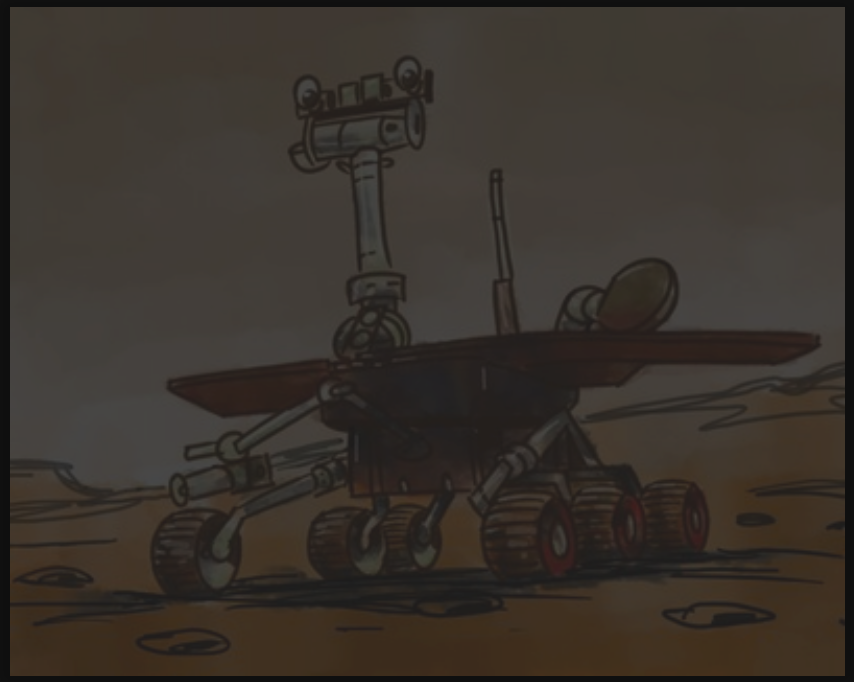
National Aeronautics and Space Administration
NASA
The Integrated Space Weather Analysis System
Marlo Maddox
SW REDI Boot Camp
June 4th, 2013
NASA Goddard Space Flight Center
Greenbelt, MD
http://ccmc.gsfc.nasa.gov
HSD
Space Weather LAB
www.nasa.gov

...but first,

A little

Story

In 2004, the Mars Rover Spirit experienced an anomaly...



Communication with Earth was lost for several days...

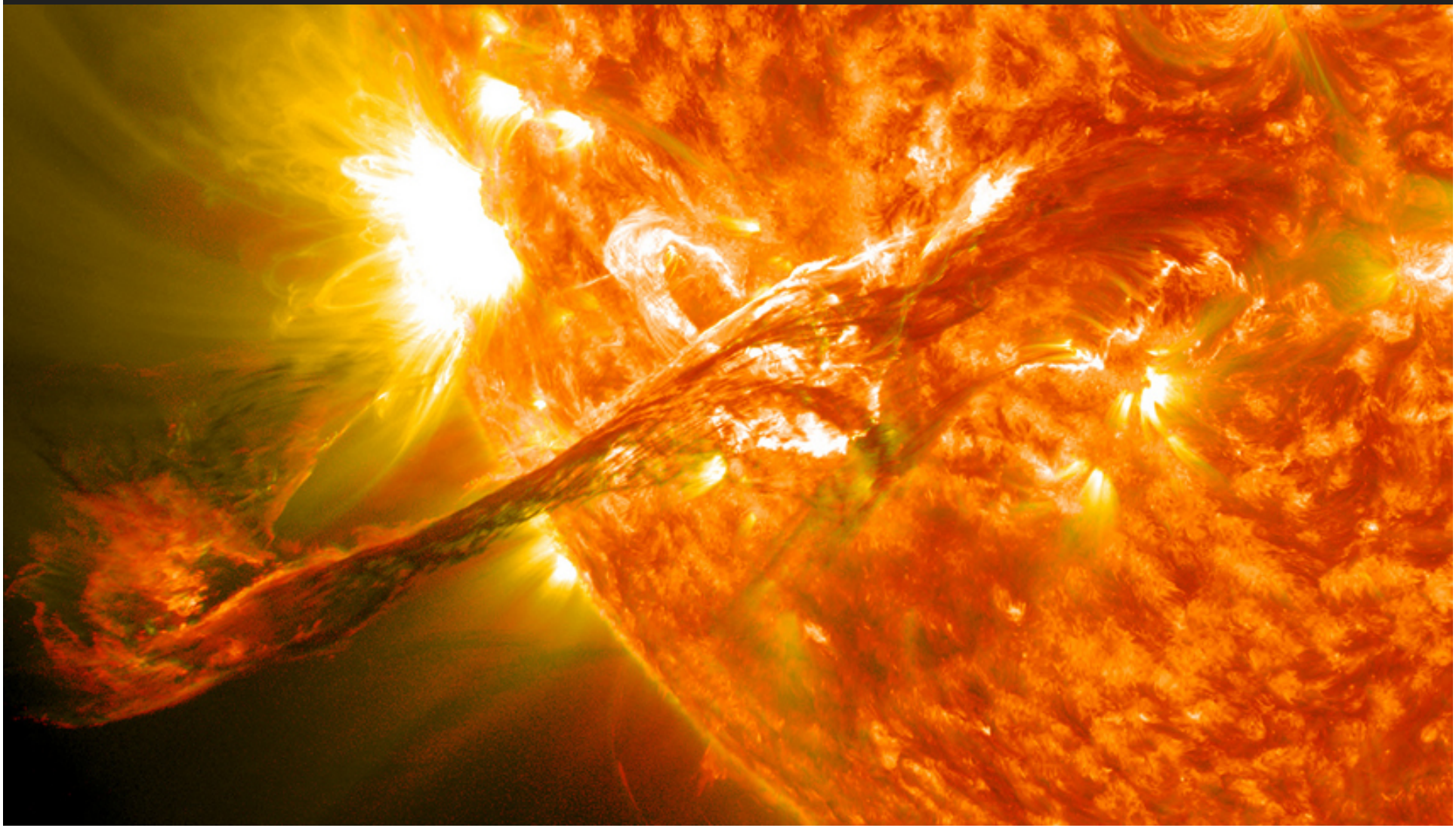
Teams scrambled to gather information.

Was this a hardware issue?

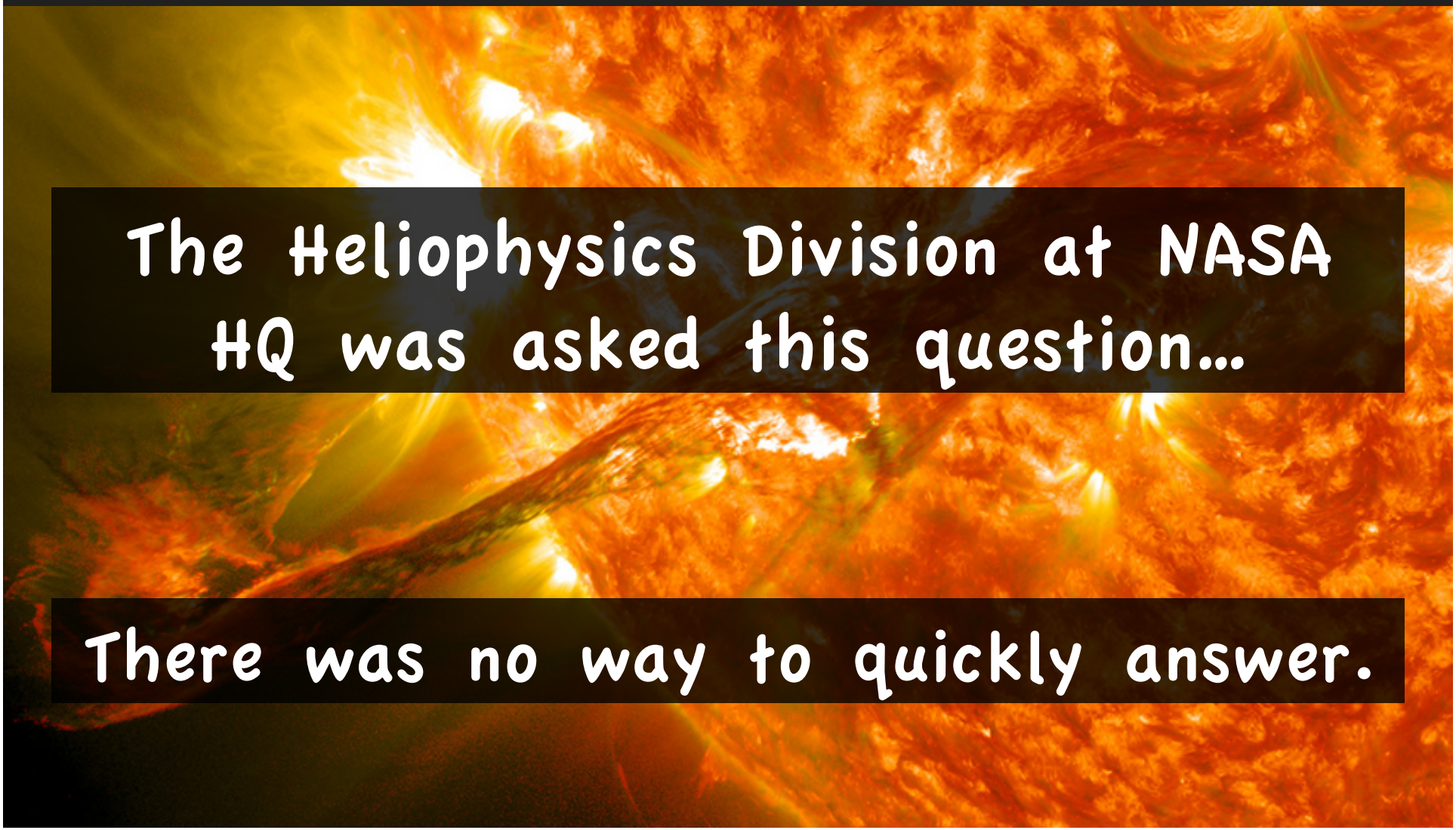
...a software issue?

