

NOAA Operational Space Env Monitoring



Paper J1.2 - AMS

W.F. Denig¹ & P Mulligan²

¹National Geophysical Data Center

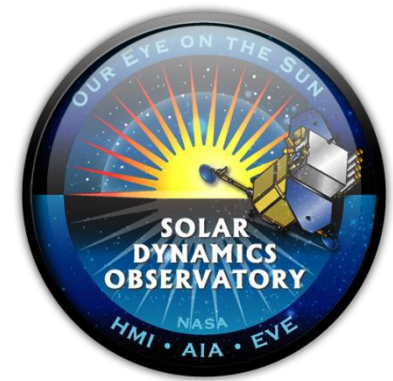
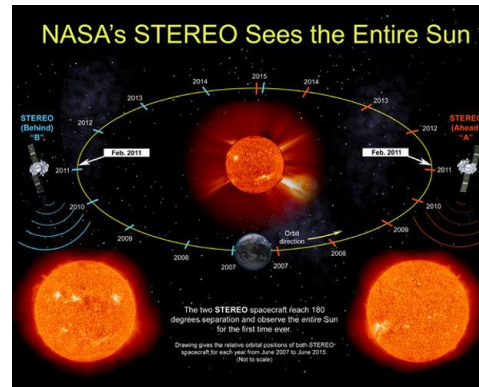
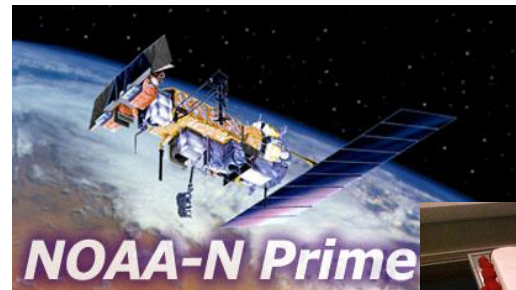
²Office of Systems Development



NOAA Operational Space Weather

Data Used in SWx Operations

The NOAA Space Weather program relies on a variety of NOAA (top) and non-NOAA (bottom) satellite assets to conduct its operational mission

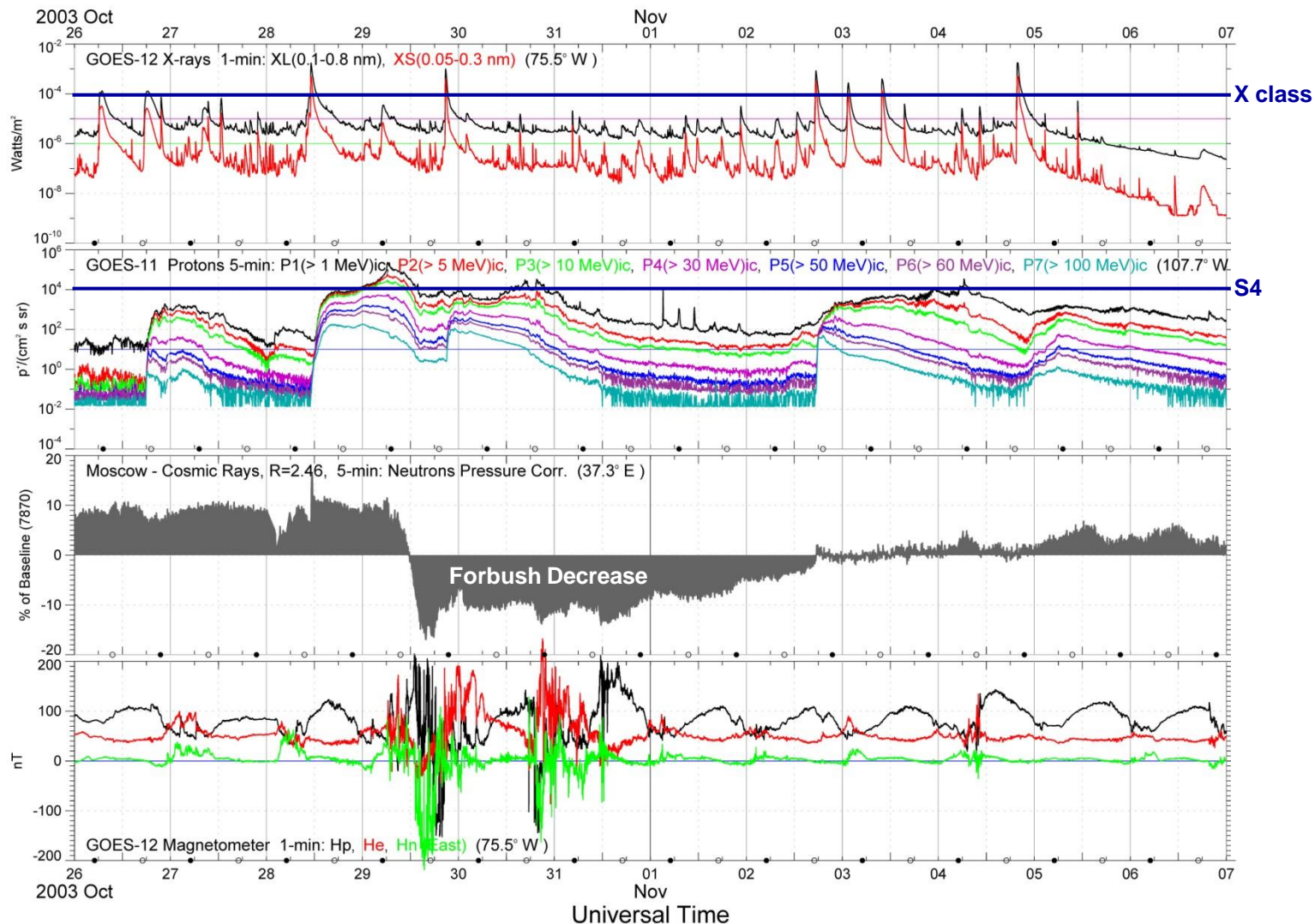




GOES Environmental Data

40 Years of Geostationary Measurements

Extreme Event: 2003-10-26 00h - 2003-11-06 24h



Solar X-Rays

Proton Events

Cosmic Rays (non-GOES)

