Update on the NOAA Polar Satellite Program, Data, and Products

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Summary

The constellation of operational NOAA / EUMETSAT polar satellites is one of the few sources of near real time and historical measurements of energetic particles impacting the atmosphere. These measurements are critical for understanding how particle precipitation affects atmospheric chemistry, circulation and ultimately climate. Here we provide an update on the current polar satellite fleet and recent improvements to the particle data and derived products.

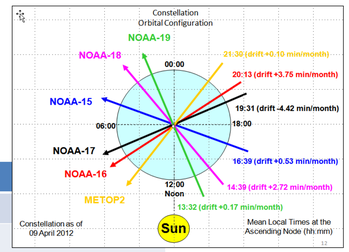
Uses for POES/MetOp Particle Data

Scientists study the space environment and developing space physics and atmospheric models with particle data.
Airlines identify areas of communication loss with products derived from energy flux and high energy ion data.
Power companies manage the power grid and avoid damage and black outs due to ground induced currents with products derived from the energy fluxes.
GPS customers quantify GPS errors with products derived from energy fluxes.
Satellite operators assess and mitigate satellite anomalies with medium and high energy particle fluxes.
Satellite launch operators determine launch safety with medium and high energy particle fluxes.
NASA assesses safety risks to astronauts and equipment with medium and high energy particle fluxes.

Polar Satellite Particle Data Processed at NOAA – POES and MetOp

Polar Orbiting Environmental Satellites (POES) operated by NOAA.
MetOp satellites operated by EUMETSAT.

altitude: ~810 km (low earth orbit)
inclination: ~98.7°
period: 101 minutes (14 orbits/day)



Satellite	Launched	Notes
POES (NOAA-15)	1998	
POES (NOAA-16)	2000	
POES (NOAA-17)	2002	To be decommissioned in 2013.
POES (NOAA-18)	2005	
POES (NOAA-19)	2009	
MetOp-A	2006	
MetOp-B	2012	
MetOp-C		Launch expected 2017.

SEM-2 Instrument Package

The POES and MetOp satellites each carry a SEM-2 package with three types of particle detectors covering different energy ranges.

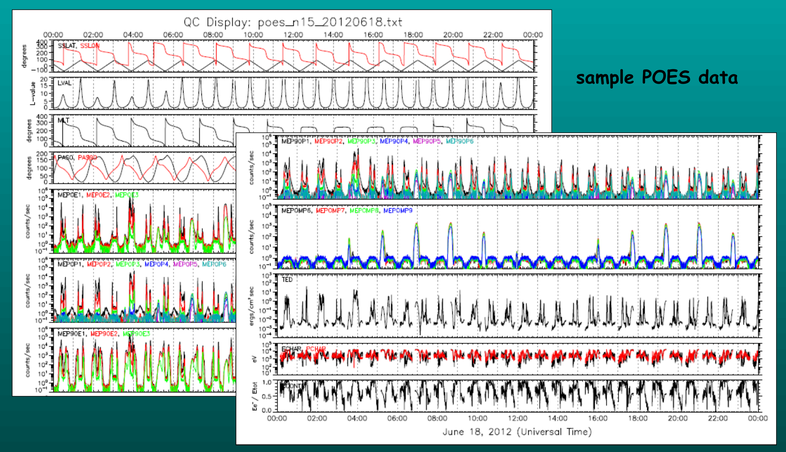
Instrument (Total no. of detectors)	Description*	No. of bands per e^- detector	e^- energies	No. of bands per p^+ detector	p^+ energies
TED (8)	Electrostatic analyzer Pointing: 0° and 30°. FOVs: 3° to 10°	16	0.05 - 1 keV 1- 20 keV	16	0.05 - 1 keV 1- 20 keV
MEPED Telescopes (4)	Solid state detectors Pointing: 0° and 90° FOV: 30°	3	0.03-2.5 MeV	6	0.03-6.9 MeV
MEPED OMNIs (4)	"Omni-directional" solid state detectors Pointing: 0° FOVs: 120° to 360°	--	--	1	16-250 MeV

* Detector angles relative to satellite-Earth line; 0° points away from Earth.
FOV: full-width field of view

New Near Real Time Processing at NGDC

The NOAA National Geophysical Data Center (NGDC) is currently updating the software for processing space weather data from the POES/MetOp satellites to provide higher quality and more timely data.

