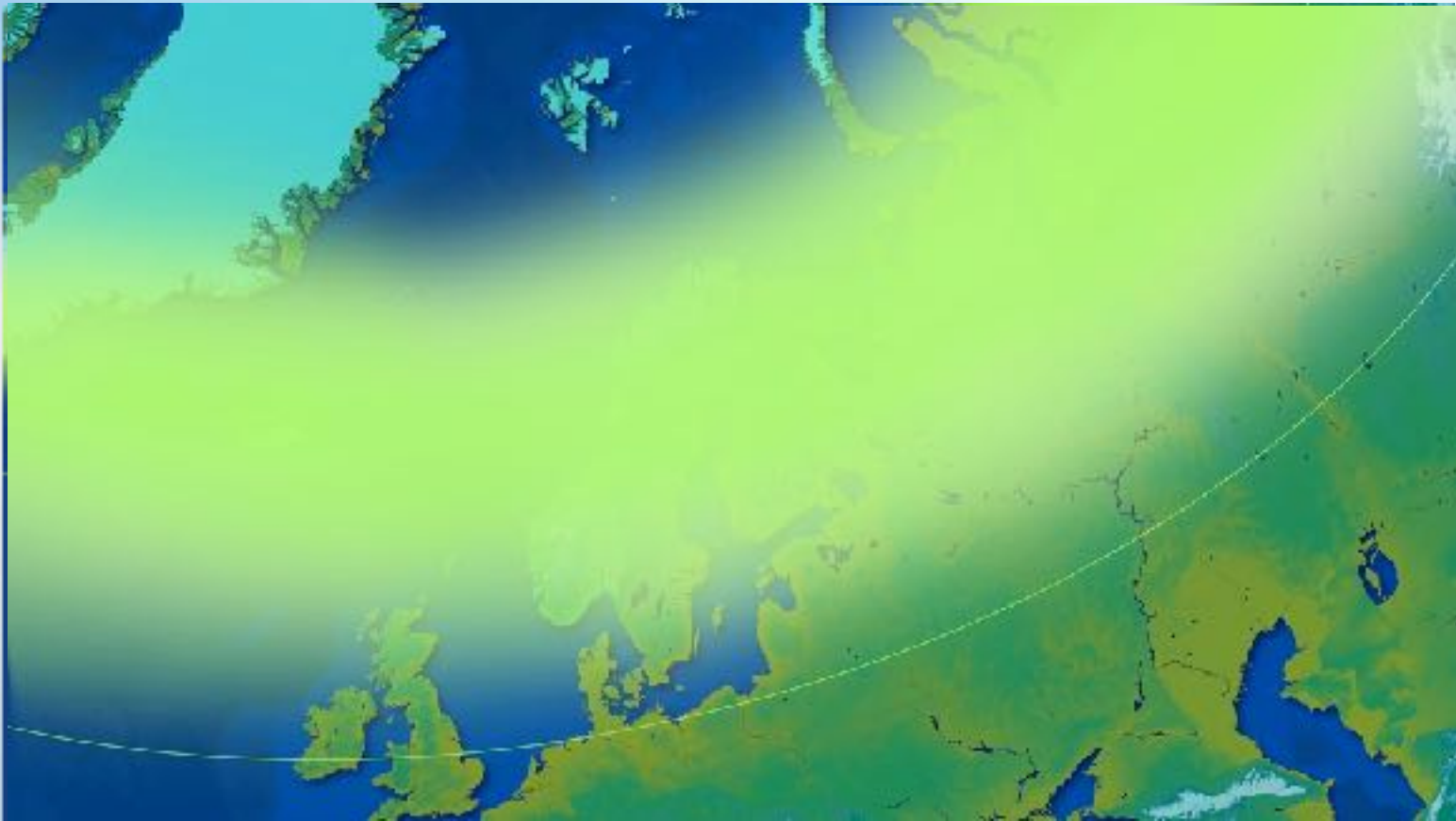


VÆRET

I samarbeid med 

Hvordan er været . SØK

Aurora Borealis - forecast for 10pm tonight



Forecast for tonight - updated 11:00

Auroral activity will be quiet. Quiet displays will be visible directly overhead in northern Iceland and Norway, and visible low on the horizon as far south as Rovaniemi, Finland and Mo i Rana, Norway.

What is really forecasted here?

Information about where the aurora will be located in the near future and from where one could observe it. The forecast is based on observations of solar and geophysical disturbances - what has happened on the Sun and what we expect will happen the next few days.

Read more about aurora borealis: www.northern-lights.no

Samarbeidspartnere: [Norsk Romsenter](#) [UNIS](#) [University of Alaska](#)

Basert på data fra: [NASA/NOAA/SEC](#)

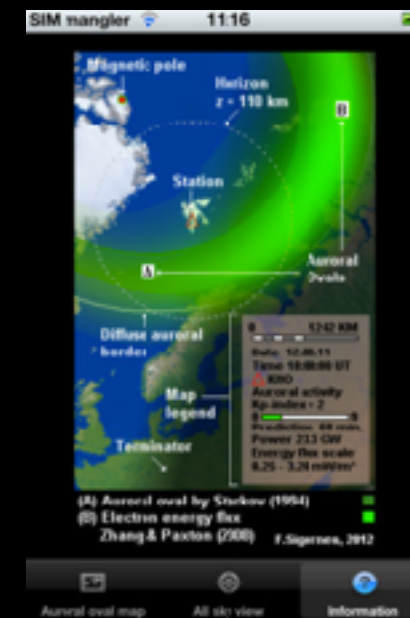
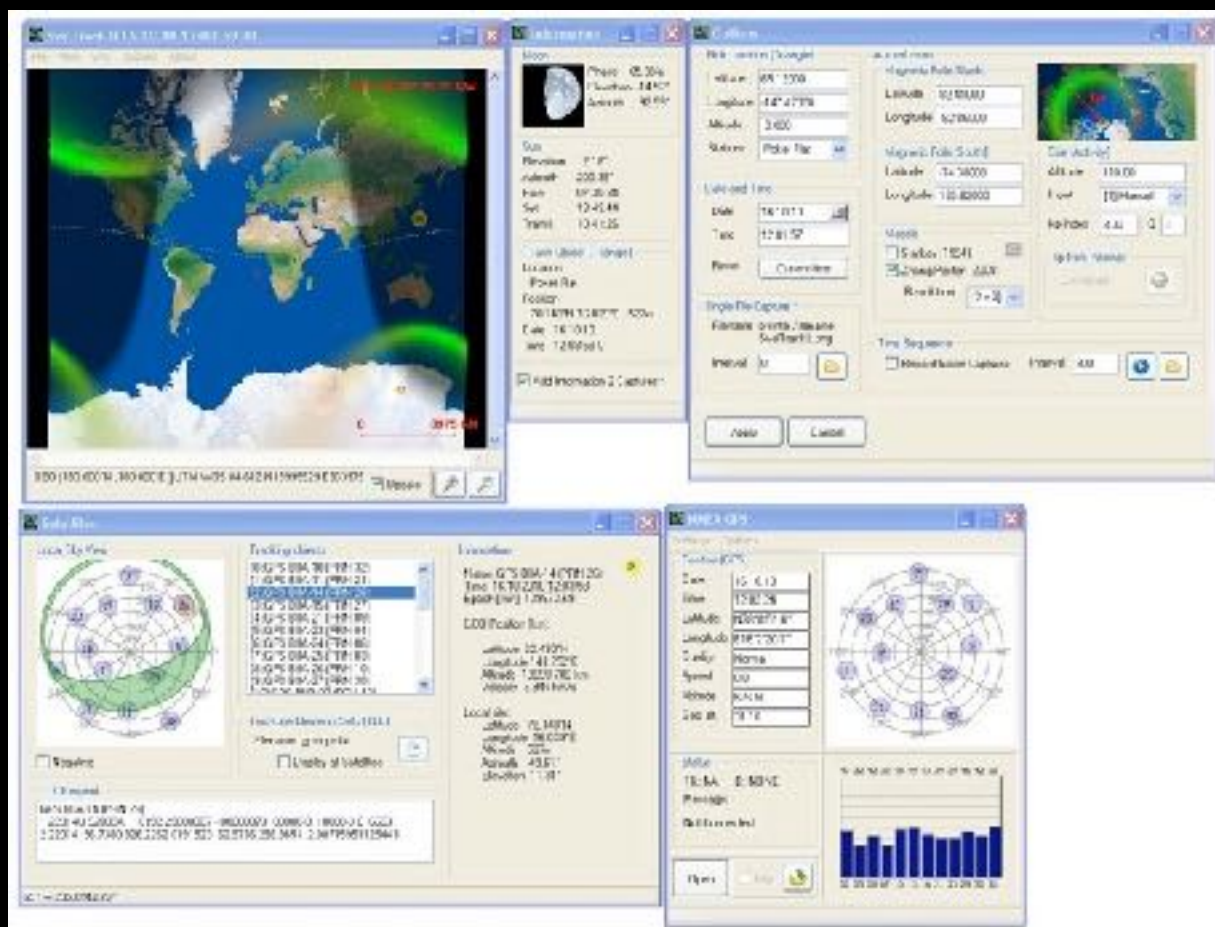
The UNIS Aurora forecaster

