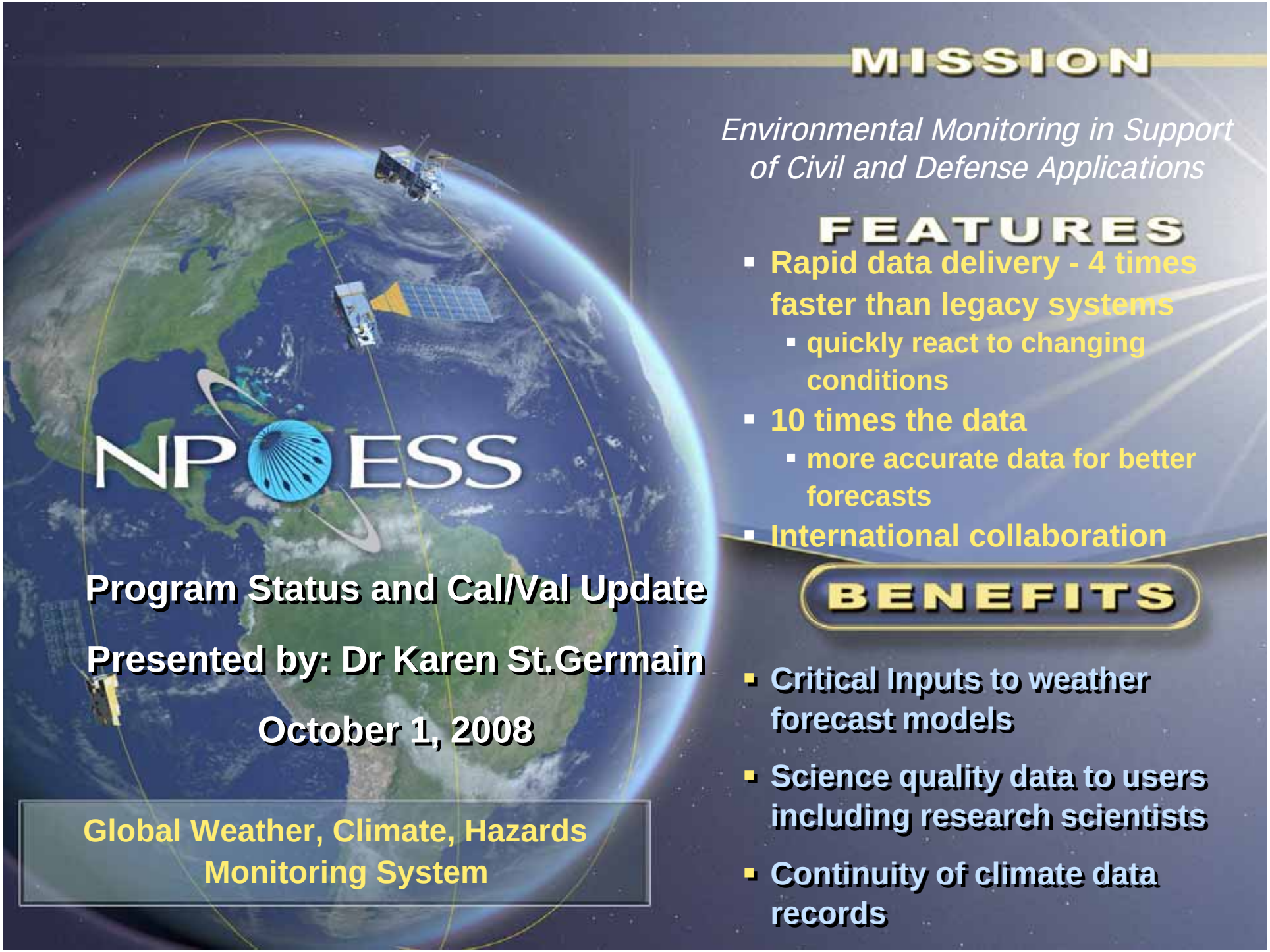

MISSION
Environmental Monitoring in Support of Civil and Defense Applications
FEATURES
Rapid data delivery - 4 times faster than legacy systems
quickly react to changing conditions
10 times the data
more accurate data for better forecasts
International collaboration
BENEFITS
Critical Inputs to weather forecast models
Science quality data to users including research scientists
Continuity of climate data records
NPOESS
Program Status and Cal/Val Update
Presented by: Dr Karen St.Germain
October 1, 2008
Global Weather, Climate, Hazards Monitoring System