Magnetic Field

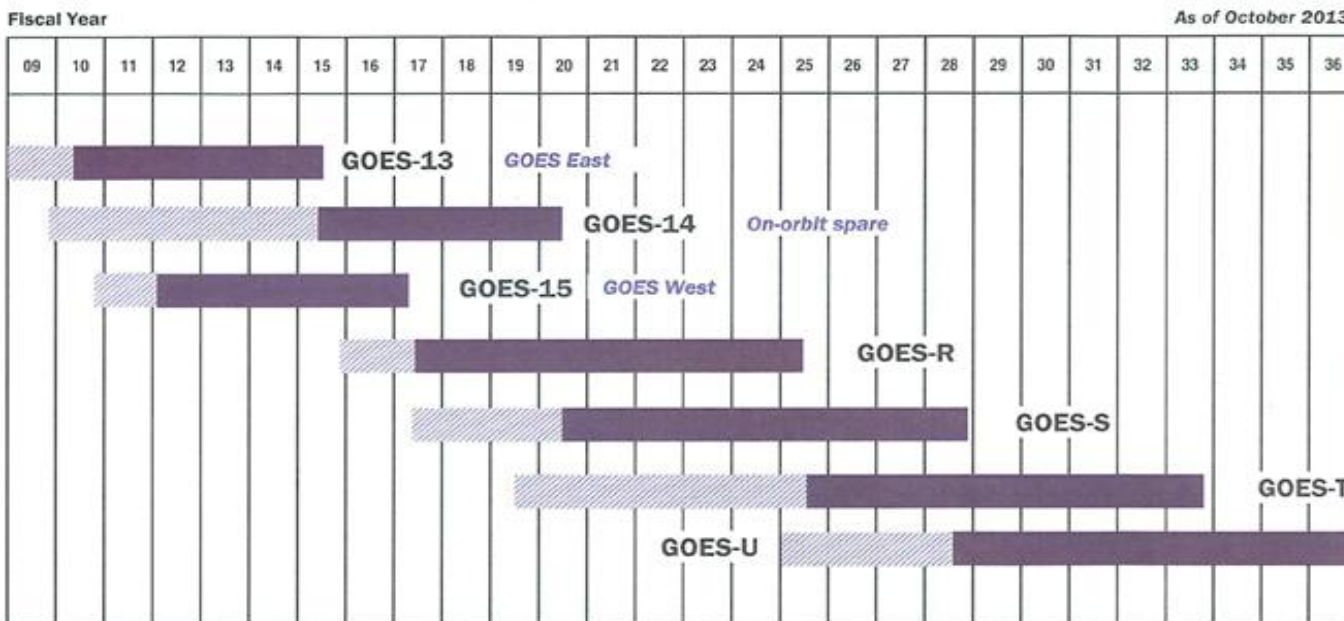


Continuity of GEO Measurements

Transitioning to GOES-R/S/T/U



Continuity of GOES Mission



Approved: Mary E. Kuczi
 Assistant Administrator for Satellite and Information Services

GOES: Geostationary Operational Environmental Satellite

- On-orbit storage
- Operational
- Operational beyond design life



GOES-R (R/S/T/U) Series Improved SWx Capabilities

The GOES-R series space/solar sensors provide incremental improvements to current NOAA GEO space weather monitoring. First launch date of the GOES-R series is late 2015 / early 2016.



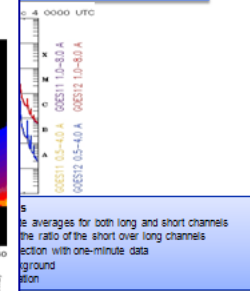
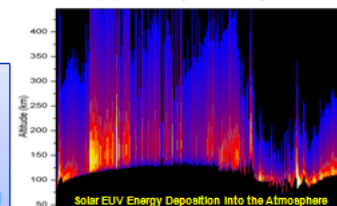
Credit: Lockheed-Martin

Solar X-Ray Sensor (XRS)

- Measures the irradiance (total brightness) of the sun in two x-ray channels
 - 0.05 to 0.4 nm
 - 0.1 to 0.8 nm
- Provides a first alert of impending solar storms and space weather events.
- Observes solar flares and provides absolute brightness information.
- Drives space weather scales and operational models.

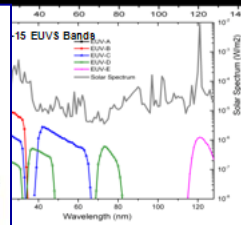
Solar Extreme Ultra-Violet Sensor (EUVS)

- Observations of the Solar EUV Spectrum from 5 to 125 nm
- Provides solar EUV input to thermosphere and ionosphere models which provide specification and forecasts
- Models provide specification and



Solar Ultra-Violet Imager (SUVI)

- Completely Different than GOES NOP:
- GOES NOP SXI observes in x-rays (0.6-6 nm)
 - SUVI will observe in the Extreme Ultra-Violet (EUV) (10-30 nm)
 - Narrow band EUV imaging: Permits better discrimination between features of different temperatures
 - 30.4 nm band adds capability to detect filaments and their eruptions
 - 6 wavelengths (9.4, 13.1, 17.1, 19.5, 28.4, and 30.4 nm) 2 minute refresh for full dynamic range
- SUVI will provide
- Flare location information (Forecasting event arrival time and geo-effectiveness)
 - Active region complexity (Flare forecasting)
 - Coronal hole specification (High speed solar wind forecasting)



Increased # of wavelength bands

Space Environment In-situ Sensor Suite SEISS

Four Subsystems
Measuring Electrons, Protons, and Heavier Particles

MPS-Low: Spacecraft charging, ground-induced currents (electric power grid)

- 30eV-30keV electrons
- 30eV-30keV protons
- 14 angular bins

MPS-High: Spacecraft charging, deep dielectric charging

- 40keV-4MeV electrons
- 80keV-10MeV protons
- 10 energy bands at 5 angles

SGPS: Solar Energetic Particle events (SEP), solar radiation storms (protons), HF communication (airlines), astronaut radiation, satellite degradation.

