NASA/NOAA Atmospheric Sounding Science Team Meeting
October 14-17, 2008
Greenbelt, Maryland

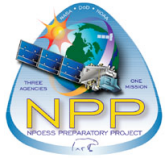
The NPOESS Preparatory Project (NPP) Science Data Segment: Overview & Update

Robert Schweiss

NASA/ GSFC

Greenbelt, Maryland

NPP Science Data Segment Introduction



- **Measurement-Based Processing**
  - Discipline based groups are selected to Assess or Generate Measurements

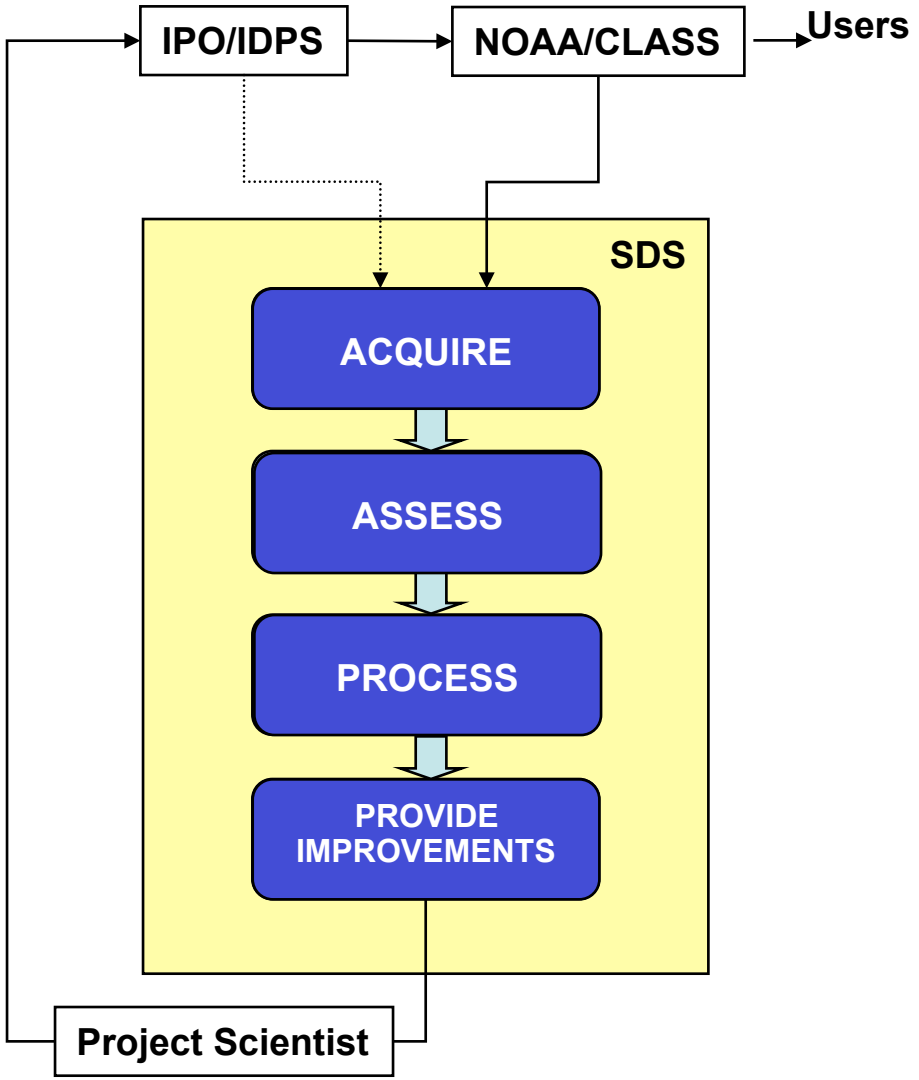
- **Primary Charter for SDS: To assess the quality of the NPP Environmental Data Records for their ability to support Climate Research**
  - **Five** Product Evaluation & Analysis Tool Element (PEATEs)
    - Ocean, Land, Atmosphere, Ozone, and Sounder
  - **One** Climate Research Analysis System (CARS)
    - Earth Radiation Budget

In developing the SDS, the Project assumes that EDRs produced by the NPP Program are climate quality and put in place the capability to test that hypothesis in order to contribute to improving the quality of future EDRs.