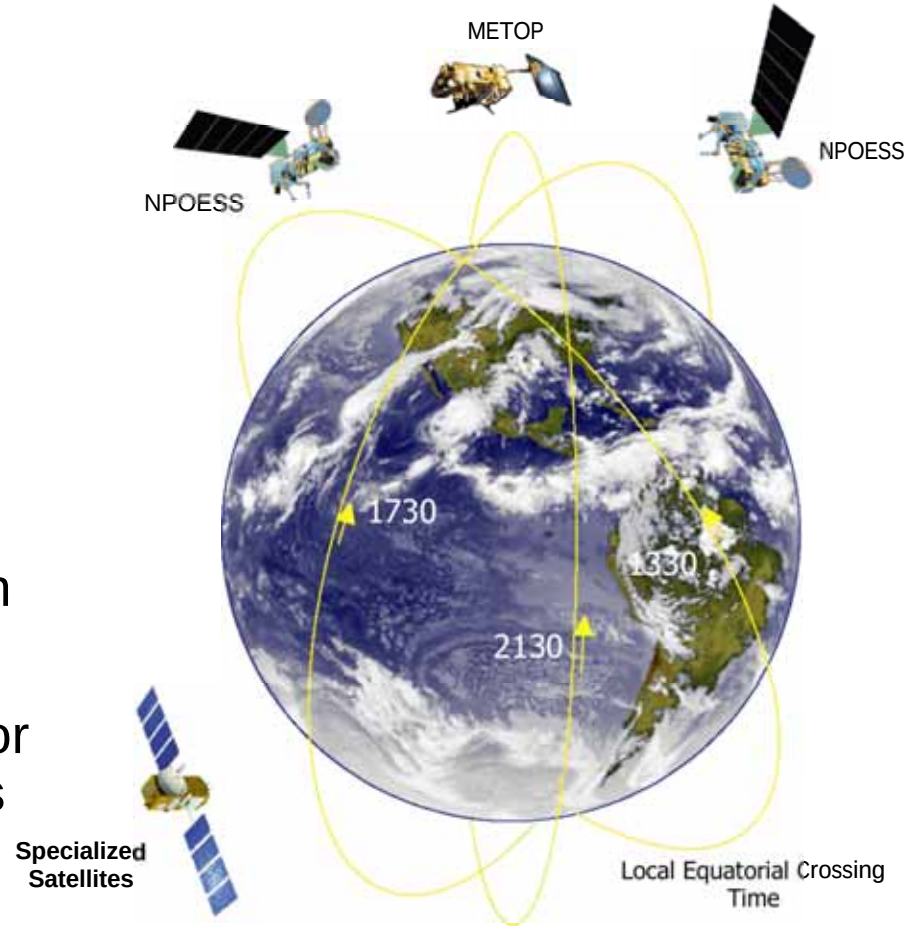
Tri-agency Effort to Leverage and Combine Environmental Satellite Activities

Mission

- Provide a national, operational, environmental polar-orbiting remote-sensing capability

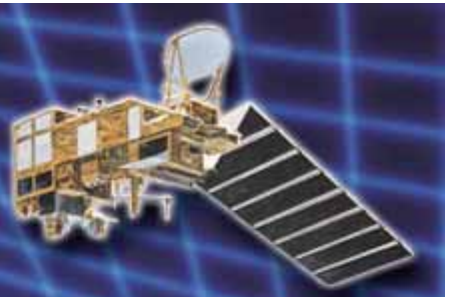
Program

- Converges DoD and NOAA satellite programs
- Three satellite system with European partnership
- NOAA is the host agency and lead for operations and international partners
- Air Force has acquisition responsibility
- NASA responsible for development of and insertion of new technologies

