NPOESS Integrated Program Office (IPO)

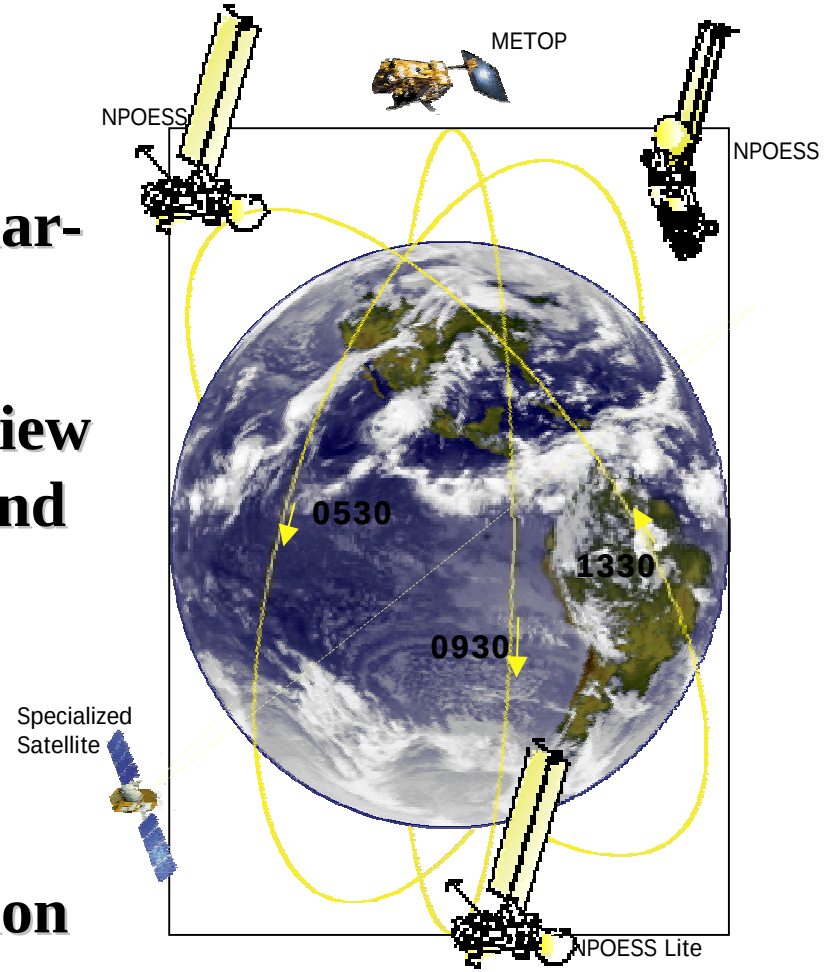
NPOESS PROGRAM STATUS AND OUTLOOK BRIEFING TO Global Precipitation Mission Workshop

May 16, 2001

Tri-agency Effort to Leverage and Combine Environmental Satellite Activities

Mission

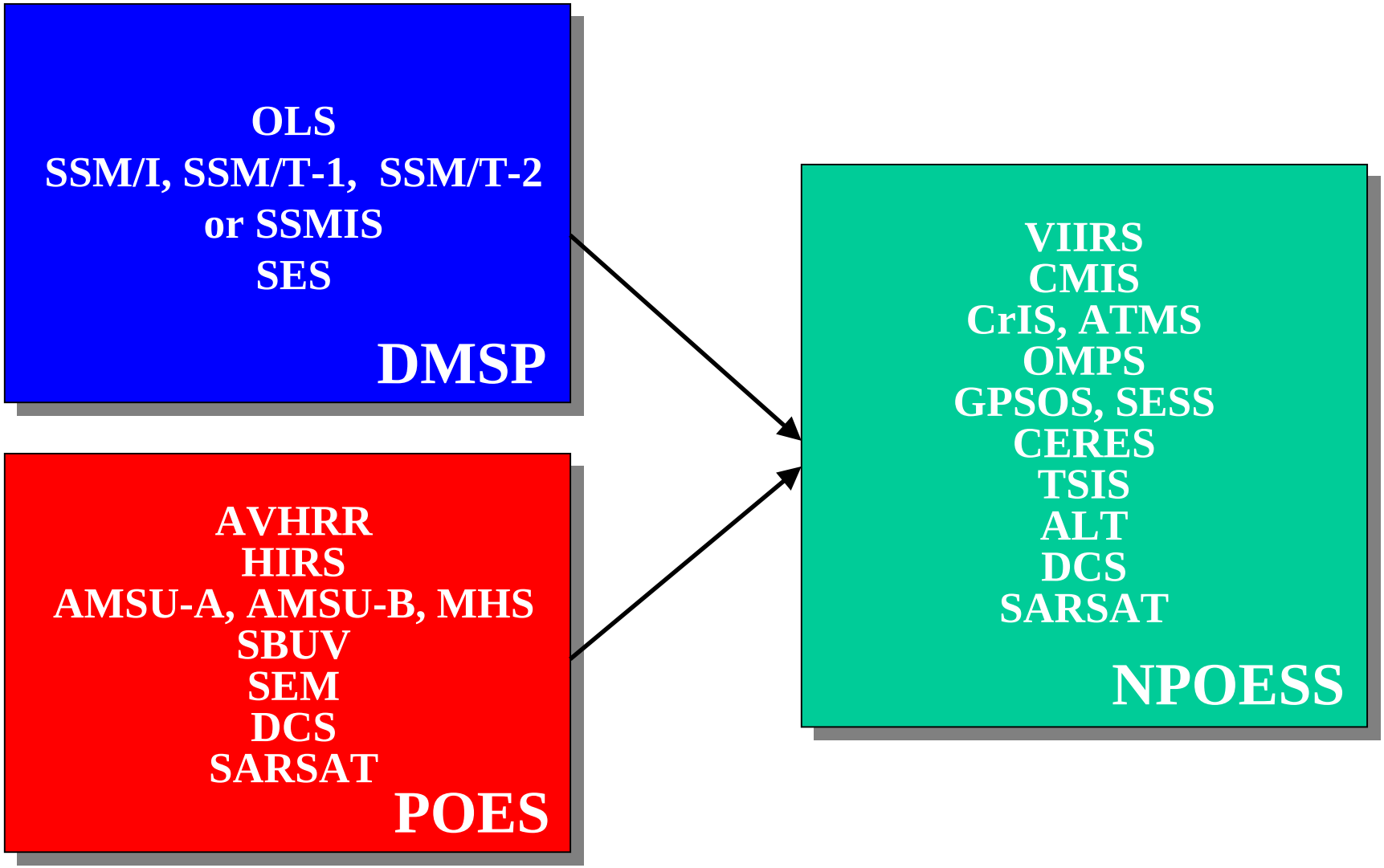
- Provide a national, operational, polar-orbiting remote-sensing capability
- Achieve National Performance Review (NPR) savings by converging DoD and NOAA polar satellite programs
- Incorporate new technologies from NASA
- Encourage International Cooperation



