

Getting to Know You



Solar & Terrestrial Physics Division

aka Space Weather



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Solar-Terrestrial Physics

Its All a Matter of Perspective



When you look at earth from space . . .

. . . what do you see?

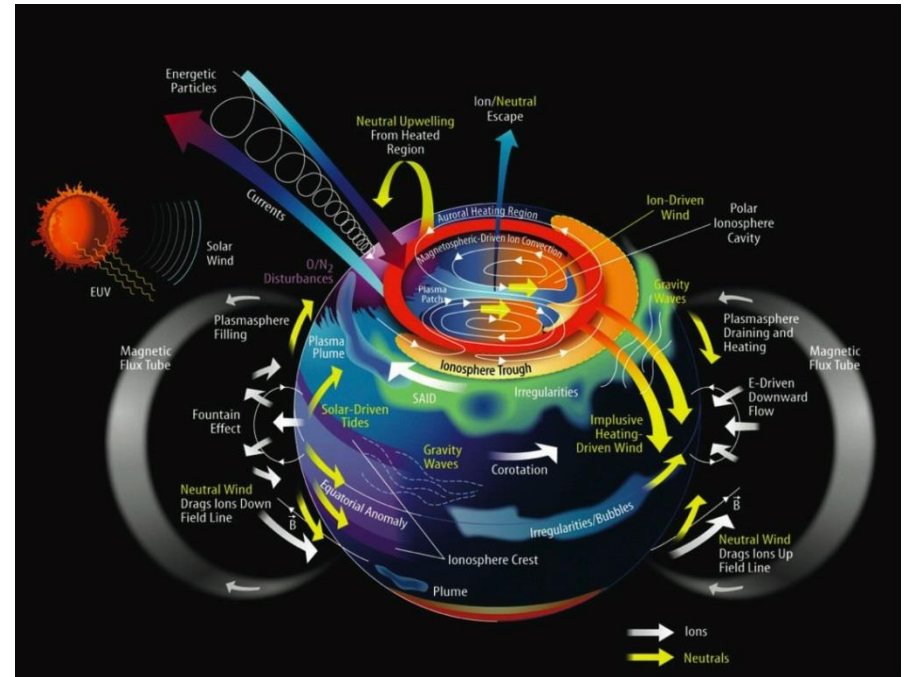


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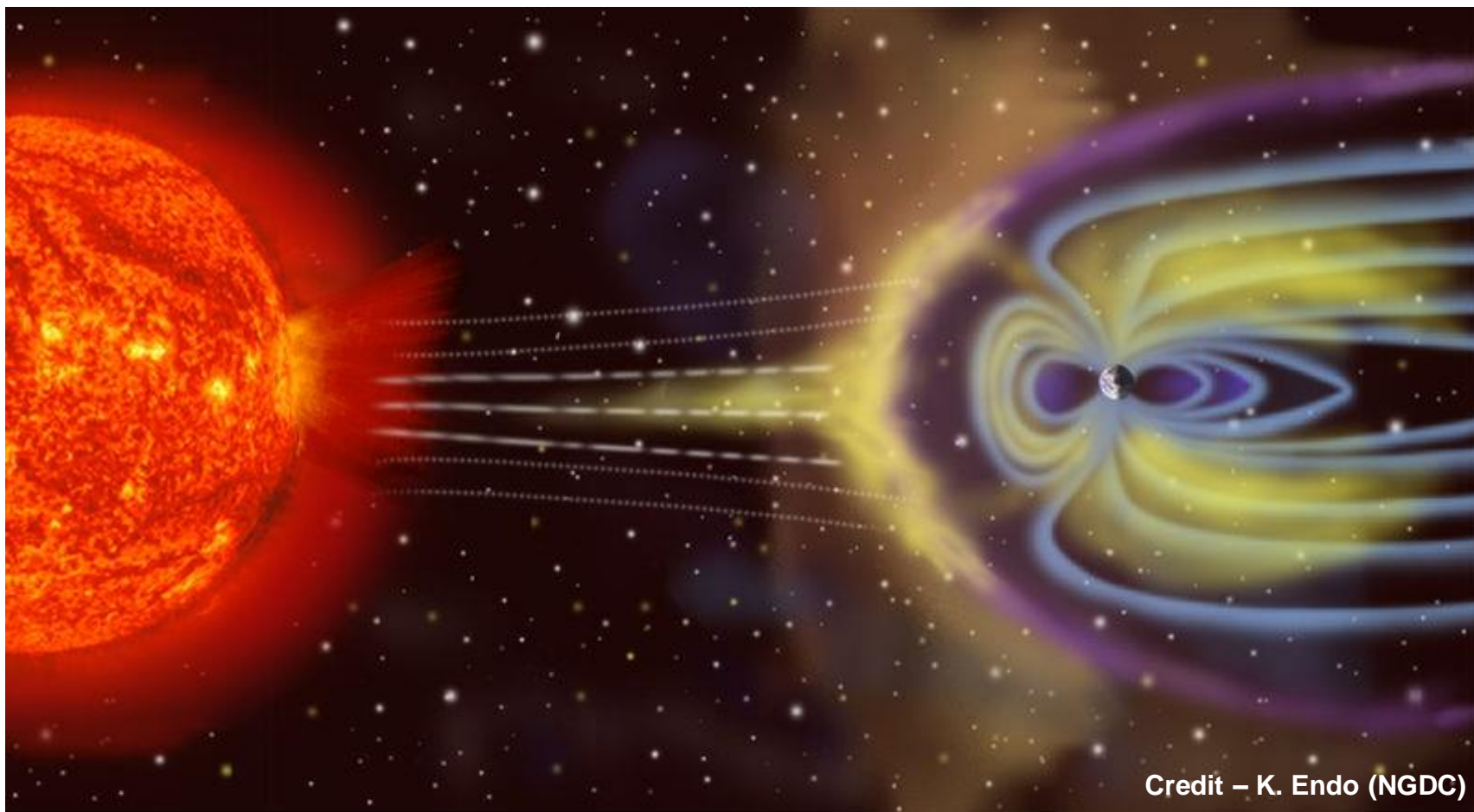
. . . what do I see?