- 1 MeV-500MeV protons
- 4MeV-500MeV alphas
- 10 energy bands at 2 angles

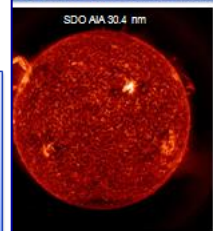
EHIS: Satellite single event upsets, astronaut radiation

- 10MeV/nucleon-200MeV/nucleon
- Distinguishes H, He, C-N-O, Ne-S and the Fe group, Z=17-28
- 5 energy bands

SEISS Algorithms

- SEISS.16: One-minute averages - all MPS channels
- SEISS.17: Five-minute averages - all MPS and SGPS channels
- SEISS.18: Convert differential proton flux values to integral flux values
- SEISS.19: Density & temperature moments & level of spacecraft charging
- SEISS.20: Event detection based on flux values

provides improved proxy data: many pixels as SUVI coverage in 8 EUV bands, 5 of which match SUVI exactly



Solar UV imagery versus soft x-rays

Improved particle energy coverage





An End of an Era (since 1978)

LEO Space Environmental Monitor (SEM)

NOAA-19 (POES)

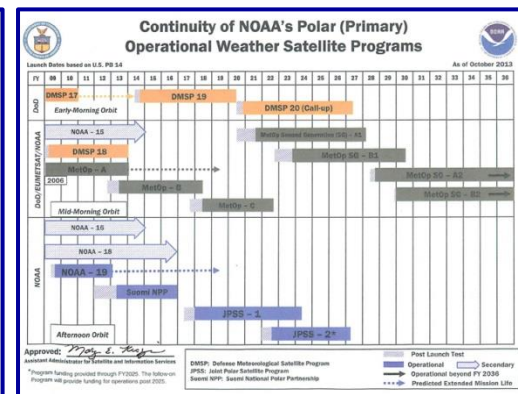
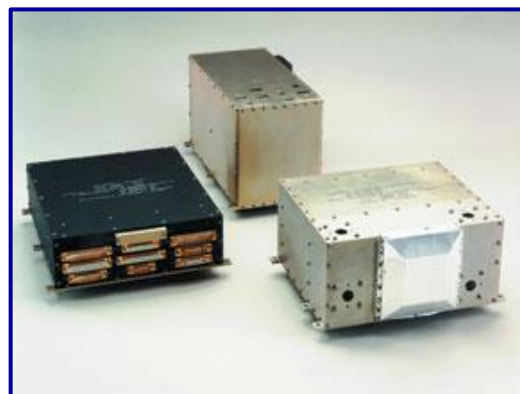
Launched: 08 Feb 2009



- NOAA-19 is the last NOAA satellite in polar LEO to provide operational SWx data
 - NOAA-19 Extended EOL – CY19
 - NOAA-15/16/18 still provide SEM data
- European MetOp satellites carry NOAA SEM-2 packages
 - MetOp A – CY2006 – 2014 (SEM-2)
 - MetOp B – CY2013 – 2018 (SEM-2)
 - MetOp C – CY2018 – 2022 (SEM-2)