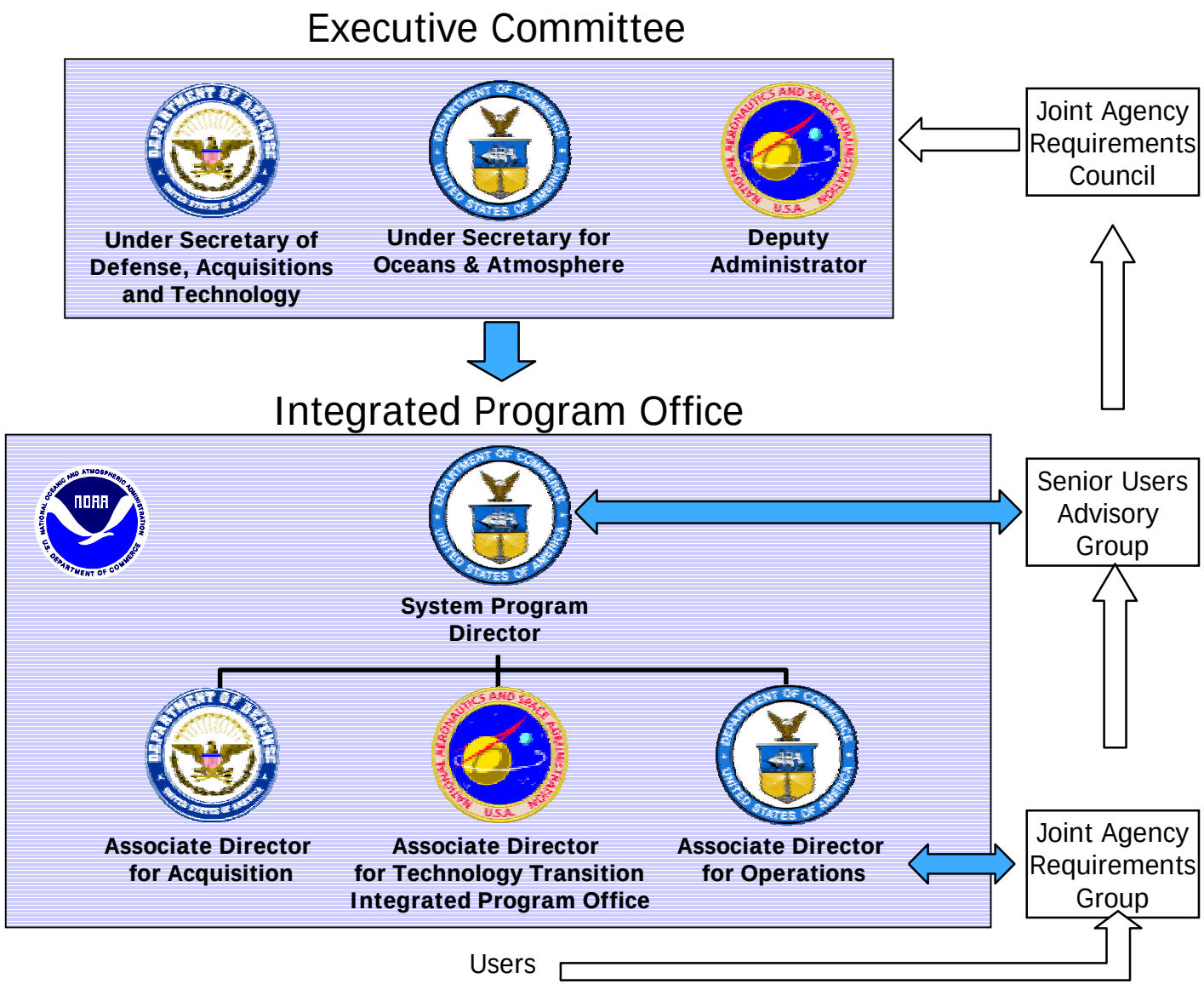
Saves > $1.8B through System Life Cycle compared to NPR target of $1.3B

NPOESS is Good Government!

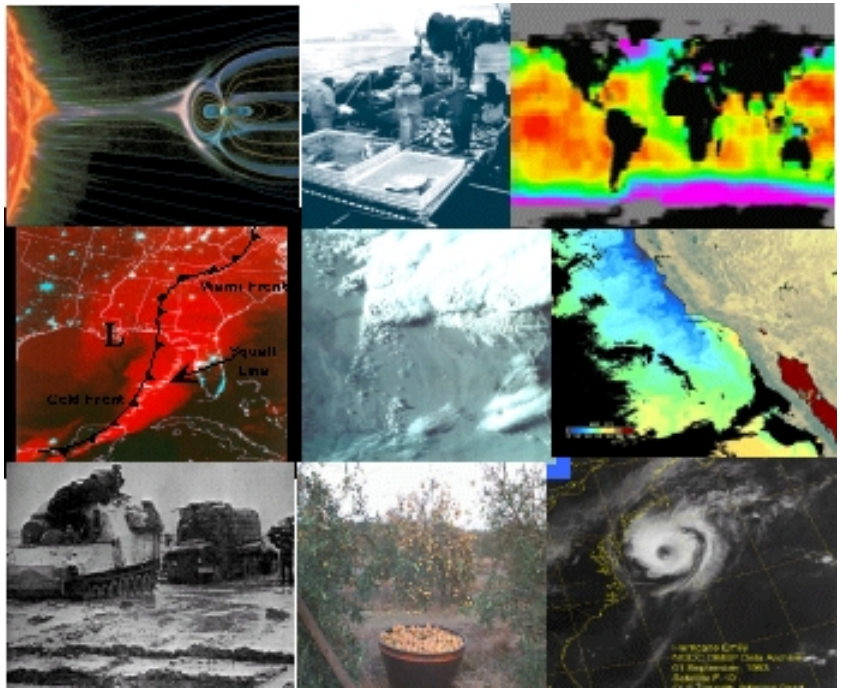
DMSP/POES to NPOESS
Convergence / Evolution of Missions



Organizational Relationships



NPOESS Requirements



Convergence of Alternatives

Integrated Operational Requirements Document (IORD-I)

- **59 Data Products**
- **9 Enhancement Data Products**

Validated by:

- **Deputy Under Secretary of Commerce for Oceans and Atmosphere**
- **Vice Chairman of Joint Chiefs of Staff**
- **NASA Associate Administrator for Earth Science**

Convergence of Requirements

Converged requirements provide foundation for combined program

First success after eight previous attempts

Environmental Data Records

By Sensor Allocation

★ Atmospheric Vertical Moisture Profile	Downward Longwave Radiance (Sfc	Ozone - Total Column/Profile	
★ Atmospheric Vertical Temperature Profil	Electric Fields	Precipitable Water	
★ Imagery	Electron Density Profile	Precipitation Type/Rate	
★ Sea Surface Temperature	Energetic Ions	Pressure (Surface/Profile)	
★ Sea Surface Winds	Fresh Water Ice	Sea Ice Age and Ice Edge Motion	
★ Soil Moisture	Geomagnetic Field	Sea Surface Height/Topography	
Aerosol Optical Thickness	Ice Surface Temperature	Snow Cover/Depth	
Aerosol Particle Size	In-situ Plasma Fluctuations	Solar Irradiance	
Albedo (Surface)	In-situ Plasma Temperature	Supra-Thermal - Auroral Particles	
Auroral Boundary	Insolation	Surface Type	
Auroral Imagery	Ionospheric Scintillation	Fires	
Cloud Base Height	Medium Energy Charged Particles	Surface Wind Stress	
Cloud Cover/Layers	Land Surface Temperature	Suspended Matter	
Cloud Effective Particle Size	Littoral Sediment Transport	Total Auroral Energy Deposition	
Cloud Ice Water Path	Mass Loading / Turbidity	Total Longwave Radiance (TOA)	
Cloud Liquid Water	Net Heat Flux	Total Water Content	
Cloud Optical Depth/Transmittance	Net Short Wave Radiance (TOA)	Vegetation Index (NDVI)	
Cloud Top Height	Neutral Density Profile		
Cloud Top Pressure	Neutral Winds		
Cloud Top Temperature	Ocean Color/Chlorophyll		
Currents (Ocean)	Ocean Wave Characteristics		