Solar-Terrestrial Physics

Illustration – “Image Not To Scale”



Credit – K. Endo (NGDC)

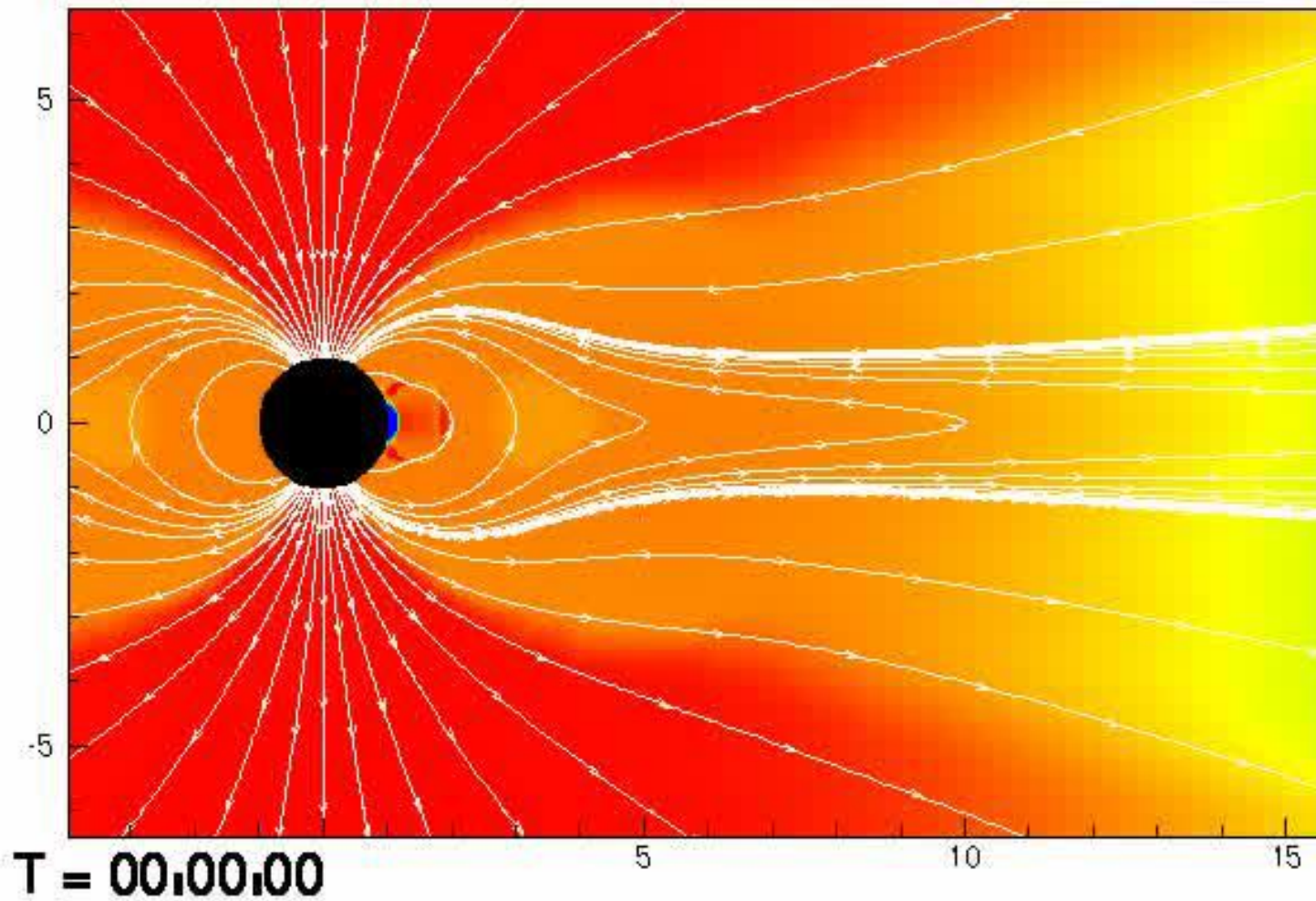


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So What is the Correct Scale?



Center for Space Environment Modeling
University of Michigan



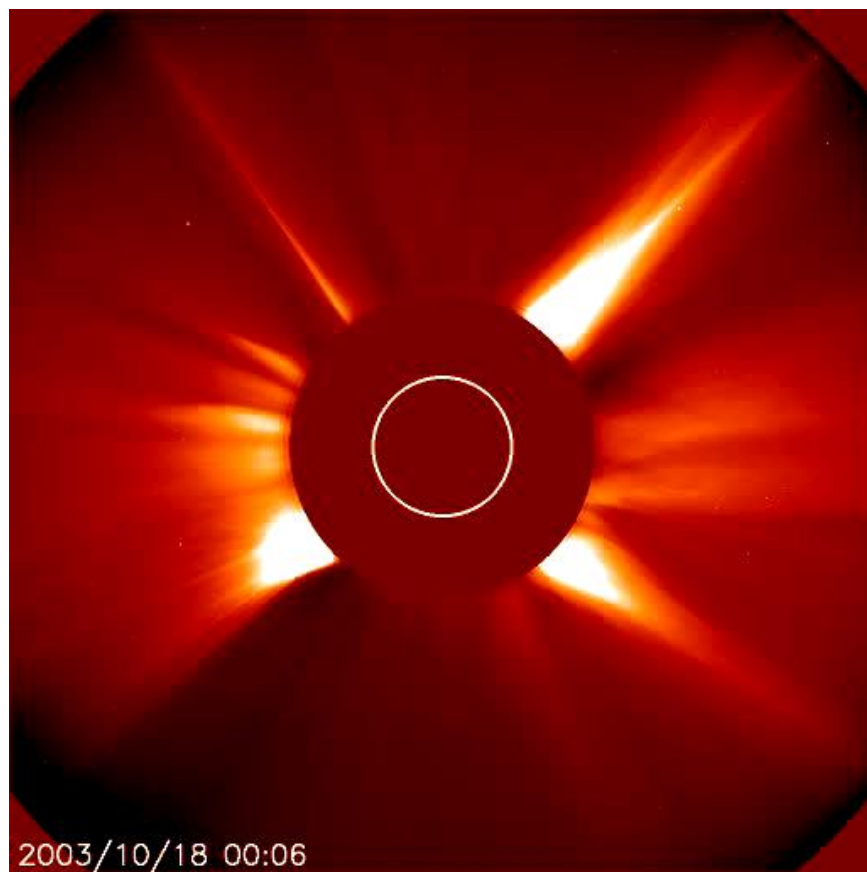
Solar-Terrestrial Physics

And What is the Big Deal?