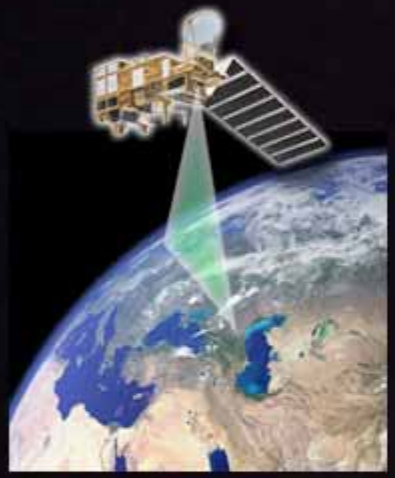


Concept of Operations

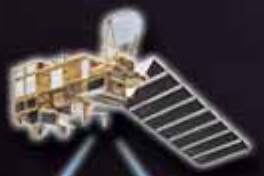
NPOESS



1. Sense phenomena



2. Downlink raw data



X and L bands

Ka-band

Field Terminals

SafetyNet™ Receptors

3. Transport data to Centrals for processing

Global fiber network connects 15 receptors to Centrals

Monitor and control Satellites and Ground Elements

MMC (Suitland)

Aurora MMC

4. Process raw data into SDRs & EDRs, deliver to Centrals & Archive

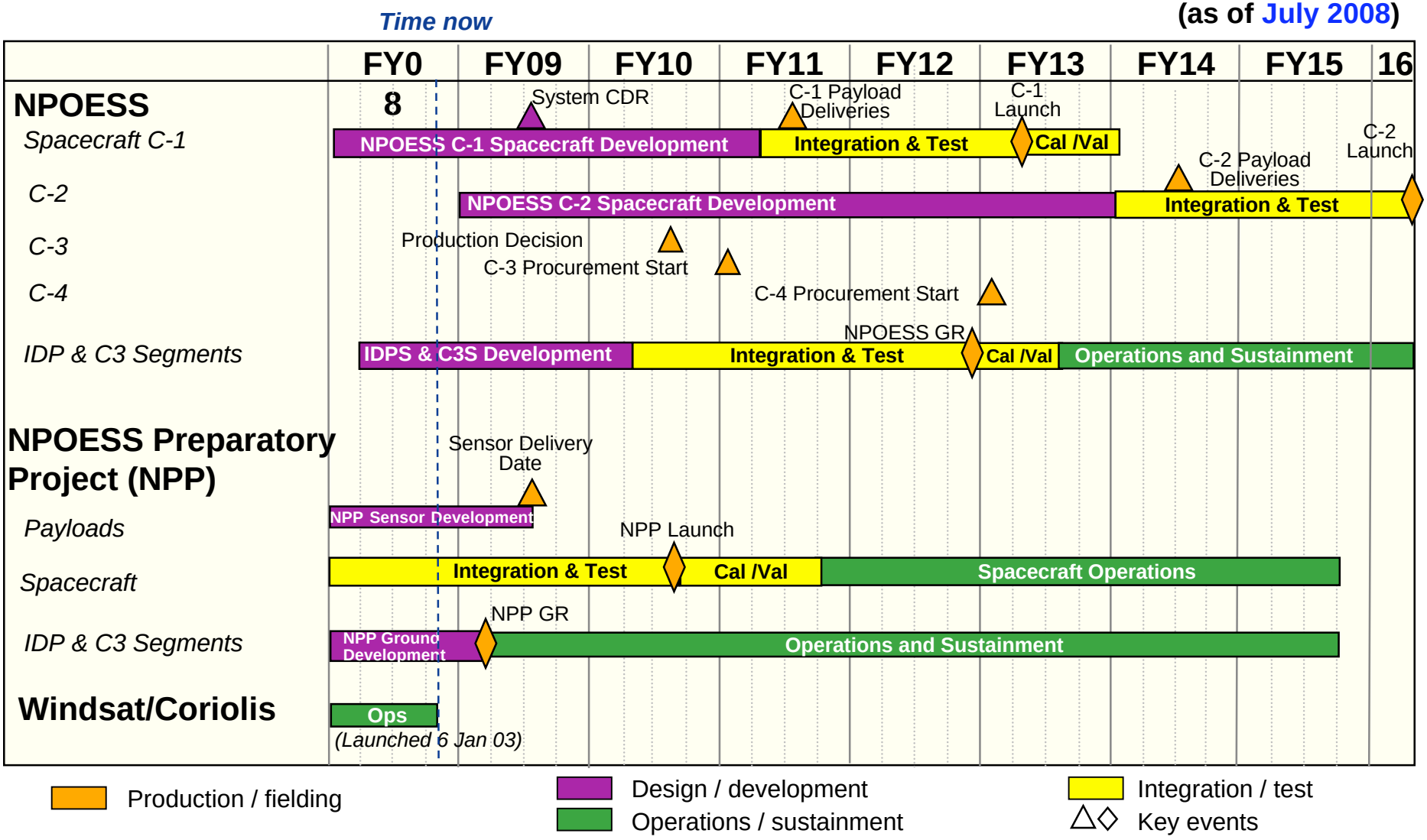
Full IDP Capability at each Central NESDIS, AFWA, FNMOC, NAVO

