JASD

JOINT AGENCY
SATELLITE DIVISION

NAC Science Committee Update

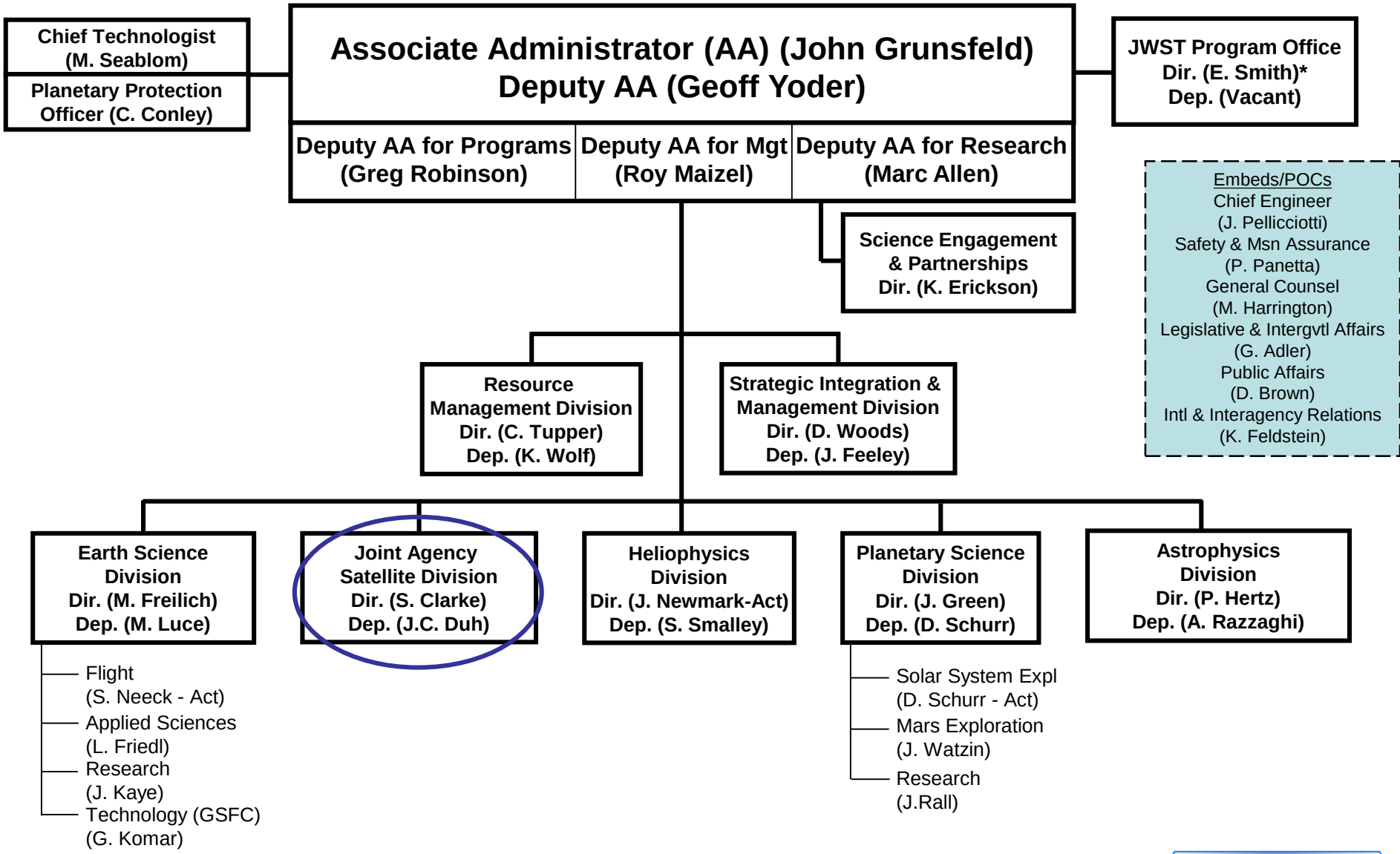
Steven W. Clarke, Director

April 7, 2015

JASD Overview

- JASD performs the typical HQ role for NASA projects, but has unique responsibilities to the reimbursable customer.
  - Manages Program/Project implementation on behalf of the funding agency
  - Distributes reimbursable funding authority to Centers
  - Oversees Center execution
  - Represents Program/Project in Directorate and Agency-level reporting
  - Represents reimbursable customer on Human Exploration and Operations Mission Directorate Flight Planning Board for the planning, acquisition and manifesting of launch vehicles
- JASD uses the same NASA Program Requirements (NPR 7120.5) processes to ensure mission success for reimbursable programs that are standard for NASA's own programs.
- JASD relies on the other Science Divisions to represent NASA science requirements for reimbursable missions through existing inter-agency forums.
- Decision authority and responsibilities for strategic planning, legislative and executive branch coordination remain with the funding agency.