VIIRS	CMIS	CrIS/ATMS	OMPS	SES	GPSOS	ERBS	TSIS	ALT

★ Environmental Data Records (EDRs) with Key Performance Parameters

Environmental Data Records

By Discipline

★	Atmospheric Vertical Moisture Profile	DownwardLongwaveRadiance(Sfc)	Ozone - Total Column/Profile
★	Atmospheric Vertical Temp Profile	Electric Fields	Precipitable Water
★	Imagery	Electron Density Profile	Precipitation
★	Sea Surface Temperature	Fresh Water Ice	Pressure (Surface/Profile)
★	Sea Surface Winds	Geomagnetic Field	Sea Ice Age and Edge Motion
★	Soil Moisture	Ice Surface Temperature	Sea Surface Height/Topography
	Aerosol Optical Thickness	Energetic Ions	Snow Cover/Depth
	Aerosol Particle Size	In-situ Plasma Fluctuations	Solar Irradiance
	Albedo (Surface)	In-situ Plasma Temperature	Supra-Thermal - Auroral Particles
	Auroral Boundary	Insolation	Surface Wind Stress
	Auroral Imagery	Medium Energy Charged Particles	Suspended Matter
	Cloud Base Height	Ionospheric Scintillation	Total Auroral Energy Deposition
	Cloud Cover/Layers	Land Surface Temperature	Total Longwave Radiance (TOA)
	Cloud Effective Particle Size	Littoral Sediment Transport	Total Water Content
	Cloud Ice Water Path	Net Heat Flux	Turbidity
	Cloud Liquid Water	Net Short Wave Radiance (TOA)	Vegetation Index/Surface Type
	Cloud Optical Depth/Transmittance	Neutral Density Profile	
	Cloud Top Height	Neutral Winds	
	Cloud Top Pressure	Normalized Difference Vegetation Index	
	Cloud Top Temperature	Ocean Color/Chlorophyll	
	Currents (Ocean)	Ocean Wave Characteristics	

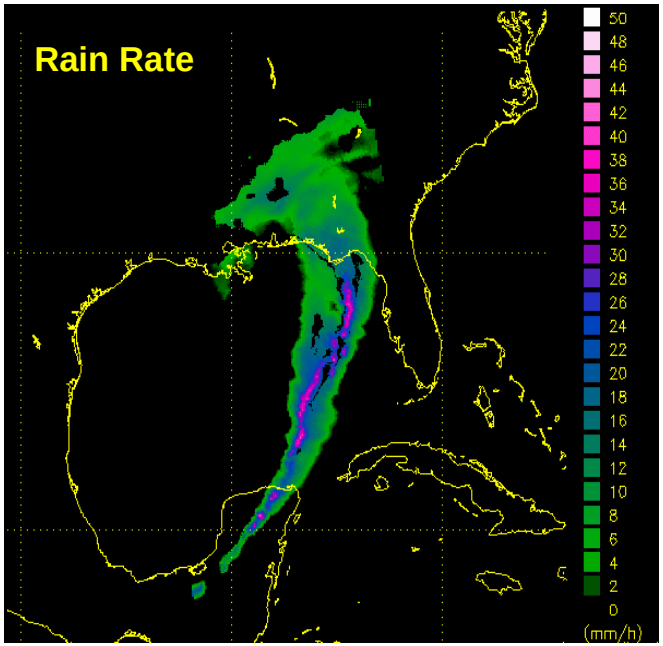
Atmospheric | Oceanic | Terrestrial | Space | Climate

★ Environmental Data Records (EDRs) with Key Performance Parameters

Precipitation Type/Rate Environmental Data Record (EDR)

System Capability	Thresholds	Objectives
Horizontal Cell Size	15 km	0.1 km
Mapping Accuracy	5 km	0.1 km
Measurement Range	0 to 50 mm/hr	
Measurement Precision	1 mm/hr	1 mm/hr
Measurement Accuracy	2 mm/hr	2 mm/hr
Latency	90 min	15 min
Refresh	8 hrs	1 hr
Long Term Stability	1.0 mm/hr or 10%	0.1 mm/hr or1%

Conical Microwave Imager Sounder (CMIS)



Schedule

Award - Jul 97
PDR - Feb 01
Down-select - July 01
Unit 1 Delivery - Dec 05

Description

Collects microwave imagery and sounding data. Data types include Atmospheric, Clouds, All-weather surface (Land & Water)

Heritage or Similar Sensors

DMSP - SSMI & SSMIS

TRMM - TRMM Microwave Imager (TMI)

EOS - Japanese AMSR (Aqua & ADEOS II)

US Navy- Windsat Coriolis

Contractors

Ball Aerospace Systems Division (BASD)
- GFO S/C, Quikscat, ICESat

Boeing Space Systesm Inc (BSD)
- SSMI, TMI, GOES OPQ S/C

CMIS

Environmental Data Records (EDRs)

- Atmospheric Vertical Moisture Profile
- Atmospheric Vertical Temperature Profile
- Imagery
- Sea Surface Temperature
- Sea Surface Winds
- Soil Moisture
- Precipitable Water
- Precipitation (Type, Rate)
- Pressure Profile
- Total Water Content
- Cloud Base Height
- Cloud Ice Water Path
- Cloud Liquid Water
- Snow Cover/Depth
- Fresh Water Ice
- Ice Surface Temperature
- Sea Ice Age and Sea Ice Edge Motion
- Surface Wind Stress
- Land Surface Temperature
- Vegetation/Surface Type

- CMIS EDRs allocated from system-level requirements per NPOESS Integrated Operational Requirements Document (IORD-I)
- Some CMIS EDRs are duplicative with VIIRS and CrIS - Different technologies required to meet different aspects of the requirements