NPOESS Satellite & Sensors

	Afternoon Orbit	Morning Orbit	NPP Mission
Visible/Infrared Imager/Radiometer Suite **VIIRS**	X	X	X
Microwave Imager/Sounder **MIS**	C-3	X	
Cross-track Infrared Sounder **CrIS**	X		X
Advanced Technology Microwave Sound **ATMS**	X		X
Ozone Mapping and Profile Suite **OMPS**	N		X
Space Environment Monitor **SEM**	X		
Advanced Data Collection System **ADCS**	X	X	
Search & Rescue Satellite Aided Tracking **SARSAT**	X	X	
Cloud's and Earth's Radiant Energy System **CERES**	C-1		X
Total Solar Irradiance Sensor **TSIS**	C-1		

N = Nadir sensor only

Program Schedule



C3: Command, Control, Communications
I&T: Integration & Test
NPOESS C-3 and C-4: Production units to be incrementally funded

Cal/Val: Calibration/Validation
IDP: Interface Data Processing

CDR: Critical Design Review
PDR: Preliminary Design Review

GR: Ground Readiness

NPOESS Payload Development Status

CrIS Instrument (ITT)

Cross-track Infrared Sounder

- Modules built and re-integrated
- Initial bench test completed Nov 07
- Electromagnetic Interference (EMI) testing completed Dec 07
- Vibration testing completed Feb 08
- EDU integrated onto NPP spacecraft for initial functional test
- Final CrIS Thermal Vacuum (TVAC) testing has started
- Incremental sell off effort on going
- Upcoming: Pre-Ship Review in Dec

VIIRS Instrument (Raytheon)

Visible/Infrared Imager/ Radiometer Suite

- Ambient testing completed
- Electronics Module (EM) Thermal Cycle completed
- Cryoradiator vibration testing completed Jan 08
- Final Ambient Regression testing completed Feb 08
- Pre-Environmental Test Review (PER) completed Apr 08
- Cryoradiator integrated with rest of sensor
- Environmental Testing underway

OMPS Instrument (Ball)

Ozone Mapping & Profiler Suite

- Integrated Sensor Risk Reduction testing completed
- Nadir, Limb and Main Electronic Box (MEB) testing completed
- Nadir/Limb/MEB integrated into final Integrated Sensor Suite configuration
- Incremental sell off effort on-going
- Final Acceptance Testing ongoing
- Upcoming: TVAC this summer and Pre-Ship Review in Sept 08

NPOESS Payload Development Status

ATMS Instrument (NGES)

Advanced Technology Microwave Sounder

- Flight Unit 1 delivered to NPP in 2005 for integration
- Delta Critical Design Review (CDR) for replacement of obsolete components - Sep 2008

CERES Instrument (NGST)

