Updates on NPP/NPOESS; NOAA Ocean Color Activities

Dr. Paul M. DiGiacomo
NOAA/NESDIS/STAR
Chief, Marine Ecosystems & Climate Branch;
NOAA CoastWatch Program Manager

13th IOCCG Committee Meeting
Paris, France, 12-14 February 2008

NOAA Satellites and Information
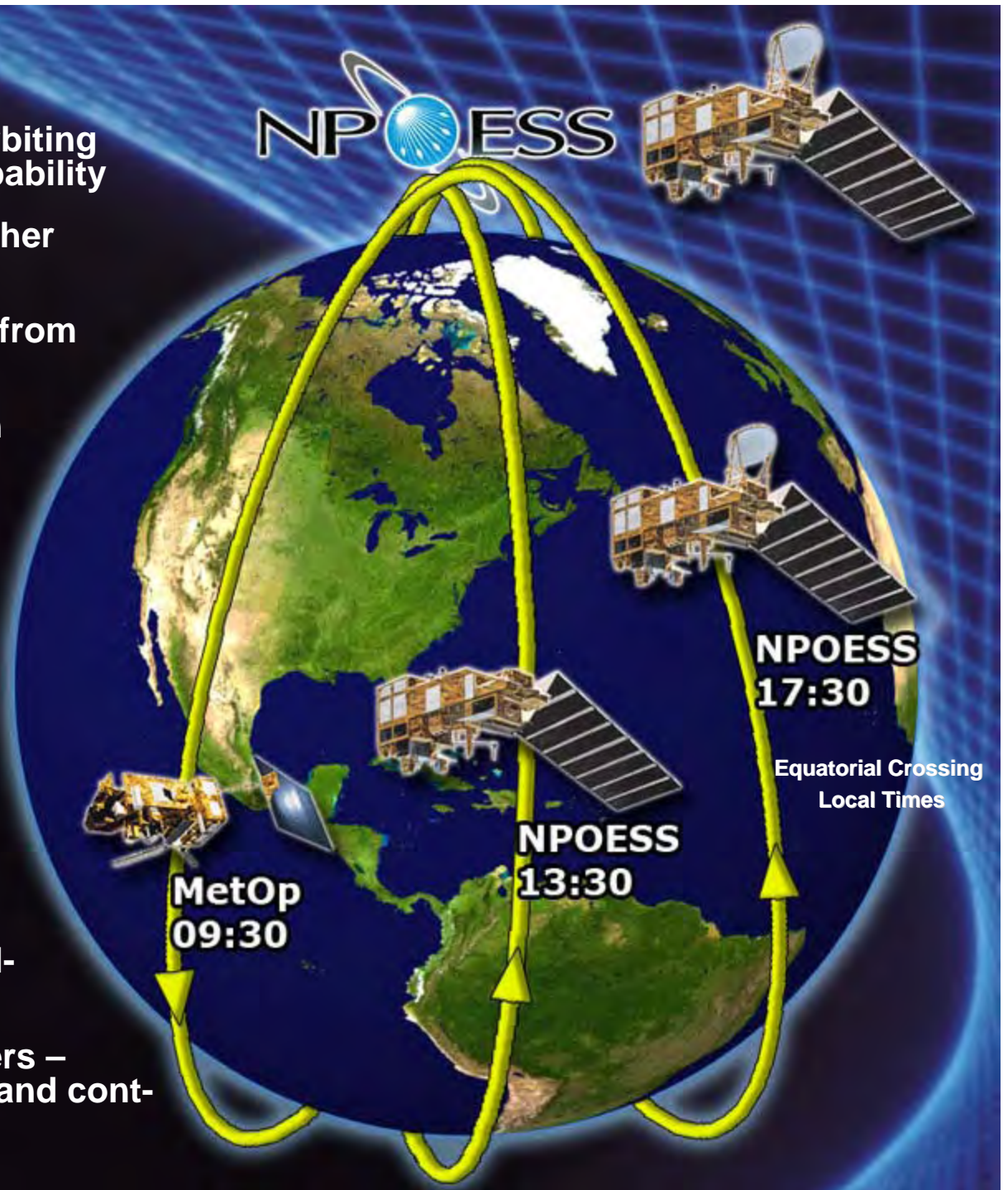National Environmental Satellite, Data, and Information Service