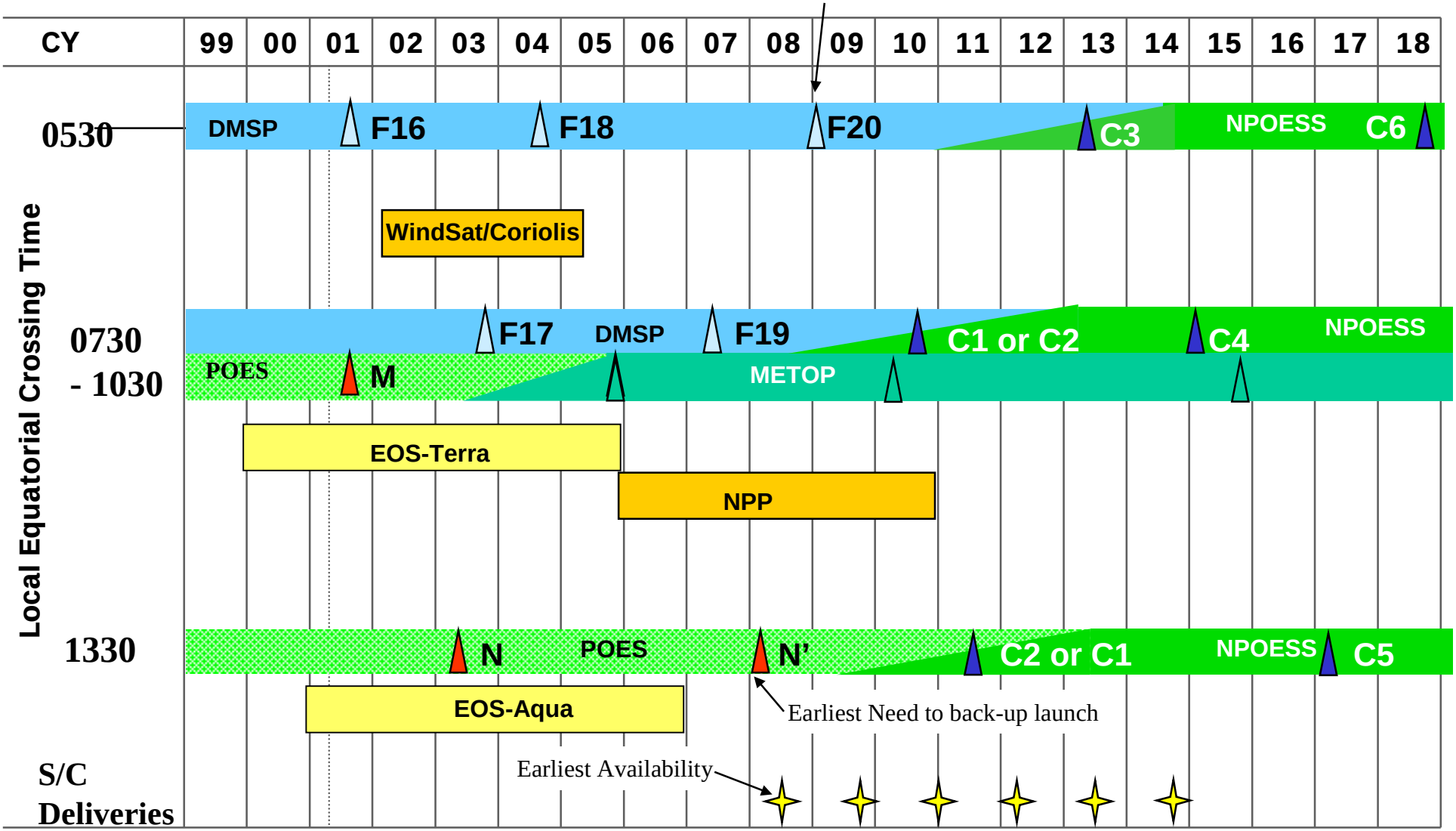
Notional Payloads to Satisfy IORD-I

NPOESS Instruments	0530	0930	1330	METOP 0930	NPP 1030	Free Flyer TBD
IPO Developed						
Visible/IR Imager Radiometer Suite (VIIRS)*	X	X	X		X	
Cross-track IR Sounder (CrIS)*			X	X (IASI/HIRS)	X	
Conical MW Imager/Sounder (CMIS)*	X	X	X			
Ozone Mapper/Profiler Suite (OMPS)			X	X (GOME)		
GPS Occultation Sensor (GPSOS)	X		X	X (GRAS)		
Space Environmental Sensor Suite (SESS)	X		X	X (SEM)		
Leveraged						
Advanced Technology MW Sounder (ATMS)*			X	X (AMSU/MHS)	X	
Data Collection System (DCS)	X		X	X		
Search and Rescue (SARSAT)	X		X	X		
Earth Radiation Budget Sensor			X			
Solar Irradiance Sensor (TSIS)	X					
Radar altimeter (ALT)						X
Advanced Scatterometer (ASCAT)				X		