Clouds and Earth's Radiant Energy System

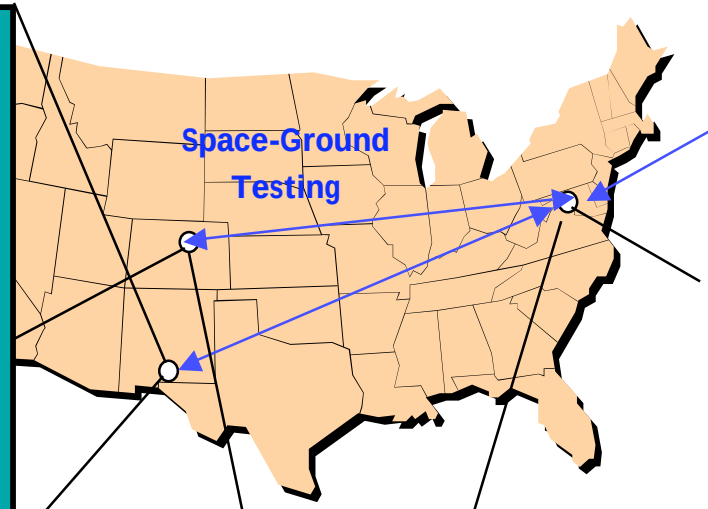
- Approved for flight by NASA for NPP
- Delta CDR complete
- Undergoing modifications for Oct 08 delivery to NPP
- Approved for flight by NOAA for NPOESS C1

NPP Space-Ground Testing

NPP / NPOESS Backup Relay C&C Equipment White Sands, New Mexico

NPP/NPOESS C&C Backup Relay

- C3S Racks/ Equipment



NPP / NPOESS Command & Control Station Svalbard, Norway

NPP/NPOESS C&C

- C3S Racks/ Equipment

NPP Spacecraft I&T Facility Boulder, Colorado

NPP Satellite

- NPP Spacecraft
- ATMS Flight Unit
- CrIS Engineering Model (EDU)
- VIIRS Engineering Model (EDU)

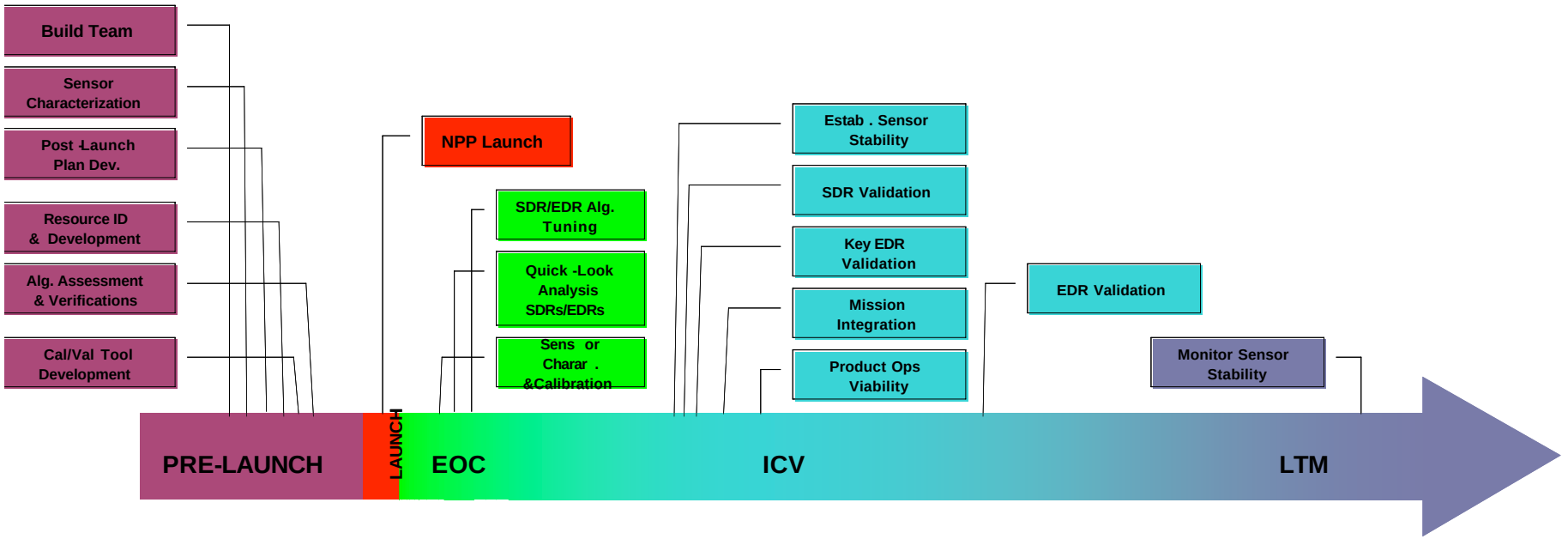
NOAA Satellite Operations Facility Suitland, Maryland