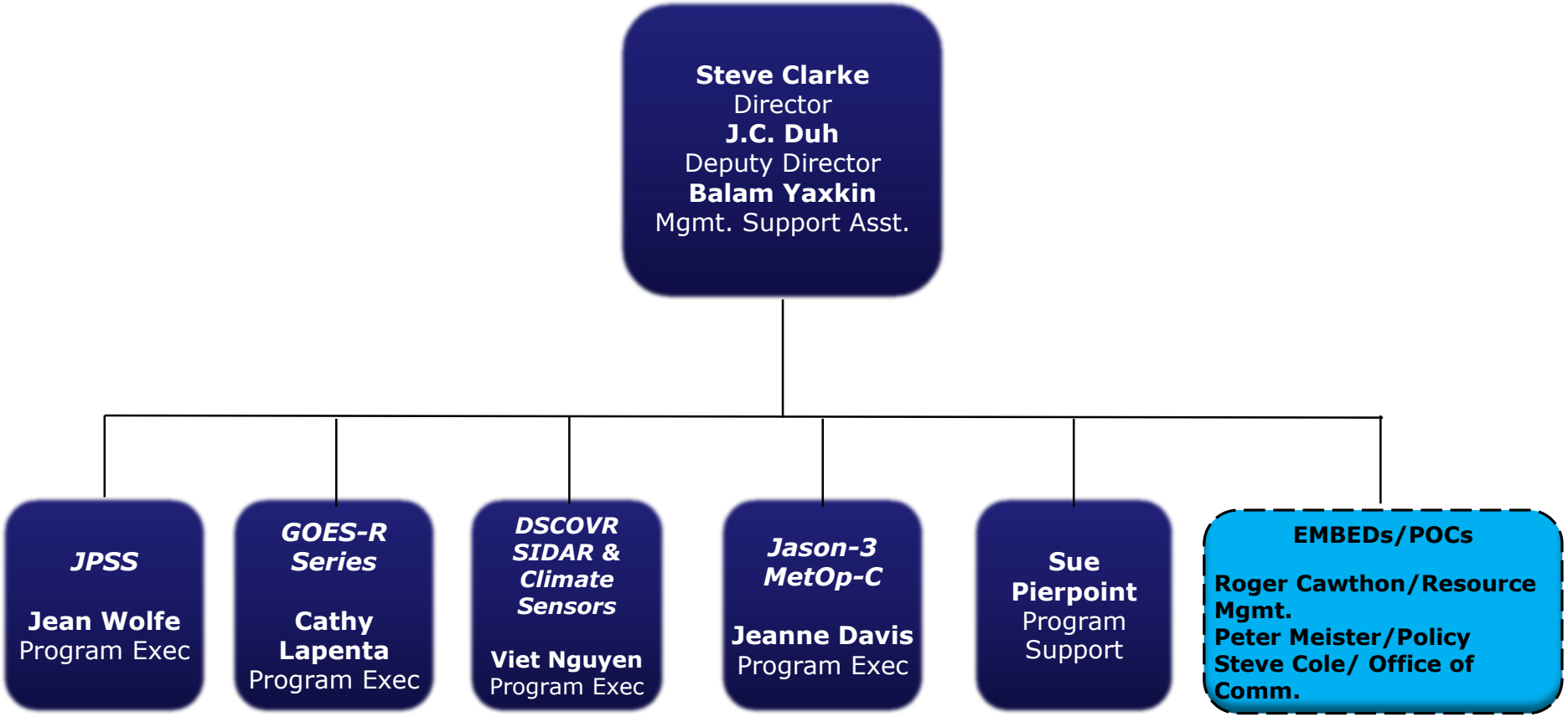
SMD Organization



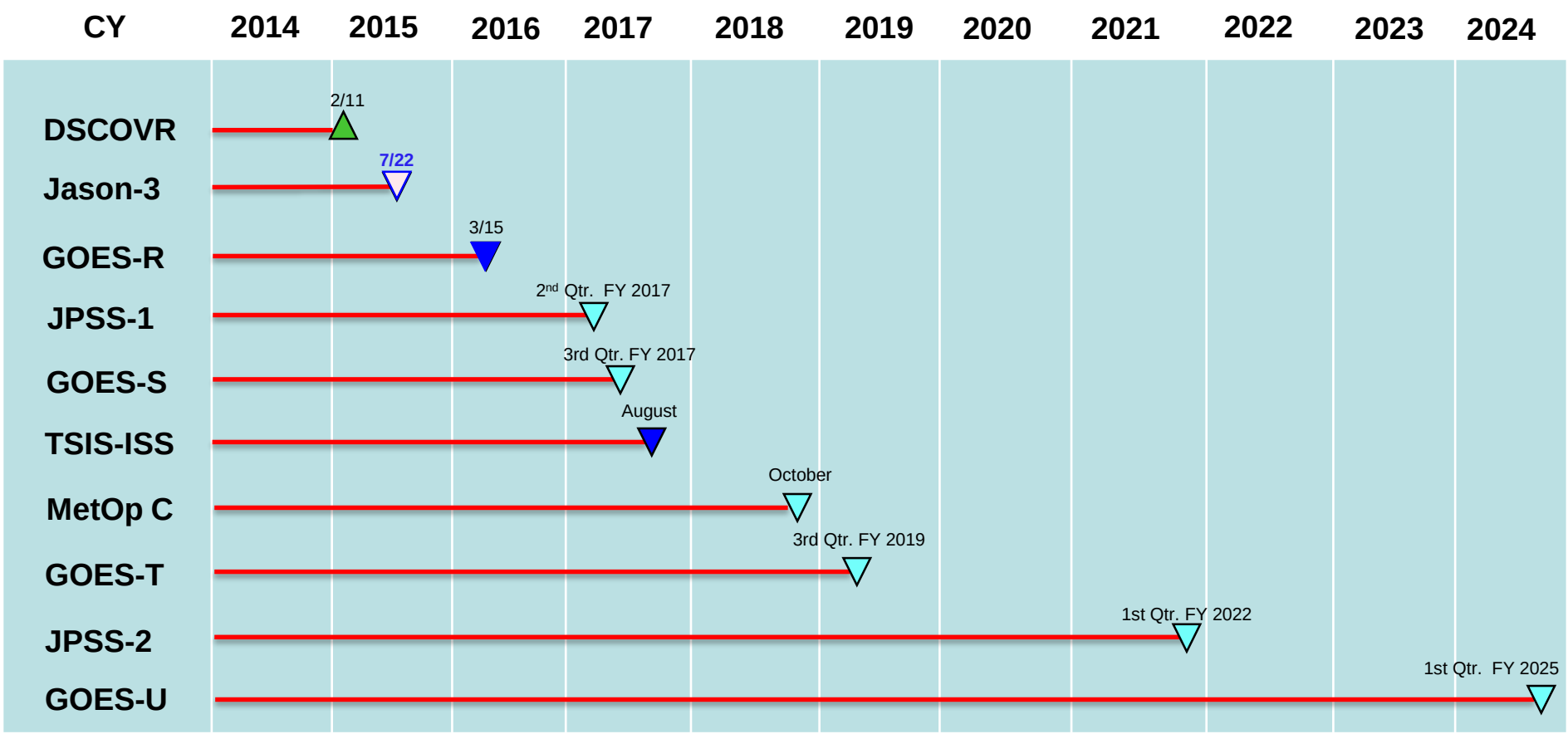
* Direct report to NASA Associate Administrator

April 2015

JASD Organization



Reimbursable Launch Commitment Dates



Launch Commitment Date | Estimated Launch Date | Range Date | Launched

DSCOVR

Mission Objectives

- Continue solar wind measurements in support of space weather requirements
- Observe the Earth from the unique Sun-Earth L1 Lagrange Point perspective
- Measure the energetic particle environment

Upcoming Events

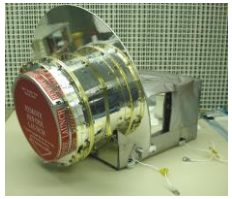
- Spacecraft arrives at L1: ~June 7, 2015
- NASA/NOAA Handover: ~July 27, 2015