* Critical instrument - Failure constitutes need to replace satellite

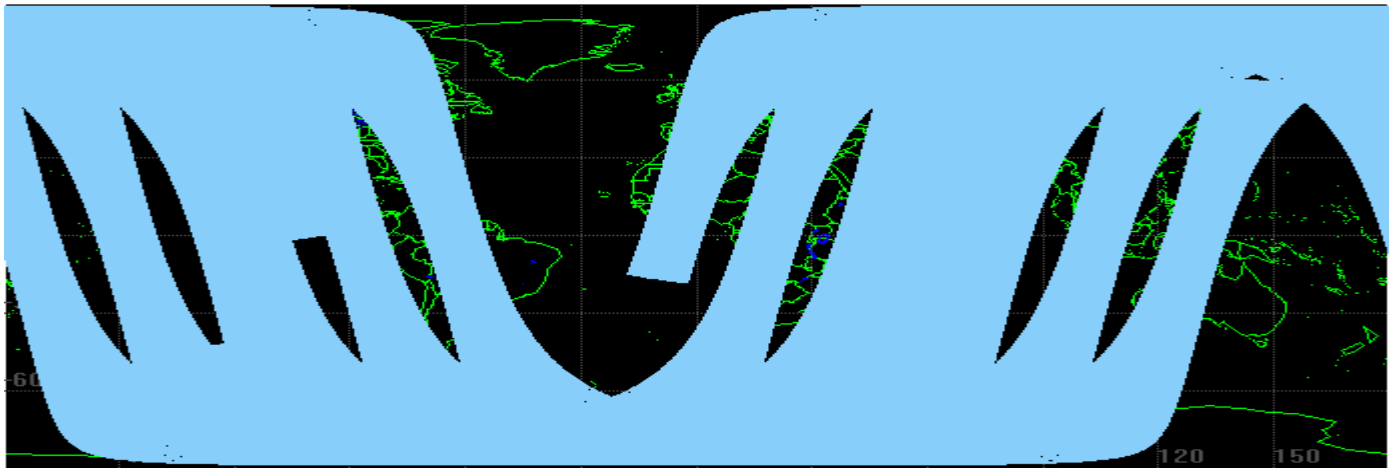
Critical Milestones

NPOESS Transition Schedule

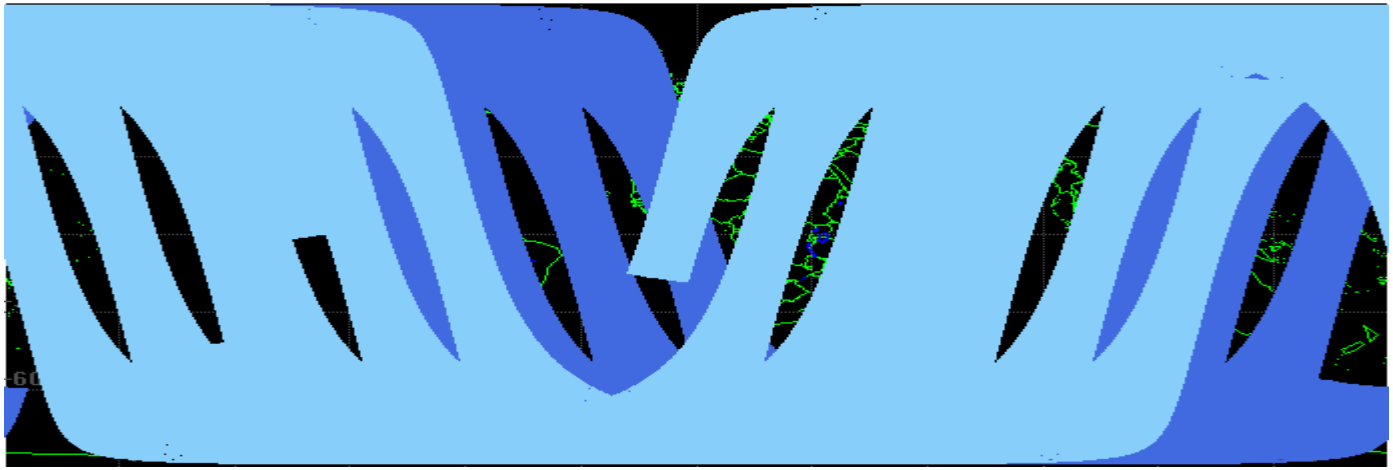


S/C delivery interval driven by 15 month IAT schedule

2 vs 3 CMIS - 6 Hour Coverage



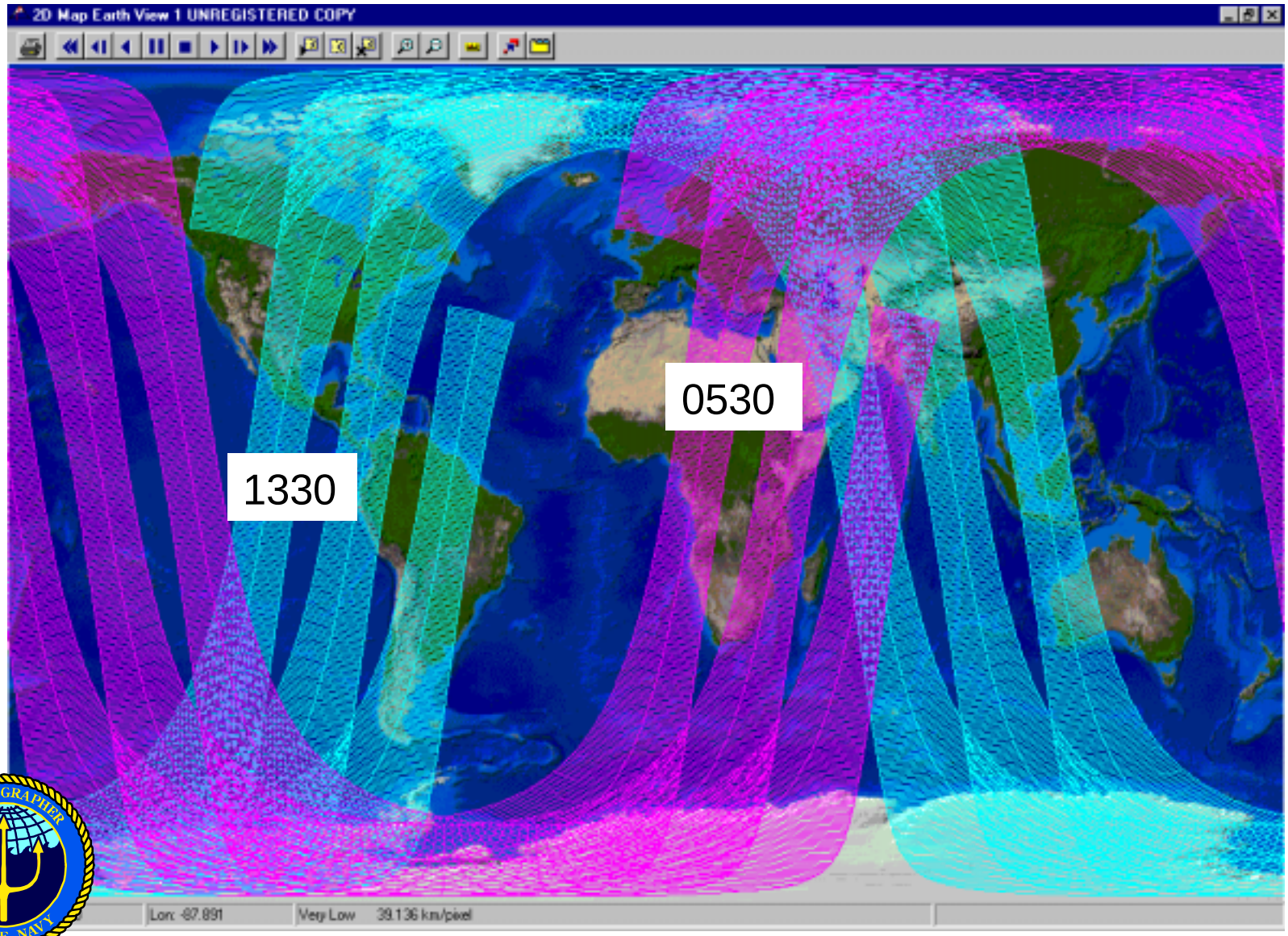
2 CMIS



3 CMIS

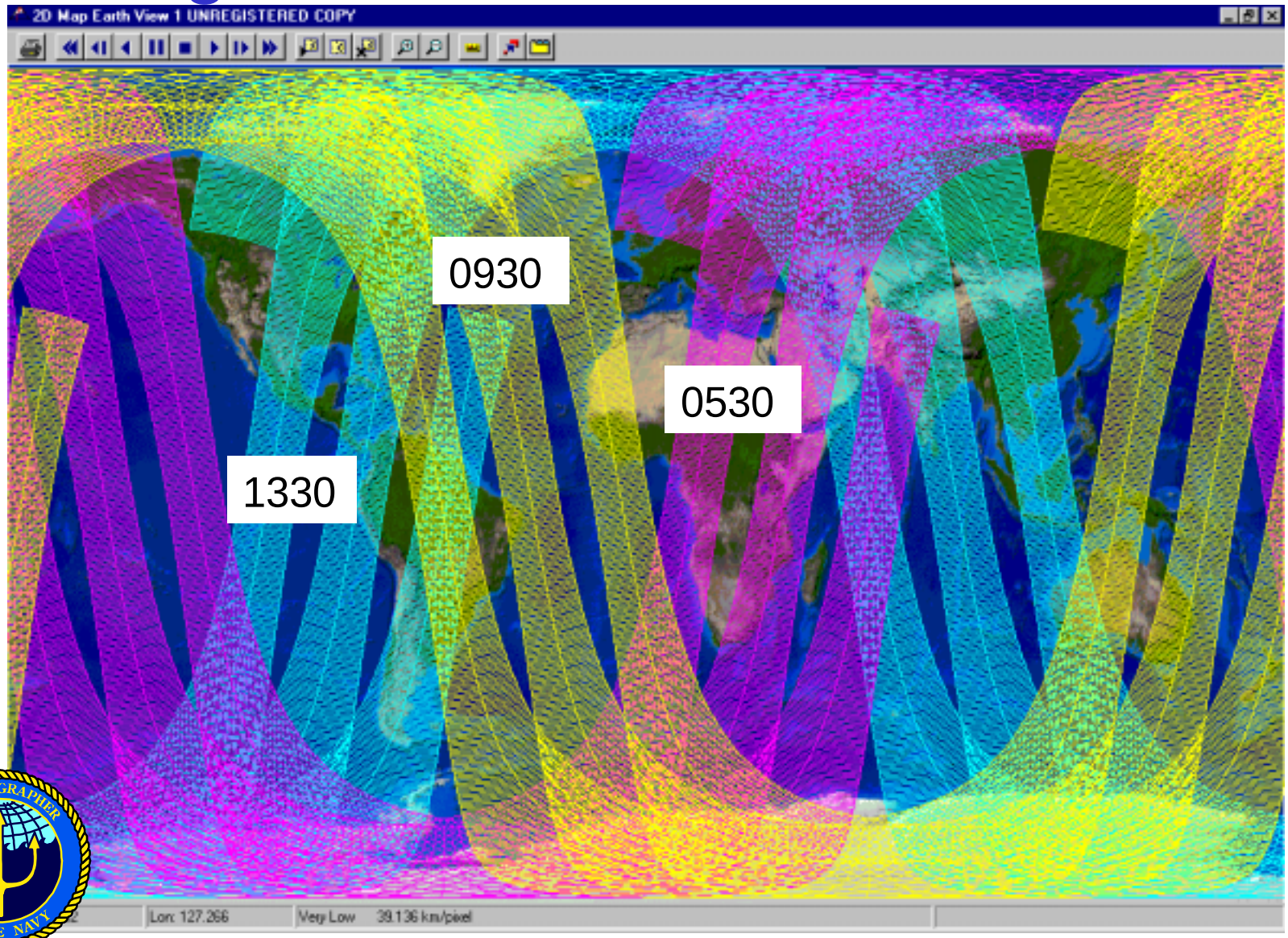
EDRs - SST, SSW, Cld Base Hgt, Ice Water Path, Land Sfc Temp, Precip Water