Were environmental forces at play?

Was It Space Weather Related?

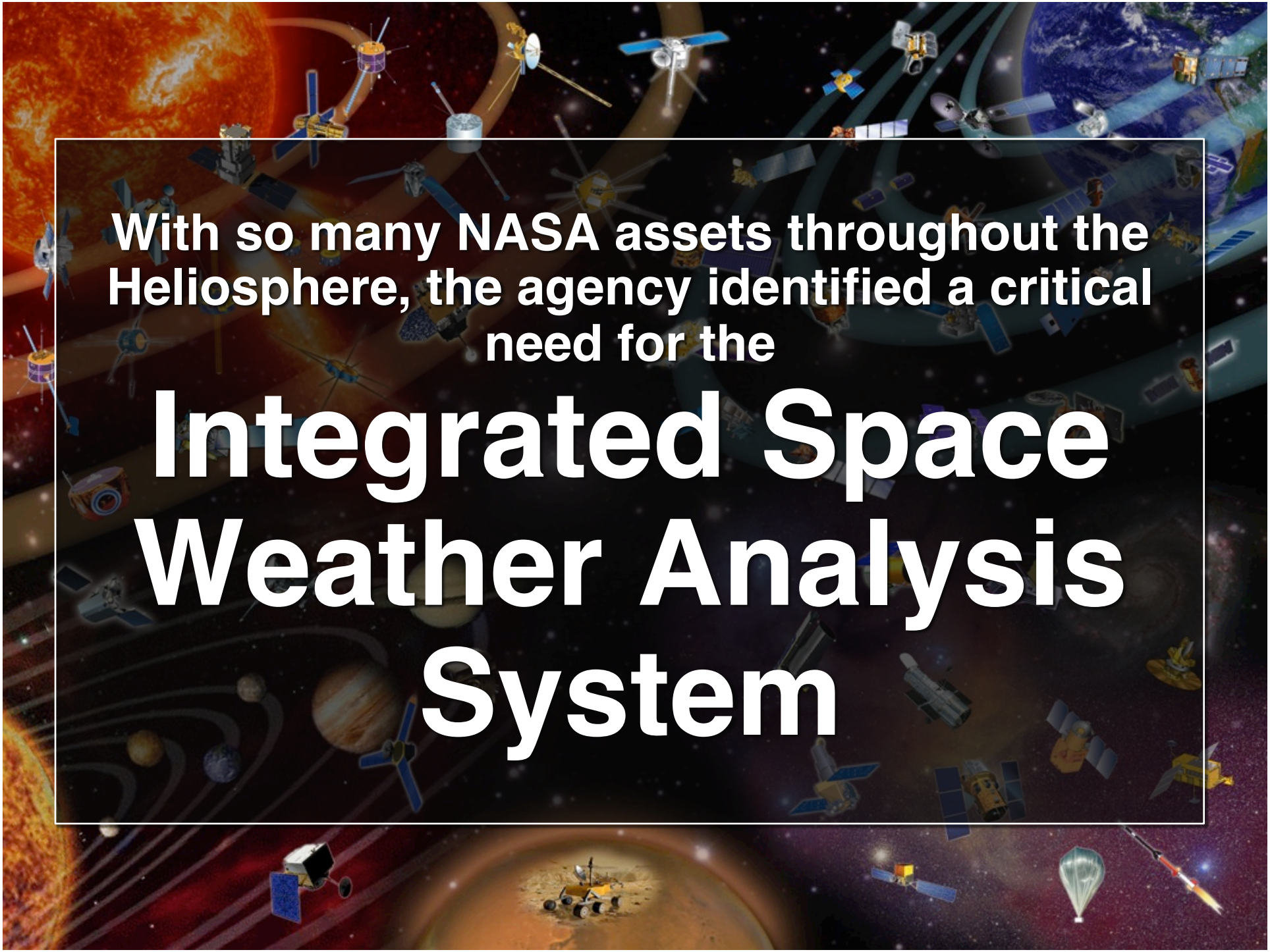


Was It Space Weather Related?

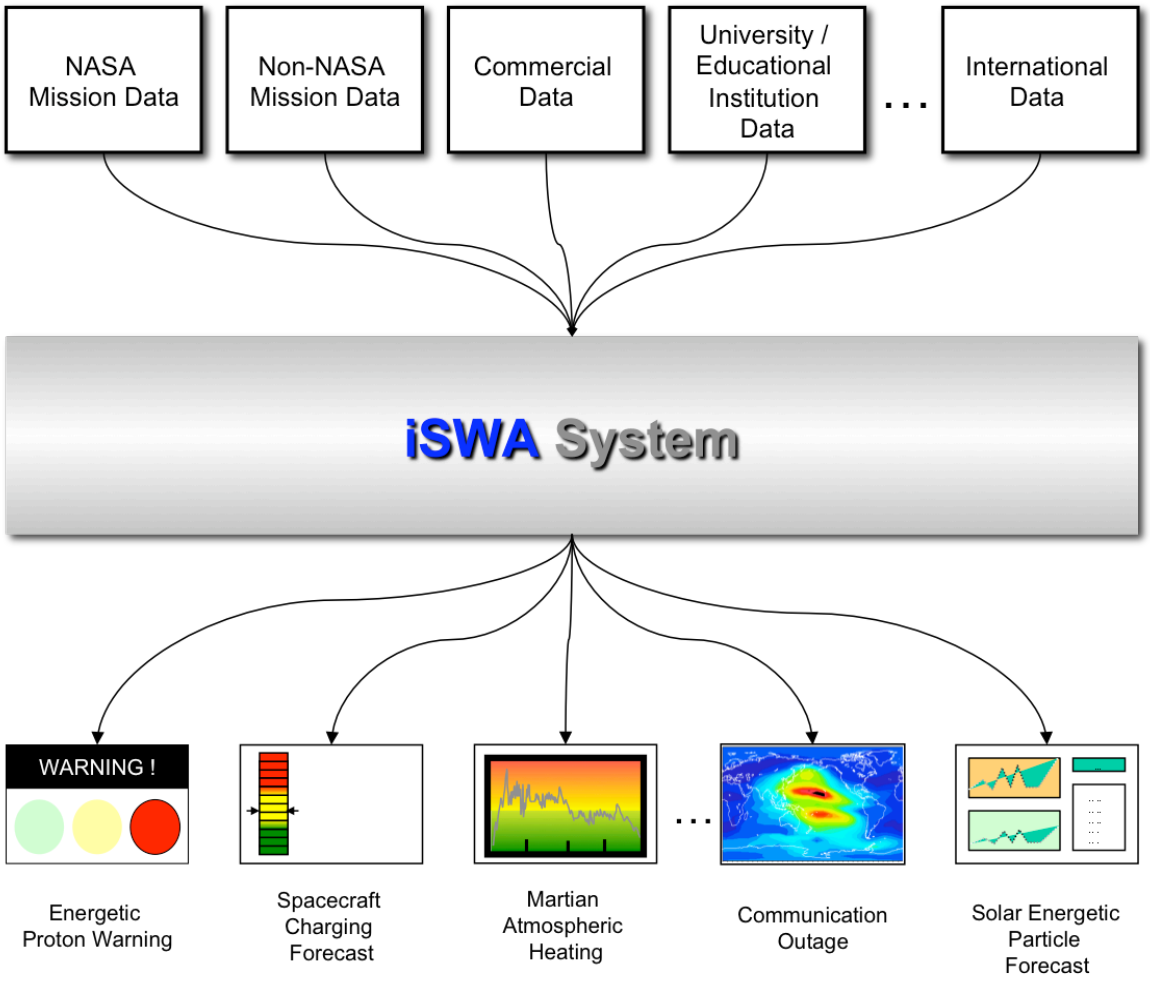


The Heliophysics Division at NASA HQ was asked this question…

There was no way to quickly answer.


