



The Joint Polar Satellite System Weather Satellite Enterprise Information Chain

Kerry Grant, Shawn Miller and Shawn Cochran, Raytheon Co., Aurora CO

Michael Jamilkowski, Raytheon Co, Greenbelt MD

Raytheon
Intelligence, Information and Services



- The Joint Polar Satellite System (JPSS) will contribute the afternoon orbit component and ground processing system to replace the current Polar-orbiting Operational Environmental Satellites (POES)
 - JPSS satellites will carry a suite of sensors designed to collect meteorological, oceanographic, climatological, and solar-geo-physical observations of the earth, atmosphere, and space
 - The ground processing system for JPSS, known as the Common Ground System (JPSS CGS), provides command, control, data acquisition, routing and processing, and product delivery
 - JPSS constellation consists of Suomi National Polar-orbiting Partnership (S-NPP), JPSS-1, JPSS-2, and Polar Free Flyer
- The CGS currently flies S-NPP and acquires, routes and processes S-NPP mission data to provide Environmental Data Records (EDRs) to NOAA and DoD processing centers operated by the U.S. government, generating multiple terabytes per day across more than two dozen environmental data products.
- Each point in the JPSS value stream, from the satellite through final delivery to the consumer, adds value in the form of maintaining timeliness and accuracy, enabling dissemination, and providing understanding.
- This information, in the hands of decision makers, enables activities that directly benefit society and the economy



What is valuable?

- Timely, accurate, understandable environmental information in the hands of a decision maker
 - First responders
 - Aviators
 - Transportation Managers
 - Retailers
 - Utility Managers
 - Mariners
 - Construction Managers
 - Industrialist
 - Emergency Managers
 - Farmers
 - Commodity Brokers
 - Individuals
- What is the "value chain"?
 - Processes or activities that directly contribute to timeliness, accuracy, dissemination, and understanding
 - Sense phenomena
 - Capture data accurately
 - Move data to processing centers
 - Process data into products
 - Deliver products to consumers
 - Use products to create additional products
 - Disseminate information to decision makers

Perform within necessary timeline

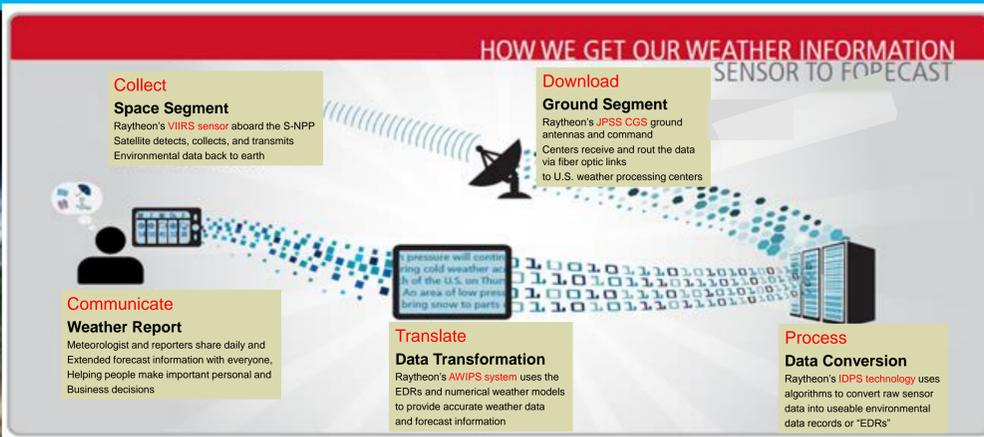
The value of the data itself is embedded in the value of the final information product or service
- Rodney Weiher, NOAA Chief Economist

On Orbit

- Satellite/ground interactions
 - Spacecraft bus
 - Orbit and pointing - 14 orbital correction burns performed on NPP during first two years on orbit
 - Collision avoidance - 1 collision avoidance maneuver performed on NPP since launch
 - Calibration maneuvers - 62 calibration maneuvers performed during first two years on orbit
 - Instruments
 - Mode
 - Calibration
 - Downlink
 - Downlink sites are driving factor in overall data latency
 - First copy, retransmits
 - Conjunction handling
 - Interference from other objects (satellites, sun) can delay data receipt
 - Foreknowledge allows CGS to mitigate impacts by clever scheduling, use of different antenna guidance modes, etc.

