NPOESS Preparatory Project (NPP)
Science Overview

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NPP Continues Important Operational and Research Remote Sensing Data Time Series

Measurement System

- Ozone
  - NIMBUS 4
  - NIMBUS 7 TOMS
  - N16
  - N17
  - N18
  - N19
  - NPP
  - JPSS
  - OMPS
  - (Ozone Mapping and Profiler Suite)

- Microwave Sounding
  - AMSU
  - N15-17, AQUA
  - NPP
  - JPSS
  - ATMS
  - (Advanced Technology Microwave Sounder)

- Imaging
  - MODIS
  - TERRA
  - AQUA
  - NPP
  - JPSS
  - VIIRS
  - (Visible/Infrared Imaging Radiometer Suite)

- Thermal Infrared Sounding
  - AIRS
  - AQUA
  - CrIS
  - NPP
  - JPSS
  - CrIS
  - (Cross-track Infrared Sounder)

- Earth Radiation
  - ERBS
  - TERRA CERES
  - AQUA CERES
  - NPP
  - JPSS
  - CERES
  - Clouds & Earth Radiant Energy System

Year

- 1975
- 1980
- 1985
- 1990
- 1995
- 2000
- 2005
- 2010
- 2015

Conventional Operations EOS Technology Jump Research Quality Operations
NPP Sensor Data Records (SDRs) Produce Environmental Data Records (EDRs)

**VIIRS (22)**
- Albedo (Surface)
- Cloud Base Height
- Cloud Cover/Layers
- Cloud Effective Part Size
- Cloud Optical Thickness
- Cloud Top Height
- Cloud Top Pressure
- Cloud Top Temperature
- Ice Surface Temperature
- Net Heat Flux
- Ocean Color/Chlorophyll
- Suspended Matter
- Vegetation Index
- Aerosol Optical Thickness
- Aerosol Particle Size
- Active Fires
- Imagery
- Sea Ice Characterization
- Snow Cover
- Sea Surface Temperature
- Land Surface Temp
- Surface Type

**CrIS/ATMS (3)**
- O$_3$ Total Column
- O$_3$ Nadir Profile
- Atmosphere Vertical Moisture Profile
- Atmosphere Vertical Temperature Profile
- Pressure (Surface/Profile)

**OMPS (2)**
- O$_3$ Total Column
- O$_3$ Nadir Profile

**CERES (4)**
- Down LW Radiation (SFC)
- Down SW Radiation (SFC)
- Net Solar Radiation (TOA)
- Outgoing LW Radiation (TOA)

Denotes Key Performance Parameter (KPP)
Provide Data for Weather Forecast Models

Short term Environmental Observations (Events)

Long term Environmental Observations (Climate Change Detection)
Provide Data for Weather Forecast Models

Short term Environmental Observations
(Events)

Long term Environmental Observations
(Climate Change Detection)
Advanced Technology Microwave Sounder (ATMS)

- Scanning passive microwave radiometer
- Heritage instruments:
  - Advanced Microwave Sounding Unit (AMSU)-A1
    - NOAA-15, 16, 17, 18, & 19
    - NASA Aqua
    - EUMETSAT MetOp-A
  - AMSU-A2
    - NOAA-15, 16, 17, 18, & 19
    - EUMETSAT MetOp-A
  - Microwave Humidity Sounder (MHS)
    - NOAA-18 & 19
  - Humidity Sounder for Brazil (HSB)
    - NASA Aqua
  - AMSU-B
    - NOAA-15, 16, 17
  - Microwave Sounding Unit (MSU) & Stratospheric Sounding Unit (SSU)
    - Pre-NOAA-15
Crosstrack Infrared Sounder (CrIS)

- 3-Band Michelson Interferometer
- Heritage instruments:
  - Advanced Infrared Sounder (AIRS)
    - NASA Aqua
  - Infrared Atmospheric Sounding Interferometer (IASI)
    - EUMETSAT MetOP-A

ATMS and CrIS instrument radiances (SDRs) and temperature and moisture profiles are the primary data products required for National Weather Service forecast models.
NPP Mission