- Launched February 11, 2015 @ 6:03 PM EST; observatory successfully deployed solar arrays, reaction wheels powered up, and stable sun-pointing orientation after separation
- Successful Plasmag Instrument Data Processing Unit (IDPU) activation, magnetometer activation, checkout and boom deployment on Feb 15
- Successful NISTAR activation and checkout on Feb 16
- Successful ESA activation and checkout on Feb 27
- Successful EPIC activation and closed-door images on Mar 6
- Successful x-axis and z-axis rotations to calibrate magnetometer on Mar 10
- Successful NISTAR functional testing on Mar 11
- Project received launch delay funding; awaiting funding for Phase 2 IT Security
- Minor issues being tracked
  - Faraday Cup collector (A-side) experiencing lower readings and higher noise levels than predicted
  - Bulk memory single event upsets

DSCOVR Instrumentation

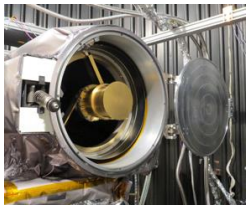
Primary Instrumentation

- Fluxgate Magnetometer
  - – to measure solar wind magnetic field vector



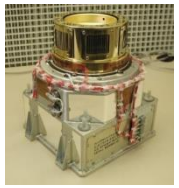
- Faraday Cup
  - – to measure solar wind thermal plasma velocity, density and temperature

Secondary Instrumentation



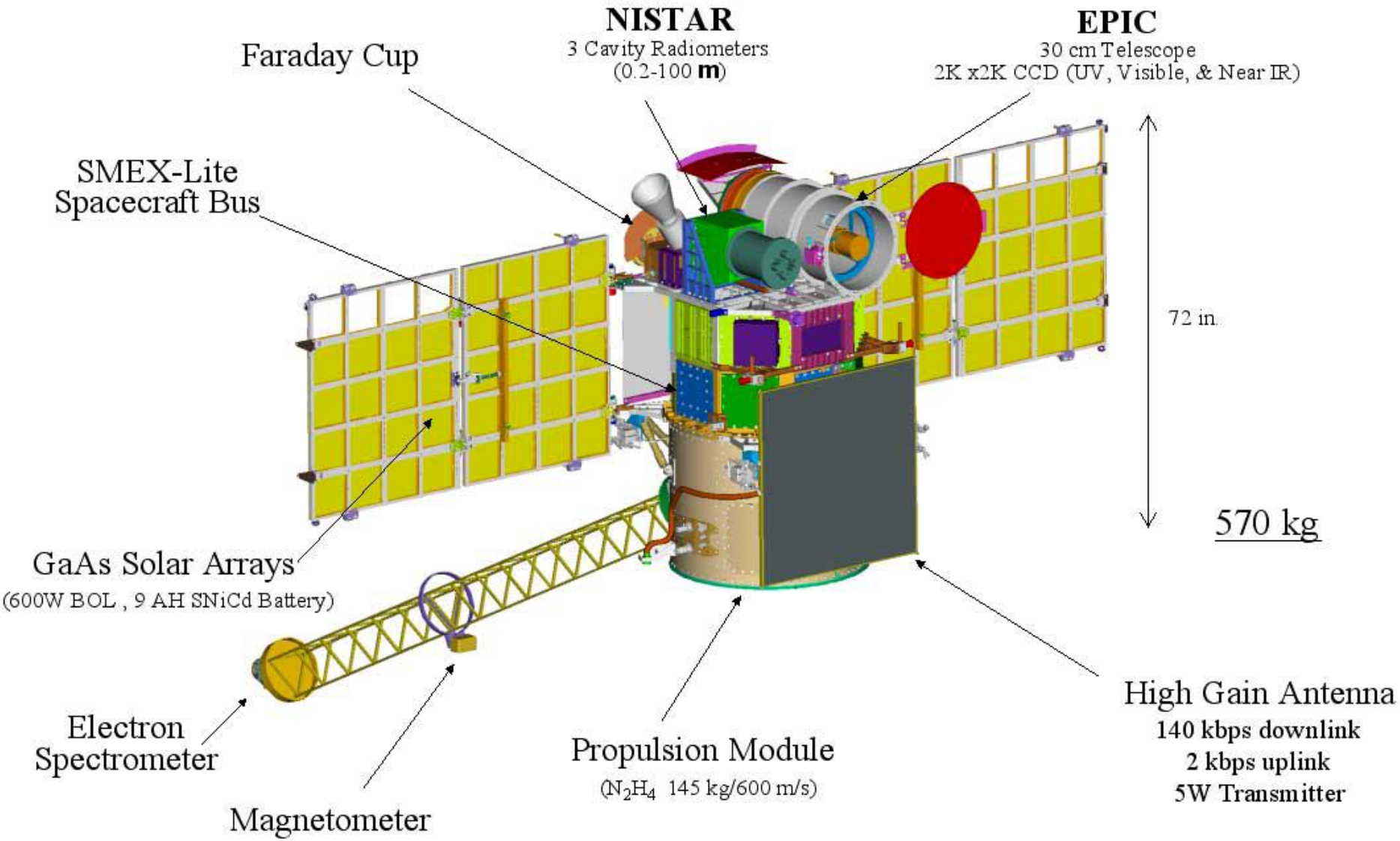
- Earth Poly-chromatic Imaging camera (EPIC)
  - – to image the sunlit face of Earth in 10 wavelengths

- NIST Active Radiometer (NISTAR)
  - – to measure the reflected and radiated energy by Earth