Download at: <http://kho.unis.no/>

Real time aurora oval forecasting - SvalTrackII

T. Sigernes⁽¹⁾, M. Dyrland⁽¹⁾, P. Brekke⁽²⁾, E. K. Gjengedal⁽¹⁾, S. Chernouss⁽¹⁾,
D. A. Lorentzen⁽¹⁾, K. Oksavik⁽¹⁾ and C. S. Deehr⁽³⁾

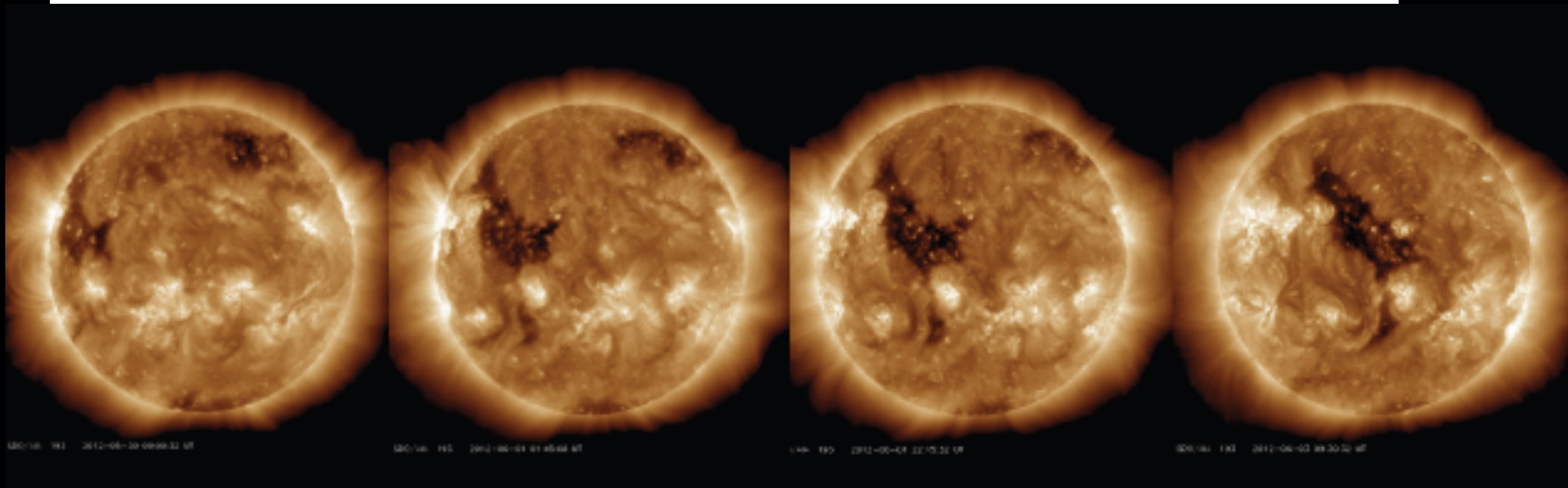
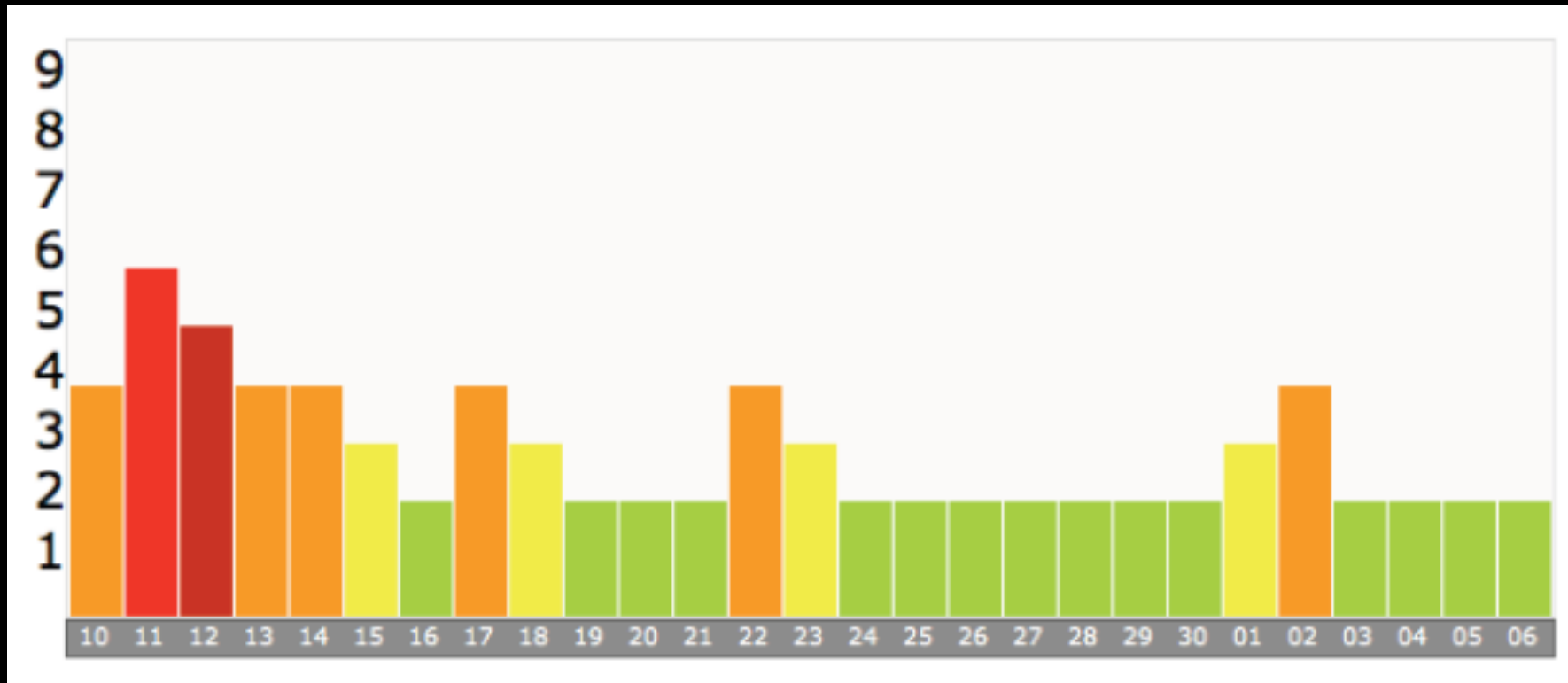
The 37th Annual European Meeting on Atmospheric by Optical Methods, Valladolid, Spain, 23 - 27 August 2010.



