

NPP / VIIRS: NASA Program Science Perspective

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Time Series Data to Reveal Global Change



Satellites: POES → EOS → **NPP** → NPOESS

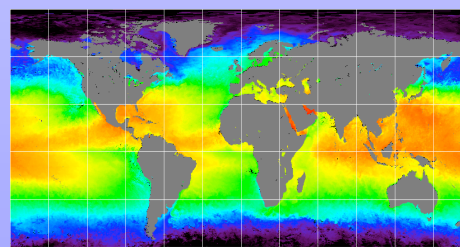
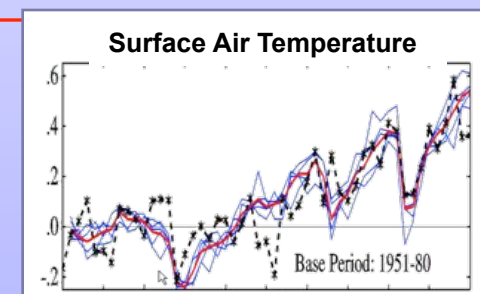
How is the global Earth system changing?

- atmospheric temperature and moisture profiles
- variability in ocean color and temperature

- vegetation productivity patterns

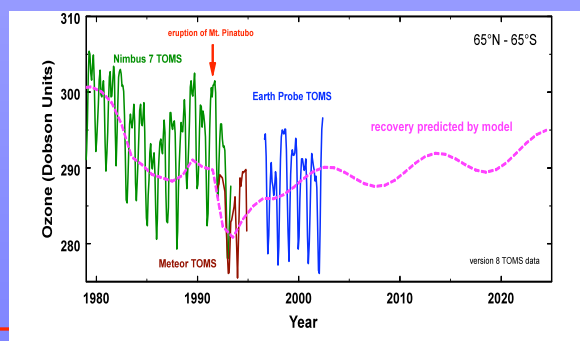
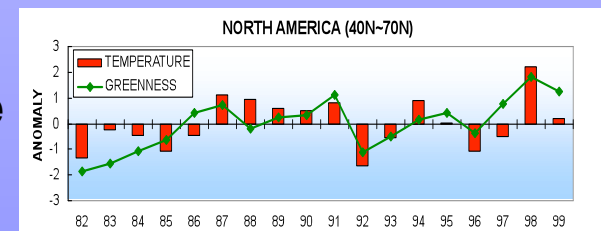
How does the Earth System respond to natural and human-induced changes?

- vegetation responses to climate
- ozone layer recovery
- clouds and aerosols

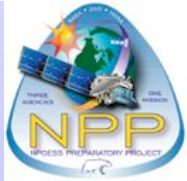


Atmospheric Sounding

Multispectral Imaging / Surface Biophysical Properties



Total Ozone Monitoring



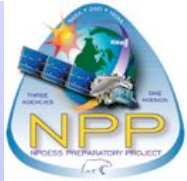
NPP Mission Goals



To provide a continuation of the EOS record of climate-quality observations after EOS Terra, Aqua, and Aura (i.e., it will extend key Earth system data records and/or climate data records of equal or better quality and uncertainty in comparison to those of the Terra, Aqua, and Aura sensors),

To provide risk reduction for NPOESS instruments, algorithms, ground data processing, archive, and distribution prior to the launch of the first NPOESS spacecraft.

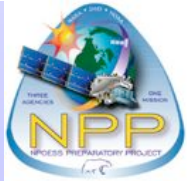
→ In March 2009, the Program Executive Committee for NPOESS decided that NPP is a critical operational mission. This means that from the operational environmental satellite system perspective, NPP is no longer only a risk reduction mission.



Agency Roles and Responsibilities



- NASA (outside of the IPO) provides the ATMS and CERES instruments, spacecraft, and launch services.
- NPOESS IPO provides the CrIS, VIIRS, and OMPS nadir instruments; Command Control and Communications Segment (C3S); and the Interface Data Processing Segment (IDPS).
- NOAA (outside of the IPO) provides the data Archive and Distribution Segment (ADS).
- NASA and NOAA are jointly providing the OMPS limb instrument.

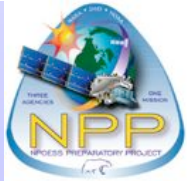


NPP Science Team Role



The NPP Science Team's primary role is to evaluate NPP/NPOESS Environmental Data Records (EDRs) and to identify any needed improvements

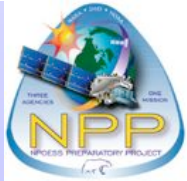
- evaluate the accuracy with which the operational algorithms provided by the NPP instrument contractors can extend the time series of environmental records begun with NASA's Earth Observing System (EOS) to assure the usefulness of the results to be provided for climate science
- address algorithm modification, refinement, and/or enhancement necessary to achieve needed accuracies for climate science, and once the necessary algorithm enhancements and/or processing changes have been identified, develop, document and test them
- conduct research that will enable scientists to understand the detailed operations of the environmental sensors to fly aboard the NPP satellite



NPP Science Team Responsibilities



- Participate in technical interchange meetings, NPP science team meetings, and relevant measurement team meetings and more frequent teleconference calls
- Review sensor and algorithm documents, algorithm code, and system descriptions as appropriate
- Conduct data simulation studies as appropriate
- Prepare an algorithm analysis report and recommend algorithm improvement activities
- Participate in the planning for science operations
- Participate in NPP calibration and validation planning as appropriate
- Provide information to NASA on a variety of technical matters associated with NPP instruments and algorithms