<http://www.ngdc.noaa.gov/stp/satellite/poes/index.html>

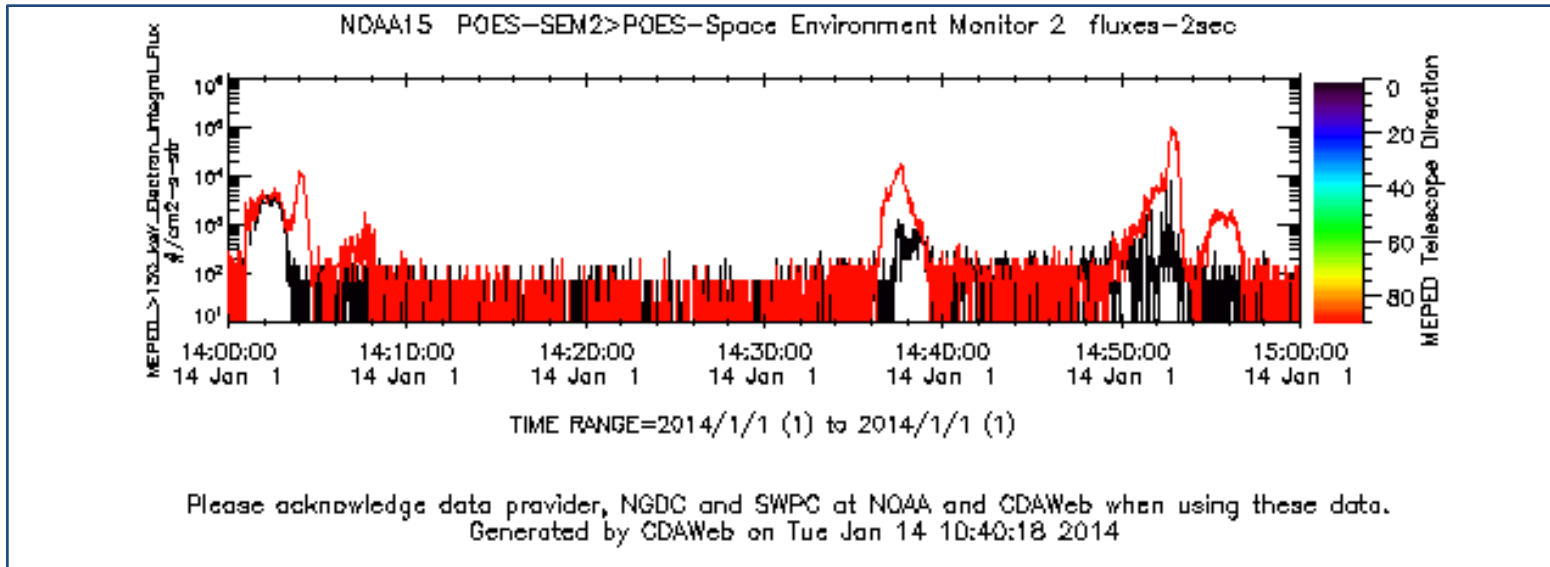
AMS – 02-06 Feb 2014





Secondary Provider

Coordinated Data Analysis Web



New NOAA datasets will soon be available via CDAWeb

NOAA15/16/18/19; MetOp-A/MetOp-B

MEPED: e: >40; >130; >287; >612 keV

p: 39; 115; 332; 1105; 2723 keV

TED: e: 50 eV – 1 keV; 1 keV – 20 keV

p: 50 eV – 1 keV; 1 keV – 20 keV

integral energy flux

differential energy flux

channel energy flux

channel energy flux

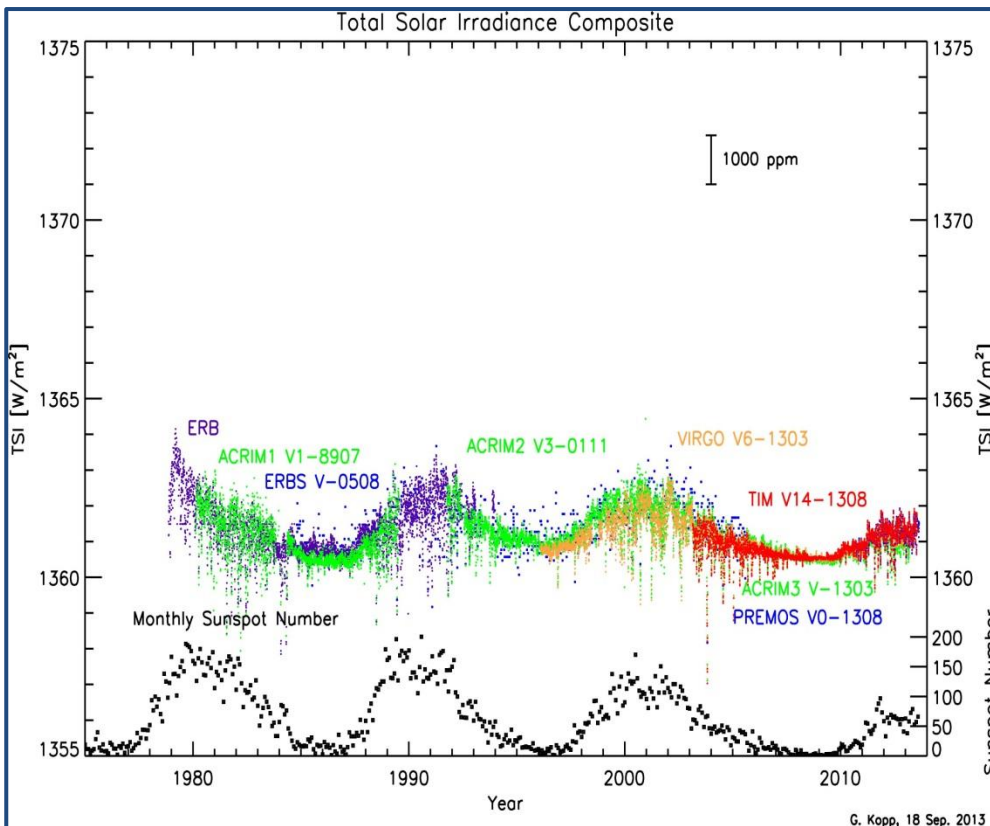
Contact [Rob Redmon](#) or [Bob McGuire](#) for details



Total Solar Irradiance

TSI Calibration Transfer Experiment (TCTE)