With so many NASA assets throughout the Heliosphere, the agency identified a critical need for the
Integrated Space Weather Analysis System

iNTEGRATED SPACE WEATHER ANALYSIS SYSTEM



Highly diverse and distributed space weather data consisting of the latest observational data along with the most advanced space weather model simulation output.

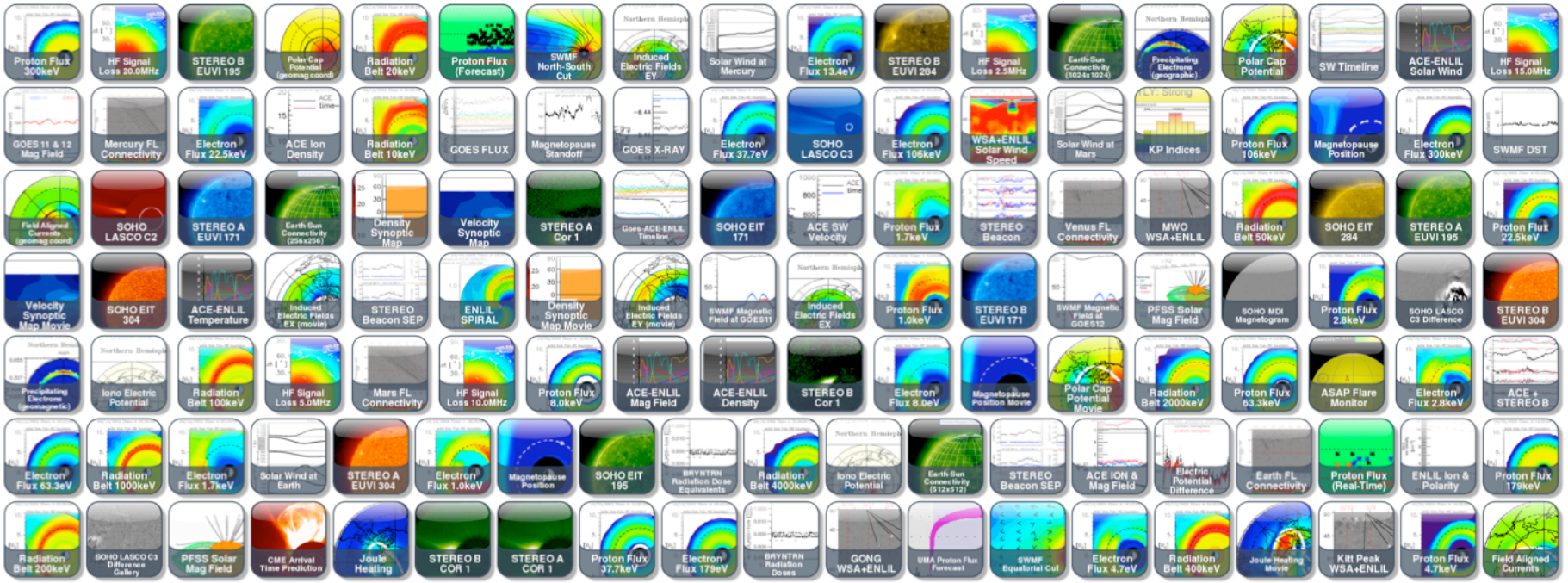
iSWA system collects data from a large and evolving list of sources. Data is sorted, characterized, and processed into 'mission decision supporting' products in response to individual user queries.

iSWA generates and provides a user-configurable display panel that can be accessed from a standard web browser. The end user can then customize their display to focus on specific products of interest.

iNTEGRATED SPACE WEATHER ANALYSIS SYSTEM

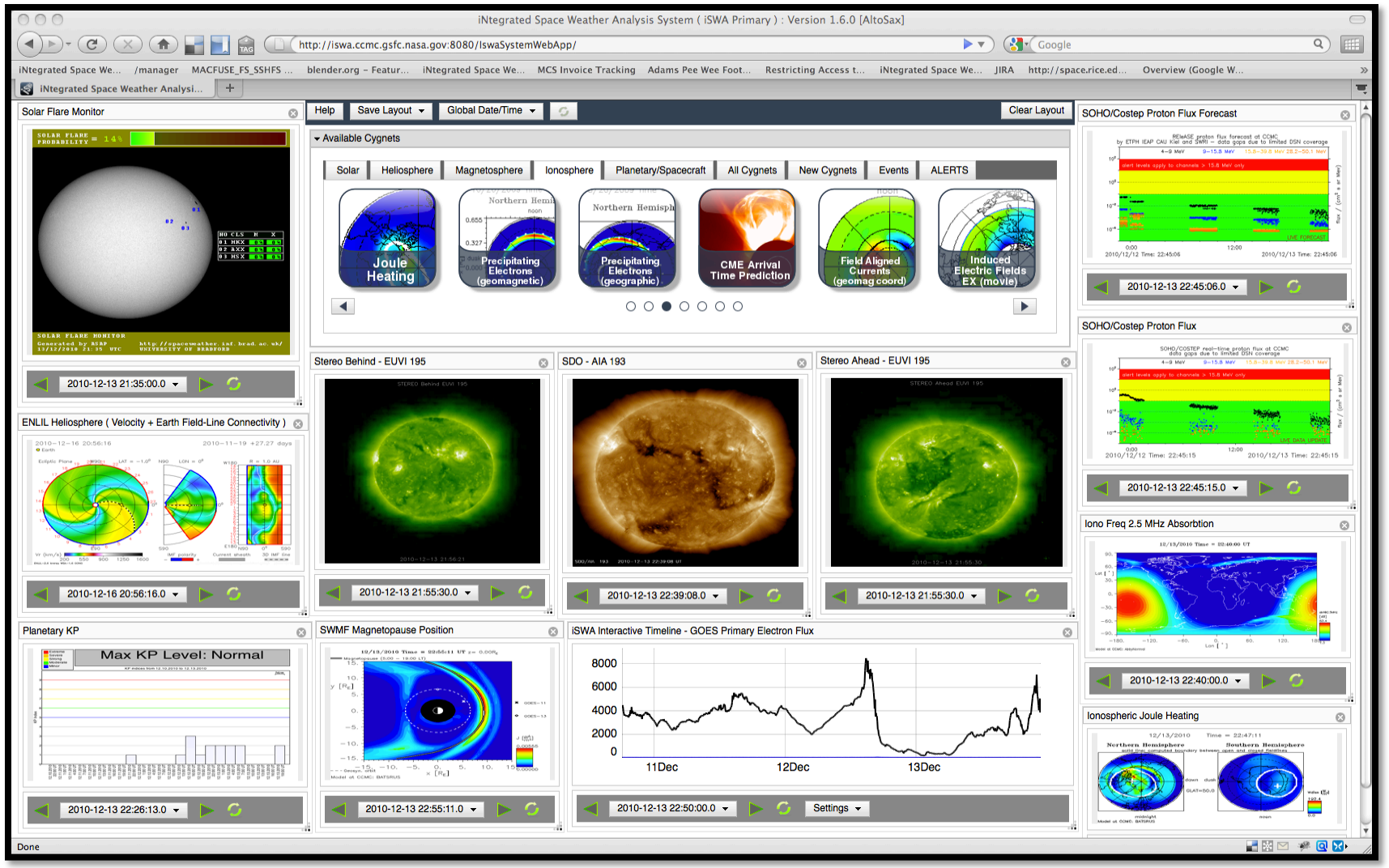
Innovative Dissemination

ISWA has ~300 products including modeling results and comprehensive sets of observational data.