My God, space is radioactive



- Solar Radiation Storms
- Geomagnetic Storms
- Radio Blackouts

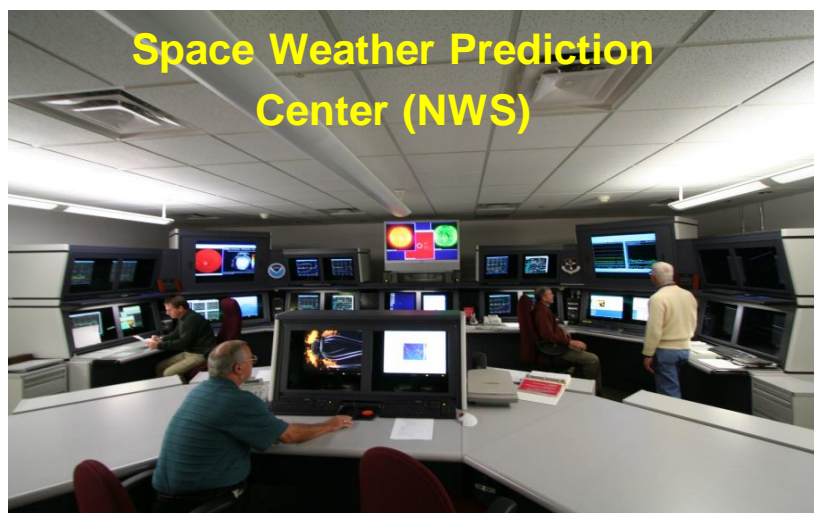
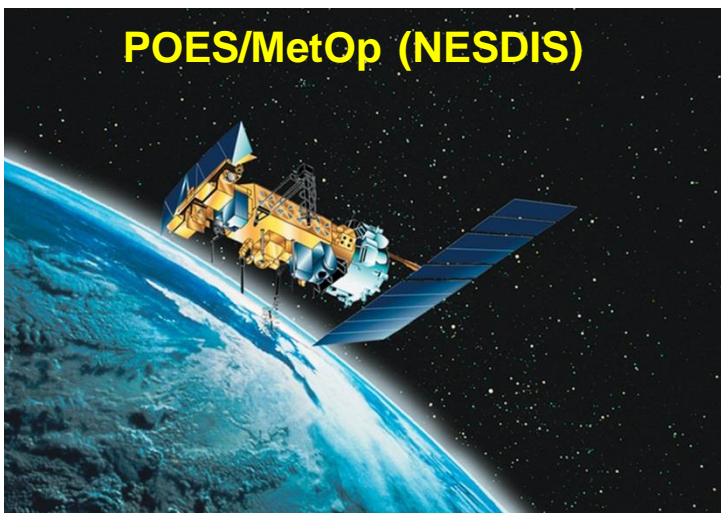
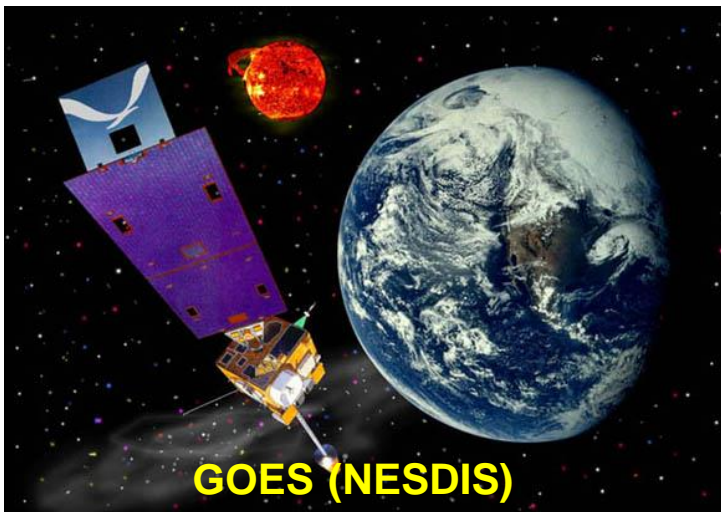


20 days of the sun



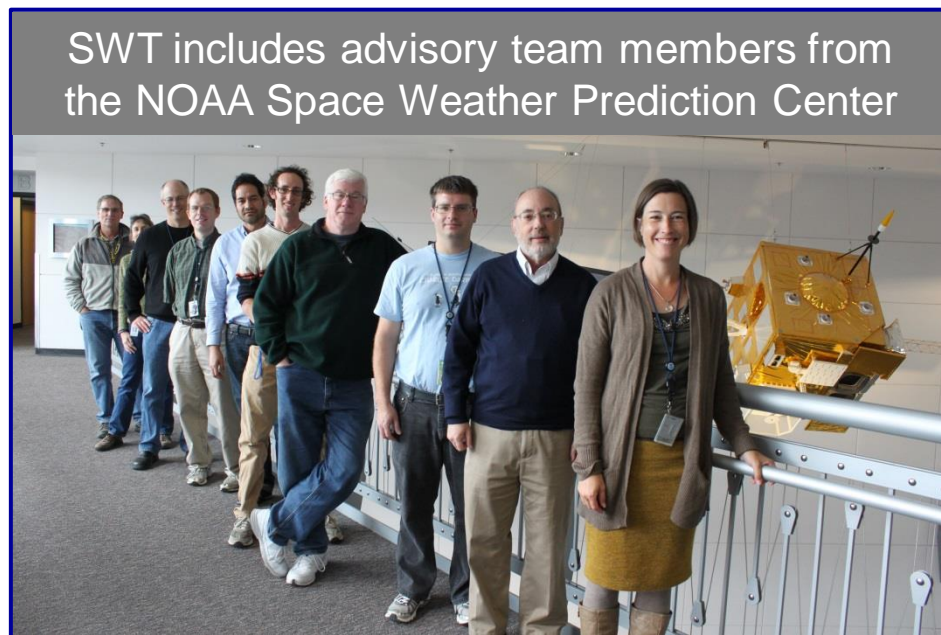
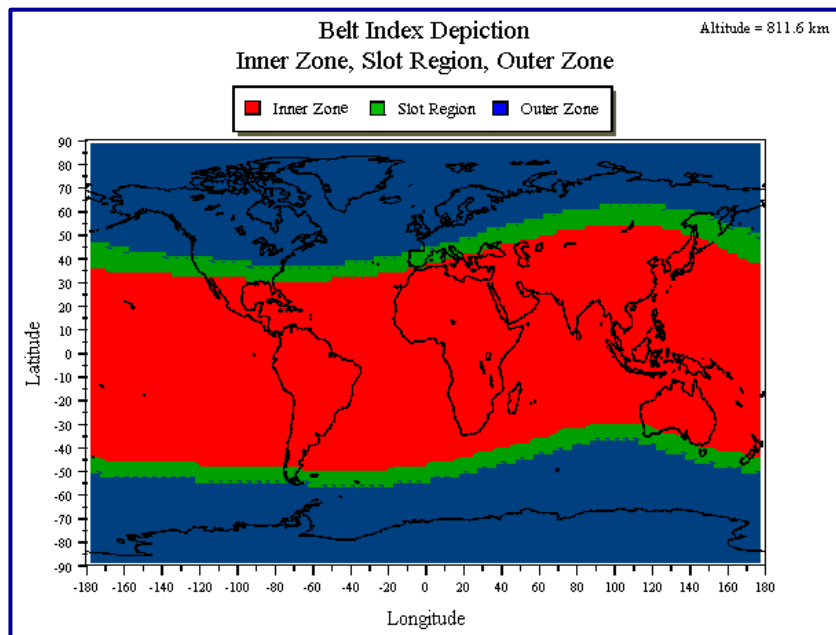
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What is NOAA Doing About It?