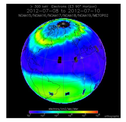
Improvement	New System	Old System
Latency of processed data	Available as it is received from the satellite (nominally once per 90-minute orbit).	Available daily.
Accuracy of magnetic parameters	Calculated.	Used look-up tables updated yearly.
MEPED telescope data units	Differential fluxes with error estimates. Determined from integral fluxes using bowtie technique.	Integral fluxes.
OMNI data units	Differential fluxes with error estimates determined from count rates with iterative fit.	Counts.
More frequent data access	~90 minute cadence based on inherent latency	Daily files



sample POES data

Related Polar Particle Work

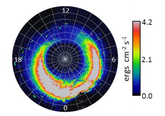
Improved Calibration of Proton Telescope Data
Corrections derived from satellite cross calibrations which include the impacts of detector pointing and satellite altitude will be applied to the MEPED data. (with JHU APL)



Improved Particle Precipitation Maps
Improved global maps of particle precipitation will be provided based on near real time measurements and new processing techniques for removing contaminating signals. (with CU/LASP)

Proton Contamination Removal in Electron Telescope Data
The lowest three channels of the MEPED electron telescopes detect protons of energies ranging from 150 keV to 1200 keV. Proton contamination will be estimated using geometric correction factors found with GEANT modeling by Yando et al., [2011]. (with JHU APL).

Auroral Maps from OVATION Prime Model
The OVATION Prime model is an empirical auroral model developed at JHU APL by Pat Newell et al [2010]. NOAA is developing a variety of real time and archived products based on the model.
http://www.ngdc.noaa.gov/stp/ovation_prime/
http://helios.swpc.noaa.gov/ovation/
http://sourceforge.net/projects/ovation-prime



Defense Meteorological Satellite Program (DMSP) Data
Space weather observations from the polar orbiting DMSP satellites include:
SSJ4/5 19 channels, electron and ion count rates (30 eV-30 keV)
SSIES plasma bulk flow parameters (n, T, v)
SSM magnetic field
Measurements from currently orbiting DMSP satellites (F16-F18) are available from NGDC with a 3 day delay. A project to convert the binary SSJ dataset into a netCDF / HDF dataset is underway and will provide a full solar cycle of original and cleaned fluxes by December.

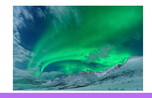
Space Weather Instruments on Future Polar Satellites

NOAA	none
US Air Force	possible
EUMETS	MetOp-C (2017), possible next generation (EPS-SG)

Summary

Improved particle data from the POES and MetOp satellites will be available from NGDC in 2012. A variety of other new products are also under development.

website: http://www.ngdc.noaa.gov/stp/satellite/poes/index.html
email lists: http://www.ngdc.noaa.gov/stp/mailinglist.html



References

aurora image: Thilo Bubek
orbiting satellite image: http://tornado.sfsu.edu/geosciences/classes/m415_715/Monteverdi/Satellite/PolarOrbiter/Polar_Orbits.html
Newell, P. T., T. Sotirelis, and S. Wing (2010), Seasonal variations in diffuse, monoenergetic, and broadband aurora, J. Geophys. Res., 115, A03216, doi:10.1029/2009JA014805.
Yando, K., R. Millan, J. Green, and D. Evans (2011), A Monte Carlo simulation of the NOAA POES Medium Energy Proton and Electron Detector instrument, *J. Geophys. Res., 116, doi:10.1029/2011JA016671.*