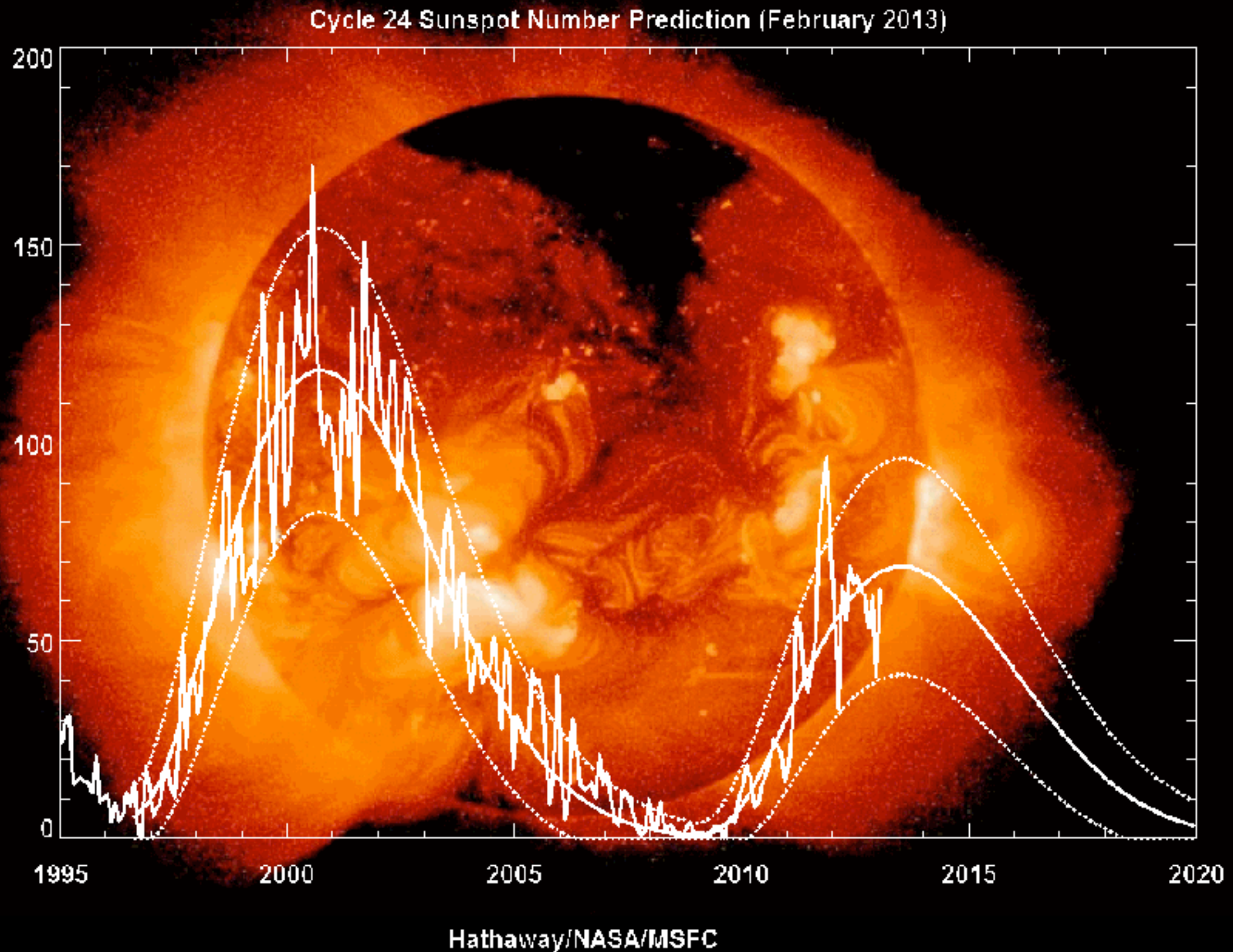
Long term forecasting

Coronal holes appear as dark areas in the solar corona in extreme ultraviolet (EUV) and soft x-ray solar images. They appear dark because they are cooler, less dense regions than the surrounding plasma and are regions of open, unipolar magnetic fields. This open, magnetic field line structure allows the solar wind to escape more readily into space, resulting in streams of relatively fast solar wind and is often referred to as a high speed stream in the context of analysis of structures in interplanetary space.

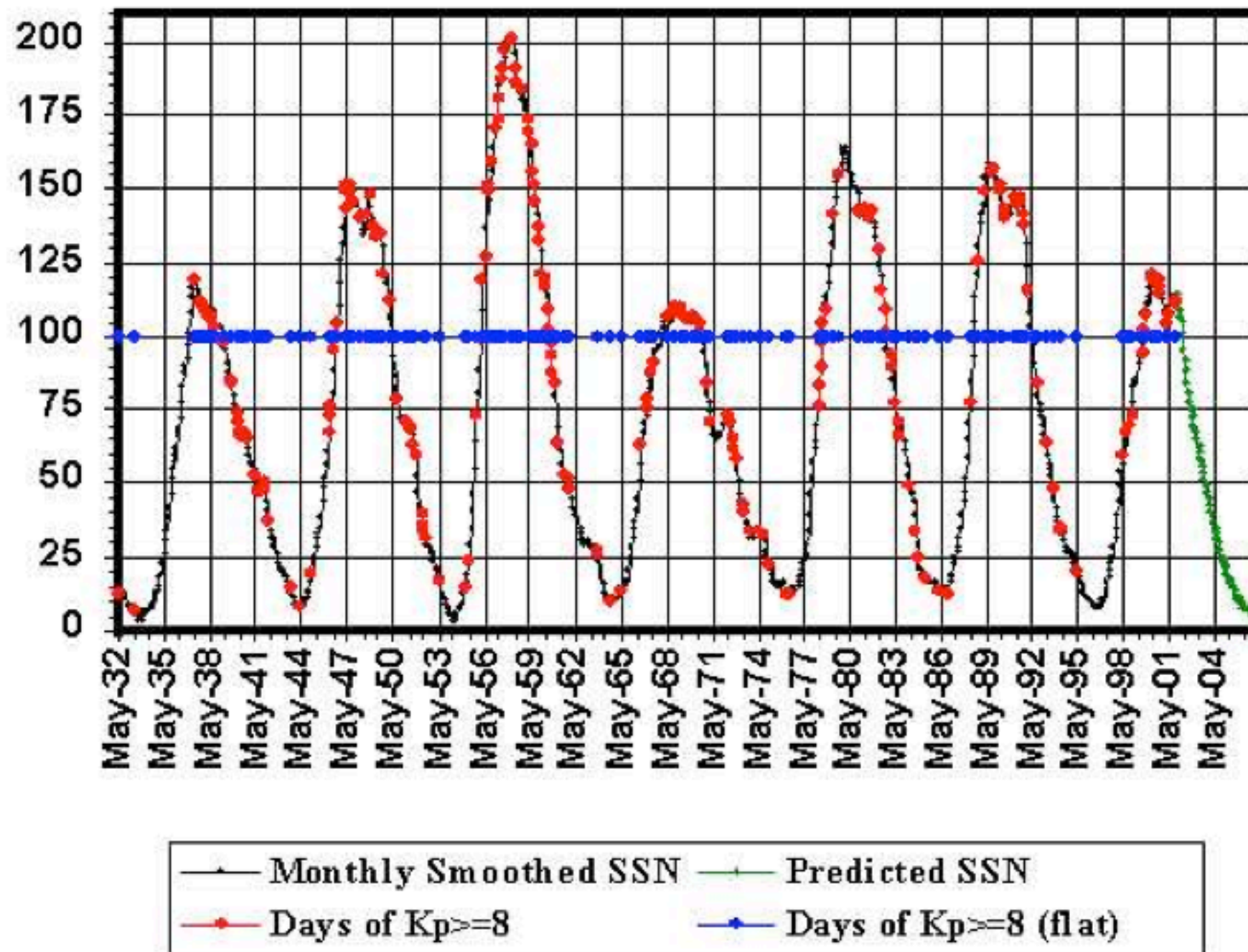
Persistent coronal holes are long-lasting sources for high speed solar wind streams.



