NPOESS Space Weather Data Products and Archive Within NOAA

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Space weather monitoring by the NPOESS satellite constellation includes measurements of energetic charged particles over a broad energy range. The complement of space environmental particle sensors included on NPOESS and the associated European MetOp satellites will be used to provide the primary Environmental Data Records (EDRs) for the Auroral Boundary, Auroral Energy Deposition, Medium Energy Charged Particles, Energetic Ions, and Suprathermal through Auroral Energy Particles. These EDRs will be used to derive a variety of operational products within the NOAA Space Weather Prediction Center (SWPC) that will continue to serve the needs of the airline industry, power utilities, and satellite operators, among others. The National Geophysical Data Center (NGDC) will provide data stewardship for the NPOESS space environmental EDRs and related operational products, including long-term archive and user access. The permanent archive for the NPOESS space weather data is the NOAA Comprehensive Large Array-data Stewardship System (CLASS) in which NGDC is a primary node. To some degree the infrastructure for accommodating the NPOESS space environmental data and derived products is in place due to the similarity in the space weather missions for NPOESS and the current NOAA Polar Operational Environmental Satellite (POES) system. This presentation will discuss plans for the utilization, retention, and distribution of NPOESS space weather data and products within the context of the current POES program and the future CLASS.

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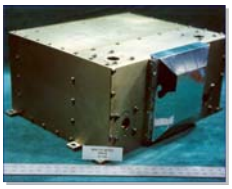
The NPOESS is a 2-ball, sun-synchronous system at 840 km at 1330 and 1730 LTAN orbits. MetOp is the European counterpart to NPOESS having similar orbital characteristics but located in the 2130 LTAN orbit. The Space Environment Monitor-2 (SEM-2) instrument is currently manifested in the NPOESS 1330 orbit and on MetOp. SEM-2 provides operational space environmental data to the NOAA and the USAF.

SEM-2 sensor

SEM-2 is currently deployed on NOAA polar orbiting spacecraft. The SEM-2 sensor is actually a suite of particle sensors covering the energy ranges from 50 eV to 1 MeV for electrons and 50 eV to >140 MeV for protons. The SEM-2 consists of separate Total Energy Detector (TED) and Medium Energy Proton and Electron Detector (MEPED) components. The TED is a cylindrical electrostatic analyzer (ESA) for measuring electron and protons in the energy range from 50 eV to 20 keV. The MEPED itself is divided up into a separate electron and proton stacked solid-state detector telescope sub-section for measuring electron and protons in the energy ranges from 30 keV to 1.1 MeV and 30 keV to >6.9 MeV, respectively, and an omni-directional proton detector sub-section for measuring protons with energies 16 MeV to >140 MeV. Multiple sensors for the TED and MEPED telescopes are used to sample particles within and outside the loss cone.

TED



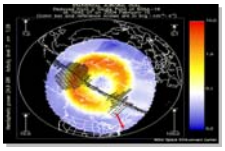
MEPED

Environmental Data Records & Space Weather Products

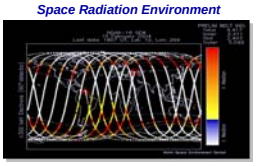
Space environmental data obtained with the SEM-2 is used to address the Auroral Boundary, Auroral Energy Deposition, Suprathermal through Auroral Energy Particle, Medium Energy Charged Particles, and Energetic Ions EDRs. These data are used by the NOAA SWPC for higher-level products and services. The *Statistical Auroral Oval* is a data-driven representation of the northern (& southern) oval determined from TED measurements – the equatorial extent of the auroral zone is an excellent indicator of the level of "space weather" stress during geomagnetic storms. Differential plots of the *Space Radiation Environment* along the satellite path are calculated using MEPED particle telescopes data and provide a valuable source of data relevant to manned spaceflight. Finally, *Solar Proton Monitor* plots use data from the MEPED omni-directional proton detectors which can be used to infer the presence polar-cap absorption region at high latitudes which adversely affect radiowave propagation. Sample pots are provided in the adjacent column.

