New capabilities in polar observations
Presented by Harry Cikanek, JPSS Director
What is JPSS?

JPSS’ scope includes three satellites, five instruments and a ground system:

- NOAA/NASA Suomi NPP successfully launched in Oct 2011
- S-NPP, JPSS-1 and JPSS-2 comprise the series of next generation polar-orbiting satellites
- The five instruments on S-NPP and JPSS-1 are CrIS, ATMS, VIIRS, OMPS and CERES
- JPSS-2 will manifest the same weather instruments
What is JPSS? – Ground Overview

JPSS Data Flow
- HRD and/or SRD
- Backup (dotted)
- TT&C
- SMD
- NASA exclusive
- NOAA exclusive
- Support
- TT&C, SMD
- Ku
- SDP – Service Delivery Point
- sDR, sIPs
- User

JPSS Managed
JPSS Supported

NASA SDP
Coriolis SDP
GCOM SDP
Metop SDP
DMSP SDP
POES SDP
ESPC
AFWA
CLASS
SDS
LASP
FT Users

TDRSS, GOES, GCOM, NPP, JPSS, PFF, DMSP, Metop

White Sands Complex, NM
Fairbanks Satellite Operations Facility, AK
Svalbard Satellite Station, NO
Troll Station, Antarctica
McMurdo Station, Antarctica

Field Terminal Segment
Field Terminal

Aurora
FGS Support
FNMOC
NAVO

NESDIS CBU
NSOF

JPSS Ground Network (WAN)
JPSS Mission

• JPSS is the next generation of U.S. civil operational polar-orbiting satellites
• Provide continuity of polar operational environmental observations in the US afternoon sun synchronous orbit
• The most important JPSS function is real time global temperature and moisture sounding information that is fed to the National Weather Service numerical forecast for 3-7 day ahead of severe weather events
• The second most important function is the role JPSS plays in supporting operational forecasting and monitoring of weather and environment phenomena in Alaska and Polar Regions where Geostationary distorts
• JPSS also addresses environmental phenomena such as floods, volcanic ash, sea ice, fog, wild fires, ozone, ocean color, algal blooms and advances weather, climate, environmental and oceanographic science through technological improvements in satellite instruments and data products used to predict and monitor weather, disasters, and the environment

• JPSS delivers critical observations for public safety, property and infrastructure protection, economic efficiency, and environmental stewardship
Enhanced data products include:

- Atmospheric temperature/moisture profiles
- Hurricane intensity and position
- Thunderstorms, tornado potential
- Alaska “nowcasting” (e.g. ice detection)
- Significant precipitation and floods
- Dense fog
- Volcanic ash
- Fire and smoke
- Sea surface temperature, ocean color
- Sea ice extent and snow cover/depth
- Polar satellite derived winds (speed/direction/height)
- Vegetation greenness indices and health
- Ozone
- Oil spills
The JPSS program is implemented through a partnership between NOAA and NASA. JPSS partners with DoD and NSF for data and infrastructure sharing. Per US National Space Policy, JPSS has agreements with EUMETSAT to afford 2-orbit global coverage, and JAXA for data and infrastructure sharing.

### JPSS Schedule

<table>
<thead>
<tr>
<th></th>
<th>Launch Dates</th>
<th>Program Architecture</th>
<th>Program Operational Life</th>
<th>Program Life-cycle (FY 2014 President’s Budget)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Launch Dates</strong></td>
<td>NLT 2QFY 2017 (JPSS-1)*; 1QFY 2022 (JPSS-2)</td>
<td>3 Satellites (S-NPP, JPSS-1, JPSS-2) S-NPP: 5-year operational design life; JPSS-1: 7-year operational design life</td>
<td>FY 2012 - FY 2025</td>
<td>$11.349 billion</td>
</tr>
</tbody>
</table>
**JPSS Implementation**

- **JPSS Program connects the dots:**
  - Flight - Instruments, spacecraft
  - Ground - data reception and real-time operational product generation and access points to the user community
  - Algorithm Program - provides algorithms for operational product generation and includes calibration and validation, long term maintenance and enhancements.
  - Proving Ground – focuses on improving user applications by fusion of JPSS data in key NOAA /partner products and services such as weather forecasting, fire monitoring, coastal ecosystems, air quality, ice/snow monitoring, drought monitoring, etc. Provides direct readout applications and training.
JPSS Program Status