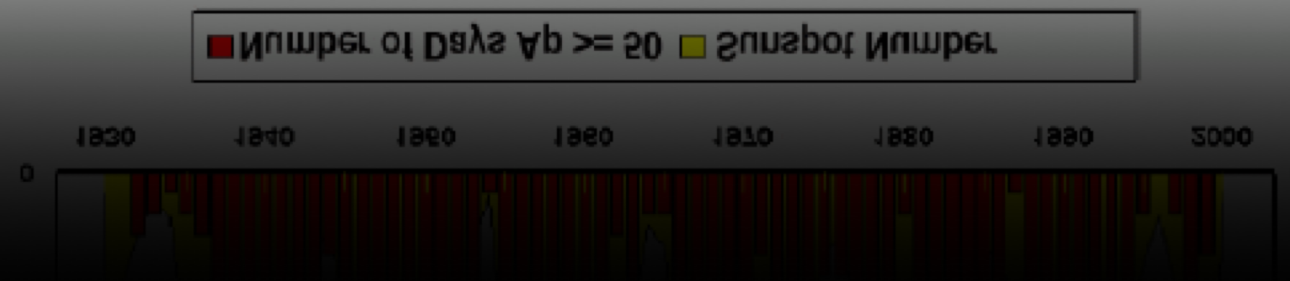
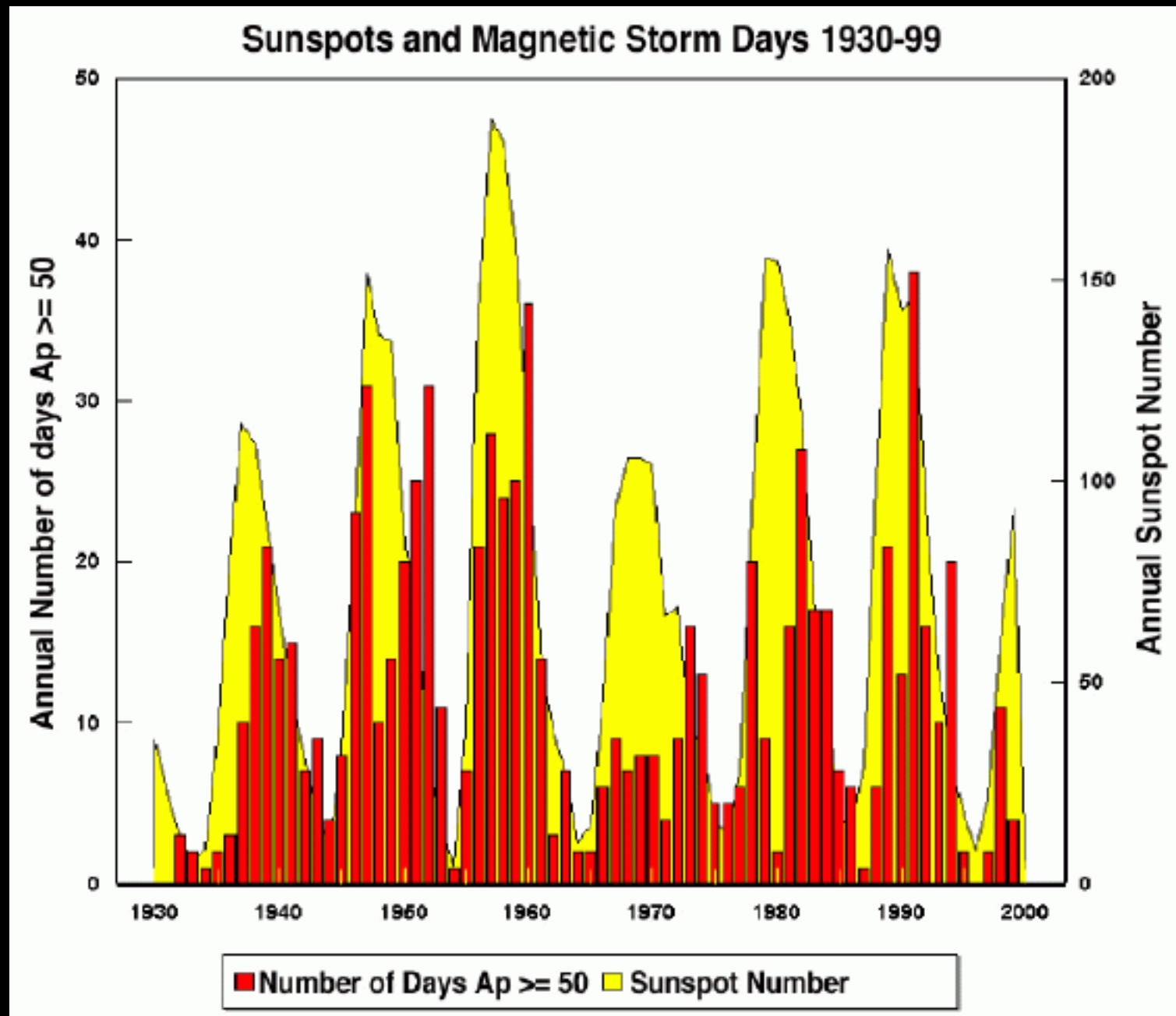
When do strong storms occure?



When do strong storms occure?