Space Environmental Data Products

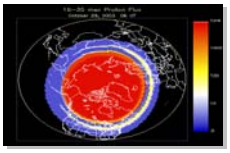
Statistical Auroral Oval



Space Radiation Environment

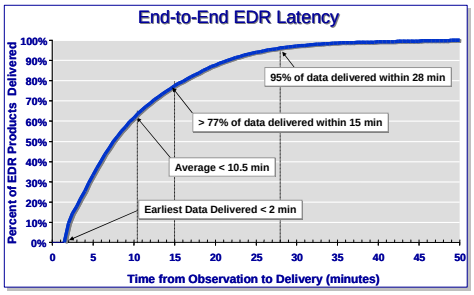


Solar Proton Monitor



Data Availability and Latency

The NPOESS architecture includes the innovative SafetyNet concept to minimize the latency of the data to the SWPC. It is expected that the NPOESS space EDRs will be available within 30 minutes of the measurements data and on a timescale consistent with the passage of the NPOESS spacecraft across the magnetic polar regions. MetOp uses a more conventional "store & dump" communication architecture having a nominal latency of ~2 hours. While the MetOp data will be of value by sampling in a distinct orbit plane it is the more-timely NPOESS data which can best serve the needs of space weather operators.



Archiving NOAA SWx Satellite Data in CLASS

CLASS is the enterprise-level data archival system for NOAA consisting of an electronic library of NOAA environmental data. CLASS is NOAA's premier on-line facility for the distribution of NOAA and US Department of Defense (DoD) Polar-orbiting operational environmental satellite data, NOAA's Geostationary Operational Environmental Satellite (GOES) data and derived products.

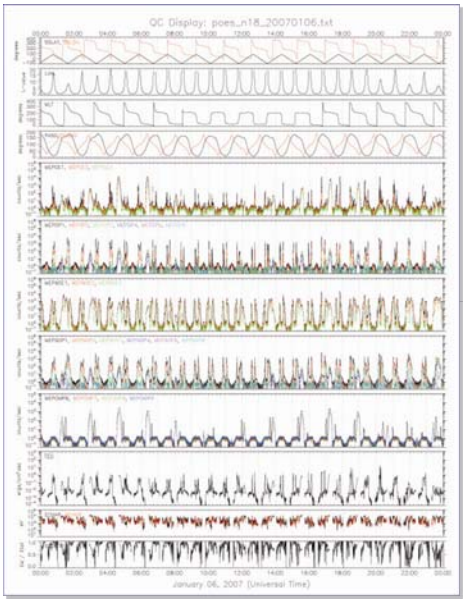
The NPOESS SEM-2 data (RDRs, SDRs and EDRs) processed in the Interface Data Processing Segment (IDPS) will be archived in CLASS and made available to users via user-friendly portals or direct Machine-to-Machine (M2M) interfaces. MetOp Level 1 SEM-2 data will also be archived in CLASS although it is undetermined whether CLASS will archive higher-level SEM-2 products. NGDC has developed several Application Programming Interfaces (APIs) to facilitate user access to the NPOESS and MetOp datasets .

Scientific Data Stewardship of NOAA SWx Data

NGDC is responsible for Scientific Data Stewardship (SDS) of NOAA SWx data and products. This responsibility includes SEM-2 data from NPOESS and MetOp. Space weather data from the currently operational MetOp-A satellite is processed within the SWPC and forwarded to NGDC for archive and dissemination. Access to the MetOp data will be via the NGDC satellite data portal at:

http://www.ngdc.noaa.gov/ngdcinfo/satellite.html

Archived SEM-2 products will include the raw, full-resolution data available in binary format and as 16-second averaged datasets available in CDF format or as standard text files. Also available from the NGDC site are sensor quality-control plots and instrument documentation. The figure below is an example of a SEM-2 data quality plot from the NOAA POES spacecraft. The MetOp data will be presented is a similar format. Daily archival datasets will be made available on the next UT day shortly after 0 UT.



Summary

Space environmental data from NPOESS and MetOp will be archived in CLASS or through NGDC. Regardless of the archive location, the intent is to make these datasets available in a seamless fashion via user-friendly, front-end applications or through M2M APIs. The SWPC will remain central in overseeing the processing of the SEM-2 data and NGDC will be responsible for the long-term SDS of the data and SWx products.

Note: Recent consideration has been made for an improved set of SWx particle sensors on NPOESS. The Integrated Program Office (IPO) is performing technical and fiscal evaluations for a substitute SEM-2 instrument and will make a final decision in concert with SUAG approval.