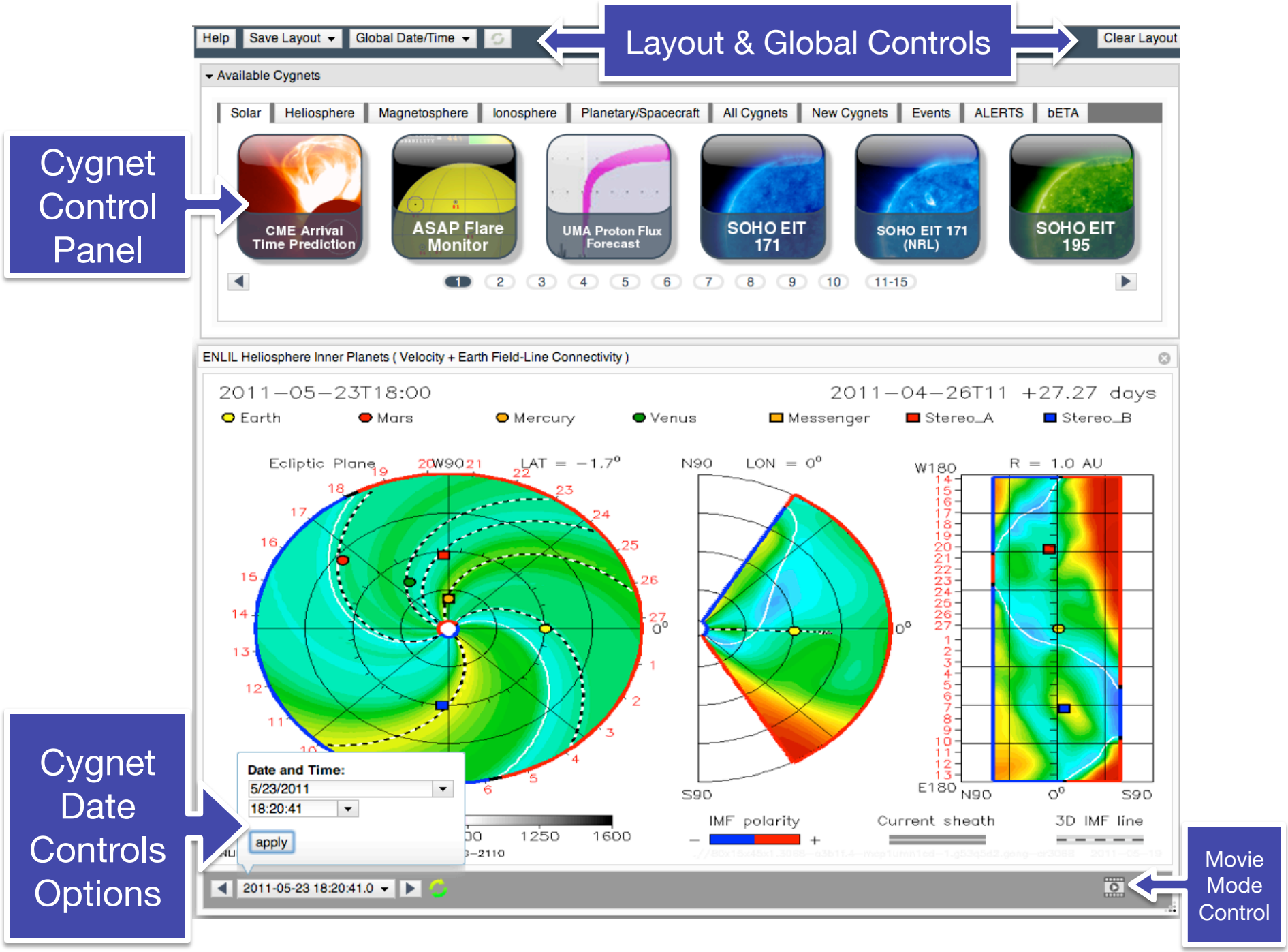


Web-based. User configurable. Available world-wide.
One-stop shop for state-of-the-art information!
http://iswa.gsfc.nasa.gov

Unprecedented Access to Space Weather Information

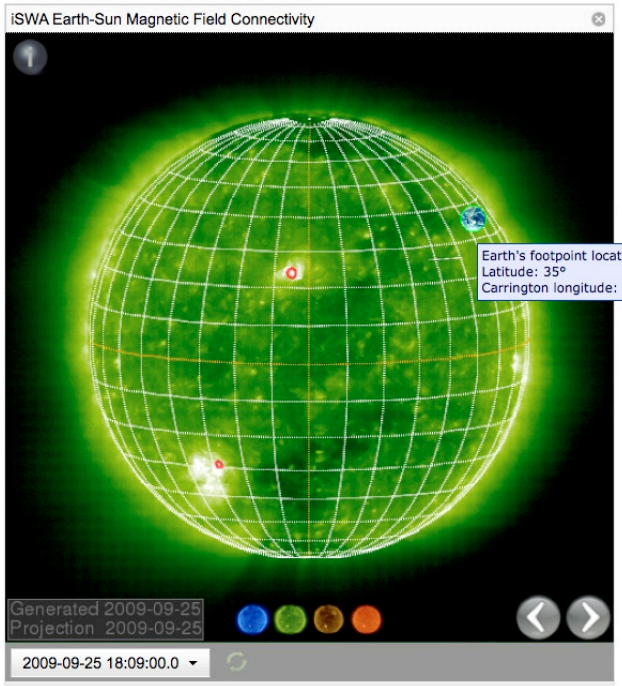


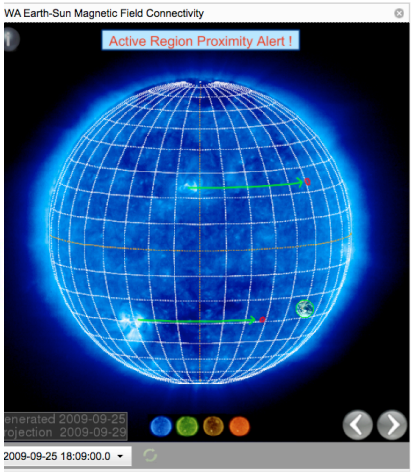
http://iSWA.ccmc.gsfc.nasa.gov

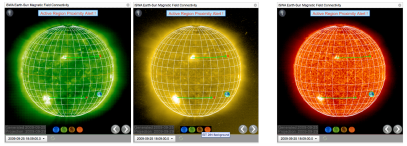

Layout & Global Controls
Cygnet Control Panel
Cygnet Date Controls Options
Movie Mode Control
Help
Save Layout
Global Date/Time
Clear Layout
Available Cygnets
Solar
Heliosphere
Magnetosphere
Ionosphere
Planetary/Spacecraft
All Cygnets
New Cygnets
Events
ALERTS
bETA
CME Arrival Time Prediction
ASAP Flare Monitor
UMA Proton Flux Forecast
SOHO EIT 171
SOHO EIT 171 (NRL)
SOHO EIT 195
1 2 3 4 5 6 7 8 9 10 11-15
ENLIL Heliosphere Inner Planets (Velocity + Earth Field-Line Connectivity)
2011-05-23T18:00
2011-04-26T11 +27.27 days
Earth
Mars
Mercury
Venus
Messenger
Stereo_A
Stereo_B
Ecliptic Plane
LAT = −1.7°
N90
LON = 0°
W180
R = 1.0 AU
E180
S90
IMF polarity
Current sheath
3D IMF line
Date and Time:
5/23/2011
18:20:41
apply
1250
1600
2011-05-23 18:20:41.0