Provide Data for Weather Forecast Models

**Short term Environmental Observations (Events)**

**Long term Environmental Observations (Climate Change Detection)**
The MODIS Active Fire Mapping Program provides a near real-time geospatial overview of the current wildland fire situation at regional and national scales. Locations of current fires and the extent of previous fire activity are ascertained using satellite imagery acquired by the MODIS sensor. This information is utilized by fire managers to assess the current fire situation and serves as a decision support tool in strategic decisions regarding fire suppression resource allocation.

http://activefiremaps.fs.fed.us/index.php
VIIRS: Global Observations of Land, Ocean, and Atmosphere at High Temporal Resolution

Visible/Infrared Imager Radiometer Suite

- Multi-spectral, moderate resolution scanning radiometer (22 bands between 0.4 µm and 12 µm with 12-bit quantization)
- Heritage Instruments:
  - MODerate resolution Imaging Spectroradiometer (MODIS)
    - NASA Terra & Aqua
  - Sea-viewing Wide Field-of-view Sensor (SeaWiFS)
    - NASA Orbview-2
  - Advanced Very High Resolution Radiometer/3 (AVHRR/3)
    - NOAA 15, 17, (AM orbit), 16, 18, & 19 (PM orbit)
    - MetOp-A (AM orbit)
  - Operational Linescan System (OLS)
    - DMSP 5D-1, 5D-2, & 5D-3
Largest Ozone Hole
30 million km²

Area of North America
25 million km²
OMPS: Monitoring Total Column and Vertical Profile of Ozone

Ozone Mapping and Profiler Suite

• Nadir and limb push broom CCD spectrometers

• Heritage Instruments:
  • Total Ozone Mapping Spectrometer (TOMS)
    • NASA Earth Probe
    • Japan ADEOS
    • Russia Meteor-3
    • Nimbus-7
  • Solar Backscatter UltraViolet instrument (SBUV)
    • NOAA 9, 11, 16, 17, 18 & 19
  • Ozone Monitoring Instrument (OMI)
    • NASA Aura
  • Global Ozone Monitoring Experiment (GOME)
    • ESA ERS-2
  • Optical Spectrograph and InfraRed Imaging System (OSIRIS)
    • Sweeden Odin
  • Scanning Imaging Absorption SpectroMeter for Atmospheric CartograpHY (SCIAMACHY)
    • ESA ENVISAT
NPP Mission

Provide Data for Weather Forecast Models

Short term Environmental Observations (Events)

Long term Environmental Observations (Climate Change Detection)
Earth Radiation Budget

**CERES Shortwave**
- Reflected Solar Radiation: 107 Wm\(^{-2}\)
- Reflected by Clouds, Aerosol, and Atmospheric Gases: 77
- Reflected by Surface: 30
- Absorbed by Surface: 168

**TSIS**
- Incoming Solar Radiation: 342 Wm\(^{-2}\)
- Emitted by Atmosphere: 67
- Latent Heat: 24
- Evapotranspiration: 78
- Absorbed by Surface: 24 Thermals
- Surface Radiation: 390
- Transpiration: 324

**CERES Longwave**
- Outgoing Longwave Radiation: 235 Wm\(^{-2}\)
- Greenhouse Gases: 165
- Atmospheric Window: 40
- Back Radiation: 324
CERES: Measuring the Earth’s Energy Budget

Clouds and the Earth’s Radiant Energy System

- Scanning radiometer measuring TOA total, shortwave, and longwave radiation
- Heritage instruments
  - CERES
    - NASA TRMM
    - NASA Terra (2)
    - NASA Aqua (2)
Summary

• NPP Instruments
  – Well understood thanks to instrument comprehensive test, characterization and calibration programs.
  – Gov’t team ready for October 25 launch followed by instrument activation and Intensive Calibration/Validation (ICV).

• NPP Data Products
  – JPSS Center for Satellite Applications and Research (STAR) team ready to support NPP ICV and operational data products.
  – NASA NPP science team ready to support NPP ICV and EOS data continuity.
NPP Spacecraft: Scott Asbury, Ball Aerospace and Technologies Corporation
ATMS: Luvida Asai, Northrop Grumman Electronic Systems
CERES: Mark Folkman, Northrop Grumman Aerospace Systems
CrIS: Ron Glumb, ITT Geospatial Systems
OMPS: Bill Roettker, Ball Aerospace and Technologies Corporation
VIIRS: Greg Roth, Raytheon
Common Ground System: Bill Sullivan

Discussion and Questions