Current Program Status

- **NPOESS has completed restructure and is executing to re-baseline contract**
- **Performance on NPOESS Engineering, Manufacturing & Development program**
    - **On schedule and budget for last two years**
    - **Contract modification signed in July 2007**
    - **System design meets requirements for improvements in data delivery for current and accurate weather forecasting**
    - **On track to deliver essential weather measurements and 14 of 26 essential climate variables**
    - **System capacity to accommodate de-manifested sensors and other sensors to provide additional monitoring**
        - **Currently re-manifesting OMPS-Limb and CERES on NPP**
- **NPOESS sensors are in final testing for delivery for NPOESS Preparatory Project launch**
- **NPOESS remains on track for Jan 2013 launch of C1 spacecraft**

Systems Engineering & Science Progress
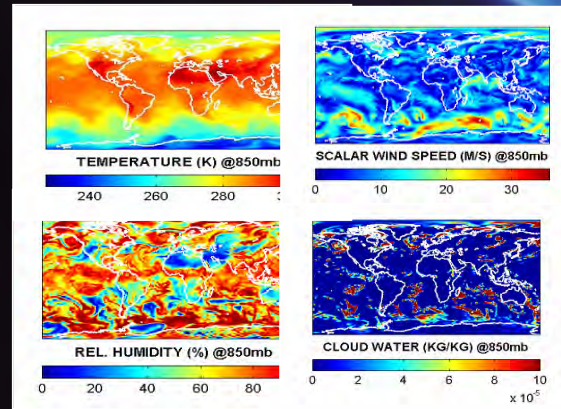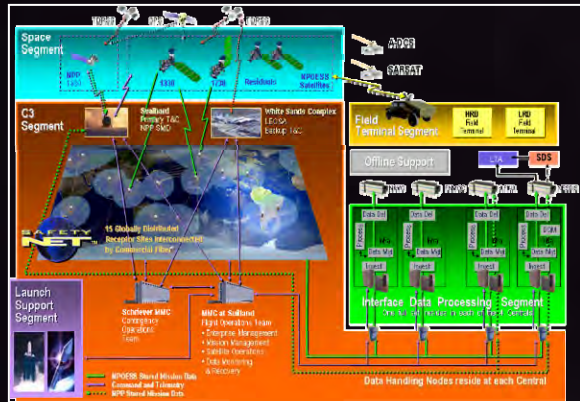
Integration and Test

- **Critical Design Review scheduled for April 2009**
- **NPOESS Preparatory Project compatibility tests completed**
- **Command, Control, Communications (C3) Segment for NPP is complete**

Algorithms & Verification

- **Algorithms functioning as an integrated system**
- **Initial phase of algorithm development is ~85% compete**
- **Near-term focus is on completing test & verification of operational algorithm software**

Operations & Support

- **Effective transition from C3 to Operations & Support (O&S) in Jan 07**
- **On track for Integrated Data Processing System and C3S development teams to perform O&S through EMD**
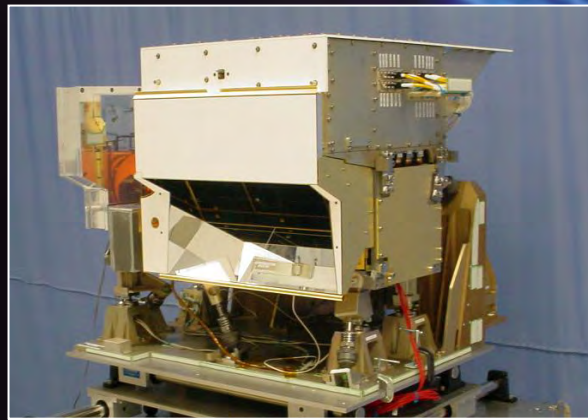
4

Sensor Payload Development Progress

VIIRS EDU
- **Completed system data handling testing while integrated on NPP**

VIIRS Flight Unit
- **System integration completed**
- **Environmental testing in Spring 08**