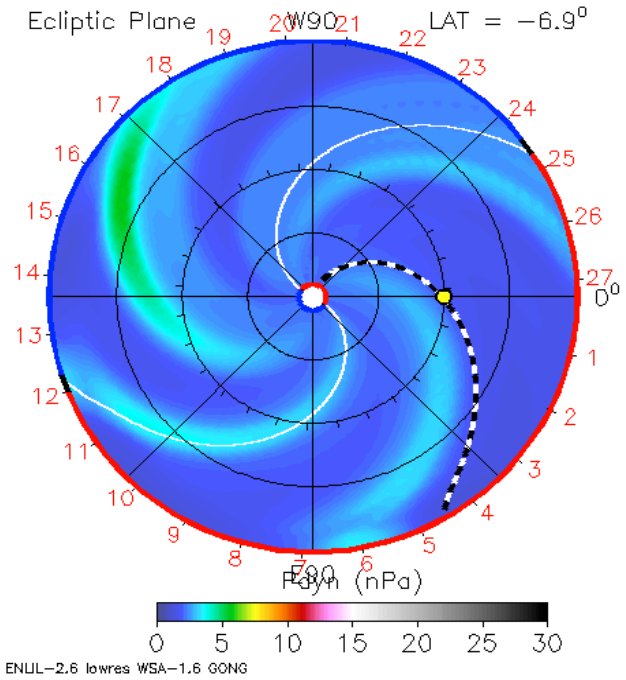
Sample iSWA Products/ Cygnets

Monitor Magnetic Connectivity and Proximity to Active Regions



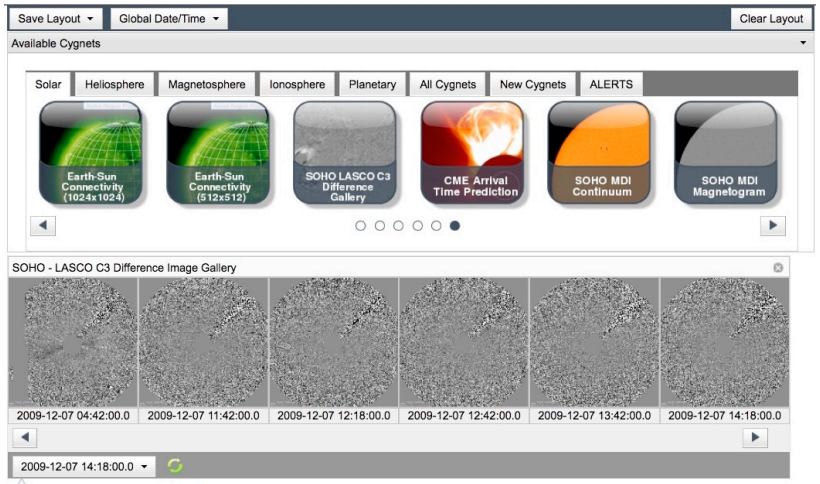


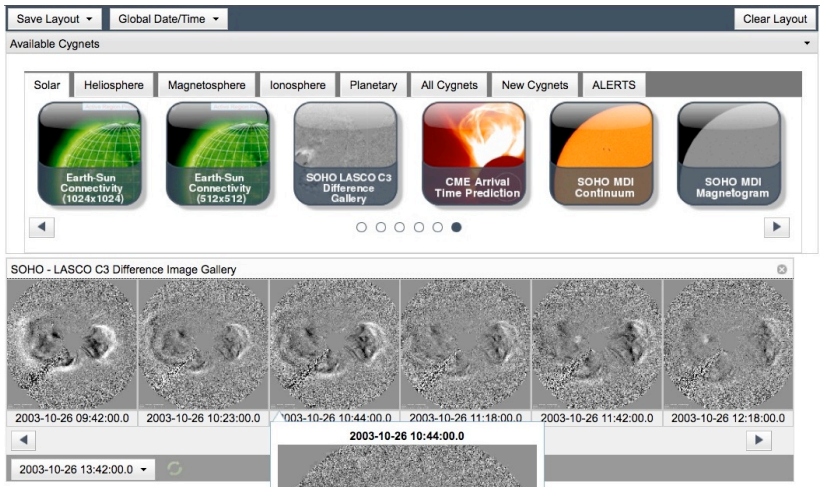


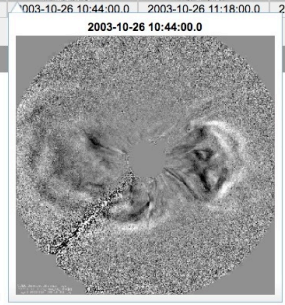


- Monitor active regions and their proximity to magnetically connected foot-point locations of the earth
- View future projections of active regions and foot-point locations
- Date selection tool for historical analysis
- Select different EIT wavelengths
- Monitor in real-time

Monitor CME propagation in real-time or for historical events



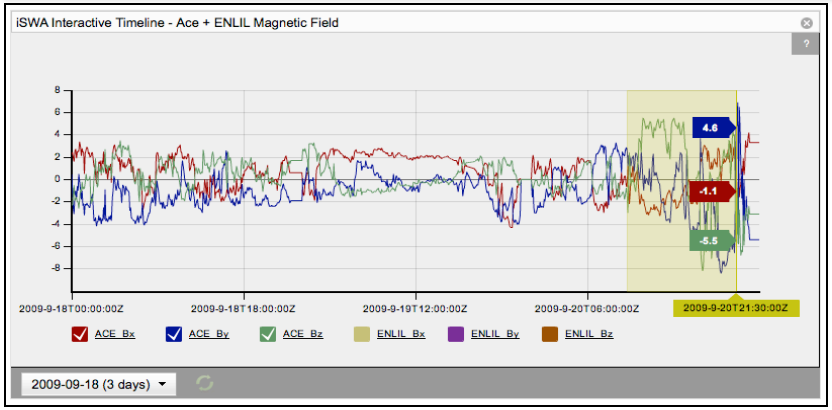




- Monitor in real-time
- Date selection tool for historical analysis
- Left/Right controls for single steps within time window

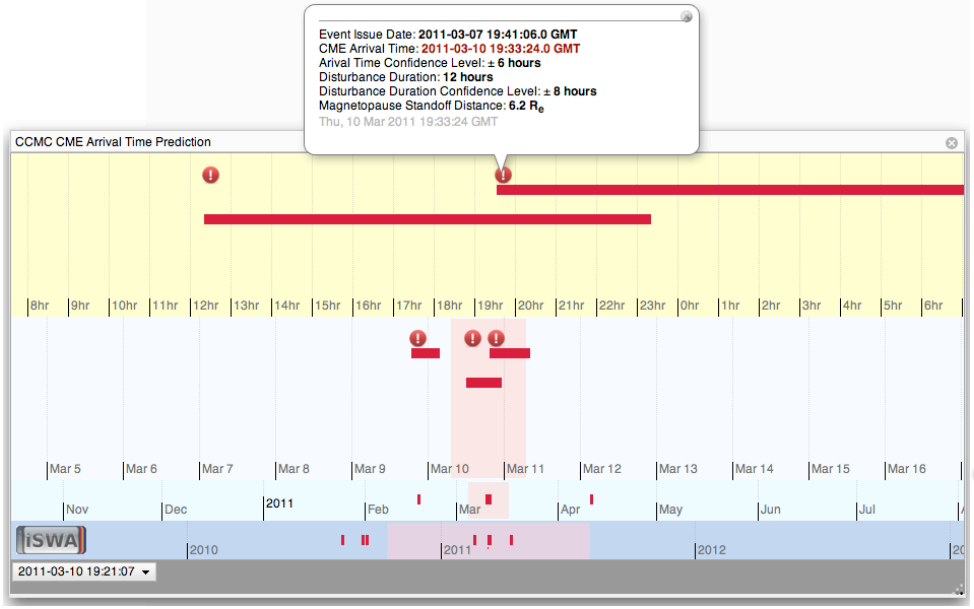
.Zoom functionality

Super Timelines



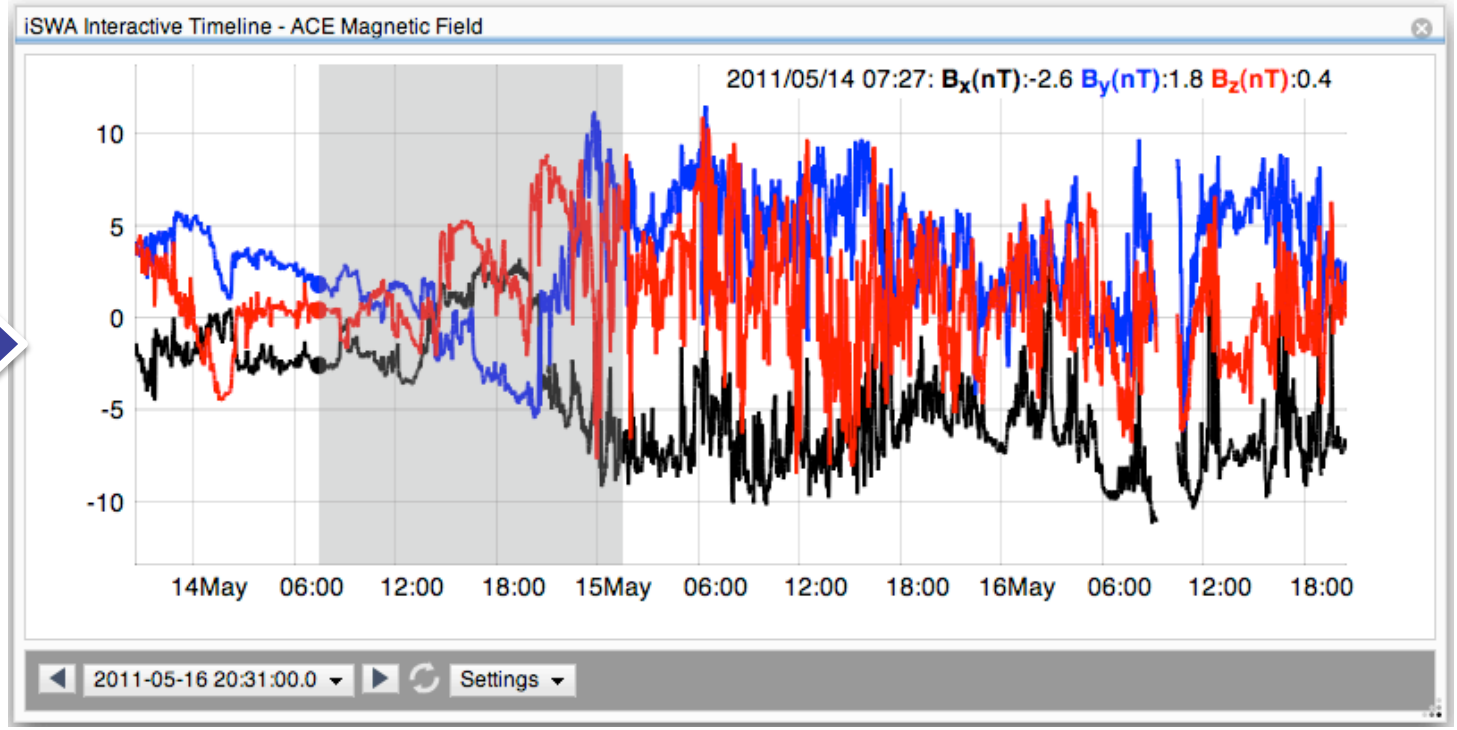
- Mouse over to view specific data values
- Zoom in feature
- Toggle on/off specific quantities
- Selectable time range 1 - 10 days
- User selectable resources & quantities