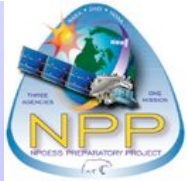
NPP Data Processing & EDR Evaluation



NPP data will be processed by the IPO-provided NPOESS data system

- The Interface Data Processing Segment (IDPS) captures the Raw Data Records (RDRs) from the data stream, then processes the RDRs into Sensor Data Records (SDRs) and ultimately Environmental Data Records (EDRs).
- During the time of NPP, the IDPS will supply RDRs, SDRs and EDRs to two meteorological centers for evaluation or use in environmental applications and to the NOAA-provided Archive and Distribution Segment (ADS) for archiving and access/distribution to the broader user community.
- The IDPS also provides RDRs to NASA's Science Data Segment (SDS).

Data processing for OMPS and CERES follows a different plan. Only the nadir products from OMPS will be handled in the process described above.



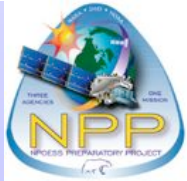
NPP Data Processing & EDR Evaluation



As part of its SDS, NASA has developed disciplinary Earth science Product Evaluation and Analysis Tool Elements (PEATE) to support NPP Science Team members and the NPP Project in their evaluation of SDR and EDR performance and assessment of the suitability of operational EDRs for use in climate analyses and support development of improvements to the operational algorithms which generate SDR and EDR products in the IDPS.

To summarize, the PEATEs support the NPP Science Team in its work to:

- analyze operational data records (RDR, SDR or EDR),
- analyze pre- and post-launch instrument calibration,
- analyze operational IDPS algorithm software,
- devise algorithm improvements, and
- test and demonstrate calibration and algorithm improvements.

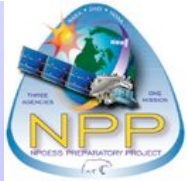


NPP Calibration and Validation



Current NPP Science Team members have been following the calibration and validation plans being developed by the IPO and NGST in order to evaluate their suitability for ensuring high-quality ESDRs and CDRs from NPP.

They have also been preparing to provide scientific inputs on or, in the case of some Principal Investigators, to make available certain, specific NASA EOS calibration/validation capabilities in support of critical calibration and validation approaches for science-quality data.



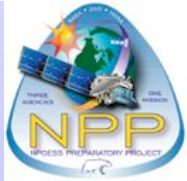
VIIRS and MODIS/SeaWiFS/AVHRR Data Continuity



The United States plans to continue many long-term environmental data sets through the National Polar-Orbiting Operational Environmental Satellite System (NPOESS).

- These Earth system data records (ESDRs) and climate data records (CDRs) are required for quantitative understanding of the Earth system and for ascertaining the magnitude of any natural or human-induced changes to that system.
- It is imperative that the different satellite sensors used to create a long time series data set be well-characterized, stable, and inter-calibrated.
- It is equally imperative that the data products created over time be accurate and consistent, with known precision and well-quantified uncertainties.

The emphasis for NASA's participation in NPP is on securing continuous, well-characterized, long-time-series measurements of sufficient quality to answer critical Earth system science, global change, and/or applied sciences questions.



VIIRS and MODIS/SeaWiFS/AVHRR Science Data Continuity is Difficult to Summarize



Our current understanding of VIIRS and the performance of the VIIRS instrument on NPP is complicated. Here is an example of what I know and/or have been hearing from Science Team / Project personnel:

- Some EOS measurements/data product time series will end; they were not included in the original plans for NPP (e.g., chlorophyll fluorescence, fire radiative power)
- Some NPP VIIRS measurements are unlikely to be of equivalent quality to those from MODIS/SeaWiFS; some of these may not be adequate for climate science (e.g., ocean color, aerosols), others may be OK
- Some NPP VIIRS EDRs may not be suitable for climate science due to deficiencies in the algorithm/processing methods (but a new or improved algorithm could mitigate)
- Instrument testing and characterization has identified problems and addressed certain concerns, but not all . . .
 - VIIRS on NPP has known performance limitations (cross-talk)
 - Testing of VIIRS has been more extensive than that for MODIS, but not adequately extensive based on “lessons learned” in these programs
 - Some desired tests were not performed, so we do not know what we don’t know about other areas of concern



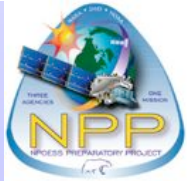
VIIRS and MODIS/SeaWiFS/AVHRR Data Continuity is Difficult to Summarize



**NPP VIIRS White Papers
reporting on EDR evaluation
are most welcome!**



Backup



NPP Status as of January 2010



- As of December 2009, the NASA-provided NPP Spacecraft, ATMS, and CERES sensors have been delivered and ATMS and CERES have been integrated onto the NPP spacecraft.
- The IPO-provided OMPS sensor has been delivered and integrated.
- The IPO-provided VIIRS sensor has been delivered.
- The project is awaiting delivery of the IPO-provided CrIS sensor for final integration and testing.
- Due to ongoing delays caused by both management and technical issues, the NPP launch will be no earlier than January 2011.
- The NPOESS C1 launch will be no earlier than March 2014 and NPOESS C2 no earlier than May 2016.