CrIS Instrument (ITT)

VIIRS EDU (Raytheon) integrated on NPP (BATC)

CrIS EDU
- **Completed system data handling testing while integrating on NPP**

CrIS Flight Unit
- **Frame testing successfully completed**
- **System integration and test started in October 2007**
- **Delivery in May 2008**

OMPS Flight Unit
- **Nadir environmental testing completed**
- **Electrical and mechanical interface to NPP verified**
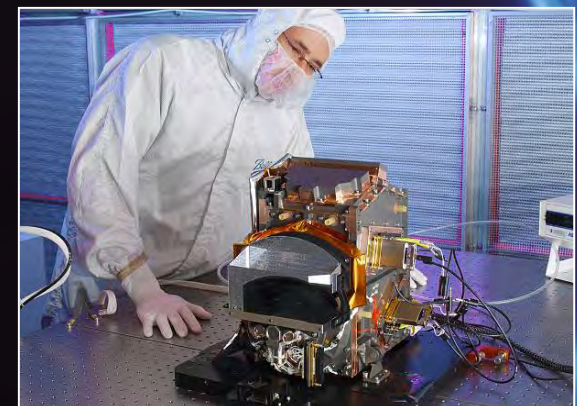- **OMPS Limb re-manifested on NPP**
- **Integrated Sensor Suite Testing in Spring**

OMPS Instrument (BATC)

Ground Segment Progress

NPOESS

NOAA Satellite Operations Facility

Integrated Data Processing System Development

Downlink at Svalbard

- Ground Segment
  - NOAA Satellite Operations Facility (NSOF) complete
  - Command and Control completed and installed at 4 locations
  - NPP Flight Vehicle Simulator installed
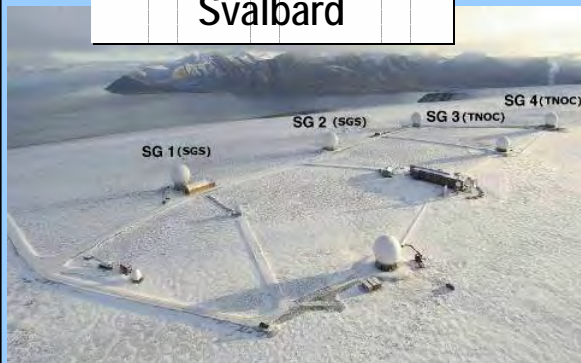
- NPP Svalbard Modifications Completed
- Communications services to NSOF established
- End to End compatibility checkouts conducted
- WindSat data relay operational

- IDP Segment
  - Build 1.4 completed qualification testing
  - Final NPP Software Increment Build 1.5 in development
  - Acceptance Test at sites in Summer 2008
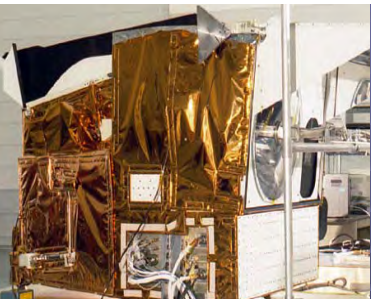
NPP-VIIRS Ocean Color Status, Impacts & Plans

- The Visible/Infrared Imager/Radiometer Suite (VIIRS) on the NPOESS Preparatory Project (NPP) does not appear capable of providing climate-quality ocean color data for the U.S. research and applications communities.

- Regardless if NPP delayed, unable to seek changes to VIIRS to ensure adequate performance for ocean color imaging that meets radiometric standards for climate-quality data; there would be unreasonable risk in opening up the optics module in which the filter resides.

- Every effort is being made to implement changes to VIIRS on NPOESS C1 to ensure performance for ocean color imaging that meets radiometric standards for climate-quality data, and will do with other climate products, make pre-flight test data sets available in a timely and transparent manner.

- Discussion and coordination efforts underway with ESA (MERIS) and ISRO (OCM-II) regarding international sources of ocean color data

NPOESS Data Exploitation (NDE)

NDE Mission Statement: Deliver data products and assist NOAA and other civilian operational users to realize the potential of NPOESS observations.