Solar cycle and geomagnetic disturbances



Extreme Solar Weather Has Happened Before

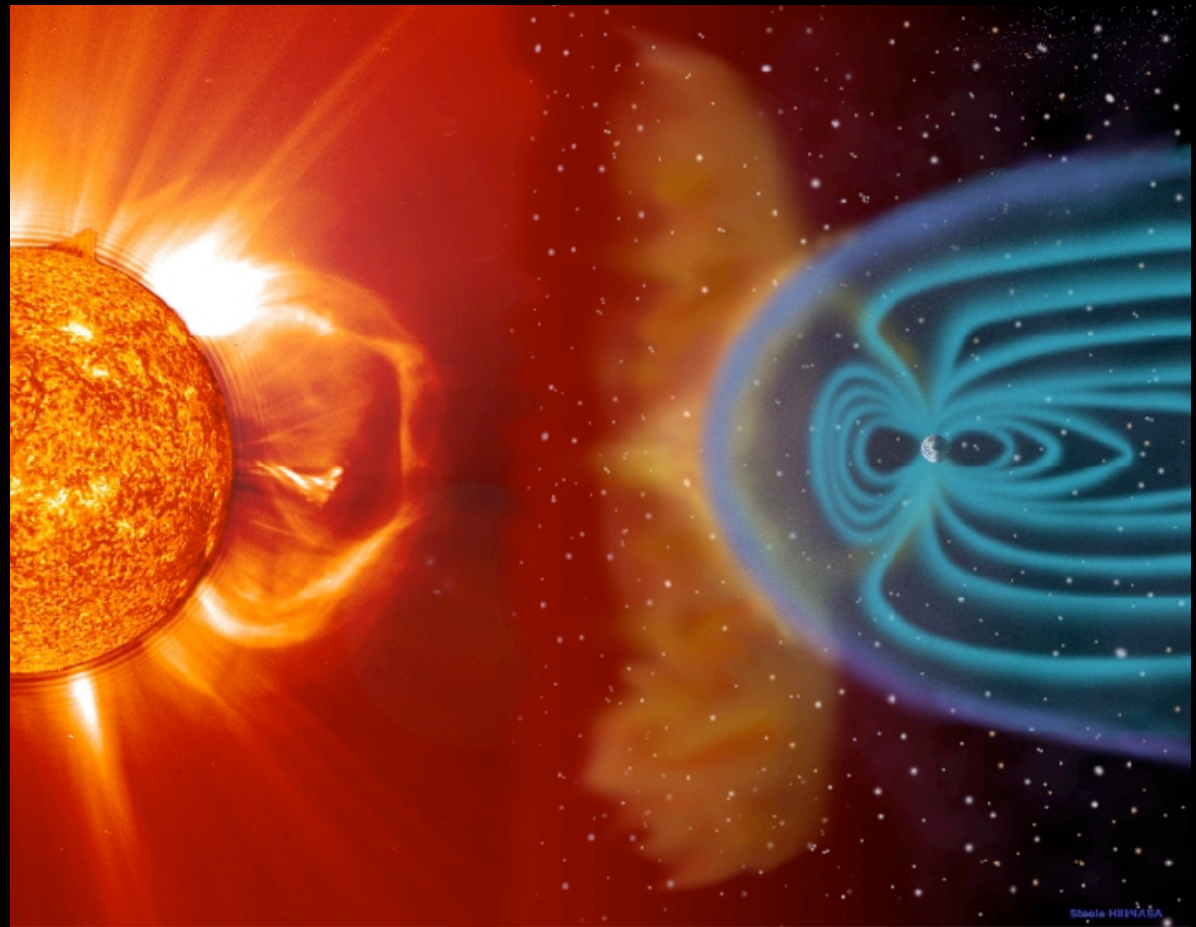
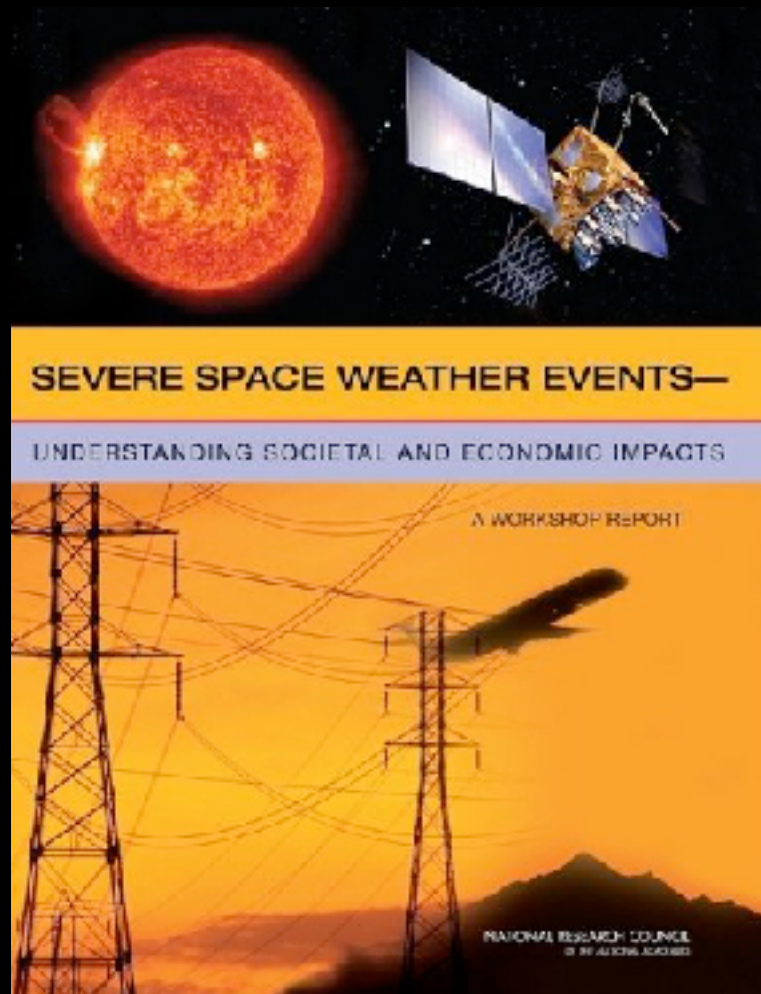


Morse Telegraph Table

Photo from www.telegraphlore.com

- **1847** – “Anomalous current” noted on telegraph line between Derby and Birmingham. First recorded impact of solar weather on technology.
- **August 28-29, 1859** – Telegraph service disrupted worldwide by geomagnetic superstorm.
- **September 1-2, 1859** – Carrington-Hodgson event is largest geomagnetic storm in 500 years.
- **May 16, 1921** – The “Great Storm” disrupted telegraph service, caused fires, burned out cables. **Storms like this may occur roughly every 100 years.**
- **March 13, 1989** – Geomagnetic storm collapsed Quebec power grid. Northeast U.S. and Midwest power grid came within seconds of collapse.
- **October 19 – November 7, 2003** – “Halloween Storms” interrupted GPS, blacked out High Frequency (HF) radio, forced emergency procedures at nuclear power plants in Canada and the Northeastern United States, and destroyed several large electrical power transformers in South Africa.