Interactive Products

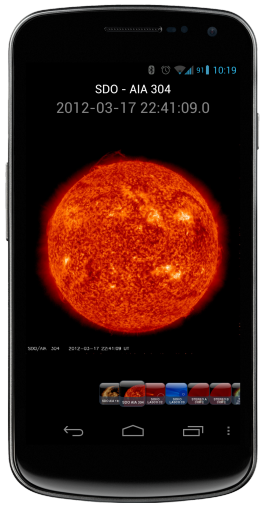


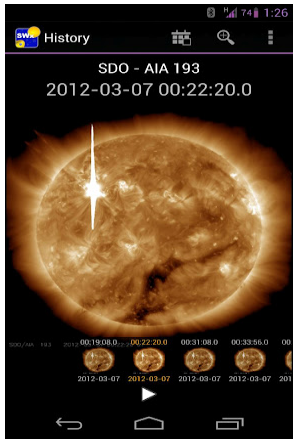
Interactive CME alert tool with chronological record of SWx Center issued CME time of arrival predictions

Interactive timeline tool with pan, zoom, mouse-over, and quantity toggling functionality



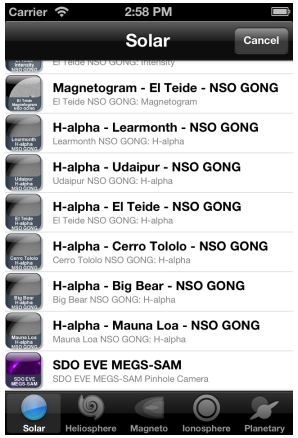
Mobile Access Powered by iSWA

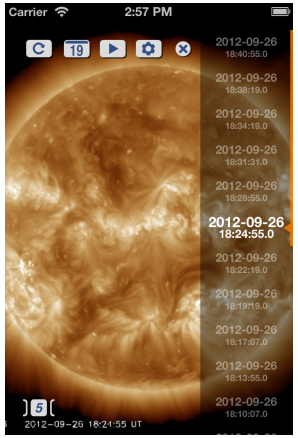




Android Front-End to iSWA

- History Mode
- Movie Mode
- >50k Downloads
- Available in Google Play Store





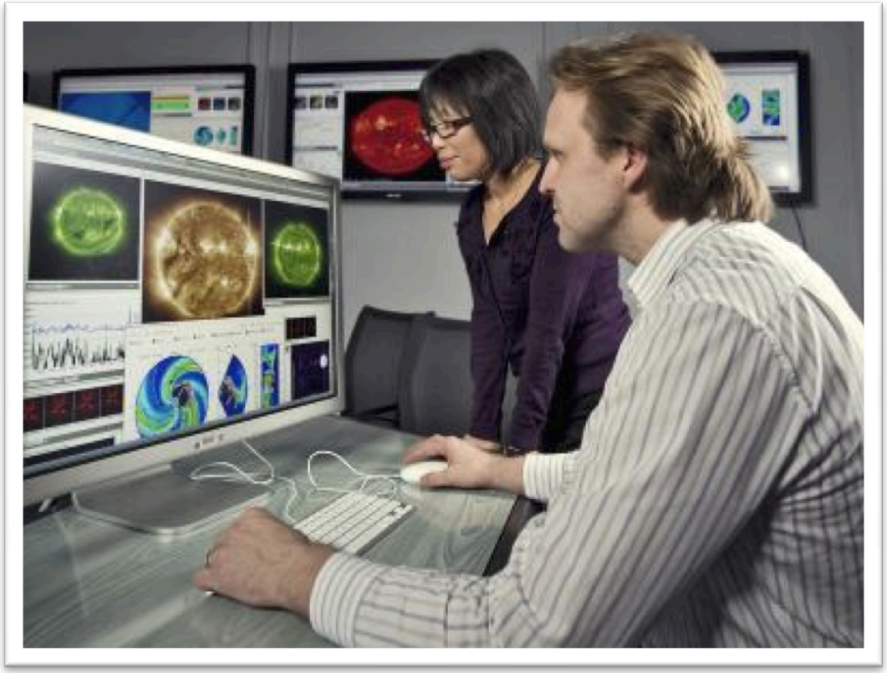
IOS Front-End to iSWA

- History Mode (coming soon)
- Movie Mode (coming soon)
- >100k Downloads
- Available in App Store

Services for NASA Robotic Missions Powered by iSWA

1. Providing assistance in spacecraft anomaly resolution by assessing whether space weather has any role in causing the observed anomaly/ anomalies.

2. Sending out weekly space weather reports/ summaries to NASA mission operators, NASA officials and involved personnel.



Services for NASA Robotic Missions Powered by iSWA

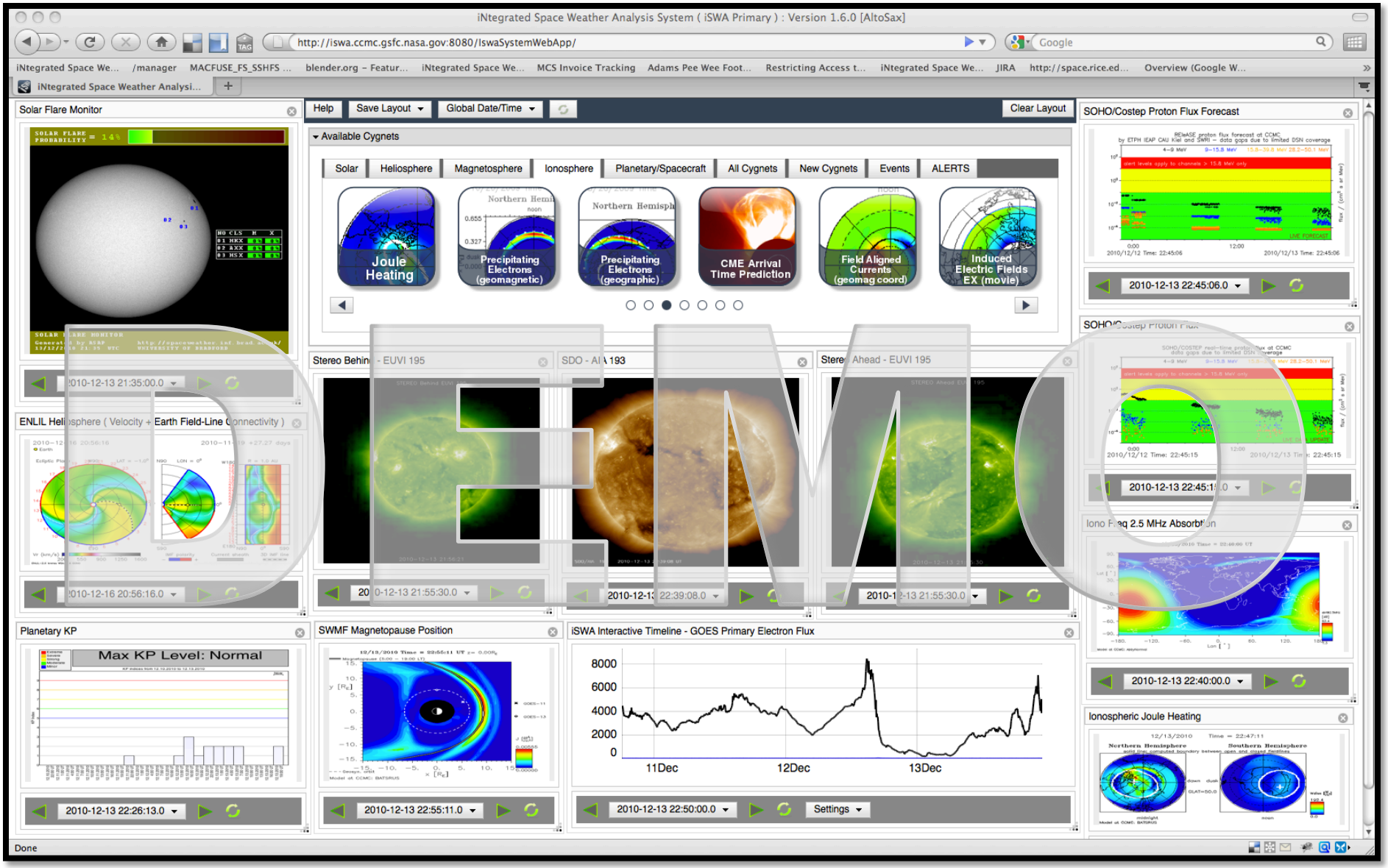
3. Sending out timely space weather info/forecasts regarding adverse conditions throughout the solar system, such as significant CME events, elevated radiation levels, etc.