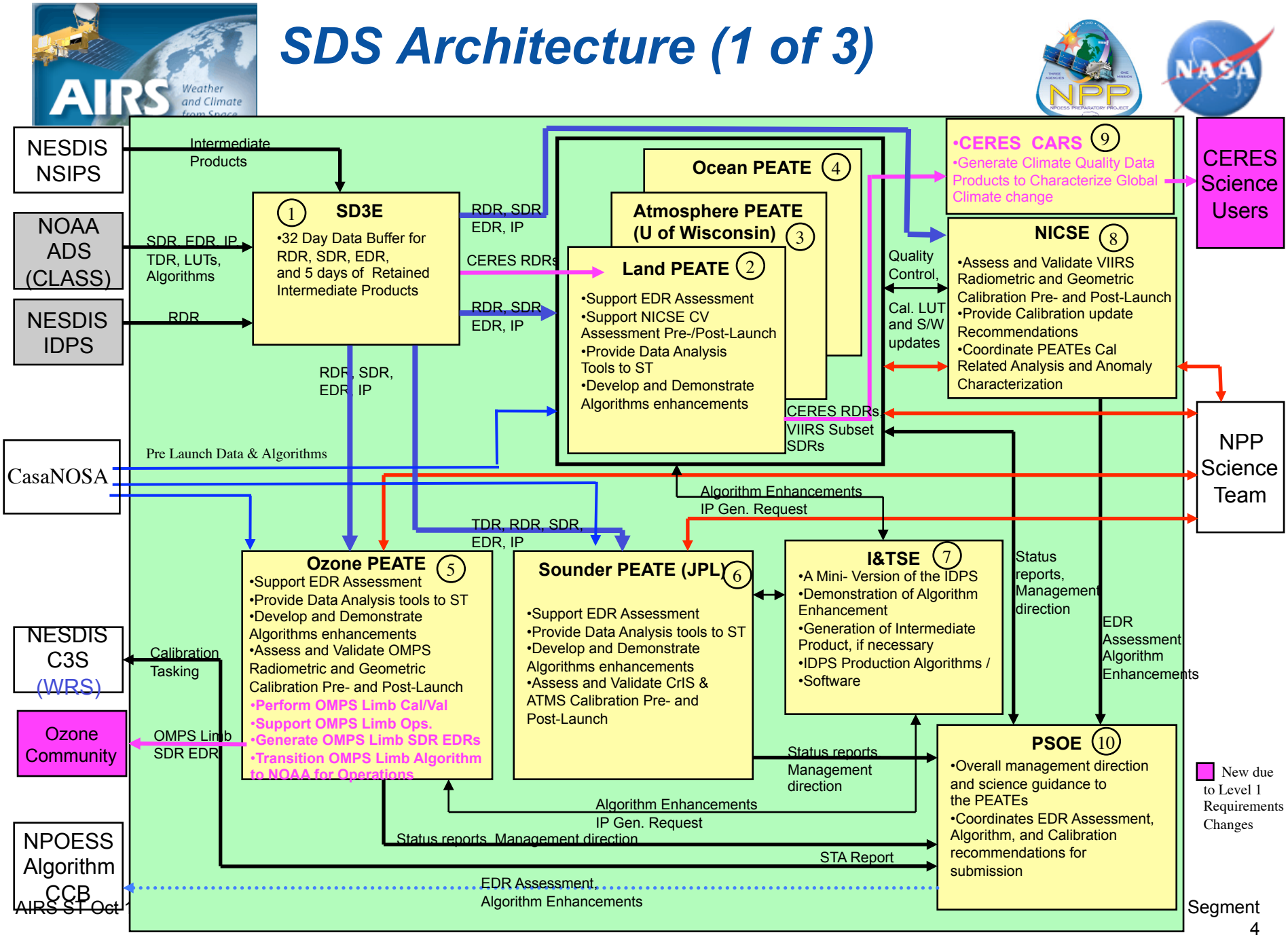
Basic SDS PEATE Requirements

Level 1 requirements

- **acquire** RDRs, SDRs, and EDRs from CLASS (2.1.2.2)
- **assess** the quality of the NPP EDRs for accomplishing climate research (2.1.2)
- **process** selected data subsets … in support of Calibration/ Validation activities (2.2.2)
- **provide** suggested algorithm **improvements** to the IDPS (2.1.2.3)



SDS Architecture (1 of 3)



Not all data flows shown here.