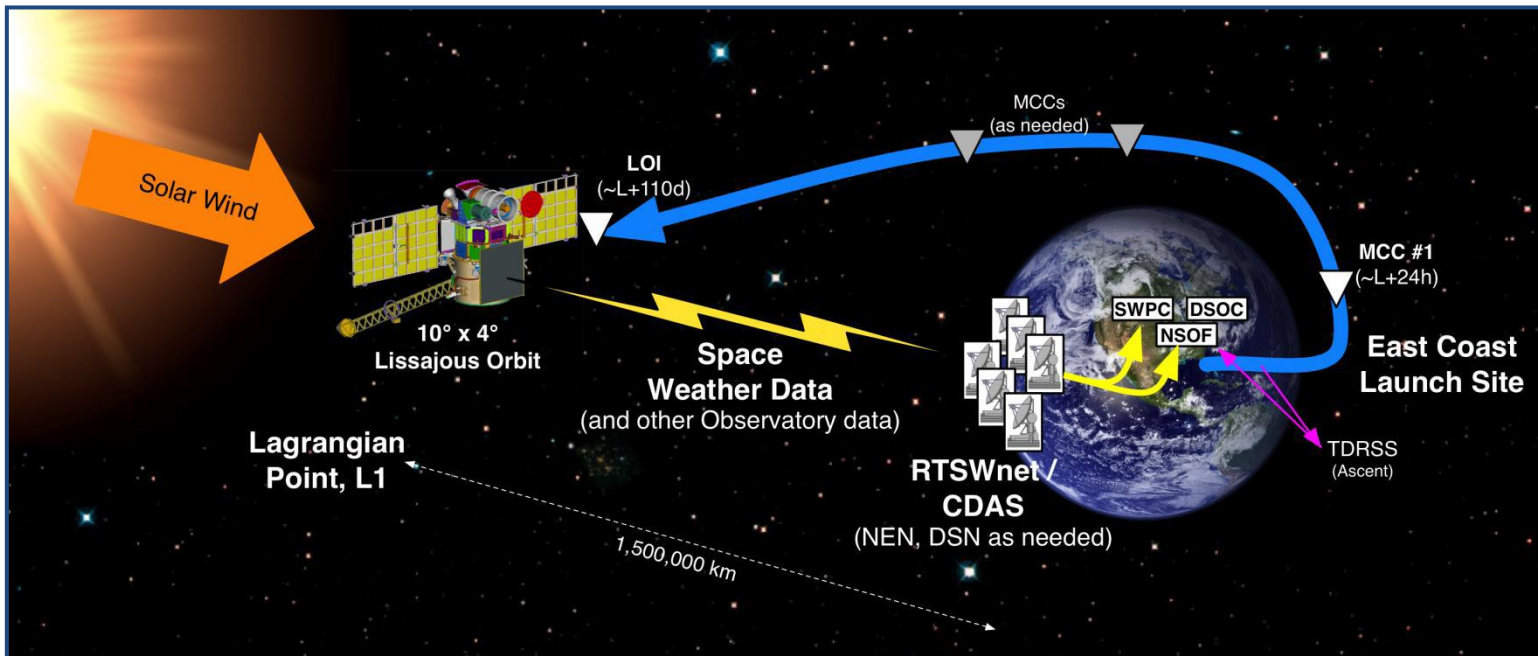
TCTE was launched on the Air Force's STP-Sat3 on 19 Nov 2013 and put into a planned 500-km, 40-deg inclination orbit. After commissioning and outgassing, data acquisition started on 13-Dec with at least 1 orbit/day of solar observations. Overlapping Total Solar Monitor (TIM) measurements with SORCE were made in late December. Strategies for a F/O TSI mission under consideration.





New Capability

Operational SWx Data from L1



- The DSCOVR spacecraft will measure the solar wind (n_p , v_p , t_p) and the interplanetary magnetic field at 240 R_e forward of the earth
- Space-X Falcon 9 launch scheduled for 13 Jan 2015; DSCOVR on-station in 110 days
- DSCOVR solar wind/IMF data downlinked via the Real-Time Solar Wind Network (RTSWnet) as is currently done for ACE
- SWPC provides real-time data / NGDC provides retrospective data (>1 day)

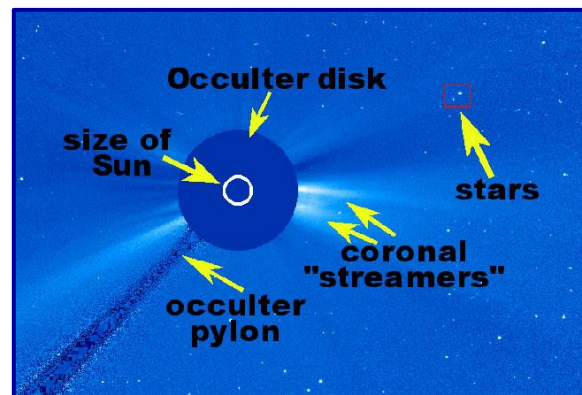
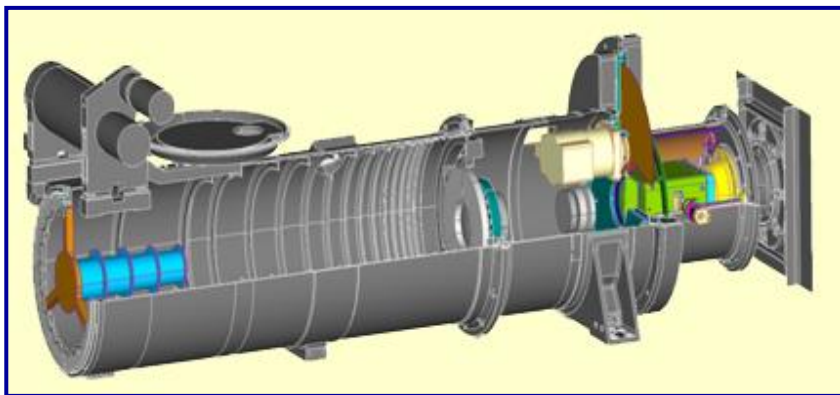
**SWPC plans to host a NOAA Solar Wind and L1 Requirements Workshop
06-07 April 2014 in conjunction with the Space Weather Workshop
Contact [Doug Biesecker](#) for details**



Continuing Studies

Compact Coronagraph (CCOR)

NOAA currently uses SOHO coronagraph to detect and characterize coronal mass ejections (CMEs)



- CCOR design offers reduced sensor mass and volume at lower cost
 - 6 kg telescope, 17 kg for sensor
 - Optical train is 1/3 length of traditional coronagraphs & uses multiple occulters
- NRL completed Phase A study & successfully bench tested the optical design
- NOAA will continue to fund risk reduction studies at NRL during FY13-14
- CCOR ranked in DoD Space Experiments Review Board for STP launch
- CCOR under consideration for DSCOVR follow-on mission options