JPSS Program and JPSS-1 Mission are baselined
  • Significant changes introduced to sharpen weather focus and reduce cost
  • Climate sensors become NASA responsibility in JPSS-2 era
  • Polar Free Flyer moved into separate NOAA NESDIS Program

S-NPP is producing outstanding data
  • Satellite healthy; data availability high (~99.99%)
  • Operations transitioned to OSPO in February 2013
  • Significant progress in cal/val and operational use of instruments

JPSS-1 is executing as planned
  • Instruments and spacecraft proceeding well
  • All instruments assembled and in test
  • Spacecraft is in assembly and integration
JPSS Program Status (continued)

JPSS-2 procurement activities are progressing well
- VIIRS, CrIS, OMPs under initial contracts,
- Spacecraft bus procurement activities proceeding

Ground Segment multi-mission operations and development successes
- Block 2.0 racks in place at NSOF and CBU
- Ground on track for February CDR and hardware installation start
- Updates to Block 1.2 are giving outstanding availability

TCTE Launched in 2013
- Successful launch; cross calibration activities are completed
- Data analysis will continue for several months
# JPSS Milestones

<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
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<tbody>
<tr>
<td>2011</td>
<td>Suomi NPP Launched 1st Q FY 2012</td>
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<tr>
<td></td>
<td>J-1 Mission PDR Part II</td>
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<td></td>
<td>J-1 Mission Critical Design Review (CDR)</td>
</tr>
<tr>
<td></td>
<td>J-1 S/C Integration and Test (I&amp;T) Begins</td>
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<td></td>
<td>J-1 ATMS Pre Environmental Review (PER)</td>
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<td>J-1 CERES Delivery</td>
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<td></td>
<td>J-1 CrIS Delivery</td>
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<td>J-1 OMPS Delivery</td>
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<td></td>
<td>J-1 VIIRS Delivery</td>
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<tr>
<td>2013</td>
<td>J-2 Mission PDR</td>
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<td></td>
<td>J-2 Mission CDR</td>
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<td></td>
<td>J-2 VIIRS Delivery</td>
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<td></td>
<td>J-2 ATMS Delivery</td>
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<td></td>
<td>J-2 OMPS Delivery</td>
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<td></td>
<td>J-2 CrIS Delivery</td>
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<td></td>
<td>J-2 RBI Delivery</td>
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<tr>
<td></td>
<td>J-2 S/C I&amp;T Begins</td>
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<tr>
<td>2014</td>
<td>J-2 LRR</td>
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<tr>
<td>2015</td>
<td>Block 2.0 TTO</td>
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<tr>
<td>2016</td>
<td>KDP-II PIRR</td>
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<tr>
<td>2017</td>
<td>Block 3.0 dCDR</td>
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<tr>
<td>2018</td>
<td>KDP-1 PSDR</td>
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<tr>
<td>2019</td>
<td>NOAA Satellite Operations Facilities Consolidated Back-Up Facilities</td>
</tr>
<tr>
<td>2020</td>
<td>TCTE Launch</td>
</tr>
<tr>
<td>2021</td>
<td>NOAA Satellite Operations Facilities</td>
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<td></td>
<td>Consolidated Back-Up Facilities</td>
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*Milestones are reflected in the calendar year unless otherwise noted*
JPSS – Advancing Value

- Advanced JPSS Instruments demonstrated on S-NPP
- Algorithm Program provides the science and stewardship to enable high quality ATMS SDRs from the ground segment

- Enables Proving Ground to invest in the necessary changes to the HWRF model to demonstrate improved hurricane track forecasting using ATMS
Operational use of S-NPP data

- May 1, 2012, VIIRS imagery used to support local warning and forecast operations throughout the NWS Alaska Region.
- May 22, 2012, the ATMS radiances were operationally assimilated in the National Centers for Environmental Prediction’s (NCEP)/NWS Global Forecast System (GFS).
- September 25, 2012, ATMS data was assimilated operationally into the European Centre for Medium-Range Weather Forecasts (ECMWF) weather forecast models.
- April 2013, the United Kingdom Meteorology Office began assimilating operational data from CrIS and ATMS into weather forecast models.
- August 20, 2013, NCEP began incorporating S-NPP CrIS satellite data operationally into the GFS.
- October 31, 2013, NCEP/CPC started to use OMPS Ozone operationally.
- November, 2013, NRL started to use ATMS operationally in their global forecast model.
JPSS: Supporting the Advanced Forecast Enterprise