NPOESS 0530/1330 Orbits Ingested into 00Z NOGAPS run



Based on 21Z - 02Z Ingested period

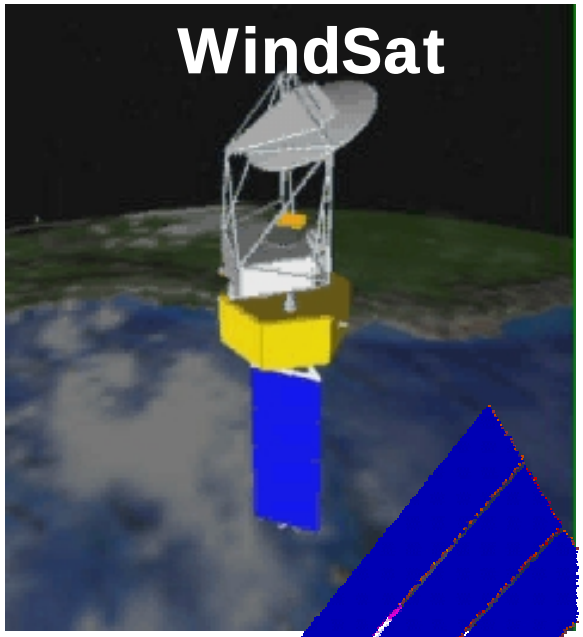
NPOESS 0530/0930/1330 Orbits Ingested into 00Z NOGAPS run



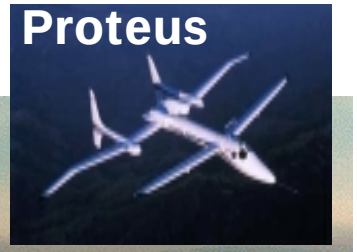
Based on 21Z - 02Z Ingested period

NPOESS Risk Reduction

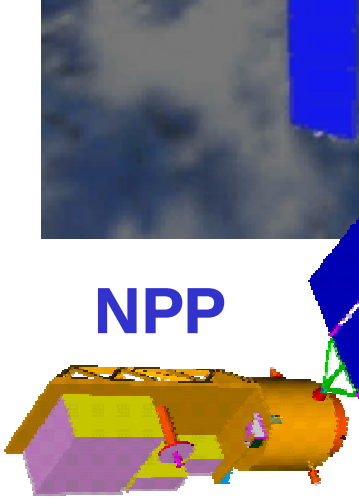
- **Validate technological approach to remote sensing**
- **Early delivery of NPOESS data to users**
- **Sensor demonstrations on non-operational platforms**
  - Lower risk to operational users
  - Lower risk of launch delays due to operational schedule
- **Share cost & risk among agencies**

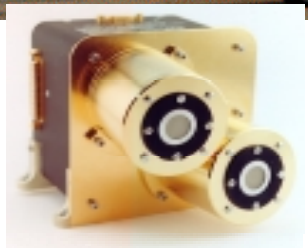


NASA ER2 / NAST



NPP





DIDM

SOLSE

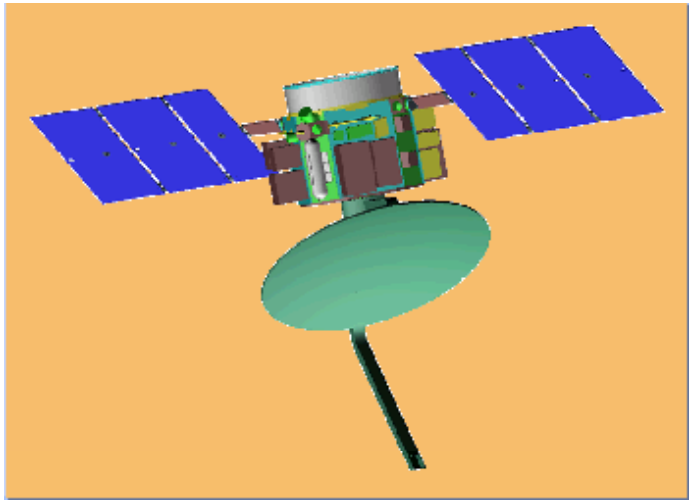
LORE

WINDSAT/CORIOLIS

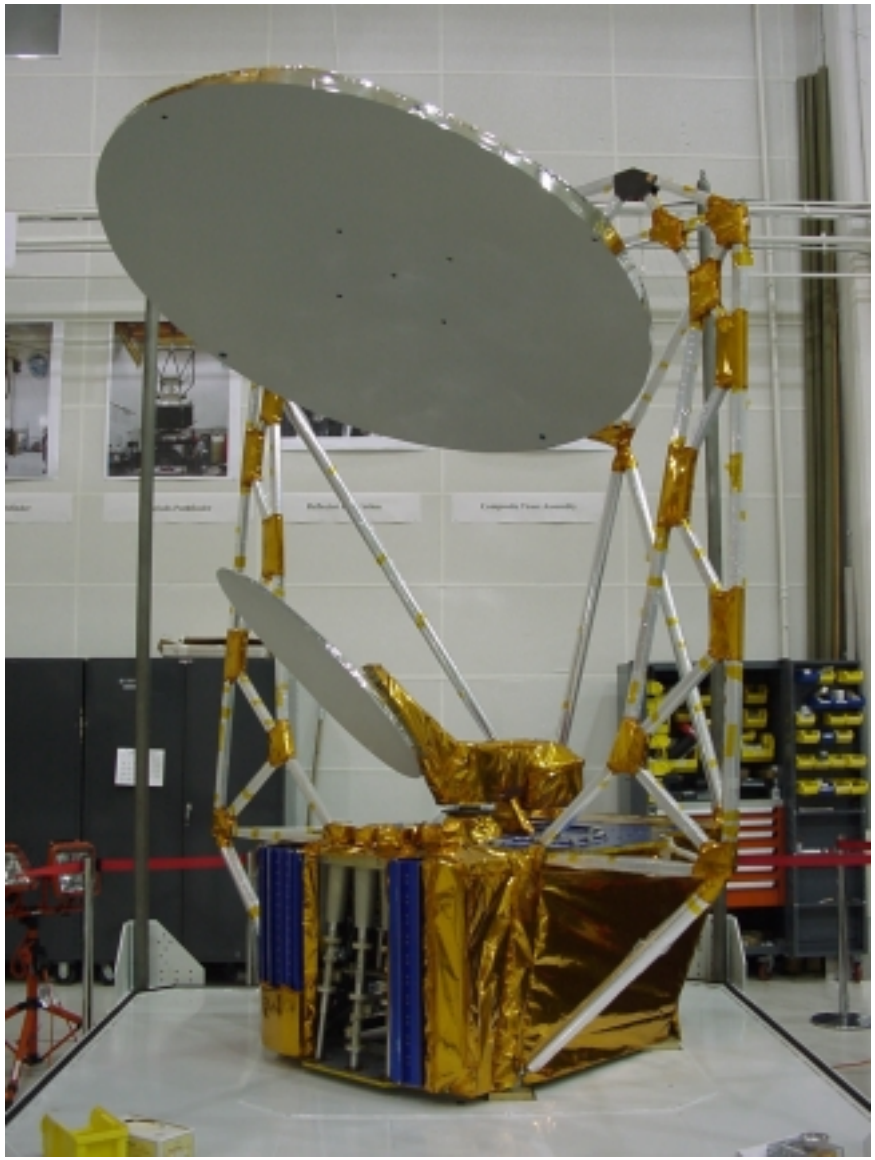
Risk Reduction for NPOESS/CMIS

- Passive Microwave Polarimetry for Ocean Wind Remote Sensing WINDSAT (NRL-701)
- Experiment Objectives
  - Spaceborne Demonstration of Passive Microwave Polarimetry to Measure the Ocean Surface Wind Speed and Direction
  - Satisfy Navy/NPOESS Requirement for Ocean Wind Vector and Other Environmental Parameters
  - Employ Sensor-to-Shooter Philosophy Compatible With DoD/NPOESS C4I
  - Transition Technology to NPOESS