Super Storms

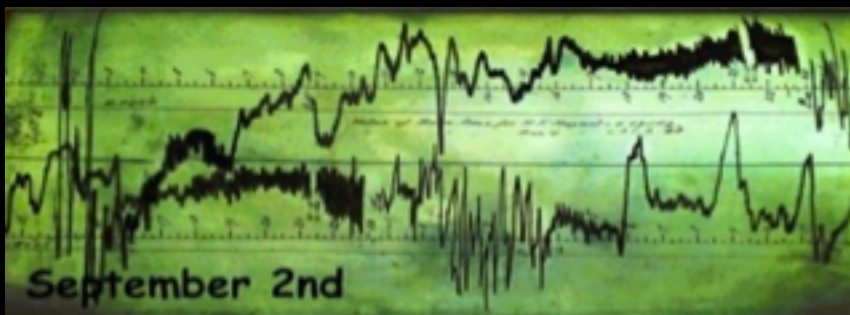
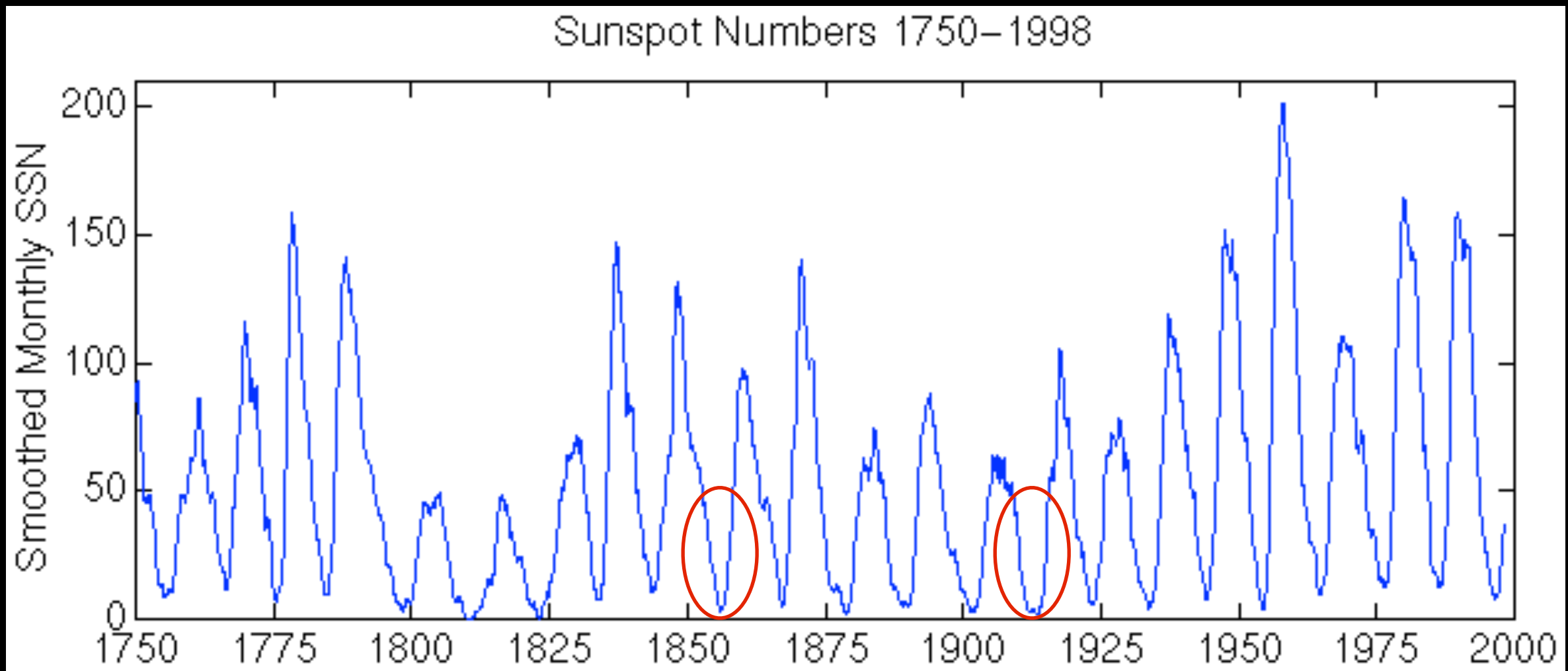


http://www.nap.edu/catalog.php?record_id=12507

According to a study by the Metatech Corporation, the occurrence today of an event like the 1921 storm would result in large-scale blackouts affecting more than 130 million people and would expose more than 350 transformers to the risk of permanent damage

....and an estimate of \$1 trillion to \$2 trillion during the first year alone was given for the societal and economic costs of a “severe geomagnetic storm scenario” with recovery times of 4 to 10 years.



When do strong storms occure?



1859 Storm

1921 Storm

Current Space Weather conditions



SPACE WEATHER PREDICTION CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Wednesday, February 08, 2017 09:54:29 UTC

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SPACE WEATHER CONDITIONS on NOAA Scales

24-Hour Observed Maximums

R

S

G

none none none

Latest Observed

R

S

G

none none none

Predicted 2017-02-08 UTC

R1-R2

R3-R5

1%

1%

51 or greater

1%





G

none

Solar Wind Speed: **486** km/sec

Solar Wind Magnetic Fields: Bt **4** nT, Bz **0** nT

Noon 10.7cm Radio Flux: **72** stu



Latest GOES Satellite now in Successful Orbit; Re-designated GOES-16
published: Thursday, December 01, 2016 21:47 UTC
On November 29, 2016, the newest GOES satellite was successfully placed into geostationary orbit (approximately 22,000 miles away from Earth) and h

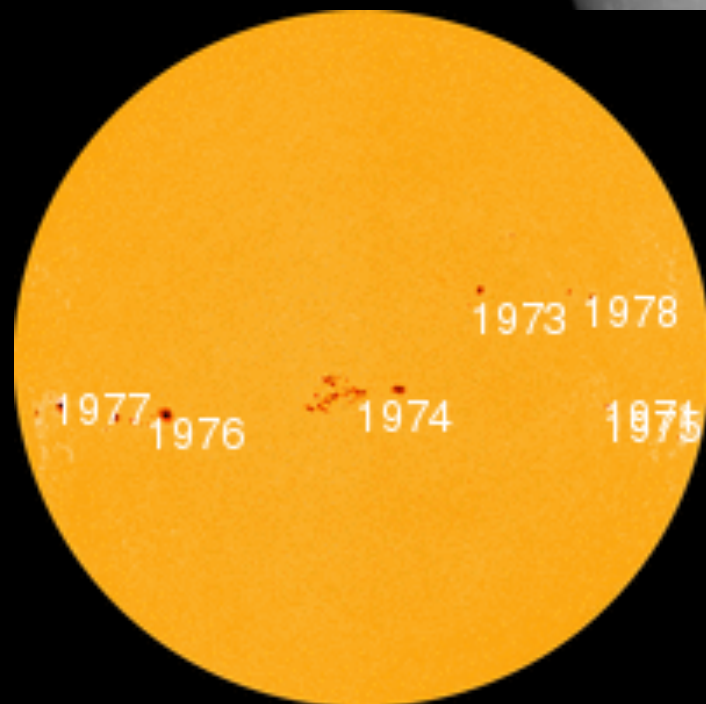
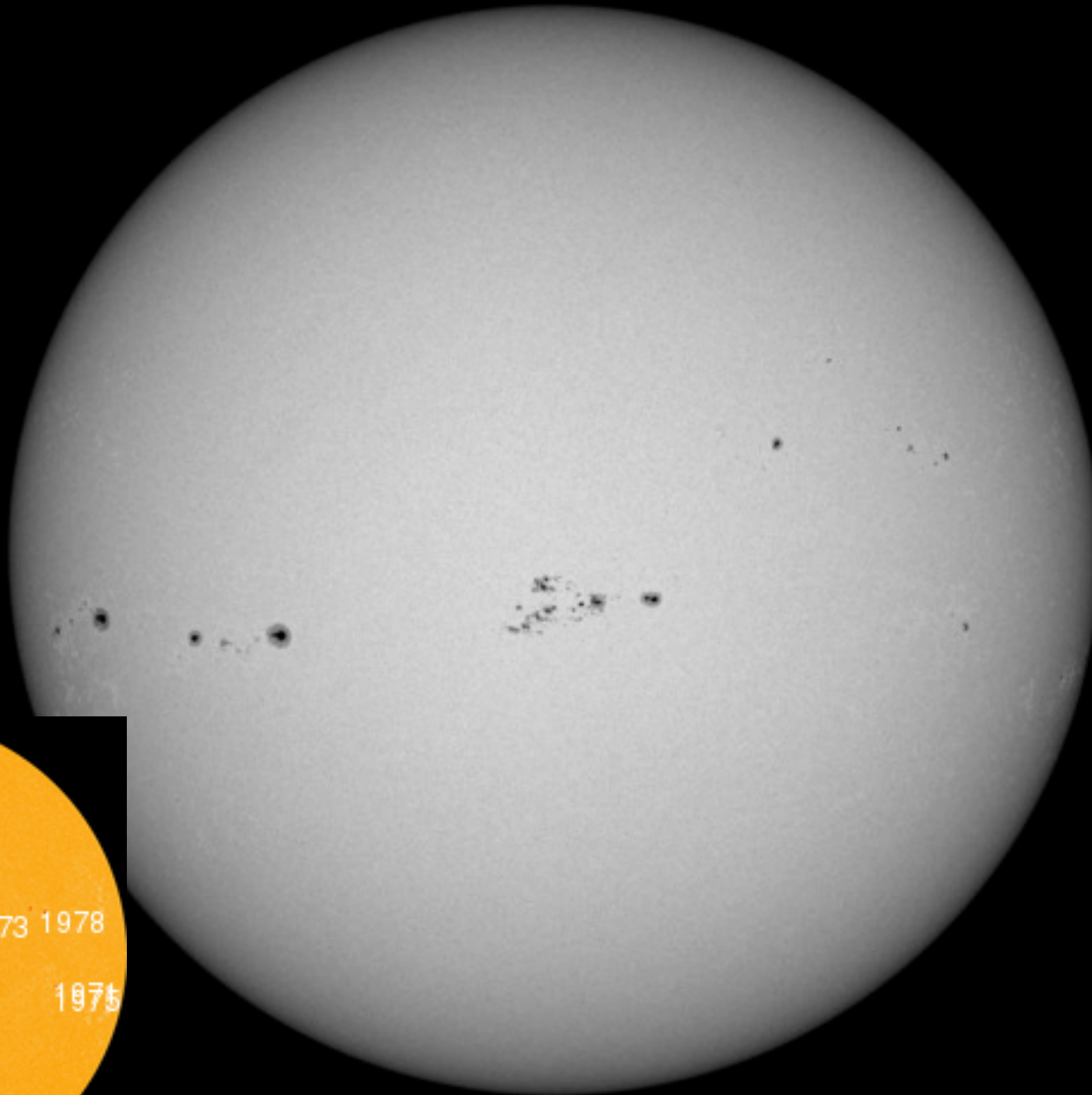
Winter Weather Preparedness and Safety Tips from the NWS
published: Thursday, December 01, 2016 05:18 UTC
Winter can bring with it a wide variety of potentially dangerous weather that can impact roadways, outdoor activities, infrastructure, and more. Be