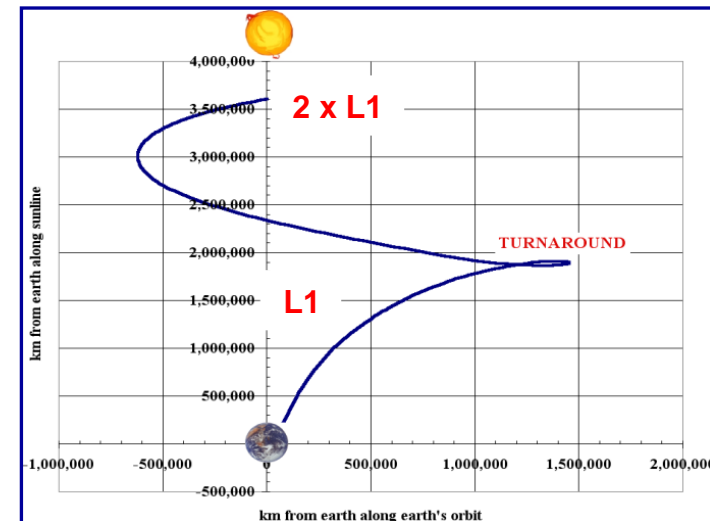
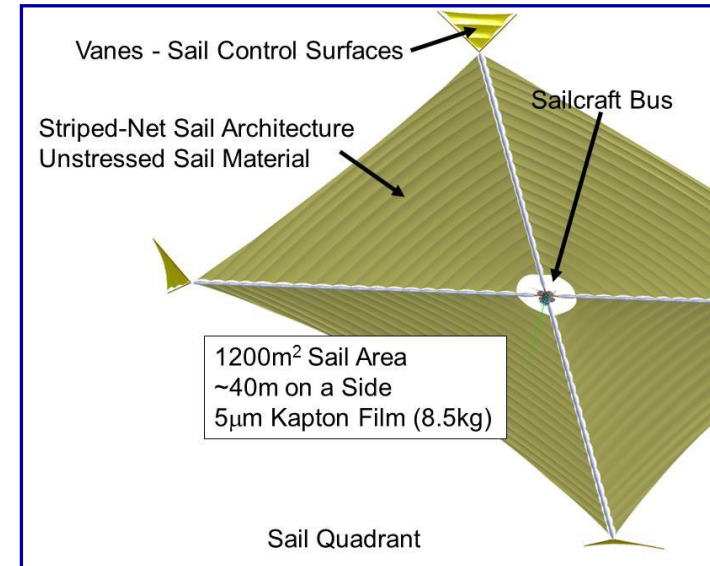


Technology Demonstration

Sunjammer – Solar Sail Demonstration



- Sunjammer is a NASA technology demonstration mission (TDM) to examine the propellantless propulsion potential of solar sails
- Mission will demonstrate sail maneuvers in its first 30 days – then fly to 2 x L1 and then out of the ecliptic plane if within orbital constraints
- NOAA plans to partner with NASA to provide data reception, analysis and archive
- Space weather instruments:
 - Particle spectrometer – MSSL
 - Magnetometer – Imperial College London
- Previously co-manifested with DSCOVR – now looking for a GEO-transfer launch





DSCOV R Follow-on

Operational Solar Wind / CME Imagery Missions

NOAA is committed to continued solar wind/CME monitoring

Solar Wind – Commercial and other options:

- Evaluate Sunjammer mission performance data for improved space weather forecasts
- Evaluate business case for Sunjammer commercial data buy option
- Examine sensor concepts for improved sensor performance
- Refresh cost estimates for other options such as government satellites

CME Imagery

- Continue CCOR risk reduction studies at NRL
- Pursuing STP launch option
- Include CME imagery option in DSCOV R follow-on studies

NOAA Solar Wind and L1 Requirements Workshop (Pre-announcement)

- 06-07 April 2014 – Boulder, Colorado (just before Space Weather Workshop)
- If interested, send an e-mail to Doug Biesecker (doug.biesecker@noaa.gov)



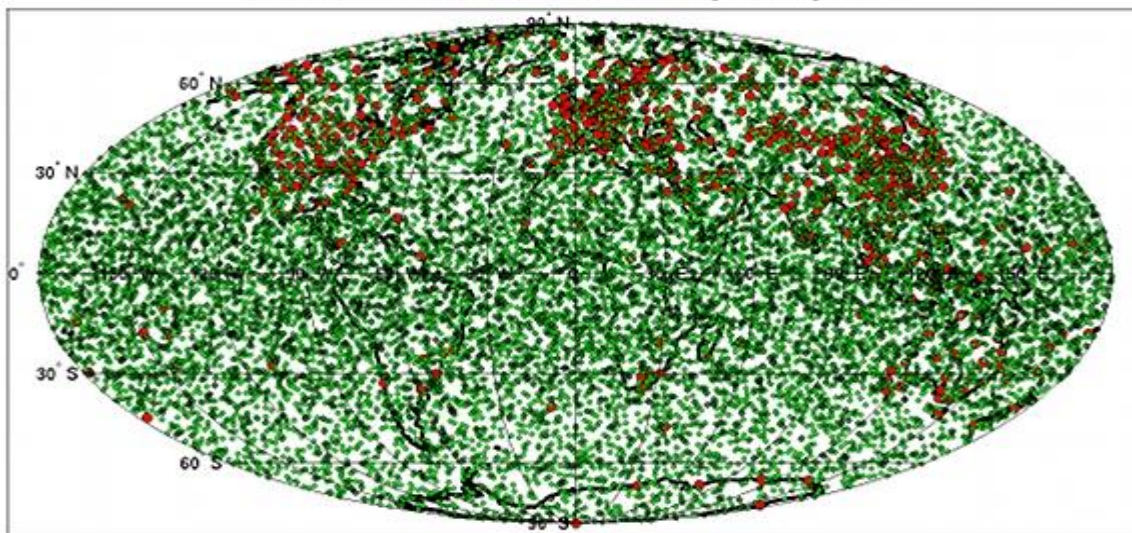
New Capability

GNSS Radio Occultation – COSMIC II

Constellation Observing System for Meteorology, Ionosphere & Climate

- Taiwan-USAF-NOAA Partnership
- 12 satellite constellation – 6 @ 24° inclination (low) / 6 @ 72° inclination (high)
- Phase 1 launch planned for March 2016 – low inclination; Phase 2 launch - >2018
- NOAA coordinating with international partners to host/operate ground receptors
- Full up constellation will acquire more than 8000 ionospheric soundings per day