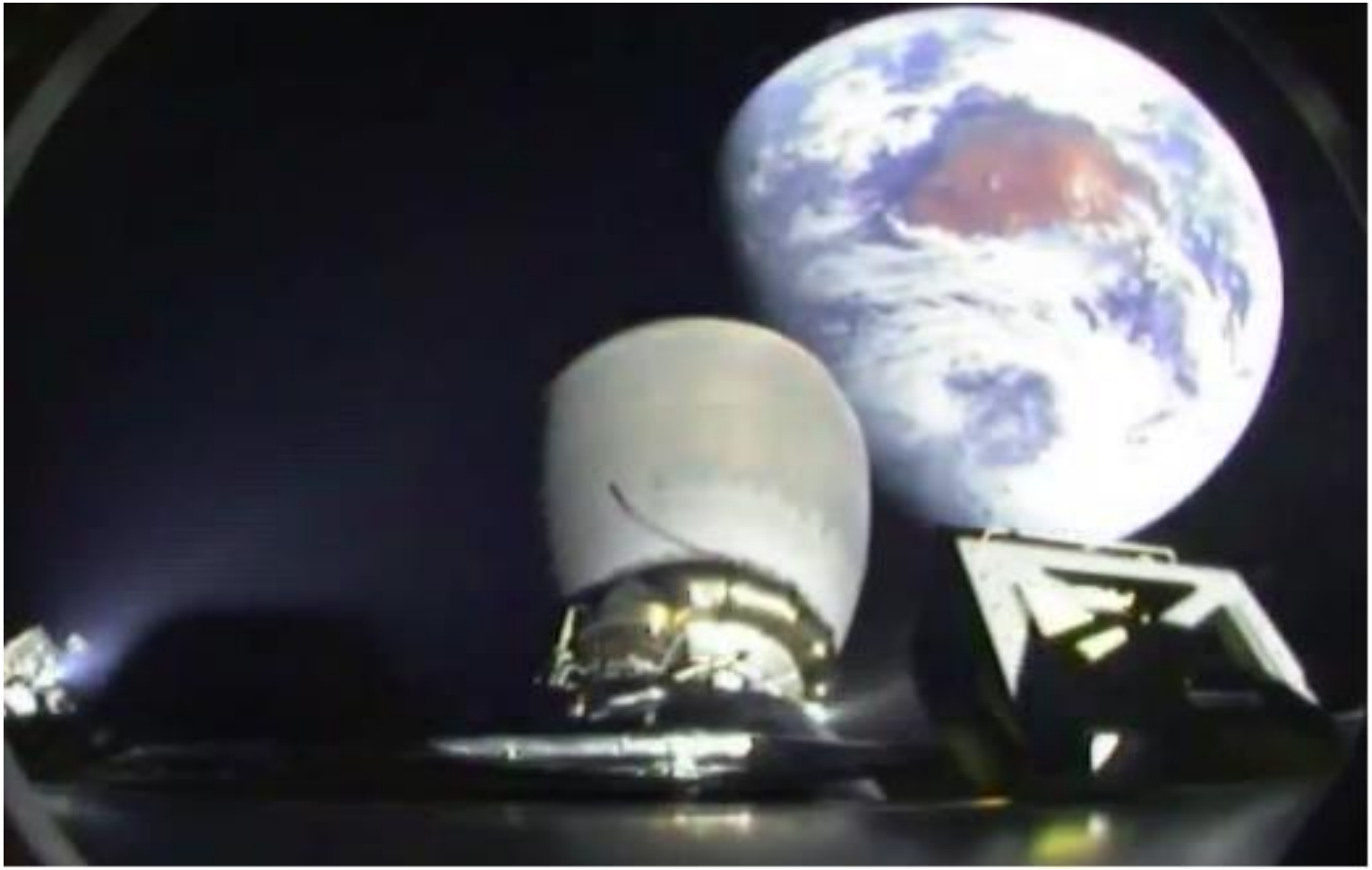
- Electron Spectrometer (ESA)
  - – to measure the solar wind thermal electron population
- Pulse Height Analyzer (PHA)
  - – to measure energy deposited by energetic particles in electronics

DSCOVR Spacecraft



DSCOVR

DSCOVR



DSCOVR is L1 Bound!

DSCOVR and Space Weather Follow-On FY16 Budget

DSCOVR*

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
75,994	21,100	3,200	2,400	2,069	-	-	-	104,763

* Does not include NASA ESD Funding for EPIC and NISTAR

Space Weather Follow On

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
		2,500						2,500

FY16 Activities:

- Maintain and operate DSCOVR spacecraft
- Plan and initiate development of the Space Weather Follow On program
- Formulation of life cycle costs for the Space Weather Follow On mission will be provided with the FY17 President's Budget

Note: Budget numbers documented in NOAA FY16 President's Budget Request

Jason-3 Mission Summary

Science Measurements

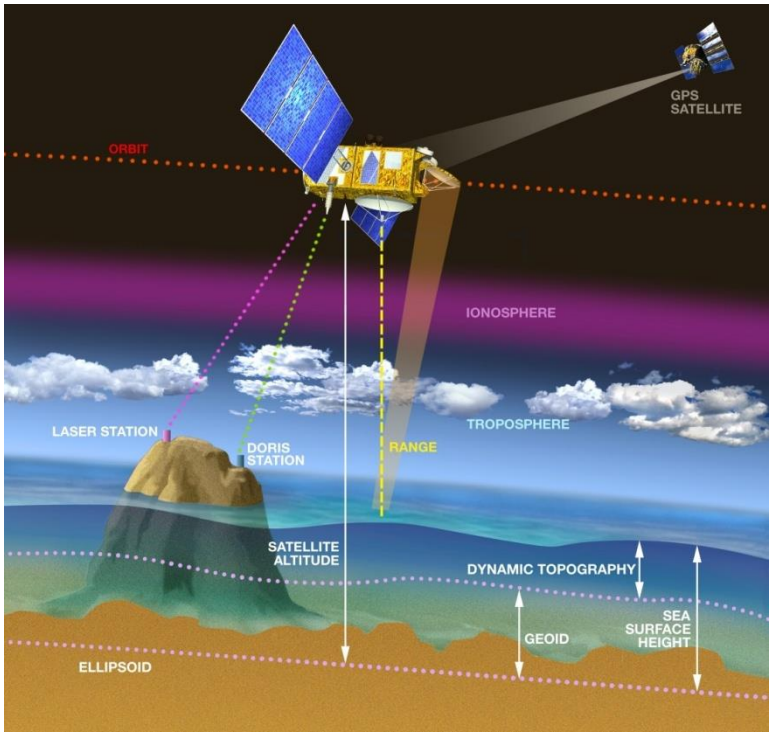
Global sea surface height to an accuracy of ≤ 4 cm every 10 days, for determining ocean circulation, climate change and sea level rise

Mission Objectives

- Provide continuity of ocean topography measurements beyond TOPEX/Poseidon, Jason-1 and OSTM/Jason-2
- Operational ocean altimetry mission to enable the continuation of multi-decadal ocean topography measurements
- NOAA and EUMETSAT are lead agencies with CNES and NASA/JPL providing implementation support

Instruments

- Core Mission:
  - Poseidon-3B Altimeter
  - DORIS (Precise Orbit Determination System)
  - **Advanced Microwave Radiometer (AMR)**
  - **GPS Payload (GPSP)**
  - **Laser Retro-reflector Array (LRA)**
- Passengers (Experiments):
  - JRE (Carmen3 + LPT)



Mission Overview

- Launch Date: July 22, 2015
- **Launch Vehicle: Falcon 9**
- 7120.5 Project Category: II
- Risk Classification: B
- Proteus Spacecraft Bus provided by CNES
- Mission life of 3 years (goal of 5 years)
- 1336 km Orbit, 66º Inclination