The Space Weather Team is responsible for:

- Archive, Assess and Assessment of NOAA (and USAF) space environmental data
- Performing space environmental reports for spacecraft charging anomaly assessments
- Supporting the O&M (including calibration) of the GOES and POES space weather sensors
- Calibration and Validation (Cal-Val) of GOES-R L1b/L2+ space weather data and products
- Development of L2+ science codes and prototype ground processing system for the GOES-R
- Supporting the mission planning and future dissemination of DSCOVR interplanetary data





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How Much Satellite Data??



Over 30 years of continuous operational space environmental data are available online. For the most part the measurement parameters have remained the same except for some improvements in sensor design and performance – sometimes, much to the angst of the operational agencies:

NOAA GOES – particles, fields, solar observation

Date range: 1974 – present

of satellites: 15 (not counting 1 failure)

NOAA POES – energetic charged particles

Date range: 1978 – present

of satellites: 12 (not counting 1 failure)

USAF DMSP – particles & fields, UV imagery

Date range: 1976 – present

of satellites: 17 (not counting 1 failure)

Availability: on-line (F6 and beyond only)

It keeps going and going and going

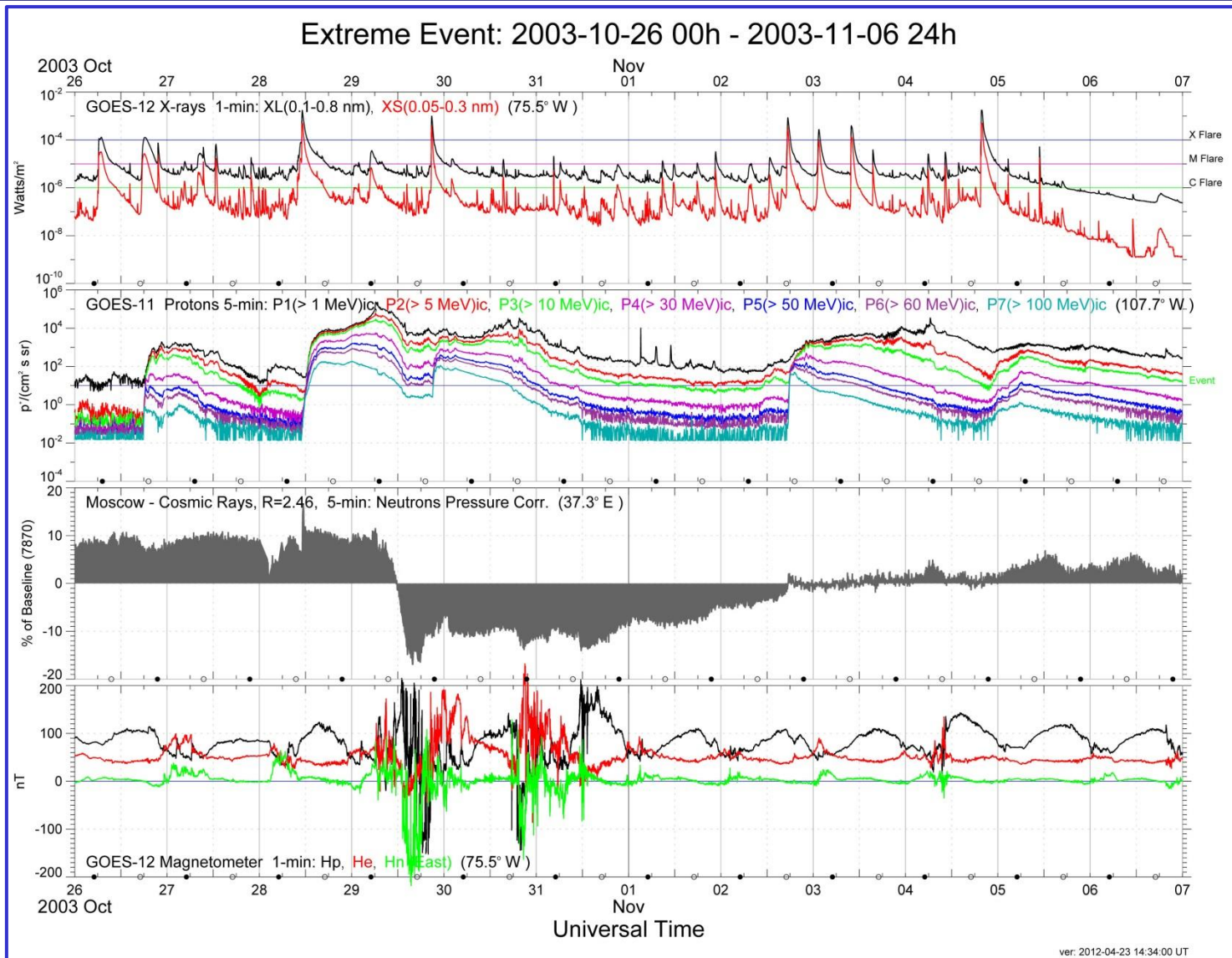


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How Bad Can It Get?