NPP/NPOESS Ground Elements

- C3S Command and Control Segment
- IDPS Processing Segment
- O&S Team

NPP Cal/Val Phases

- Four Phases of Cal/Val:
  1. **Pre-Launch; all time prior to launch – Algorithm verification, sensor testing, and validation preparation**
  2. **Early Orbit Check-out (first 30-90 days) – System Calibration & Characterization**
  3. **Intensive Cal/Val (ICV); extending to approximately 18 months post-launch – xDR Validation**
  4. **Long-Term Monitoring (LTM); through life of sensors**
- For each phase:
  - **Exit Criteria established**
  - **Activities summarized**
  - **Products mature through phases independently**



Evolution of Expertise

PRODUCT CHAIN →

TIME ↓

Pre-Launch	RDR Development and Verifi	SDR Development and Verification	EDR Development and Verification
Early Orbit Check-out	RDR On-Or Verification	DR Verification, q, and lidation	EDR Verification and Initial Validation
ICV	Establish Sensor Stability	SDR Validatio	R Validation
LTM	Sensor Long-Term Monitoring	SDR Detailed Validation and Maintenance	EDR Detailed Validation and Correction and Improvement

Sensor Engineers

Users/Scientists

Expertise shifts from Contractor Sensor Engineers to Government Customers and Users over time and product chain.

NPP Cal/Val Plan Development
IPO Discipline Team Leadership

- **NPP IPO Cal/Val Discipline Leads selected strategically from community to best represent Customer product priorities.**
  - ***SDR Lead Dr. Bruce Guenther***
    - **VIIRS – Dr. Frank DeLuccia, Aerospace**
    - **CrIS/ATMS - Dr. Gail Bingham, USU/SDL**
    - **OMPS – Dr. Scott Janz, NASA/GSFC**
  - ***EDR Lead Mr. Carl Hoffman***
    - **VIIRS Atmosphere: Dr. David Starr, NASA/GSFC**
    - **VIIRS Land: Dr. Jeff Privette, NOAA/NESDIS/NCDC**
    - **VIIRS Ocean: Dr. Bob Arnone, NRL**
    - **VIIRS Imagery/Cloud Mask: Mr. Tom Kopp, Aerospace at AFWA**
    - **CrIS/ATMS Sounding: Dr. Chris Barnet, NOAA/NESDIS/STAR**
    - **OMPS Ozone: Dr. Larry Flynn, NOAA/NESDIS/STAR**
- **Cal/Val Discipline Leads building teams of Subject Matter Experts (SMEs) to develop and execute cal/val tasks.**

NPP SDR Cal/Val Objectives

- Evaluate instrument response on orbit
- Characterize instrument response from pre-launch bench and TVAC tests
- Incorporate lessons learned from heritage radiometric and spectral calibration approaches
  - CrIS - AIRS, IASI, TES
  - ATMS - AMSU
  - VIIRS - MODIS
  - OMPS - OMI, TOMS, SBUV/2, GOME(-2), SCIAMACHY
- Build team of SMEs from both customer and science communities to leverage heritage knowledge and tools as well as assure understanding of Customer Mission Success.

CrIS SDR
Cal/Val Strategy Highlights

- Prelaunch activities:
  - Analysis of TVAC data
  - Evolve TVAC findings into improved operational algorithm
  - Verification of RDRs and sensor vendor engineering parameters (LUTs)
  - Update TVAC analysis tools for on-orbit operational data
  - Exercise operational algorithm with TVAC gas cell dataset and day-in-the-life test sequence
- Postlaunch activities
  - Comparisons of SDRs against other sensor measurements (e.g. A-Train; MetOp)
  - Radiometric, Spectral and Geolocation evaluation and trending
  - Comparisons of SDRs with cloud-cleared radiance IPs, GFS models
  - Long-term stability SDR characterization