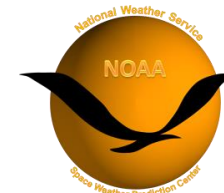
Occultation Locations for COSMIC-2, 24 Deg + 72 Deg, 24 Hrs



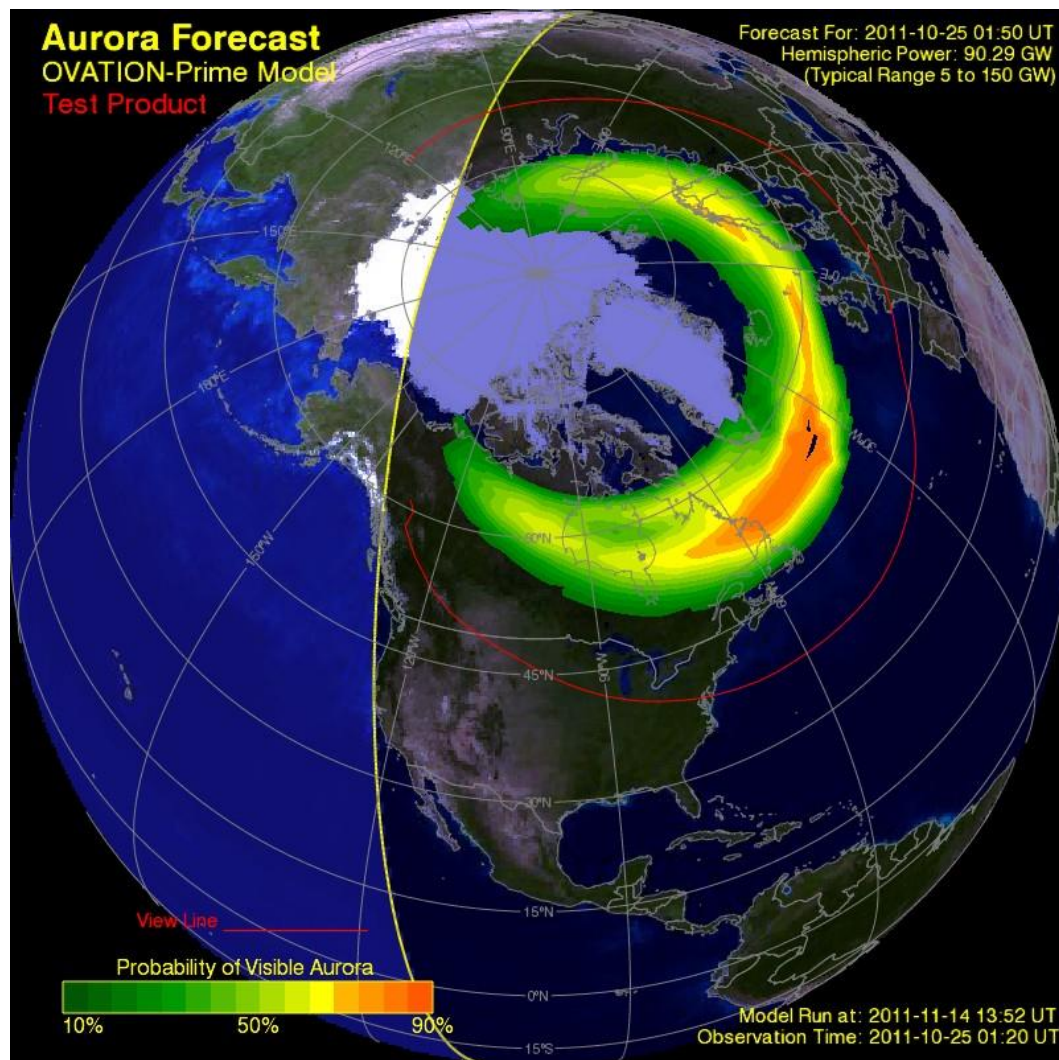
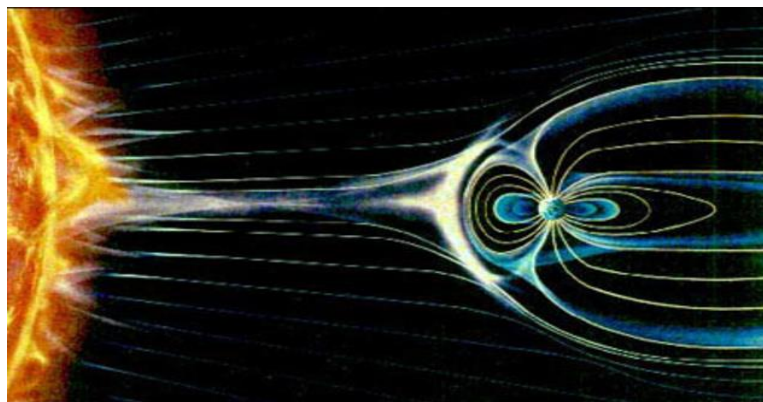