2011 Irene Forecast
Advanced Forecast Enterprise
Observations + Models + Supercomputers + Expert Forecasters

“2001” Irene Forecast
Thank You
JPSS-1 Spacecraft

- Clouds and Earth’s Radiant Energy System
- Ozone Mapping Profiler Suite
- Advanced Technology Microwave Sounder
- Cross-track Infrared Sounder
- Visible Infrared Imaging Radiometer Suite

Ka-band TDRSS Antenna, 2-axis gimbal, and boom deployed
Ka-band SMD Antenna, 2-axis gimbal, and boom deployed
## JPSS Instruments

<table>
<thead>
<tr>
<th>JPSS Instruments</th>
<th>Measurements</th>
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<tr>
<td><strong>ATMS</strong> - Advanced Technology Microwave Sounder</td>
<td>ATMS and CrIS together provide high vertical resolution temperature and water vapor information needed to maintain and improve forecast skill out to 5 to 7 days in advance for extreme weather events, including hurricanes and severe weather outbreaks</td>
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<tr>
<td><strong>CrIS</strong> - Cross-track Infrared Sounder</td>
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</tr>
<tr>
<td><strong>VIIRS</strong> – Visible Infrared Imager Radiometer Suite</td>
<td>VIIRS provides many critical imagery products including snow/ice cover, clouds, fog, aerosols, fire, smoke plumes, vegetation health, phytoplankton abundance/chlorophyll</td>
</tr>
<tr>
<td><strong>OMPS</strong> - Ozone Mapping and Profiler Suite</td>
<td>Ozone spectrometers for monitoring ozone hole and recovery of stratospheric ozone and for UV index forecasts</td>
</tr>
<tr>
<td><strong>CERES</strong> - Clouds and the Earth’s Radiant Energy System</td>
<td>Scanning radiometer which supports studies of Earth Radiation Budget (ERB)</td>
</tr>
</tbody>
</table>
• 22 channels (23.8-183.3 GHz)
• Produce atmospheric profiles with CrIS as well as rainfall rates, snow and ice information
• More channels, wider swath, better resolution compared to AMSU/MHS – about 1.2x the impact on forecast error
• Assimilated into National Weather Service NWP models only 7 months after launch
• J1 unit scheduled to deliver in May 2014

Advanced Technology Microwave Sounder

AMSU vs ATMS

• 1305 spectral channels, similar number to AIRS on Aqua, only 18 on HIRS
• Provides higher-resolution temperature, moisture and pressure profiles in cloud-free regions with better radiometric and spectral accuracy
• Temperature retrieval accuracy < 1K
• About 6x the relative forecast error reduction compared to HIRS
• Currently operational in NWS global forecast system
• J1 unit scheduled for delivery in September 2014
Next-Generation Instruments

- 22 spectral bands
- Largest number of products including clouds, land and sea surface temperatures, fire, smoke, snow, ice, vegetation, & ocean chlorophyll
- Better spatial resolution, larger swath
- Reduced variation over scan
- Higher resolution imaging bands
- High radiometric accuracy
- User community providing feedback through JPSS Proving Ground
- J1- unit scheduled for delivery in Dec 2014
Next-Generation Instruments

Ozone Mapping Profiler Suite

- Monitors ozone from space
- Improves upon current NASA heritage instruments
- Helps fulfill U.S. treaty obligation to monitor ozone depletion
- Major improvement over SBUV
- J-1 unit scheduled for delivery in July 2014

Clouds and Earth’s Radiant Energy System

- Measures Earth’s Radiation Budget with three broadband radiometers that scan the earth from limb to limb with 30 Km spatial resolution
- Continues a more than 25-year-old Earth radiation data record
- CERES FM5 on S-NPP operating nominally
- J-1 unit scheduled for delivery in 2014

NOAA POES SBUV/2

AMSR-2 on JAXA GCOM-W1

- Deployable main reflector system with 2.0m diameter
- Frequency channel set is identical to that of AMSR-E except 7.3GHz channel for RFI mitigation
JPSS Instruments Improve Weather Forecasting

CrIS/ATMS on JPSS and IASI/AMSU on METOP will maintain and improve weather forecasting over the coming decades.
Noise Comparison for CrIS, AIRS, and IASI
Satellite Ice Imagery

This page is used to post satellite images of sea ice. Resolution of the images ranges from 250 meters to 4 kilometers. Sources for the images are the POES AVHRR from NWS Alaska Region. Images are added to this page as cloud cover and time permit.