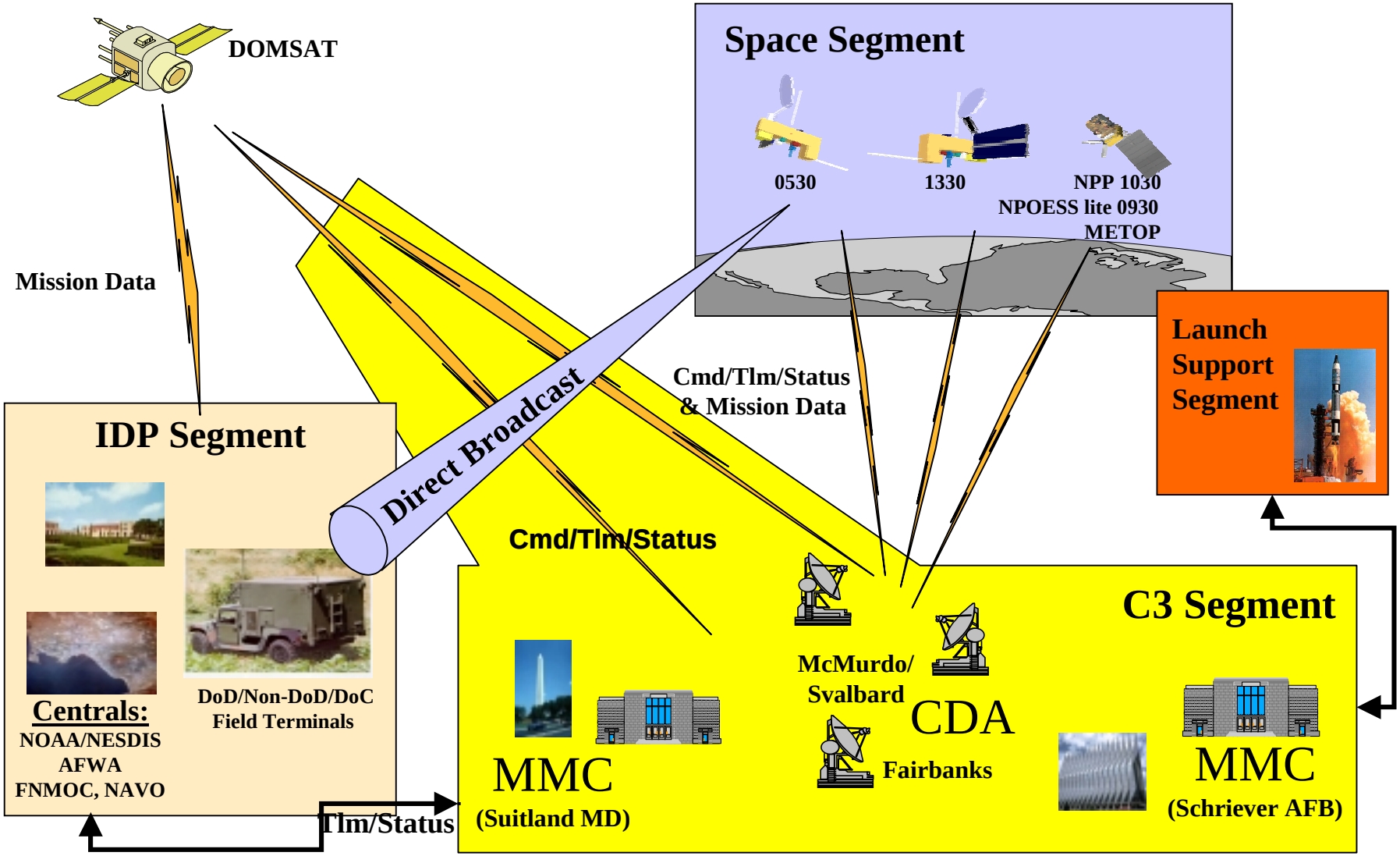
- Performance Parameters
  - Multi-Frequency Polarimetric Radiometer (6.8, 10.7, 18.7, 23.8, 37.0 GHz)
  - Wind Speed and Direction Requirements: ±2 m/s and ±20° for Winds 3–25 m/s
  - Radiometric Sensitivity (Signal-to-Noise Ratio): DT»0.10 – 0.15 K
  - Horizontal Spatial Resolution of 20 km



Flight WindSat Structure



Notional Architecture



SUMMARY

NPOESS can be considered part of a Global Precipitation Mission constellation

BACKUP

NPOESS Unaccommodated Environmental Data Records

EDRs not Addressed by Notional NPOESS System

Pre-Planned Product Improvement (P^3I)

- **Tropospheric winds**
- CO (carbon monoxide) column
- Optical backgrounds
- Potential Bioluminescence
- CH_4 (methane) column
- CO_2 (carbon dioxide) column
- Bathymetry
- Salinity