ATMS SDR
Cal/Val Strategy Highlights

- Pre-Launch Activities
  - Analysis of TVAC data
- Post-launch activities
  - Comparison of on-orbit vs. T/V data, possibly including maneuvers
  - Quantify scan biases from sidelobes & s/c structure
  - Scan uniformity/bias analysis
  - X-comparison w/other satellite sounders
    - Resampling & comparison w/AMSU
  - Underflights & pre-launch cal/val exercise possible
  - NWP radiance validation & comparison w/model Tb fields
  - Geolocation checking
  - RFI contamination checking
  - Ascending/descending Tb comparisons
  - Gross anomaly identification, parameter trending
  - ATMS-CrIS footprint matching
  - ATMS 57.29 GHz Center Frequency Stability & Drift between ATMS & CrIS

VIIRS SDR
Cal/Val Highlights

- Use heritage techniques
  - Geolocation – GCP training with Landsat (MODIS)
  - Reflective Band Radiometry – SD, vicarious calibration , Lunar Calibration. (MODIS, Seawifs, MISR) X-Sensor calibration (AVHRR).
  - Emissive Band Radiometry – OBCBB, vicarious calibration. (MODIS), X-Sensor calibration.
- Identify problems using EDRs
  - CM, AOT, and SST: emissive band radiometry
  - CM, AOT, and OC: reflective band radiometry
  - OC: polarization
  - Imagery: geolocation and mapping accuracy
- Comparisons with ground truth data sources
  - Lake Tahoe TOA radiance data
  - Railroad Playa TOA radiance data
  - ROLO or processed lunar data
  - Sensor data from EOS A-train during time of overlap
  - Landsat GCP database

OMPS SDR
Cal/Val Strategy Highlights

- Use heritage Calibration Techniques:
  - Dark Current Observations (Dark Current, Bad Pixels)
  - Lamp Measurements (Linearity)
  - Solar Calibrations (Diffuser Degradations and CCD characteristics)
  - Wavelength Monitoring
  - Yaw Maneuver (Diffuser Goniometry)
  - Trending of calibration parameters and results
  - Unbinned and terminator Earth SDRs (Stray Light, Geolocation, Gain)
  - Statistical analyses of calibrations and Earth SDR radiances
  - Comparisons of OMPS radiances (Cross-track calibration consistency & 300 to 310 nm)
  - Use of TC EDR and NP IP to identify problems with SDRs
  - EOF Spectral Covariance Analysis
  - Mg II Index (Core-to-Wing Ratio for Solar Activity)
  - Aerosol Index and R/lambda linearity dependence
  - Reflectivity monitoring – Ice radiances, equatorial Pacific minimum
  - Spectral Discrimination
- Use information from EDRs
  - Use to check stray light contamination
  - Analyze Ozone retrieval residuals
  - Check for degradation by examining reflectance spectra
  - Attitude check for consistency across swath
- Cross-Compare with Data:
  - VIIRS SDR M1 band radiances
  - Ground Instrument Data (CasaNosa) from pre-launch characterization
  - Radiances from OMI, GOME-2, SBUV/2
  - Solar Irradiances from SORCE, SSBUV, SBUV/2

EDR Cal/Val Strategy Highlights

- Build teams of SME's from both customer and science communities to leverage heritage knowledge and tools as well as assure understanding of Customer Mission Success.
- Incorporate lessons learned from Heritage Data Product Validation
  - Concentrate on datasets proven valuable for global validation (e.g. ECMWF, NCEP/GFS, RAOB's)
  - Work with experiments of opportunity for detailed characterization of products.
- Characterize performance of EDRs in various ensembles of cases.
- Leverage exisiting capabilities – (e.g. NESDIS operational real-time AIRS and IASI processing and validation systems and aircraft validation campaigns)
- Prioritize validation as follows:
  - Validation of "First Light" spectral with model analysis or forecasts.
  - Validation of key performance parameters using validated SDRs against other sensor products, operational and dedicated RAOBs, etc.
  - Inter-comparison of operational products (from IDPS) with research products generated by heritage algorithms.
  - Characterization of all EDR products and long-term demonstration of performance against operational and dedicated in situ observations

Summary

- Substantial progress has been made in the instrument, ground system, and NPP spacecraft development and test
- The test program will present additional challenges; expected in this phase of development
- Planning for intensive Cal/Val is underway
- NPOESS on track to deliver key weather and climate data