SDS Architecture (2 of 3)

- ***SDS Data Delivery & Depository Element (SD3E), NASA GSFC Code 586/614***
  - In-House development effort. Some reuse from SIPS. Provides ~32 days "rolling storage" for pick-up by PEATEs and the NICSE. Serves as Front end to data providers, CLASS, IDPS, NSIPS
- ***Land PEATE, NASA GSFC Code 614***
  - Developed & integrated NPPDAPS by reusing MODIS Adaptive Processing System (MODAPS) and integrating w/ LAADS. Assess Land EDRs for their ability to support Climate research.
- ***Atmosphere PEATE, University of Wisconsin-Madison***
  - Developed & integrated SPS for data staging, data management, and algorithm rules application. Assess Cloud EDRs for their ability to support Climate research.
- ***Ocean PEATE, NASA GSFC Code 614***
  - Added System Capacity to existing Ocean Data Processing System (ODPS). Requires I&TSE for Production Algorithm analysis. Assess Ocean Color & Sea Surface Temp. EDRs for their ability to support Climate research.
- ***Ozone PEATE, NASA GSFC Code 614***
  - Adding capacity to Atmospheric Composition Processing System (ACPS), formerly known as OMIDAPS. Assess O3 EDrs for their ability to support Climate research.
  - OMPS Limb SDR & EDR Production, OMPS Limb Cal/Val, & Instrument Commanding
- ***Sounder PEATE, NASA JPL, Pasadena, CA***
  - Adding Capacity to Atmospheric Infrared Sounder (AIRS) Project's Team Leader Science Computing Facility. Assess Atmosphere Vertical Moisture, Temperature , & Pressure EDRs for their ability to support Climate research.

SDS Architecture (3 of 3)

- ***Earth Radiation Budget Climate Analysis Research System (ERBCARS)*** ***NASA LARC***
  - Leverages existing processing capabilities and human resources across the Atmospheric Science Data Center (ASDC), CERES Science group, and the Data Management group at the NASA Langley Research Center for characterization of Global Climate Change & CDR Production
    - Bi-Directional Scan, daily
    - Instantaneous TOA, daily
    - Monthly Regional Averages, monthly
    - Monthly Geographical Averages, monthly
- ***Integration and Test System Element (I&TSE)*** ***NASA GSFC Code 586/614***
  - A clone of the production IDPS System. Affords PEATES ability to analyze production algorithms, trouble shoot processing chain, regenerating Intermediate Products and ability to demonstrate algorithm enhancements and / or calibration improvements
- ***NPP Instrument Calibration Support Element (NICSE)*** ***NASA GSFC Code 614***
  - Leverages MODIS Calibration Support Team and NPP/VIIRS NPP Instrument Calibration Science Team for the assessment and characterization of the radiometric and geometric performance of the VIIRS Instrument.
- ***PSOE - Project Science Office Element*** ***NASA GSFC Code 614***
  - Project Scientist Lead. Coordinates data analysis priorities, algorithm enhancement, LUT, and calibration coefficient changes with PEATES/NICSE. Web based open source tools to track requests and data issues. Submits algorithm and calibration recommendations to NPP/NPOESS Algorithm CCB.

SDS PEATE & Science Teams

Project Scientist

Sounder IR/uwave Measurement Team
- *Ramesh Kakar:NASA/HQ*
- Goldberg, Mitchell
- Aumann, George
- Revercomb, Henry
- Lambrigtsen, Bjorn
- Blackwell, William
- Strow, Larrabee

Sounder PEATE
- •Ingest and validate xDRs
- •Support Climate Research

Ozone Measurement Team
- *Mike Kurylo:NASA/HQ*
- Chance, Kelly
- McPeters, Richard
- Rault, Didier

Ozone PEATE
- •Ingest and validate xDRs
- •Support Climate Research

Clouds/Aerosol Measurement Team
- *Hal Maring: NASA/HQ*
- Baum, Bryan
- Andy Heidinger
- Menzel, Paul
- Steve Platnick,
- Hsu, Christina
- Hank Revercomb,
- Torres, Omar