NDE will be a critical link to achieve return on the NPOESS investment

NPP

NPOESS C1

NPOESS Ground Systems

NPOESS Data Exploitation

Generic NPOESS Data

SafetyNet

Command and Control
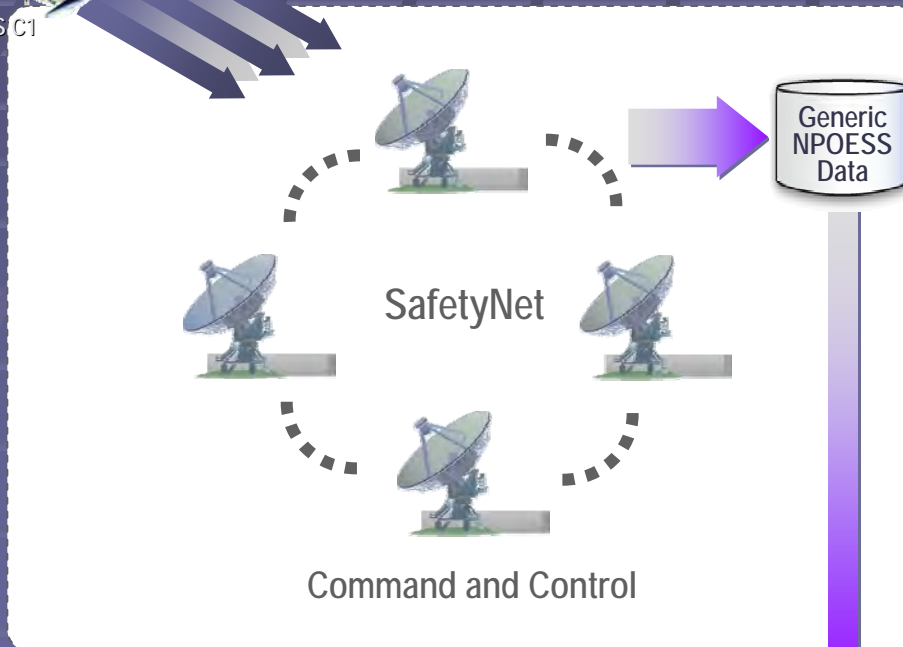
(operated in ESPC)

Ingest

Process

Quality Control

NDE Enhanced Products

NOAA Science Center

Near Real-time Delivery

Archive and Access

Operational User Community

NDE Operational System Objectives

- Disseminate NPOESS Data Records to customers
- Generate and disseminate tailored NPOESS Data Records (versions of NPOESS Data Records in previously agreed alternative formats and views)
- Generate and disseminate NOAA-unique products (augmented environmental products constructed from NPOESS Data Records)
- Deliver NOAA-unique products, product processing elements, and associated metadata to CLASS for long-term archiving
- Provide services to customers, including NDE product training, product enhancement, and *implementation support across NOAA*
- Provide software for NPOESS Data Record format translation and other data manipulations

NDE User Community

US GOVERNMENT

- DOC / NOAA
    - National Weather Service
    - Ocean Service
    - Fisheries
    - Research
    - Satellites & Information
- Department of Agriculture
- Federal Aviation Administration
- Coast Watch
- NOAA/Navy National Ice Center

DOMESTIC AND INTERNATIONAL

- Commercial Sector (e.g. Energy Industry)
- Universities, Researchers et al.
- European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT)
- International Meteorological Services (India, Japan, Brazil, UK, ECMWF, etc.)
- World Meteorological Organization
- Data Collection Service
- Search and Rescue

NPP Phase 1

Legacy mission continuity replacement products comprised of currently funded NOAA Unique Products (NUPs) and xDRs