Expanded Products & Services

Ovation Auroral Forecast Model



- Methodology developed at JHU/APL
 - 30-40 min forecast driven by ACE solar wind and interplanetary magnetic field data – ops will transition to DSCOVR
 - Model currently running in real-time at NGDC – [link](#)
 - Customer products available from SWPC – [link](#)
- Plans:
 - Transition Ovation to full operations in March 2014
 - Test & implement model upgrades for reduced noise and capability to handle larger storms



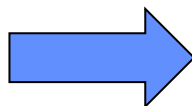
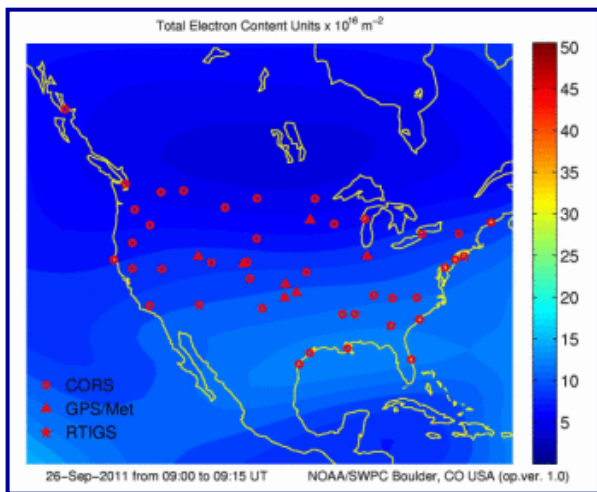
Send comments to [Rod Viereck \(SWPC\)](#)



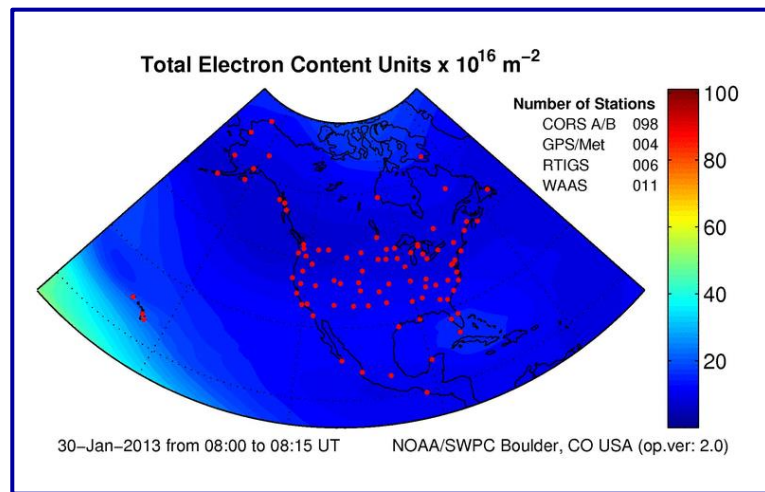
Expanded Products & Services

North America TEC

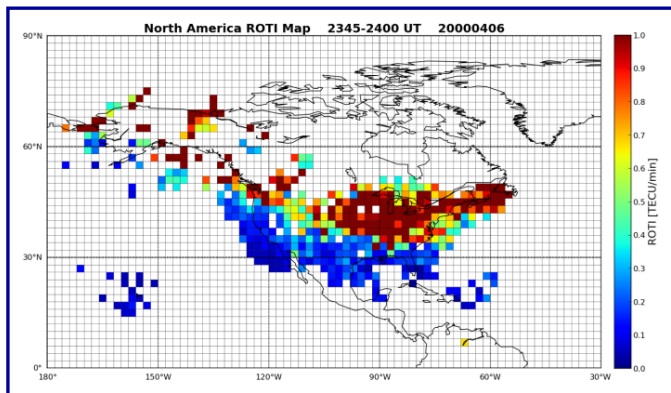
Extending current US-TEC product to NA-TEC



Research
to
Operations



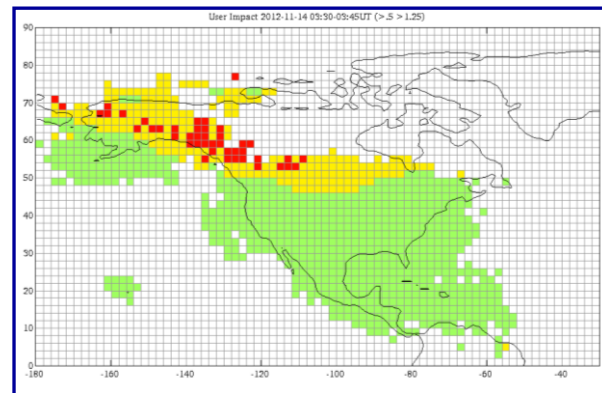
Rate of TEC Index Product



Related products

Research
and
Development

GPS Scintillation Specification





Expanded Products & Services

Summary – Take Aways

- NOAA currently provides a variety of operational space weather data and products from its existing fleet of environmental satellites (GOES and POES/MetOp)
- GOES-R/S/T/U will continue to acquire GEO measurements through 2036
- After POES/MetOp there are no planned operational (or otherwise) satellites acquiring particle/radiation data in LEO – possible AF initiative (HEALER – Joe Mazer/Aerospace)
- New near-term NOAA operational sources of space weather data include DSCOVR at the L1 Lagrange location and COSMIC-II in LEO – Sunjammer & DSCOVR follow-on are also in the mix
- NWS/SWPC has new products and services coming on line



Thank You!

A graphic for the NOAA National Geophysical Data Center. It features a central image of Earth with a color-coded bathymetry map, showing the Atlantic Ocean and surrounding continents. To the upper left of Earth is a glowing orange and red sun. The background is a light gray map of the world with a grid of latitude and longitude lines. Text is overlaid on the graphic.

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GEOPHYSICAL DATA CENTER

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with Authoritative Data

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