4. Providing general space weather support for NASA customers.

Education And Training Powered by iSWA

Arranged by NASA IV&V Educator Resource Center
High school teachers from West Virginia

Y. Zheng

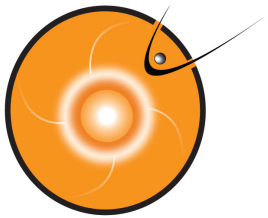


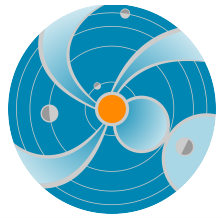
http://iSWA.ccmc.gsfc.nasa.gov

BOOKMARK DEMO

- Space Weather Event 04/11/2013 - http://go.nasa.gov/13oVkrB
- Venus Transit - http://go.nasa.gov/13oR2k1
- St. Patricks Day Storm 03/15/2013 - http://go.nasa.gov/YGUeiO
- Filament Eruption 02/27/2013 - http://go.nasa.gov/XcgWDi
- Space Weather Event 09/28/2012 - http://go.nasa.gov/XGW0Eu
- Space Weather Event 10/5/2012 - http://go.nasa.gov/XtGsmH
- Current 8-Day Timeline - http://go.nasa.gov/16TediU

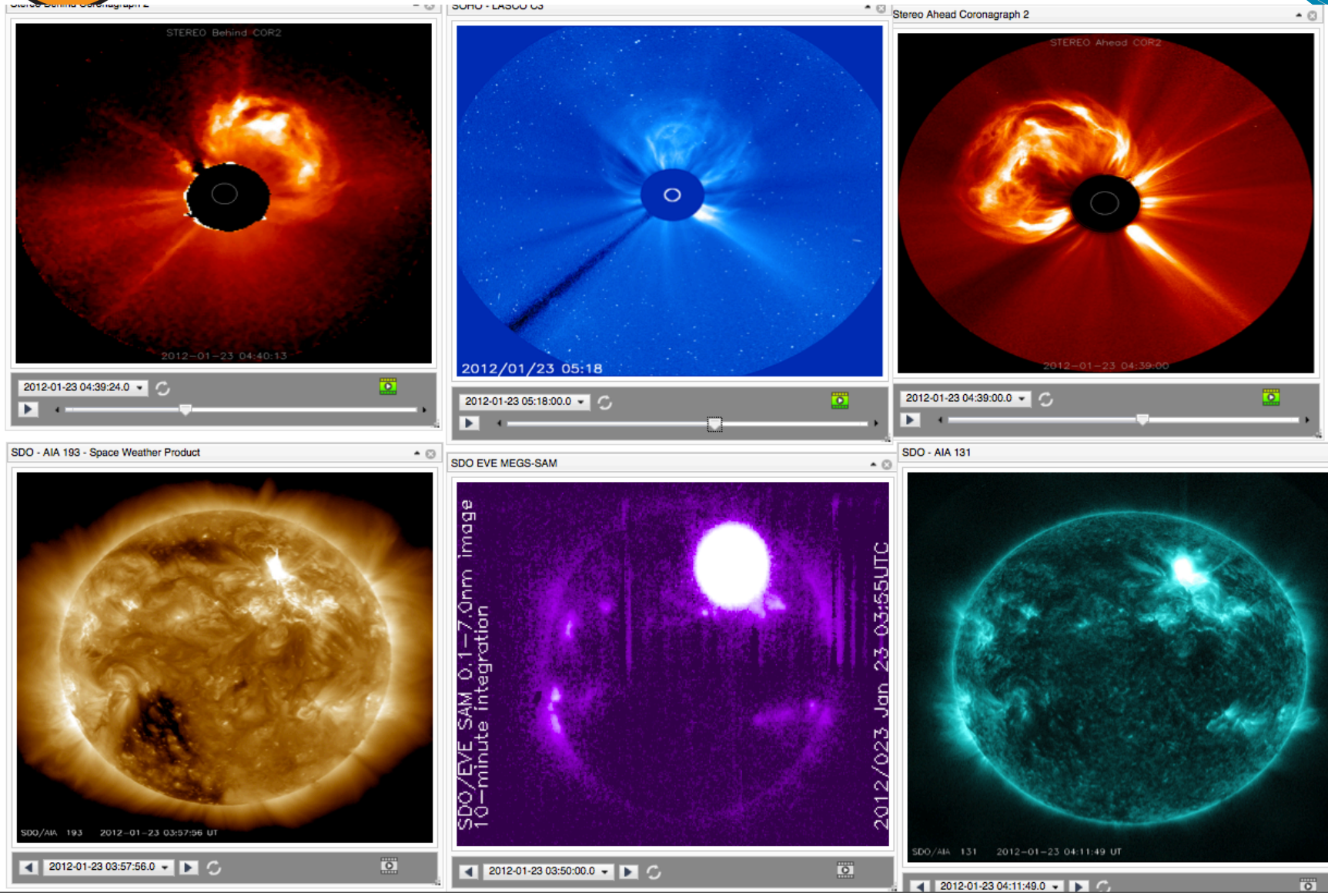
Supplemental Sides/Details





Specific Examples…

Jan 23 flare (M8.7)/CME (v=2210km/s)