CrIS Thinned Radiances	SST Anomalies	Ozone Profile
CrIS Cloud Cleared Radiances	Coral Reef Degree Heating	Ozone Total Column
Total Precipitable Water (ATMS)	Coral Reef Bleaching	Snow Cover
Snow Cover (ATMS)	Total Ozone (CrIS)	Imagery
Precipitation Type/Rate (ATMS)	Carbon products	Ocean Color/Chlorophyll
Surface Emissivity (ATMS)	SST (AVHRR-like)	Vegetation Index
Cloud Liquid Water (ATMS)	Aerosol (AVHRR-like)	Active Fires
Sea Ice Cover/Concentration (ATMS)	Rain Water Path/Profile (ATMS)	Atmospheric Temperature Profile
Snow Water Equivalent (ATMS)	ATMS Radiances	Atmospheric Moisture Profile
Ice Water Path (ATMS)	CrIS Radiances	Aerosol Optical Thickness
Land Surface Temperature (ATMS)	VIIRS Radiances	Surface Type & Vegetation Cover
Temperature Profiles (ATMS)	OMPS Radiances	Surface Albedo
Moisture Profiles (ATMS)	Cloud Mask	Cloud Cover/Layers
Blended SST	Sea Surface Temperature (SST)	

Y	NUPs
B	xDRs

11

NPP Phase 2

Enhanced products comprised of additional NUPs and xDRs not linked to mission continuity

NOAA-Unique Products	Tailored Products
Polar Winds (VIIRS)	Aerosol Particle Size
Clear Sky Radiances (VIIRS)	Cloud Top Temperature
Vegetation Health	Cloud Top Pressure
Vegetation Moisture	Land Surface Temperature (VIIRS)
Drought Indices	Cloud Base Height
Vegetation Thermal Conditions	Cloud Effective Particle Size
Leaf Area Index	Cloud Optical Thickness
Fire Potential	Cloud Top Height (VIIRS)
Near Coast Ocean Color	Ice Surface Temperature
Integrated xDRs at CrIS Resolution	Net Heat Flux
Cloud Liquid Water Path (VIIRS)	Sea Ice Characterization (VIIRS)
Cloud Ice Water Path (VIIRS)	Suspended Matter
Cloud Top Temperature (VIIRS)	Atmospheric Pressure Profile

Coastal Waters Imaging (CWI)

- *Analysis of Alternatives (AoA)*
    - Due to cancellation of GOES-R HES, the NOAA-NESDIS Office of Systems Development led an AoA study including NOAA Goal Teams, Academia, Contractors and other participants to address NOAA requirements for advanced sounding and coastal waters imaging capability

- *Summary*
    - Both LEO and GEO solutions studied in AoA **can meet NOAA requirements** for High-temporal, operational Coastal Waters Imaging (CWI) in 2014.

    - Four small satellites with CW Imagers could provide the required frequency of sampling

    - Designs for a low-risk operational multispectral or hyperspectral coastal waters imager exists for Low Earth Orbit (LEO)

    - Coverage includes WA, ME, AK and HI, which are not covered at 300 meters resolution by a single GEO sensor

    - Preliminary designs for multispectral CWI for Geostationary Orbit (GEO) look promising, but require long integration times

    - Spacecraft stability may not be adequate for ocean color imaging at 300 m GSD; requires further study

    - Conflicting estimates on the cost of the ground segment need to be resolved

    - Cost of ground segment for LEO or GEO solution similar – not a deciding factor when comparing the two approaches.

Path Forward for Coastal Waters Imaging

- Recommended path forward for a 2014 operational CWI system involves an earlier demonstration to:

    - Allow time for algorithm development and testing and user familiarization

    - Provide risk reduction in the product generation, product distribution, and user readiness

    - Take advantage of Hyperspectral Imager for the Coastal Ocean (HICO) to be launched in July 2009 on the Japanese External Module on the International Space Station (JEM-ISS) to collect a demonstration data set
        - Office of Naval Research funded instrument, Space Test Program funding integration and launch, NASA and Japanese Space Agency (JAXA) providing space and support on the ISS
        - ISS orbit allows for the collection of data at all times of day to assess optimal timing of coastal waters imaging

    - Support the COAST science team for related activities

    - Requires support for operational in situ calibration source (i.e., MOBY/ next generation replacement)

- At the same time initiate a Pre-Phase A study to evaluate issues with geostationary ocean color imaging and choose between the LEO or GEO solution (should be pursued in coordination with NASA).

14