GOES
Composite
X-ray Flares
Solar Protons
Ground Level
Event
(non-GOES)
Magnetic
Field





Case 1 – Galaxy-15

Orbit: Geosynchronous

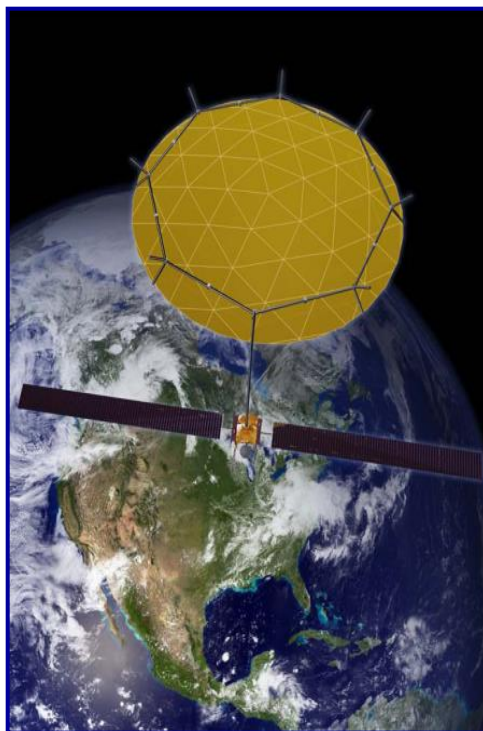
Anomaly Date:

05 April 2010 @09:48

Probable Cause:

Internal Charging/ESD

NEIO Getting to Know You – 02 May 2014



Case 2 – SkyTerra-1

Orbit: Geosynchronous

Anomaly Date:

07 March 2012 @14:43

Probable Cause:

Single-Event Upset



Case 3 – NPP/VIIRS

Orbit: Polar LEO

Anomaly Date:

Various

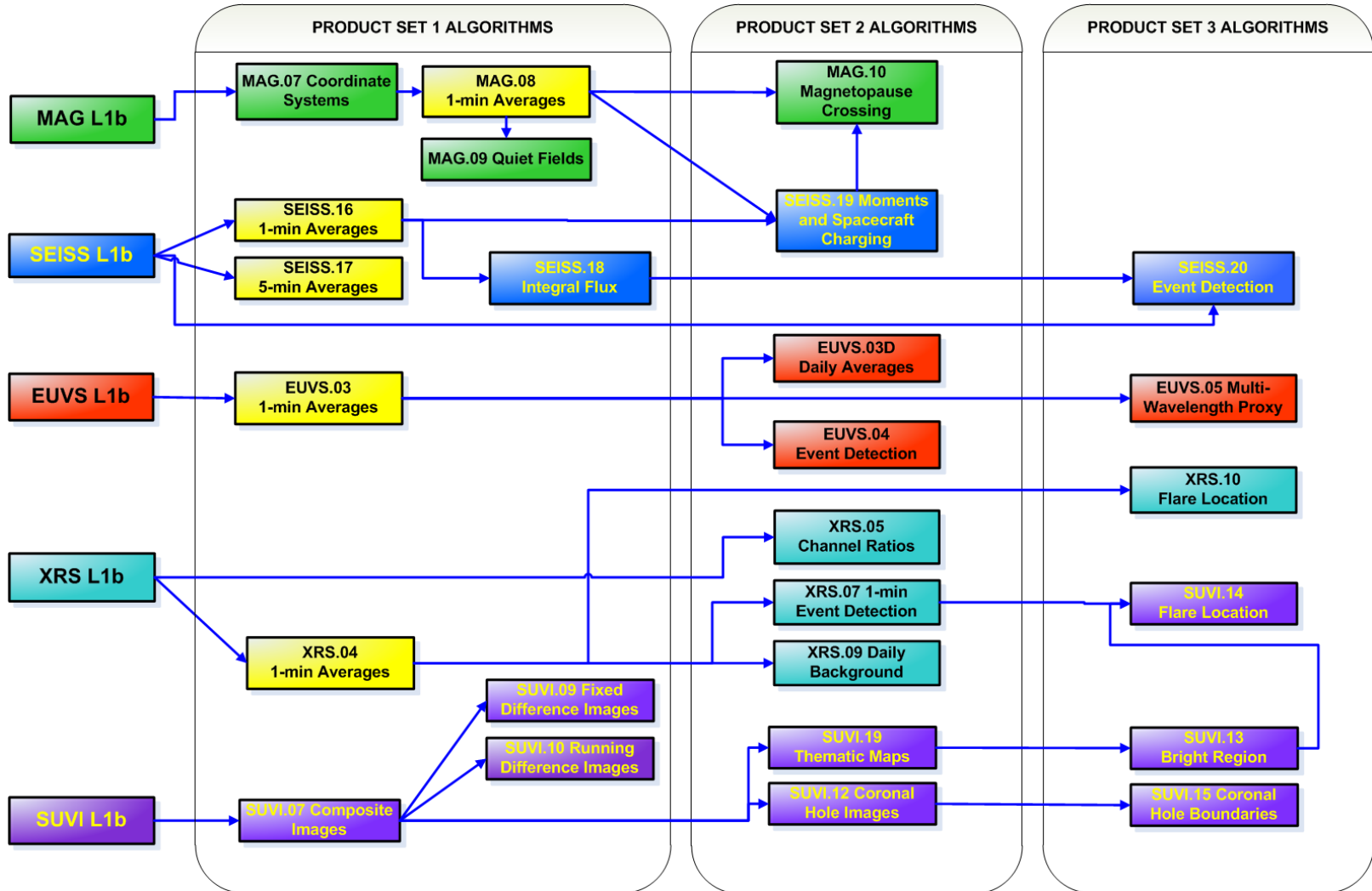
Probable Cause:

Single-Event Upsets



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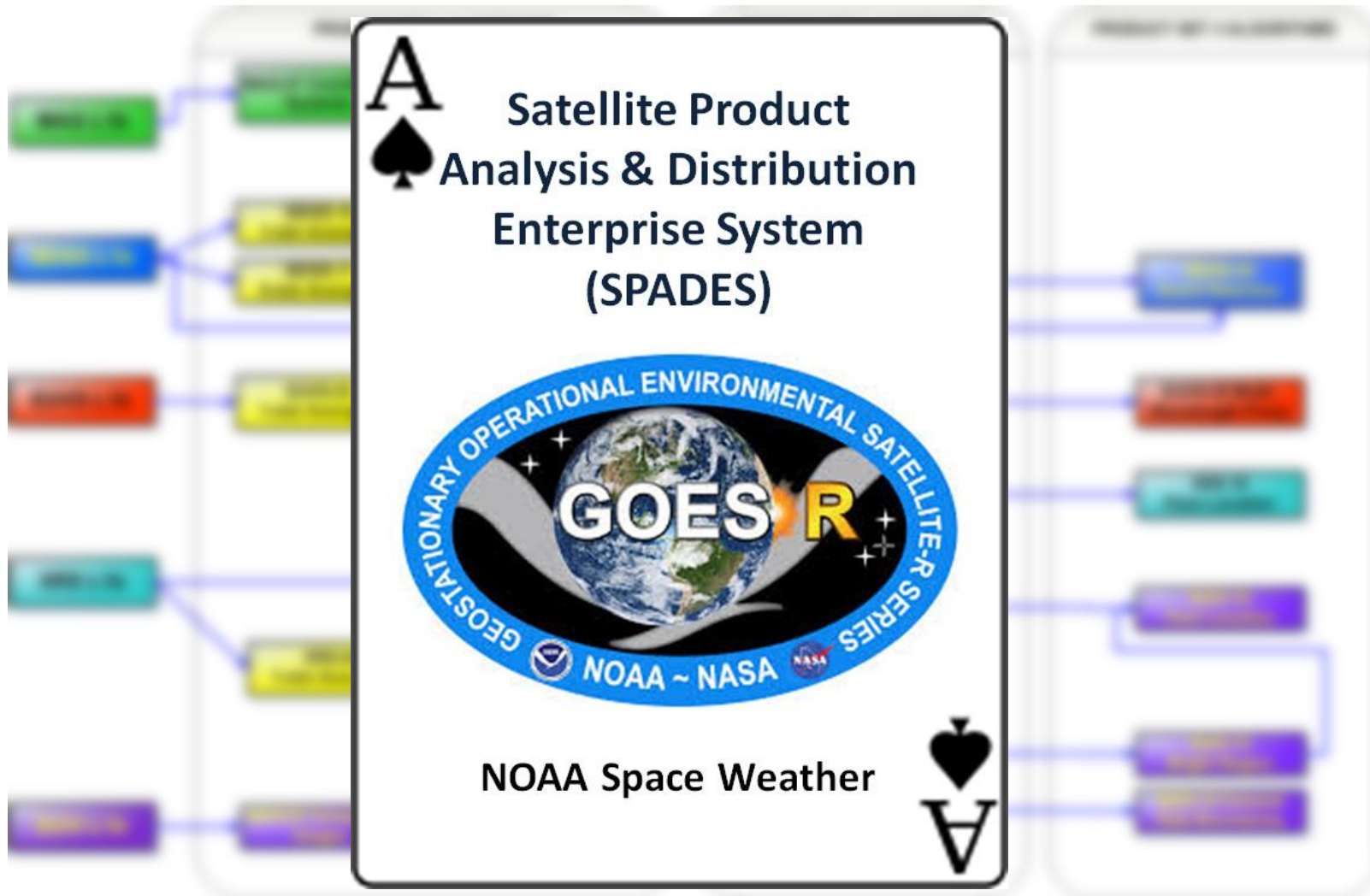
GOES-R Space Weather Algorithms





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GOES-R Space Weather Algorithms





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Space Weather = Aurora



Location: Fairbanks, AK

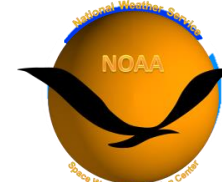
Date: 02 Mar 11


Photo by: Jim Spann (NASA)



Solar-Terrestrial Physics


But Fairbanks is Really Cold!!





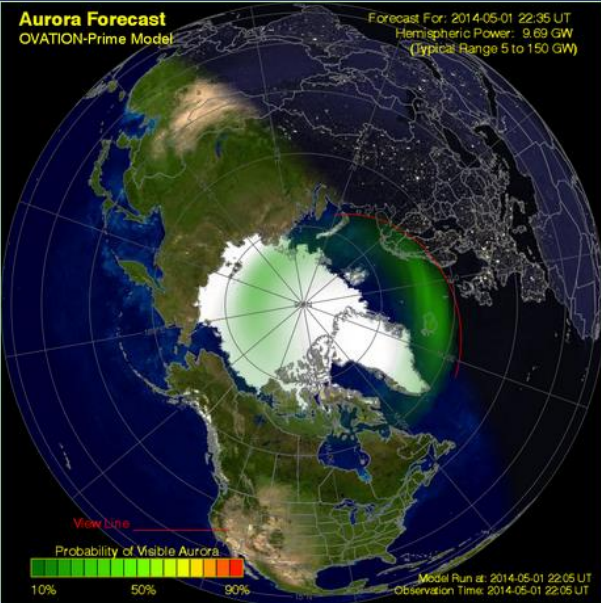
OVATION Aurora

NOAA, Space Weather Prediction Center/ Space Weather Prediction Testbed
NOAA, National Geophysical Data Center, Johns Hopkins Applied Physics Lab.



Aurora Forecast
OVATION-Prime Model

Forecast For: 2014-05-01 22:35 UT
Hemisphere Power: 9.89 GW
(Typical Range 5 to 150 GW)