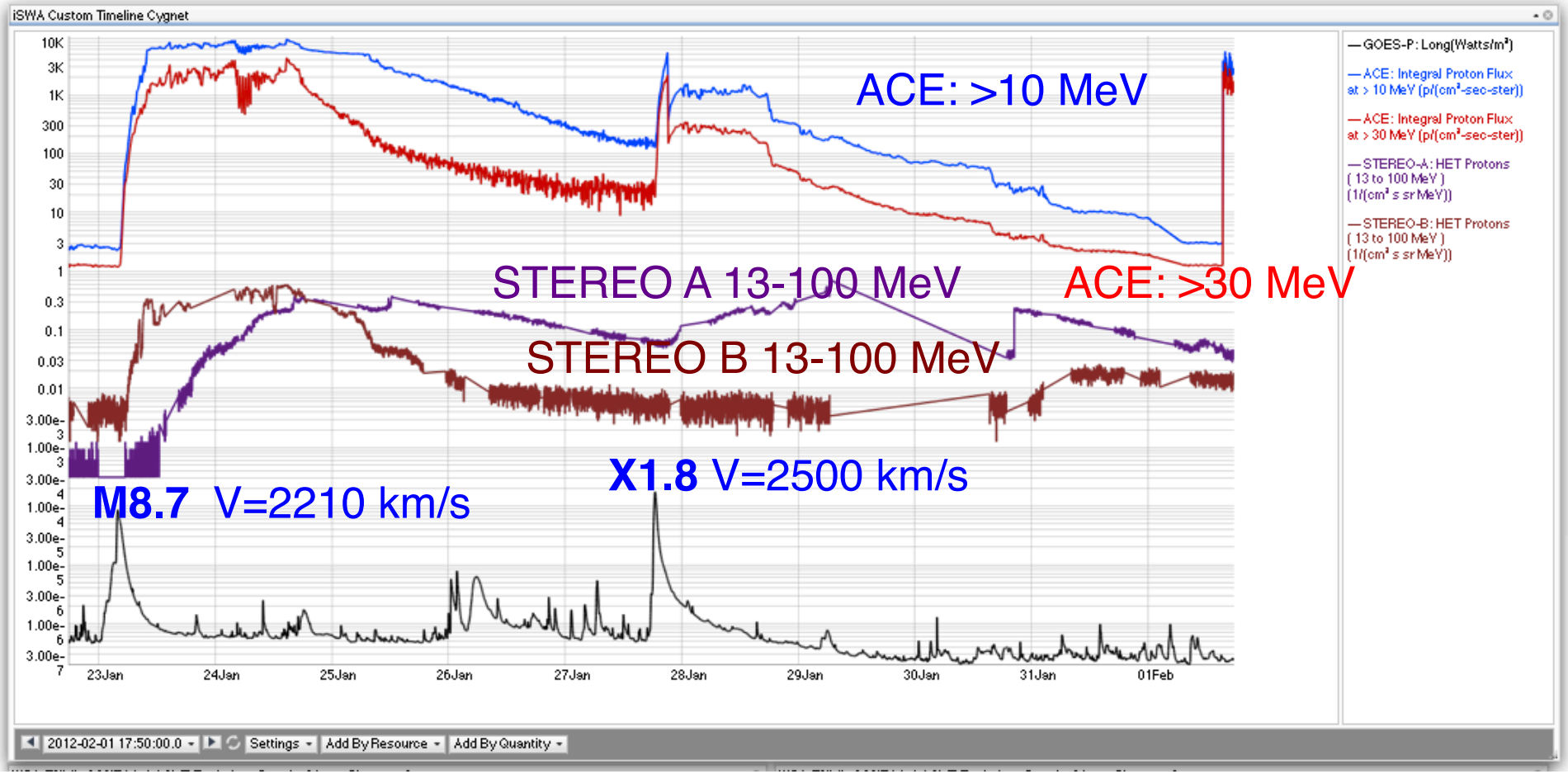


CME

Flare

SEP: proton radiation (flare and CME)

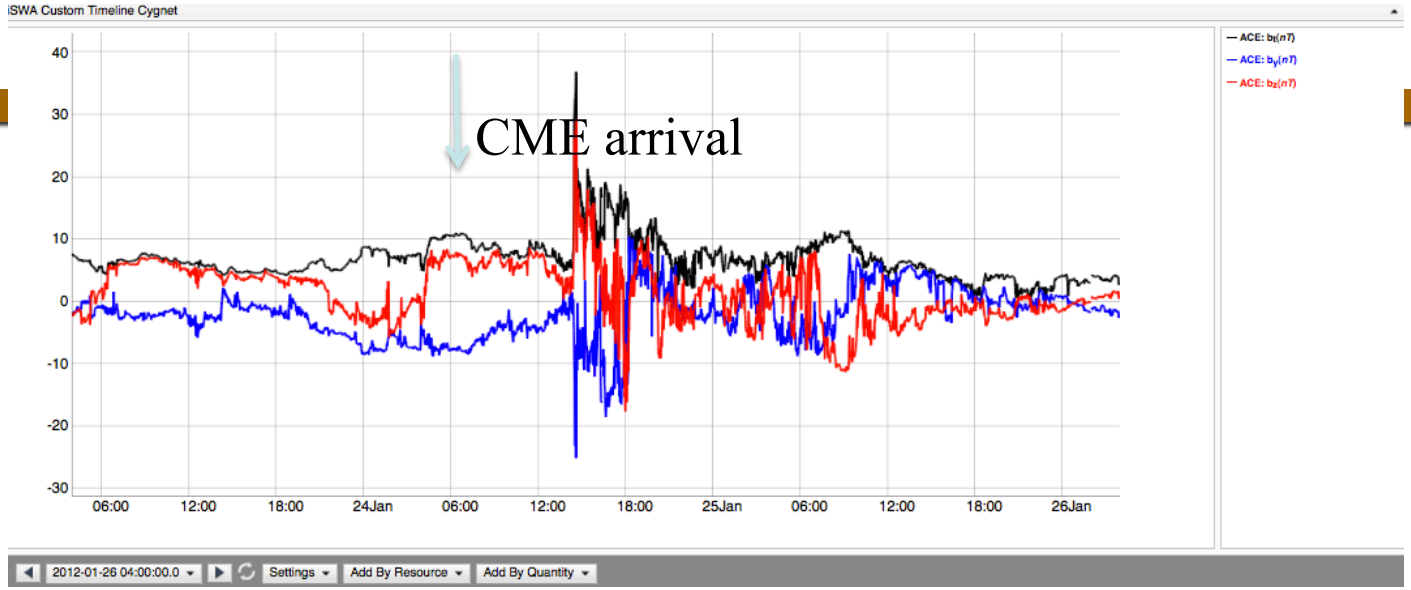
iSWA SuperTimeline

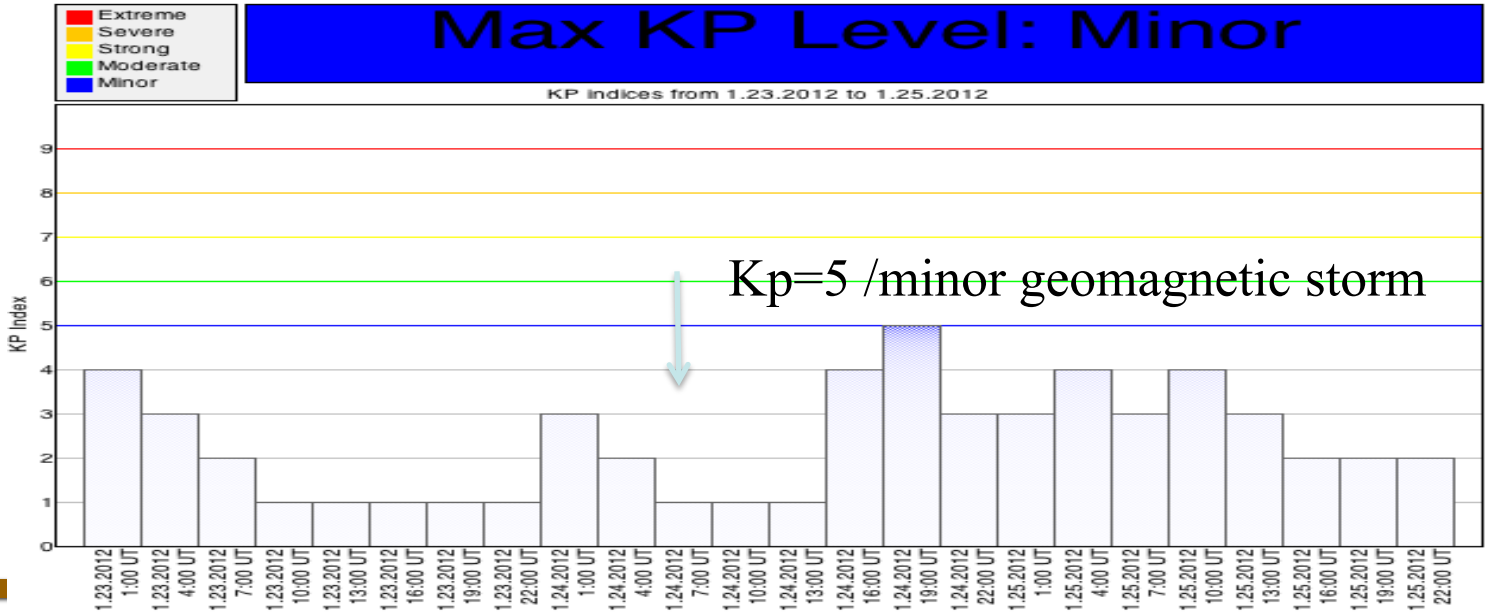


The Jan 23 and Jan 27 flare/CME pairs were associated with the same active region 1402. Both events created significantly enhanced ion radiation (SEP flux levels).

Several polar flights were rerouted due to the radiation

CME impact at Earth (a minor geomagnetic storm only)





An iSWA layout for the 23 Jan 2012 event

http://bit.ly/Jan23_27_2012_layout

Provide a dynamic view of the event with some key products

The Jan 23 event produced a very strong radiation storm
- slightly less than that of the March 7 2012 event

Peak flux (Jan 23): 6310 pfu at Jan 24 15:30 UT
Peak flux (Mar 7): 6530 pfu at Mar 8: 11:15 UT

Active Region 1429 activities during March 2012

Earthside Major Events

Backside major events