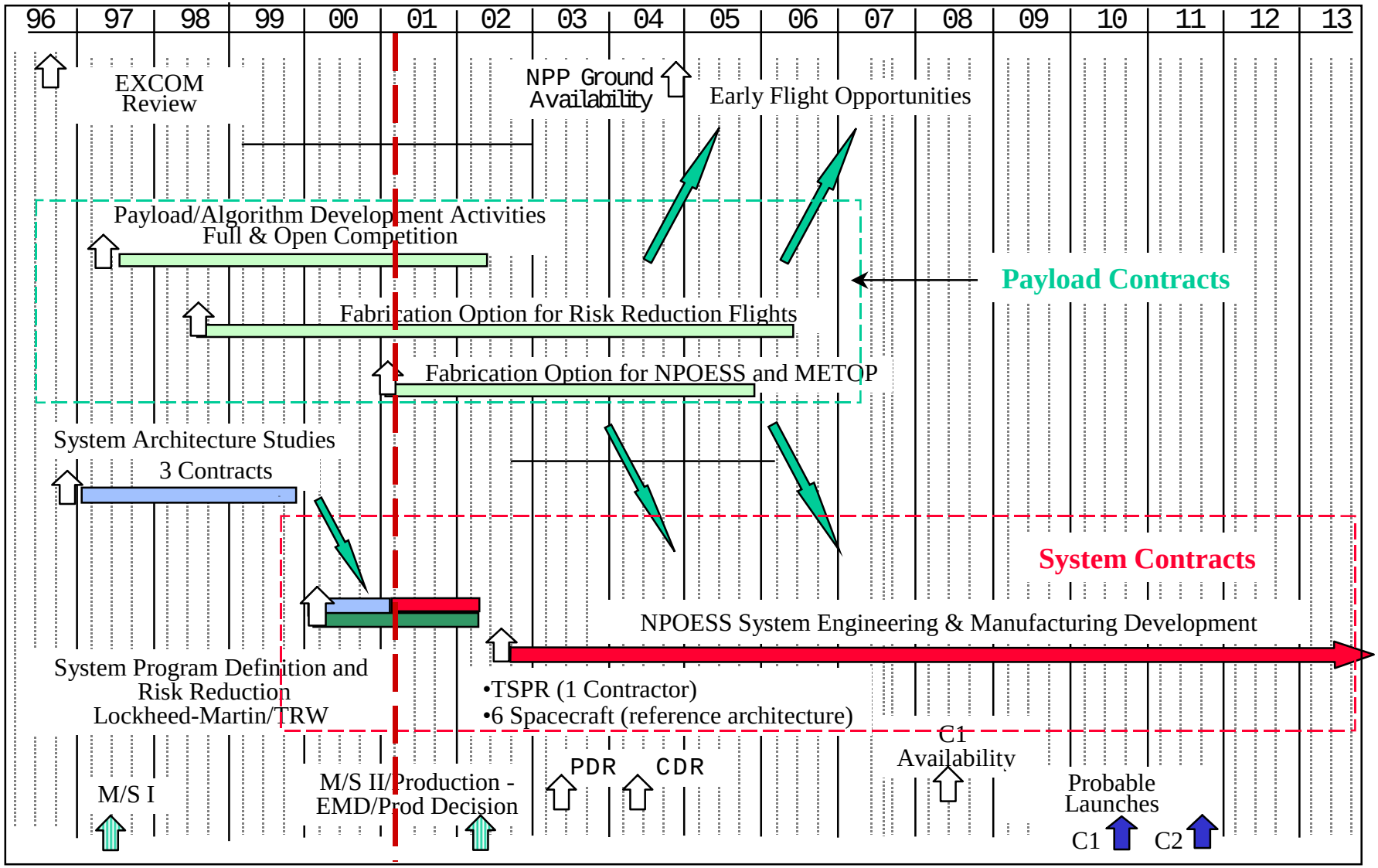
IORD I

- All Weather, Day/Night Imagery (High Res)
- Littoral Currents
- Coastal Sea Surface Temp
- Coastal Sea Surface Height
- Surf Conditions
- Vertical Hydrometer Profile
- Neutral Winds
- Coastal Ocean Color
- Coastal Sea Sfc Winds/Wind Stress
- Ocean Wave Characteristics
- Oil Spill Location
- Sea and Lake Ice
- Coastal Imager

IORD II

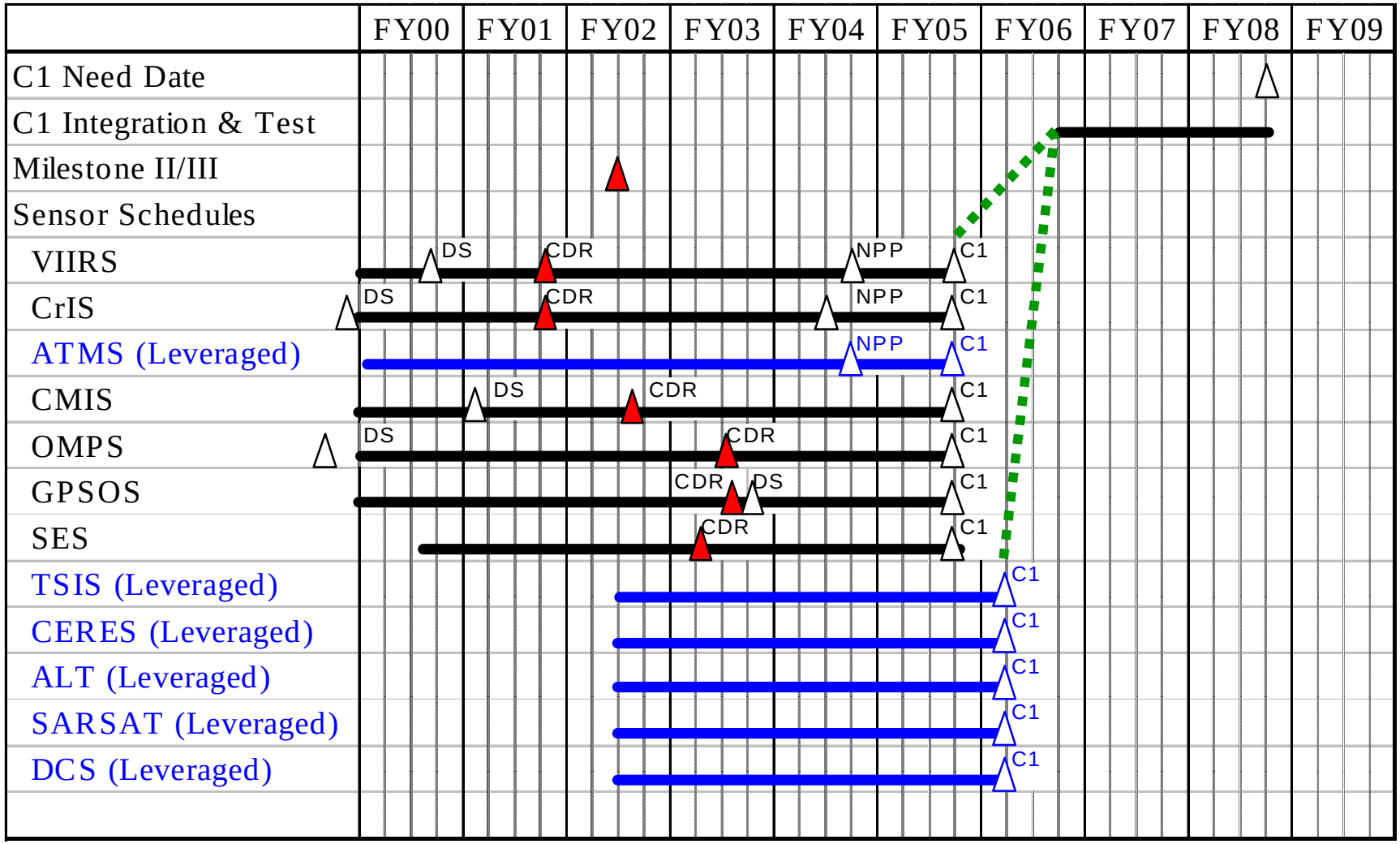
P^3I EDRs INCREASED TO 21 IN IORDII

NPOESS Master Acquisition Schedule (CY)



Note: M/S IV - Follow-on Decision FY14

Current Space Segment Schedule



IPO Sensor/Algorithm Risk Reduction Contract Status

	SRR *System Requirements Review*	**SFR** *System Functional Review*	**PDR** *Preliminary Design Review*	**CFI** *Call For Improvement*	**CDR** *Critical Design Review*	**First Unit Delivery**
CrIS *Cross-track IR Sounder*	**3/98**	**12/98**	**4/99**	**5/99**	**2/02**	**3/04**
OMPS *Ozone Mapping & Profiler Suite*	**11/97**	**8/98**	**1/99**	**2/99**	**3/02 (S)** **5/03(A)**	**6/04**
GPSOS *GPS Occultation Sensor*	**11/97**	**6/98**	**11/98**	**N/A**	**1/03**	**3/06**
VIIRS *Visible/IR Imager Radiometer Suite*	**1/99**	**10/99**	**5/00**	**6/00**	**2/02**	**6/04**
CMIS *Conical Microwave Imager Sounder*	**11/98**	**8/99**	**2/01**	**3/01**	**1/03**	**12/05**