NASA responsible for items in BLUE (on behalf of NOAA)

Jason-3

Project

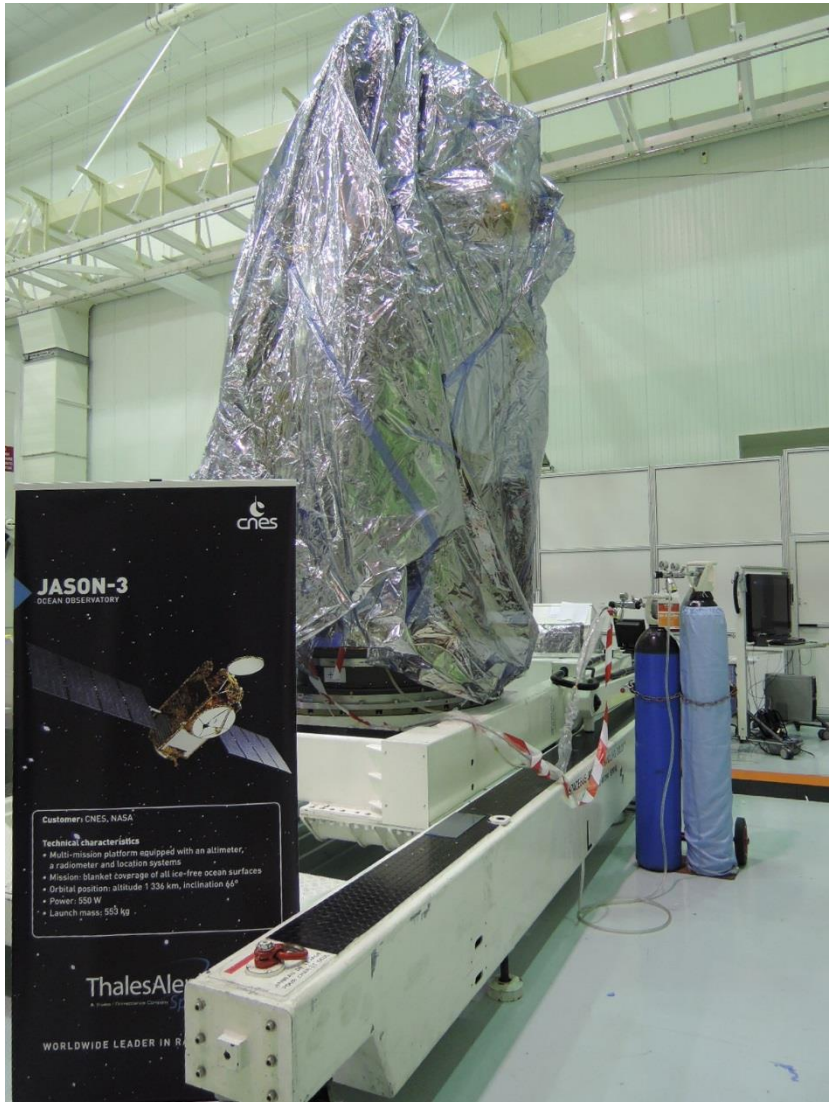
- Established new launch date of July 22, 2015

Spacecraft

- Spacecraft is now in storage awaiting shipment with AMR purged with GN2

Launch Vehicle (SpaceX Falcon 9 v1.1)

- Launch vehicle production remains on schedule; watch item for NESDIS and JASD
- Launch vehicle certification continues to progress well
- Engineering assessment of landing legs and fins scheduled for April 8
- Next launch is now CRS-6 scheduled for April 13; commercial mission delayed due to helium COPV issue



Jason-3 FY16 Budget

Jason-3

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
124,831	23,175	7,458	7,288	7,265	7,196	-	-	177,213

FY16 Activities:

- Complete the evaluation of the Jason-3 satellite and instrument performance during the calibration and validation phase
- Maintain and operate Jason-3 spacecraft

Note: Budget numbers documented in NOAA FY16 President's Budget Request

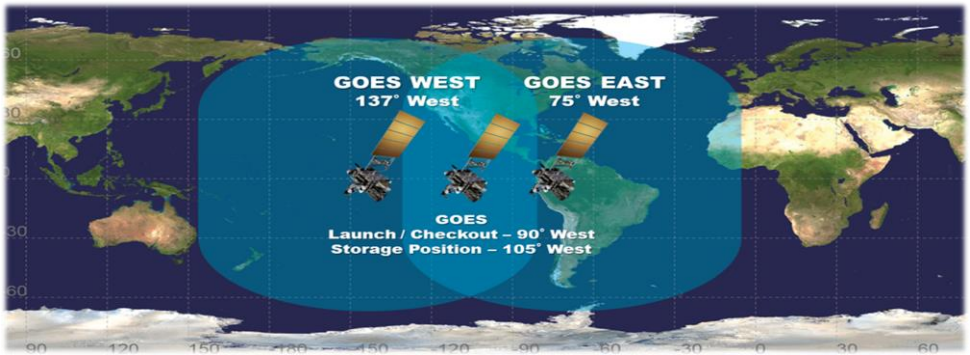
GOES-R Series Program Description

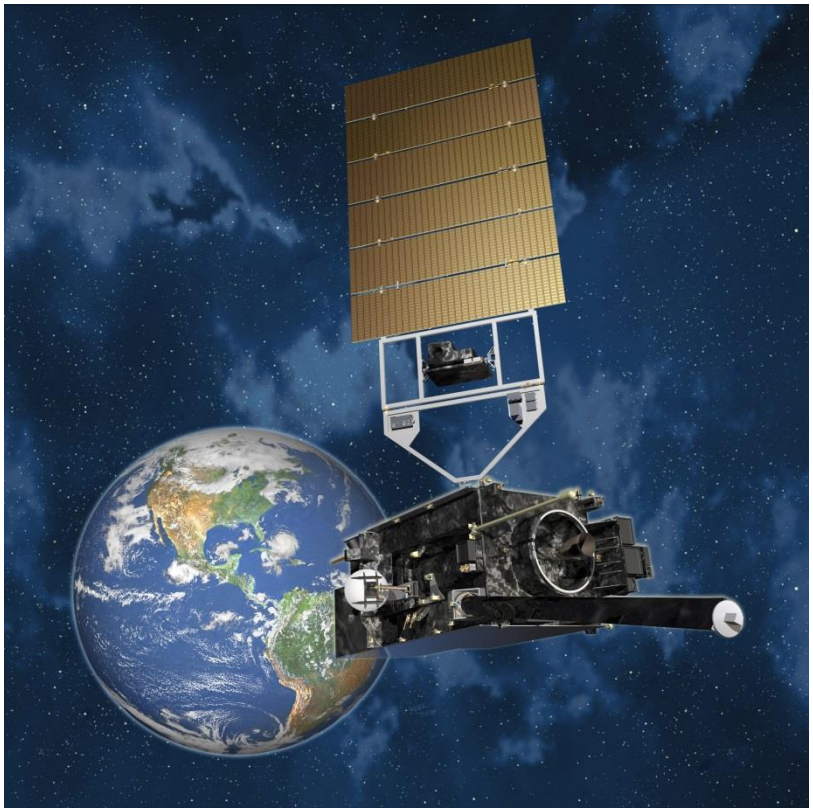
Mission Objective

To provide continuous imagery and atmospheric measurements of Earth's Western Hemisphere and space weather monitoring