Executive Order to Prepare Nation for Space Weather Events
published: Monday, November 07, 2016 16:51 UTC
An Executive Order to coordinate efforts to prepare the nation for space weather events was signed by President Obama on 13 Oct. Read the full ord

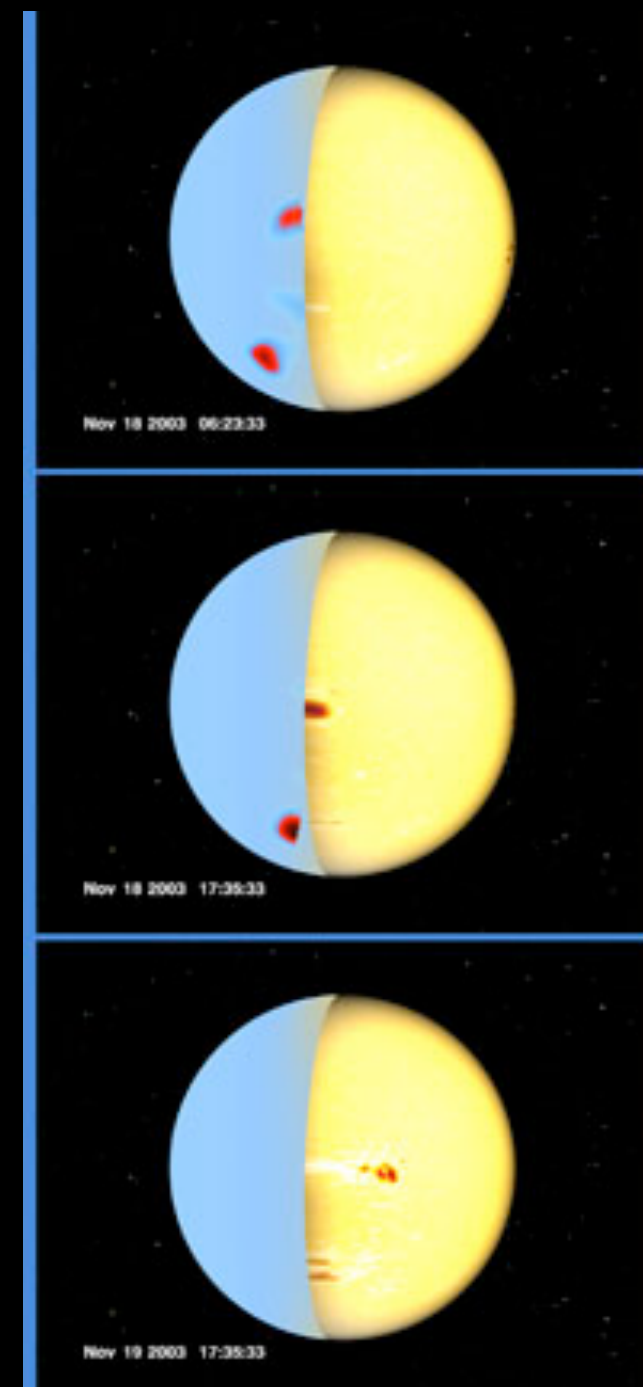
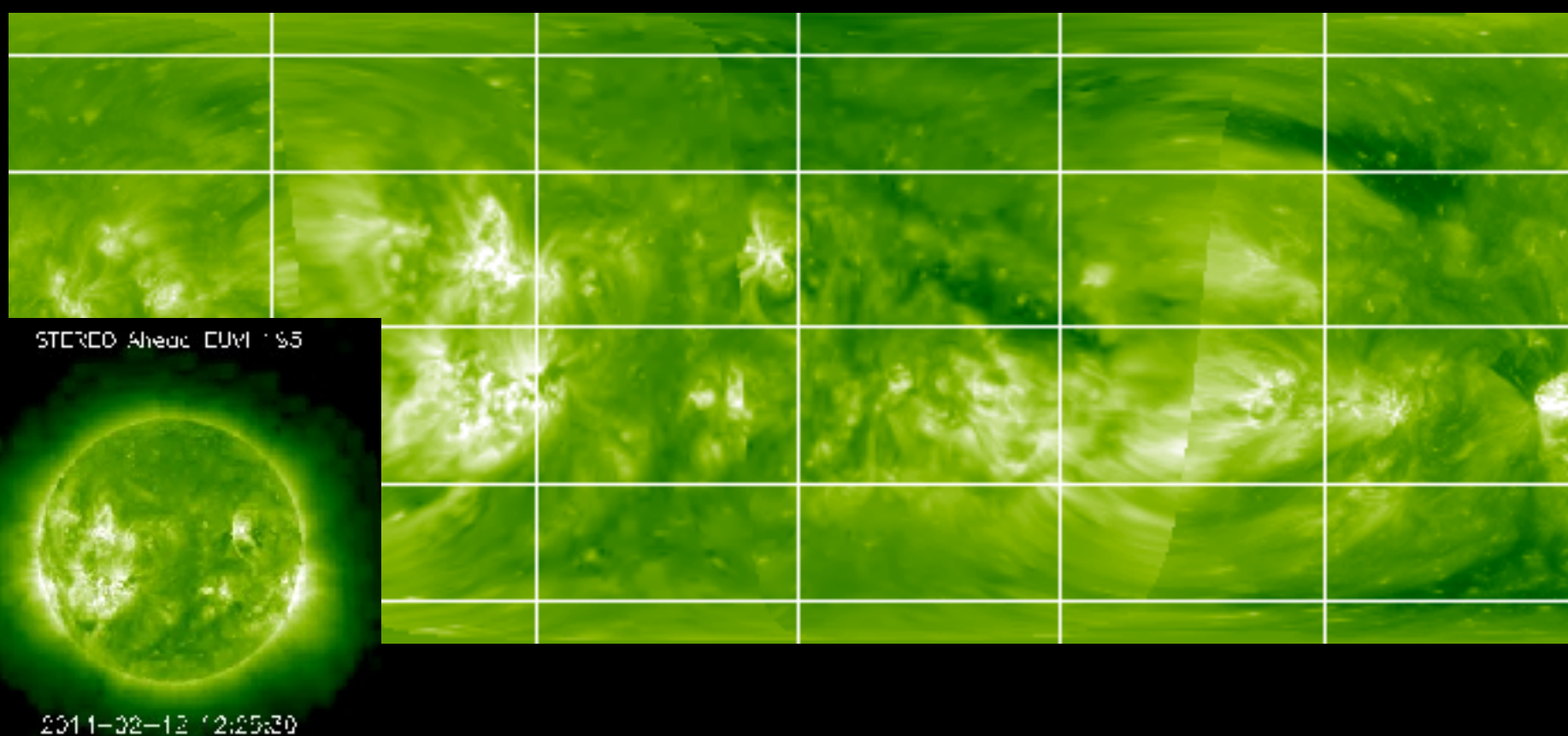
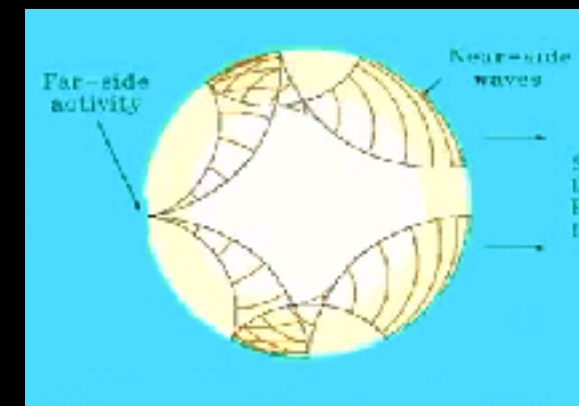
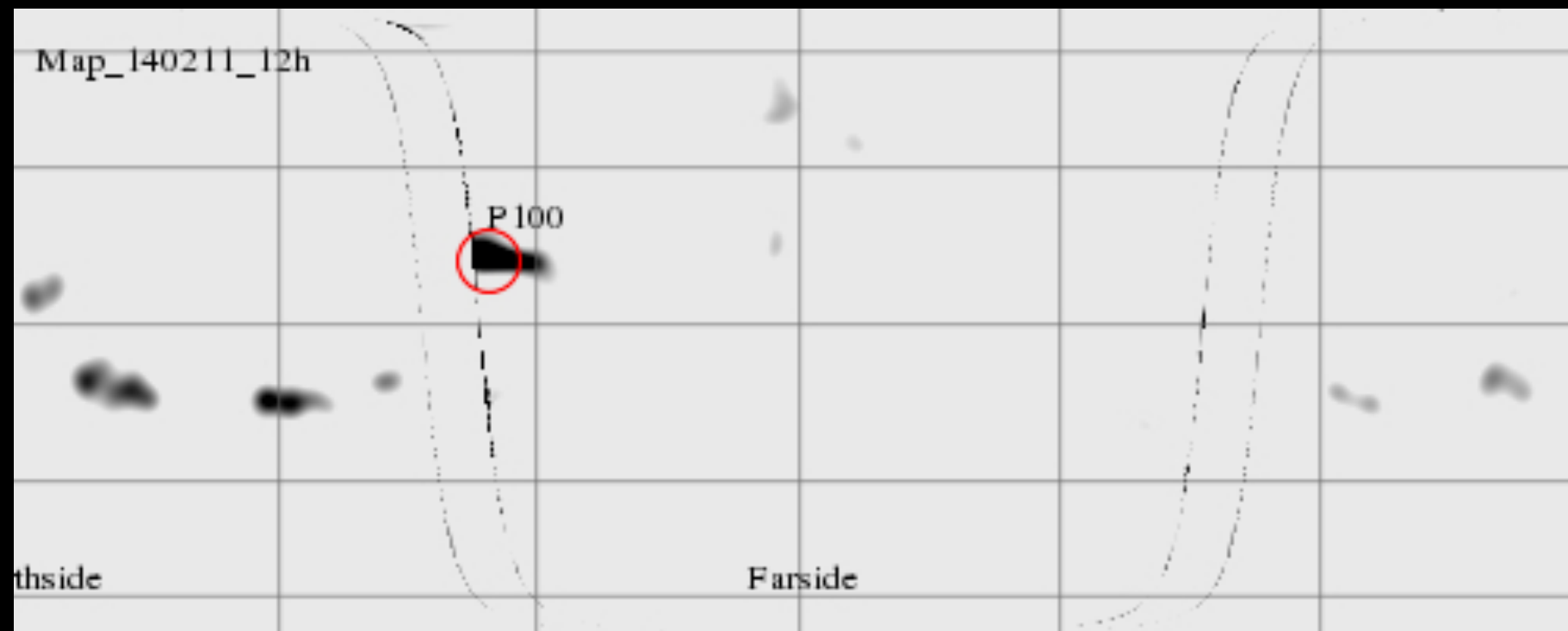
New Experimental Regional Geomagnetic Products Available
published: Monday, November 07, 2016 14:22 UTC
SWPC deployed experimental products from the new operational Geospace model on Oct 5th.

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

Current Solar conditions



Current Solar conditions - far side



Current Solar conditions

:Issued: 2014 Feb 11 2303 UTC

:Product: documentation at <http://www.sidc.be/products/presto>

#-----#

FAST WARNING 'PRESTO' MESSAGE from the SIDC (RWC-Belgium)

#-----#

The impulsive M1.7 flare peaked at 03:31 UT on February 11 was accompanied by an EIT wave, coronal dimmings and a very faint halo CME. The flare originated from the Catania sunspot group 36 (NOAA AR 1974) currently situated at the center of the solar disc. The full halo CME associated with this flare was first seen in the SOHO LASCO C2 field of view at 04:12 UT. The expected arrival of this halo CME is late February 16. We do not expect strongly disturbed geomagnetic conditions (K index maximum 4) due to its faint structure and slow speed of 300 km/s (as reported by the CACTUS software).

#-----#

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

#-----#

:Issued: 2014 Feb 11 2336 UTC

:Product: documentation at <http://www.sidc.be/products/presto>

#-----#

FAST WARNING 'PRESTO' MESSAGE from the SIDC (RWC-Belgium)

#-----#

A partial halo CME was detected in the SOHO/LASCO C2 field of view at 09:24 UT on February 11. The CME had angular width of about 200 degrees, and speed around 320 km/s (as reported by the CACTUS software). It was associated with an eruption of a filament situated between the Catania sunspot group 35 (NOAA AR 1973) and newly emerged, unnumbered active region situated on the west from the Catania sunspot group 35. The eruption was accompanied by coronal dimmings and a post-eruption arcade observed by SDO/AIA. The bulk of the CME mass was directed northward of the Sun-Earth line, so we expect the arrival of only a CME-driven shock at the Earth, probably on February 16. It may result in active to minor storm geomagnetic conditions.

#-----#

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

#-----#