View Site

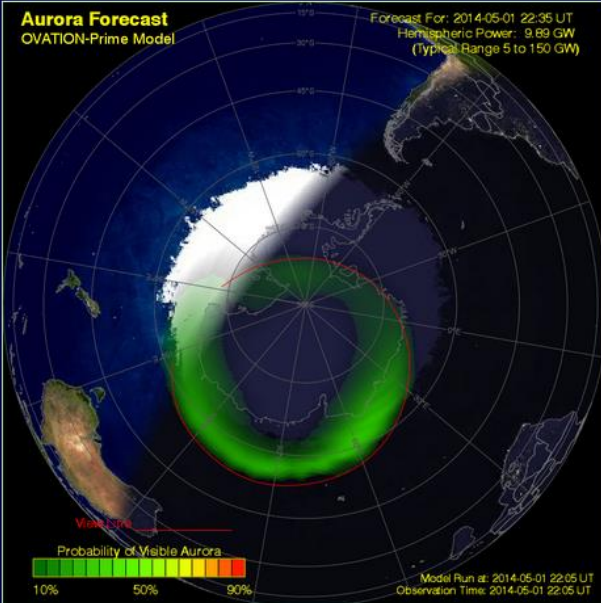
Probability of Visible Aurora

10% 50% 90%

Model Run at: 2014-05-01 22:05 UT
Observation Time: 2014-05-01 22:05 UT

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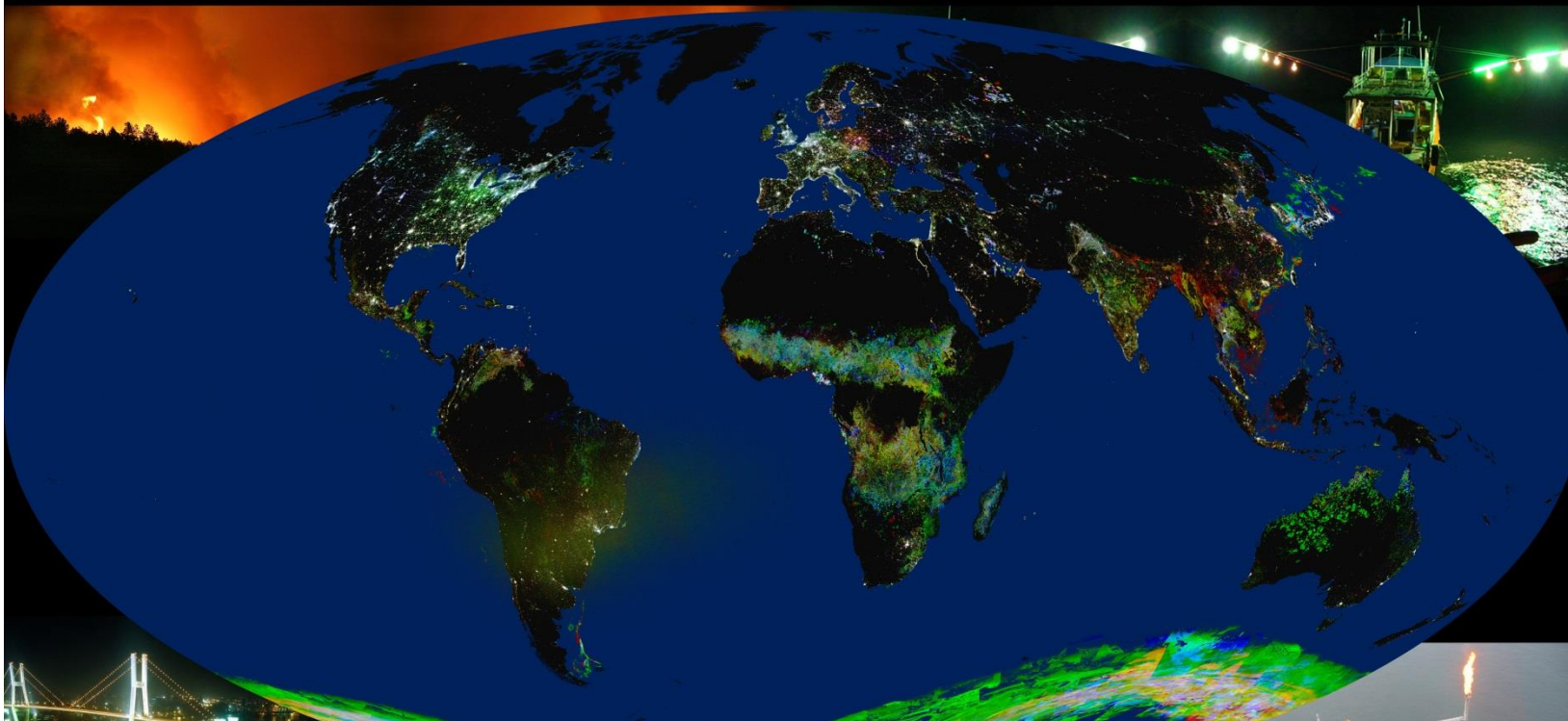
Model Run at: 2014-05-01 22:05 UT
Observation Time: 2014-05-01 22:05 UT

Homepage
OVATION Description
About Aurora
Viewing Aurora
Recent Images
Contact

2011 NOAA NATIONAL WEATHER SERVICE. DESIGN BY SWPT. __ CONTACT: EMAIL WEBMASTER

[Live Link](#)

Nighttime Lights of the World: 1992, 2000, 2006



Produced from low-light imaging data acquired by the U.S. Air Force Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS). This is a color-composite formed from three annual cloud-free composites of nighttime lights: 1992 as blue, 2000 as green, and 2006 as red. The colors indicate changes in nighttime lights between the three years. The OLS detects lights from cities and towns, gas flares in oil production areas, heavily lit fishing boats and fires. The green arches in the southern end of the image are the result of lighting detected from the southern aurora. Auroral lights in the northern hemisphere were screened out to present a clear view of the other types of nocturnal lighting. There is an area of noise in the image centered over Southern Brazil, induced by the South Atlantic Anomaly - a persistent disturbance in the ionosphere.

Color Guide	
■	1992 only = Blue
■	2000 only = Green
■	2006 only = Red
■	1992 & 2000 combined = Cyan
■	2000 & 2006 combined = Yellow
■	1992 & 2006 combined = Magenta
■	1992 & 2000 & 2006 combined = White

Projection:
The Mollweide is a pseudocylindrical projection in which the equator is represented as a straight horizontal line perpendicular to a central meridian one-half its length. It sacrifices fidelity to angle and shape in favor of accurate depiction of area. It is used primarily where accurate representation of area takes precedence over shape, for instance small maps depicting global distributions.



The data were processed by the NOAA-NESDIS National Geophysical Data Center, Earth Observation Group in Boulder, CO (Chris Dvidge, Kimberly Baugh, Benjamin Tuttle, Ara Howard, Ed Erwin, Tlotloma Ghosh).
<http://www.ngdc.noaa.gov/dmsp>



Lac-Magantic Train Derailment

First Report: 06-Jul-2013 @ 05:15 UTC


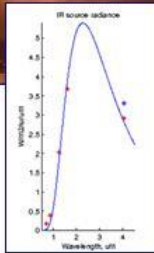


Photo credit: Radio-Canada

Latitude 45.58 Longitude: -70.88
Time: 06-Jul-2013 06:24:48
Cloud state: clear

Combustion parameters



- Temperature: 1,274 °K
- Radiant heat intensity: 58.84 W/m²
- Radiant heat: 47.19 MW
- Source footprint: 315.91 m²



Natural Gas Platform Blaze

Fire broke out on the Hercules 266 gas platform around 10:50 p.m. (CDT) on 23 Jul 2013. The platform is located around 55 miles off the Louisiana coast in the Gulf of Mexico. The blaze was detected by the NPP VIIRS at 02:33 on 24 Jul and processed by the EOG real-time system with data available online by 04:26.

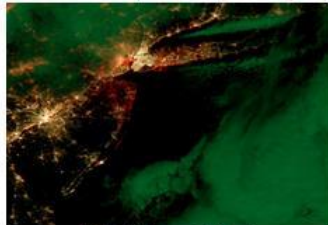
Combustion parameters:
Source ID: 010415_000_00010724_0071420_0073082_00_000000_00
Lat: 28.361433 Lon: -90.628130 dep
Temperature: 1432 deg K
Radiant heat at 1000 km: 32.28 W/m²


NGDC POC: Chris Elvidge

Hurricane Sandy Power Outages

Color-composite image from the VIIRS day/night band (DNB) data reveals the locations along the Atlantic seaboard experiencing with power outages on the morning of November 1. In the color composite, areas where lighting was not detected are red and partial outages are shown as orange compared to the golden color for normal lighting conditions. Clouds in the image appear as green. Note that clouds are obscuring lights in many areas, but the central area damaged by Sandy are largely free of clouds. In New York State power outages were detected in Lower Manhattan, Staten Island, and Long Island. In New Jersey power outages were detected in Hudson, Middlesex, Monmouth, and Ocean Counties.