Program Overview

- Launch Commitment Dates:
  - GOES-R:2Q FY 2016
  - GOES-S:3Q FY 2017
  - GOES-T: 3Q FY 2019
  - GOES-U:1Q FY 2025
- Launch Vehicle: Atlas V 541 (for R&S)
- NPR 7120.5 Project Categorization: I
- Risk Classification: B
- Satellite Mission life of 15 years
- Geostationary Orbit at 75° W and 137° W





Instruments

- Advanced Baseline Imager (ABI)
- Geostationary Lightning Mapper (GLM)
- Extreme Ultraviolet and X-ray Irradiance Sensor (EXIS)
- Solar Ultraviolet Imager (SUVI)
- Space Environment In-Situ Suite (SEISS)
- Magnetometer

GOES-R Series Program

GOES-R Spacecraft Status

- All instruments have been integrated to the spacecraft
  - Advanced Baseline Imager (ABI)
  - Geostationary Lightning Mapper (GLM)
  - Extreme Ultraviolet and X-ray Irradiance Sensor (EXIS)
  - Solar Ultraviolet Imager (SUVI)
  - Space Environment In-Situ Suite (SEISS)
  - Magnetometer
- Integrated Solar Pointing Platform (SPP) to Solar Array and installed SPP Interface Unit (SIU)
- Antenna Wing Assembly delivered for spacecraft electromagnetic interference testing
- Launch planned for March 2016 from CCAFS, FL on an Atlas V launch vehicle

GOES-S Spacecraft Status

- System module buildup in work next to GOES-R spacecraft
- Instrument buildup and testing is progressing.
- Launch planned for the April-June 2017 timeframe from CCAFS, FL on an Atlas V launch vehicle.

GOES-R Series FY16 Budget

GOES-R Series

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
5,106,246	980,838	871,791	786,684	523,049	364,032	266,865	1,928,554	10,828,059

FY16 Activities:

- Completion of GOES-R satellite, ground system, and flight-to-ground integration and test activities
- Complete GOES-R satellite pre-ship, ship, and launch site activities
- Launch of GOES-R in mid-March 2016
- Initiation of post launch satellite check-out and calibration activities
- Completion of fabrication of GOES-S spacecraft hardware and initiation of satellite-level integration
- Continue GOES-S launch vehicle service activities
- Fabrication, assembly, and integration of GOES T&U instruments and spacecraft hardware.

Note: Budget numbers documented in NOAA FY16 President's Budget Request

JPSS Mission Summary

Mission Objective

Provide data continuity for global environmental data used in numerical weather prediction models and climate modeling

Mission Overview

- Launch Commitment Dates:
  - JPSS 1: 2Q FY 2017
  - JPSS 2: 1Q FY 2022
- Launch Vehicle: Delta II (JPSS 1)
- NPR 7120.5 Project Category: I
- Risk Classification: B
- JPSS-1 Spacecraft Bus - Ball Aerospace
- JPSS-2 Spacecraft Bus – Orbital ATK
- Mission life of 7 years; 10.5 years of fuel
- 824 km Orbit, 1330 Local Time Ascending Node, Polar Sun-Synchronous

Instruments

- Advanced Technology Microwave Sounder (ATMS)
- Cross-track Infrared Sounder (CrIS)
- Visible Infrared Imaging Radiometer Suite (VIIRS)
- Ozone Mapping and Profiler Suite (OMPS) – Nadir only on JPSS-1; Nadir and **Limb** on JPSS-2
- Clouds and the Earth's Radiant Energy System (CERES) (JPSS-1)
- **Radiation Budget Instrument (RBI) (JPSS-2)**

NASA Earth Science Division responsible for items in BLUE

Joint Polar Satellite System

JPSS-1

- 4 of 5 instruments have been integrated to the spacecraft
  - Cross-track Infrared Sounder (CrIS)
  - Visible Infrared Imaging Radiometer Suite (VIIRS)
  - Ozone Mapping and Profiler Suite (OMPS) – Nadir only
  - Clouds and the Earth's Radiant Energy System (CERES)
- Advanced Technology Microwave Sounder (ATMS) will be final instrument installed onto spacecraft bus due to intermediate frequency amplifier issues
- ATMS Engineering Development Unit delivered to Ball Aerospace and will be integrated to bus in mid-April for integration & test activities
- Launch planned for January-March 2017 from VAFB on a Delta II launch vehicle

JPSS-2

- Spacecraft bus contract awarded to Orbital ATK on March 23, 2015; options for JPSS-3 and JPSS-4
- All instruments are under contract; contractors are pressing ahead with procuring parts and initial manufacturing/sub-assembly builds
  - Advanced Technology Microwave Sounder (ATMS)
  - Cross-track Infrared Sounder (CrIS)
  - Visible Infrared Imaging Radiometer Suite (VIIRS)
  - Ozone Mapping and Profiler Suite (OMPS) – Nadir and Limb
  - Radiation Budget Instrument (RBI)
- Launch planned for October-December 2022; launch vehicle has not been procured yet

JPSS Program of Record (POR) FY16 Budget

JPSS Program

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
5,935,735	916,267	808,966	797,246	735,777	558,803	439,506	1,129,825	11,322,125

FY16 Activities:

- Operate and sustain the S-NPP satellite launched on October 28, 2011
- Continue ground system operations for S-NPP under the Block 1.2X until it is retired, complete development and deployment of the new Block 2.0 upgrade, and perform integration testing of Block 2.0 with the JPSS-1 flight segment to get ready for JPSS-1 launch
- Complete testing of the JPSS-1 integrated spacecraft; prepare for JPSS-1 launch site integration and testing (I&T)
- Continue with preparation for launch vehicle services for JPSS-1 for launch by no later than 2nd quarter of FY 2017
- Continue the development of JPSS-2 spacecraft and instruments
- Support capability to launch JPSS-2 by 4th quarter FY 2021