Click on each image for a larger view:

Bering Strait Region
NPP Suomi VIIRS False Color Satellite Image
29 March 2013 at 0011Z
JPSS Benefits
• JPSS-1 instruments ready for delivery
• Bus ready to integrate instruments
• Complete JPSS-2 instrument contracting activities
• Complete installation and begin testing Block 2.0 Ground
• Ensuring continuity of observations
• Maintaining program progress on budget and on schedule
Key Customers and Partners

• NOAA Offices and Programs
• Federal Agencies
  • Department of Defense (all Services)
  • Department of State and US Agency for International Development
  • Department of Transportation
    • Federal Aviation Administration
  • Department of Agriculture
  • Environmental Protection Agency
  • Department of the Interior
  • National Aeronautics and Space Administration
  • Department of Homeland Security
    • US Coast Guard
    • Federal Emergency Management Agency
• State and Local Governments
  • Mayors, City Managers, Councils, State Legislatures
  • Agriculture, Transportation, Public Safety, Emergency Management
• Academia
• Commercial Sector
  • Networks (ABC, NBC, CBS) and cable news outlets (CNN, Weather Channel)
  • Utility and energy sector
  • Agriculture
• Non-Profit Sector
  • Red Cross
  • Conservation
• International Community
  • Space and Weather agencies
  • UN System
  • Non-Governmental Organizations
Key Partnerships

**NASA**
- Acquisition agent and system integrator - provides flight and ground capabilities to NOAA

**EUMETSAT**
- NOAA relies on EUMETSAT’s coverage of mid-morning orbit (Metop-B)
- NOAA provides current POES and S-NPP data to EUMETSAT
- Developing Joint Polar System agreement for future polar cooperation

**DoD**
- S-NPP data contributes to DoD’s real-time weather needs
- Current DMSP satellites are operated and used by NOAA, data reception at McMurdo

**JAXA**
- Global Change Observation Mission – Water (GCOM-W1) provides AMSR-2 data – continuity for NASA’s Aqua satellite
- NOAA provides ground system services

**US NSF**
- National Science Foundation supports McMurdo data reception
Suomi NPP and JPSS Data Products

**VIIRS (25)**
- 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
- Ocean Color/Chlorophyll
- Net Heat Flux*
- Suspended Matter
- Vegetation Index, Fraction, Health
- Aerosol Optical Thickness
- Aerosol Particle Size
- Active Fires
- Polar Winds
- Imagery
- Sea Ice Characterization
- Snow Cover
- Sea Surface Temperature
- Land Surface Temp
- Surface Type

**CrIS/ATMS (4)**
- ATM Vert Moist Profile
- ATM Vert Temp Profile
- Pressure (Surface/Profile)
- Carbon (CO2, CH4, CO)

**ATMS (11)**
- Cloud Liquid Water
- Precipitation Rate
- Precipitable Water
- Land Surface Emissivity
- Ice Water Path
- Land Surface Temperature
- Sea Ice Concentration
- Snow Cover
- Snow Water Equivalent
- ATM Vert Temperature Profile
- ATM Vert Moisture Profile

**OMPS (2)**
- O3 Total Column
- O3 Nadir Profile

**CERES (2) * **
- Reflected Solar Radiation (TOA)
- Outgoing LW Radiation (TOA)

**TSIS (1) * **
- Solar Irradiance

**GCOM AMSR-2 (11)**
- Cloud Liquid Water
- Precipitation Type/Rate
- Precipitable Water
- Sea Surface Winds Speed
- Soil Moisture
- Snow Water Equivalent Imagery
- Sea Ice Characterization
- Snow Cover/Depth
- Sea Surface Temperature
- Surface Type

* Transition to NASA