VIIRS DNB Image: 01 Nov 12
Power Outage Product




Hurricane Sandy
SIGNIFICANT WIND IMPACT
58 mph +
New York, Boston, Philadelphia, D.C., Norfolk, Cape Hatteras

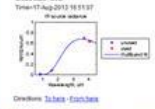
Image: CB S/AP

Mount Sakurajima Eruption

At 16:31 (local time) on 18 Aug 2013 the Japanese volcano had a significant eruption resulting in a 5,000-m plume of darkness and significant ash falls on the central part of the volcano's thermal anomaly was detected by the Radiometer Suite (VIIRS) fourteen hours before the eruption. The detection temperature was 818 °K with a source footprint of 330 m².



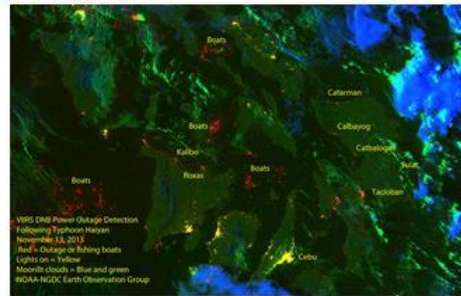
VIIRS DNB Image: 18 Aug 13
Temperature: 818 deg K
Radiant heat intensity: 11.46 W/m²
Radiant heat: 0.90 MW
Source footprint: 329.91 m²
Cloud detection: Clear
Time: 17-Aug-2013 18:51:37



Dedering, Tabata & Eschbacher

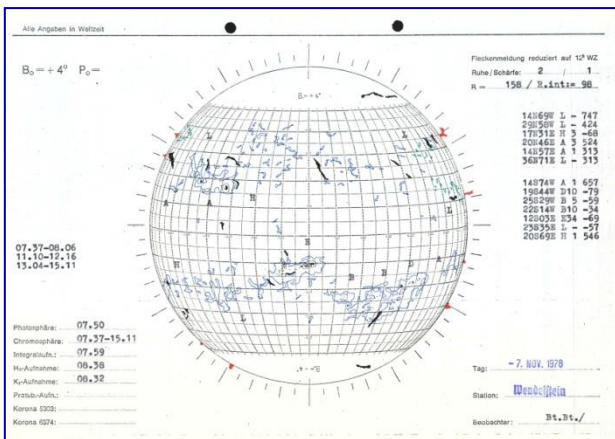
Typhoon Haiyan Power Outage

Typhoon Haiyan, the largest tropical cyclone ever recorded, struck the Philippines on Thursday evening, November 7, (U.S. time) impacting 25 million people. The Category 5 super storm harbored winds of 230 mph along with torrential rain, causing massive destruction and loss of life. The EOG used the VIIRS DNB to detect power outages in the aftermath of the storm.

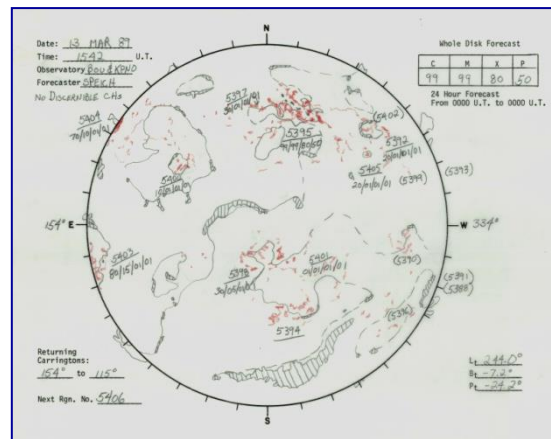


VIIRS DNB Power Outage Detection
November 13, 2013
Red = Outage for fishing boats
Lights on = Yellow
Normally dark = Blue and green
NOAA-NGDC, Earth Observation Group

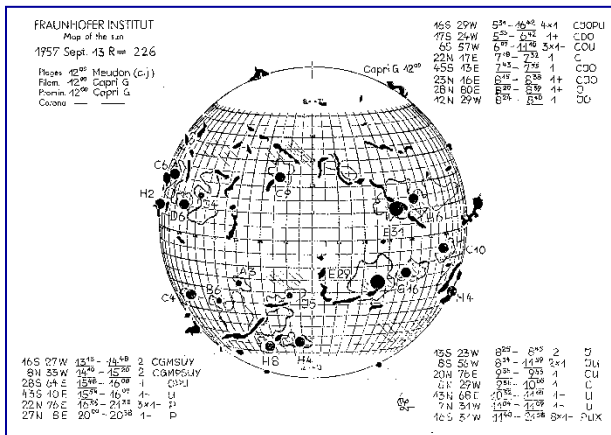
A Legacy from the 1957-58 International Geophysical Year



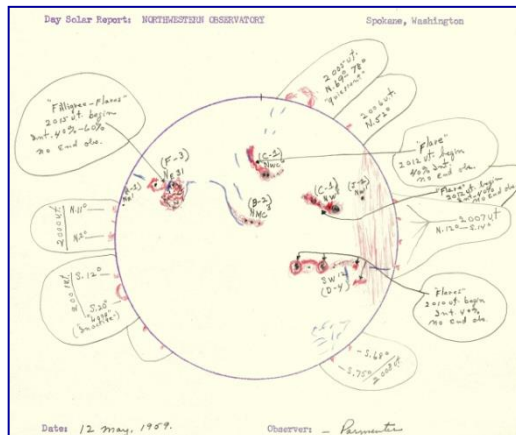
Wendelstein Observatory
(1947-1987)



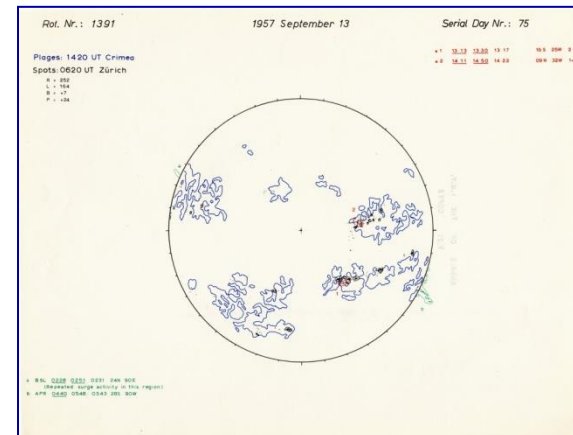
Boulder Daily Composites
(1972-present)



Fraunhofer Institute
(1956 - 1973)



Northwestern Observatory
(1958 - 1970)



Drawings from the IGY
(1957 - 1958)

Questions?