Note: Budget numbers documented in NOAA FY16 President's Budget Request

JPSS Program Follow On (PFO)
FY16 Budget

JPSS Program Follow On

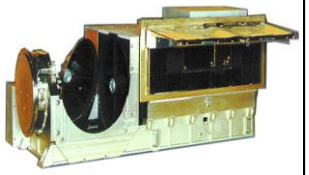
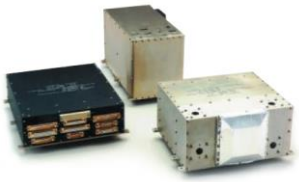
Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
-	-	380,000	438,000	594,000	581,000	579,000	TBD	TBD

FY16 Activities:

- Initiate development to support launch readiness dates of Q2 FY 2024 for JPSS-3 and Q3 FY 2026 for the JPSS-4 missions
- Provide the option for a JPSS-3 contingency mission with critical sounders, Advanced Technology Microwave Sounder (ATMS) and Cross-track Infrared Sounder (CrIS), only
- Invest in development of an advanced technology Earth Observing Nano-satellite Microwave (EON-MW) instrument

Note: Budget numbers documented in NOAA FY16 President's Budget Request

NASA Provided MetOp-C Instruments

NASA Provided Instrument		Measurement
	<u>AMSU-A1 & AMSU A2 -</u> Advanced Microwave Sounding Unit	A cross-track scanning total power radiometer, (in conjunction with the HIRS) used to calculate the global atmospheric temperature and humidity profiles form Earth's surface to the upper stratosphere. Used for weather forecast models.
	**<u>AVHRR</u> –**Advanced Very High Resolution Radiometer	A 6 channel imaging radiometer that detects energy in the visible, near infrared, and infrared portions of the EM spectrum. Used for determining cloud cover and surface temperature.
	**<u>SEM</u>** – Space Environment Monitor	Measures the charged particle environment at satellite altitude including intensities of energetic particles in the Earth's radiation belts and solar winds. Consists of two separate sensors units and a data processing unit. Used for space weather forecasting by providing warnings of solar wind occurrences.

MetOp-C Project

Project

- MetOp-C instrument contract Request For Proposals, to cover launch date change to October 2018, were released on January 15 to Northrop Grumman, Exelis, and ATC; proposals are due in mid-March

Advanced Very High Resolution Radiometer (AVHRR)

- Instrument safely arrived in Holland/ESTEC on March 23; ESA arranging for shipment from Holland to Germany

Advanced Microwave Sounding Unit (AMSU)

- In storage after completion of annual activation

Space Environment Monitor (SEM)

- Total Energy Detector (TED) outgassing activities completed with no significant change to detector performance

MetOp-C Budget

MetOp-C ($K)

FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
2,000	8,000	8,000	8,000	3,500	3,500	10,500	43,500

FY16 Activities:

- Ship Space Environment Monitor to Europe and assist in integration and test activities
- Support yearly activation of AMSU A1 and A2 instruments
- Maintain U.S. electrical ground support equipment in Europe

Note: Budget numbers documented in NOAA FY16 President's Budget Request

Solar Irradiance, Data, and Rescue (SIDAR)

- Formerly Polar Free Flyer (PFF)
  - Comprised of Total & Spectral solar Irradiance Sensor -1 (TSIS-1), Advanced Data Collection System (A-DCS) and Search and Rescue (SAR) instruments
- Initial planning for accommodating the TSIS-1 on the International Space Station
- A-DCS and SAR instruments are looking for spacecraft and launch vehicle accommodations.

Instrument		Measurement
	SARR – Search and Rescue Repeater	The Search and Rescue instruments are part of the international Cospas-Sarsat system designed to detect and locate Emergency Locator Transmitters (ELTs), Emergency Position-Indicating Radio Beacons (EPIRBs), and Personal Locator Beacons (PLBs)
	SARP – Search and Rescue Processor	
	A-DCS- Advanced Data Collection System	The A-DCS provides a worldwide in-situ environmental data collection and Doppler-derived location service with the basic objective of studying and protecting the Earth environment
	TSIS TIM – Total & Spectral solar Irradiance Sensor Total Irradiance Monitor	TIM is an active cavity radiometer that monitors changes in Total Solar Irradiance (TSI) at the top of the Earth's atmosphere
	TSIS SIM – Total & Spectral solar Irradiance Sensor Spectral Irradiance Monitor	SIM is a prism spectrometer that monitors changes in Solar Spectral Irradiance (SSI) as a function of wavelength

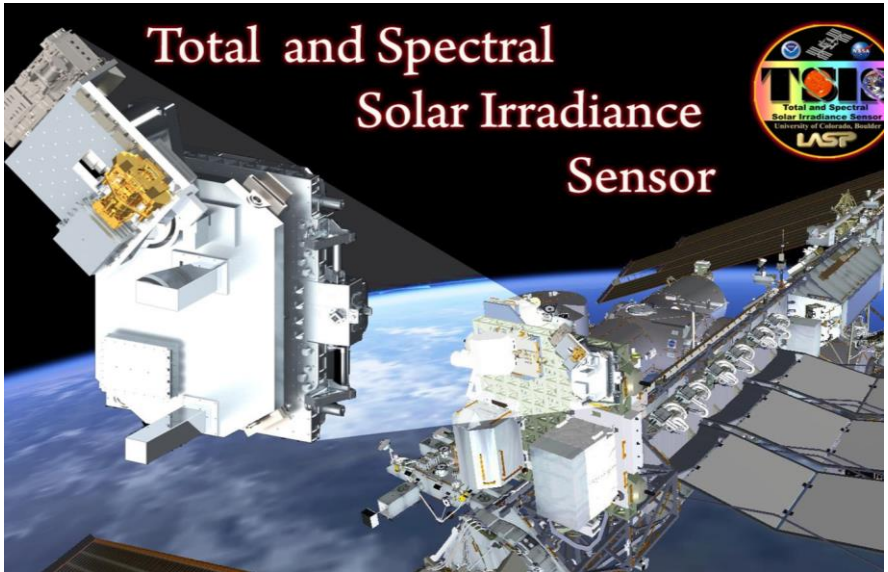
Total and Spectral Irradiance Sensor-1 on ISS

Project

- NOAA-NASA Inter-Agency Agreement (IAA) completed and ratified on March 17; FY15 funding transferred to project
- Project name has changed to TSIS-1-on-ISS as NASA is no longer required by NOAA to provide support for the A-DCS and SAR instrument activities.
- Earth Science Division has provided direction to maintain the current schedule to provide the instrument by the August 2017 timeframe.