Atmosphere PEATE
- •Ingest and validate xDRs
- •Support Climate Research

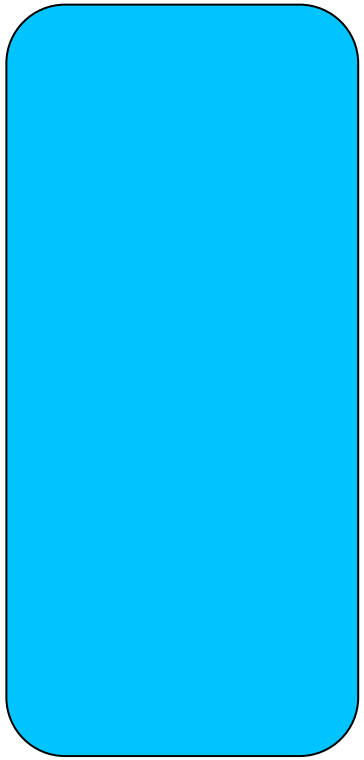
Land Measurement Team
- *Diane Wickland:NASA/HQ*
- Wolfe, Robert
- Wan, Zenming
- Huete, Alfrdo
- Lyapustin, Alexei
- Csiszar, Ivan
- Friedl, Mark
- Schaaf, Crystal
- Myneni, Ranga
- Justice, Christopher

LAND PATE
- •Ingest and validate xDRs
- •Support Climate Research

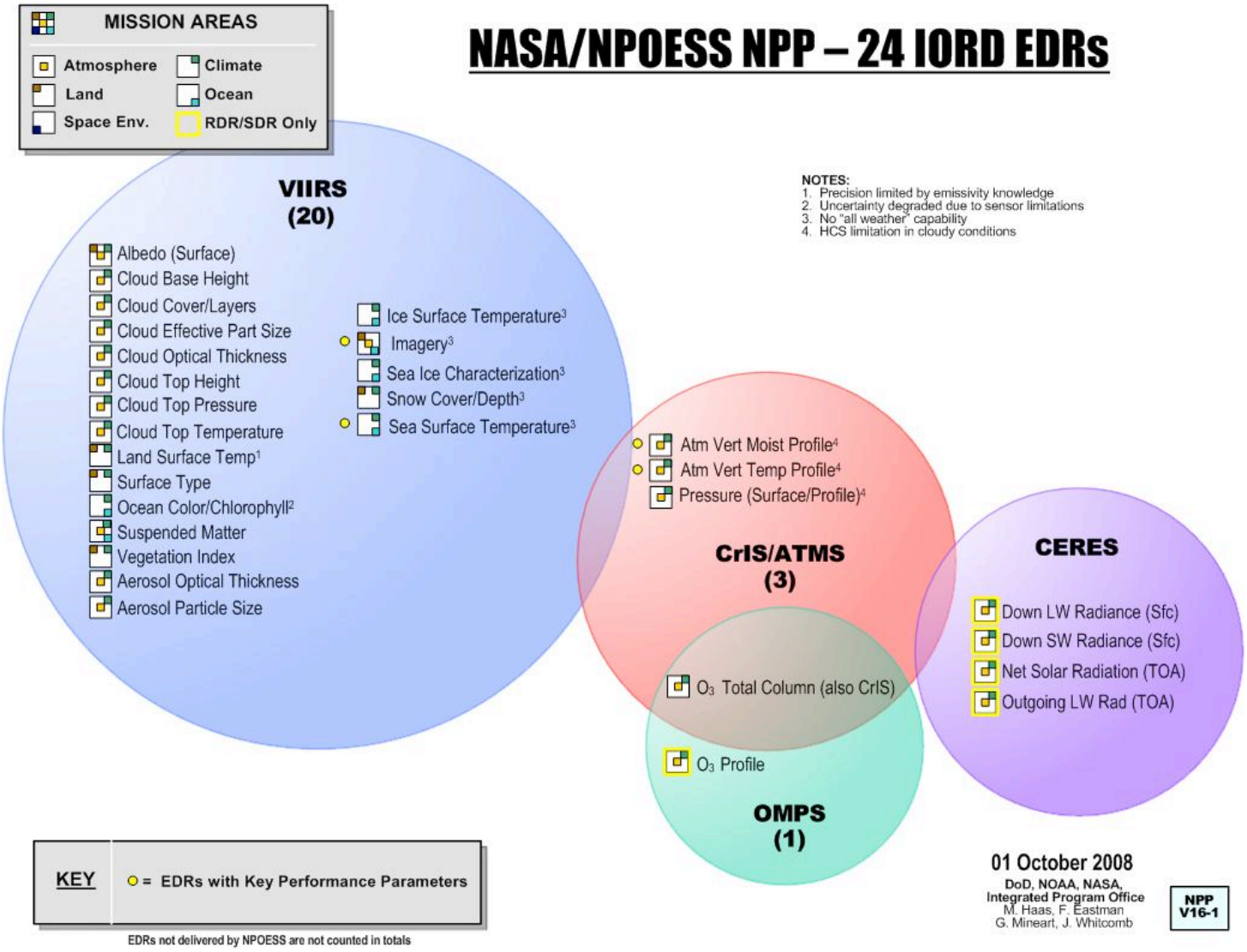
Ocean Measurement Team
- *Paula Bontempi:NASA/HQ*
- McClain, Charles
- Wang, Menghua
- Behrenfeld, Michael
- Minnett, Peter
- Evans, Robert, + 7 others