Societal Benefits

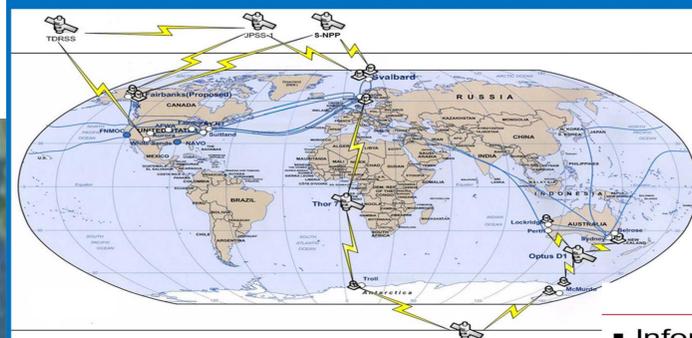
- Group on Earth Observations identifies 9 areas where improved environmental information (timely, accurate, understandable) directly benefits society at large
 - Disasters - Support of risk management cycle associated with hazards
 - Health - Application of environmental information for public health decision making
 - Energy - Support energy operations, policy planning and implementation
 - Climate - Enable prediction, mitigation, and adaptation to climate variability and change
 - Water - Support decision making for efficient management of world water resources
 - Weather - Support protection of life and property
 - Ecosystems - Enable assessment, protection, and sustainable management of terrestrial, coastal, and marine resources
 - Agriculture - Support advancements in sustainable agriculture, aquaculture, fisheries, and forestry
 - Biodiversity - Enable decision making in support of conservation and management of natural resources through observation and analyses of global biodiversity
- Direct societal benefits extend far beyond these 9
 - Efficiency in commerce and industry
 - Improved economic decisions
 - Private sector productivity gains



Communications and Data Routing

- Rapidly move complete data sets from downlink sites to processing centers
- Speed of delivery is a function of link bandwidth
- Ensuring data completeness adds complexity
 - Data accounting
 - Data transfer protocol
 - Redundant data paths
 - Data recovery methods

JPSS CGS Worldwide Communications Lines



Fast Data Delivery Using Existing Commercial Communications

Customer Usage

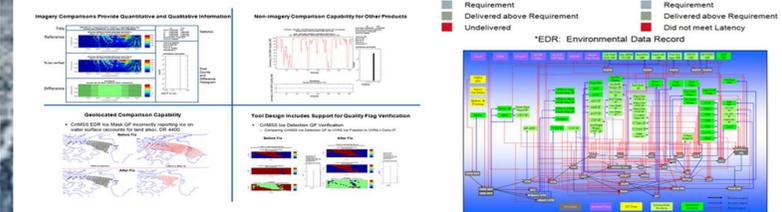
- Additional products
 - NESDIS creates 42 "NOAA Unique Products" from S-NPP data to meet their customer's needs
 - Includes "tailored" products - reformatted S-NPP data records
- Forecast models
 - Global Forecast System (GFS) / Global Data Assimilation System (GDAS)
 - North American Mesoscale (NAM) Forecast System
 - Hurricane and Weather Research Forecast Model (HWRF)
 - EUMETSAT ECMWF (since Sept 2012)
- Direct users
 - National Centers for Environmental Prediction
 - Central Operations
 - Weather (formerly Hydrometeorological) Prediction Center
 - Storm Prediction Center
 - Ocean Prediction Center
 - Hurricane Prediction Center
 - Environmental Modeling Center
 - National Weather Service
 - Cooperative Institute for Meteorological Satellite Studies
 - EUMETSAT
 - Rebroadcasts via Global Telecommunications System to European and global partners such as ECMWF, UKMET, CMA, EC, ISRO, NCMRWF, JMA, KMA, and ROSHYDROMET
 - Joint Center for Satellite Data Assimilation
 - NOAA Center for Satellite Applications and Research
 - Geographic Information Network of Alaska
 - NASA Short-term Prediction Research and Transition Center

JPSS System Architecture



Data Processing and Delivery

- Accuracy of the science
- Fidelity of the operational product generation
- Latency considerations
- Delivery
 - Formats
 - Subscriptions
 - Timeliness and accuracy, accounting



Economic Benefits

- Information -> Decisions -> Economic Outcomes
 - Value of Information
 - From Rodney Weiher (NOAA Chief Economist): "Value of the information is the increase in expected benefits (or reduction in costs) when the information is available and used, versus when it is not available"
 - Efficiency in commerce and industry
 - Improved economic decisions
 - Private sector productivity gains
 - New products, services, and business lines
- Average value of all US daily weather forecast information is around \$109 per household; \$11.4B in total¹

1. Rodney Weiher: Assessing the Economic and Social Benefits of NOAA Data, NAS/OECD Conference, Paris, February 2008

Conclusions

- JPSS is delivering increasingly accurate and timely environmental information to decision makers in an easily consumed form (content and format)
- Each point in the JPSS value stream, from the satellite through final delivery to the consumer, adds value in the form of maintaining timeliness and accuracy, enabling dissemination, and providing understanding
- This information, in the hands of decision makers, enables activities that directly benefit society and the economy