TSIS-1

- TSIS/ISS interface Control Document is in final phase of review by ISS Program
- Received updated loads data from Space X for project assessment
- Thermal Pointing System actuator CDR at MOOG scheduled for March 25
- Project CDR is planned for July 2015.



TSIS-1 Budget

TSIS-1

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
-	7,300	500	-	-	-	-	-	7,800

FY16 Activities:

- TSIS-1 project transitioned to NASA ESD beginning in FY16
- FY16 funds allow NOAA to plan the accommodation for A-DCS and SARSAT for launch in FY 2019

Note: Budget numbers documented in NOAA FY16 President's Budget Request

Constellation Observing System for Meteorology, Ionosphere, and Climate (COSMIC)

Program Description

- COSMIC is a constellation of satellites that measure the atmospheric bending of radio signals from global navigation satellites (e.g., GPS, GLONASS and GALILEO) and then converts these measurements into a precise worldwide set of weather, climate, and space weather data.
- COSMIC-1 (6 polar-orbiting satellites) launched on April 14, 2006 from VAFB
- COSMIC-2A (6 equatorial-orbiting satellites) scheduled to be launched in May 2016 on Falcon 9 Heavy (2nd Flight) from KSC.
- COSMIC-2B (6 polar-orbiting satellites) planned for launch in 2018; launch vehicle - TBD

Partners

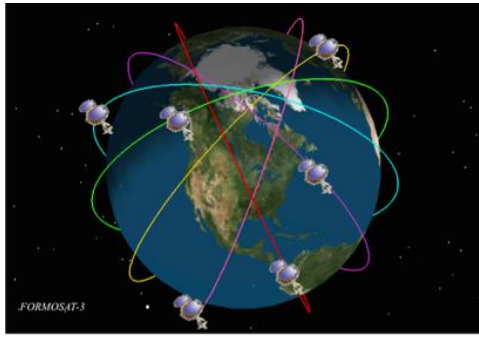
- UCAR, NOAA, NASA, NSPO (Taiwan), USAF, NSF, ONR

Funding

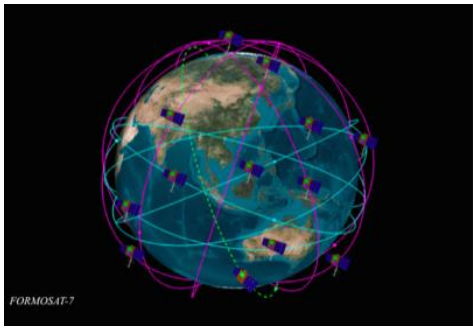
- $22.3M (FY16-20) in FY16 President's Budget Request for RO Sensors

JASD Role for COSMIC-2B

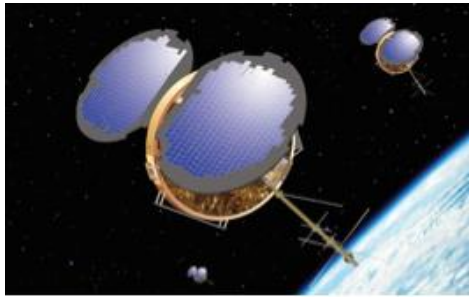
- NESDIS AA requested JASD engagement to leverage JASD expertise and recent experience with the DSCOVR mission to ensure mission success
  - Project management
  - Instrument-to-spacecraft integration and test
  - Launch vehicle integration
- JASD issued PPBE17 budget guidance to JPL based on NOAA budget direction



COSMIC-1 (FORMOSAT-3)



COSMIC-2 (FORMOSAT-7)



COSMIC Spacecraft

COSMIC-2 FY16 Budget

COSMIC-2

Prior ($K)	FY15	FY16	FY17	FY18	FY19	FY20	CTC	Total
1,997	6,800	10,100	8,100	8,100	8,100	8,100	23,200	74,497

FY16 Activities:

- USAF launches first six satellites (COSMIC-2A)
- Reception of equatorial low earth orbit satellite Radio Occultation data from COSMIC-2A mission and initial validation of data flow
- Initiation of the development of the COSMIC-2B sensors

Note: Budget numbers documented in NOAA FY16 President's Budget Request

90 Day Look Ahead

• GOES-R End-To-End Test 1b	April 4
• GOES-R Launch Vehicle Mission Specific CDR	April 15
• JPSS Combined NESDIS/CMC/DPMC KDP-D	April 17
• DSCOVR Mid-Course Correction 2 (MCC2)	April 22
• GOES-R Spacecraft Pre-Environmental Review	April 22-23
• Jason-3 Mission Operations Readiness Review-2	April 28-29
• SMC (Air Force) DSCOVR Post-Flight Review	April 30
• GOES-R End-To-End Test 2	May 7
• JPSS Mission Operations Review	May 11-12
• Jason-3 Pre-Ship Review	May 12
• 2nd Annual Suomi NPP Operations Status Review	May 13
• DSCOVR Lissajous Orbit Injection (LOI) at L1	~June 7
• COSMIC Executive Steering Committee	June 23-24

Director's Summary

DSCOVR:

- Observatory is in good health; all instruments have been turned on; activation and checkout in work
- Estimated time of arrival and completion of Lissajous orbit injection (LOI) at the sun-earth L1 Lagrange point is June 7
- Launch delay funding received from NOAA; IT Security Augmentation Phase 2 funding expected by end of the week.

Jason-3:

- Launch vehicle production and certification progressing on schedule; delta-DCR scheduled for April 8
- Launch readiness date changed from March 31 to July 22, 2015 at 12:30am (PDT) to accommodate launch vehicle production issues and Range conflicts

GOES-R Series:

- Final command and data handling boxes have been delivered and integrated onto spacecraft.
- GOES-R spacecraft I&T schedule erosion continues with 123 days of reserve remaining (56 days above requirement); LM management has implemented changes in an effort to reduce erosion
- GOES-S system module buildup continues

JPSS:

- Successfully completed JPSS-1 Mission System Integration Review
- Four of five instruments integrated to the JPSS-1 spacecraft bus
- JPSS-1 ATMS IFA issue resolution continues; spacecraft I&T schedule re-baselining in work
- JPSS-2 spacecraft bus contract awarded to Orbital ATK

TSIS-1:

- JASD and ESD are working on a transition plan to maintain the launch readiness date of August 2017.
- Interagency Agreement (IAA) with NOAA approved; first increment of FY15 funding received

MetOp-C:

- Advanced Very High Resolution Radiometer (AVHRR) shipped to ESTEC on March 23.