Ocean PEATE
- •Ingest and validate xDRs
- •Support Climate Research

SDS PEATE & Science Teams



NPP EDRs

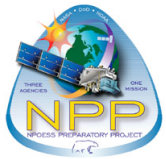

MISSION AREAS
Atmosphere
Climate
Land
Ocean
Space Env.
RDR/SDR Only
NASA/NPOESS NPP – 24 IORD EDRs
NOTES:
1. Precision limited by emissivity knowledge
2. Uncertainty degraded due to sensor limitations
3. No "all weather" capability
4. HCS limitation in cloudy conditions
VIIRS
(20)
Albedo (Surface)
Cloud Base Height
Cloud Cover/Layers
Cloud Effective Part Size
Cloud Optical Thickness
Cloud Top Height
Cloud Top Pressure
Cloud Top Temperature
Land Surface Temp[1]
Surface Type
Ocean Color/Chlorophyll[2]
Suspended Matter
Vegetation Index
Aerosol Optical Thickness
Aerosol Particle Size
Ice Surface Temperature[3]
Imagery[3]
Sea Ice Characterization[3]
Snow Cover/Depth[3]
Sea Surface Temperature[3]
Atm Vert Moist Profile[4]
Atm Vert Temp Profile[4]
Pressure (Surface/Profile)[4]
CrIS/ATMS
(3)
O3 Total Column (also CrIS)
O3 Profile
OMPS
(1)
CERES
Down LW Radiance (Sfc)
Down SW Radiance (Sfc)
Net Solar Radiation (TOA)
Outgoing LW Rad (TOA)
KEY
= EDRs with Key Performance Parameters
EDRs not delivered by NPOESS are not counted in totals
01 October 2008
DoD, NOAA, NASA,
Integrated Program Office
M. Haas, F. Eastman
G. Mineart, J. Whitcomb
NPP
V16-1

Measurements to PEATES

- **LAND PEATE**
  1. Albedo (Surface)
  2. Land Surface Temperature
  3. Snow Cover and Depth
  4. Surface Type
  5. Active Fires
  6. Ice Surface Temp.
  7. Vegetation Index
- **Ocean PEATE**
  10. Ocean Color/Chlorophyll
  11. Sea Surface Temperature
- **Ozone PEATE**
  12. Ozone Total Column/Profile
  12.5 Ozone Limb SDR / EDR

- **Atmosphere PEATE**
  13. Suspended Matter
  14. Cloud Cover/Layers
  15. Cloud Effective Particle Size
  16. Cloud Top Height
  17. Cloud Top Pressure
  18. Cloud Top Temperature
  19. Cloud Base Height
  20. Cloud Optical Thickness
  8. Aerosol Optical Thickness
  9. Aerosol Particle Size
- **Sounder PEATE**
  21. Atmospheric Vertical Moisture Profile
  22. Atmospheric Vertical Temperature & Pressure Profiles

SDS Pre and Post Launch Activities



- **Pre-Launch**
  - Acquire, adapt and integrate Science and Operational SDR and EDR software into processing Systems
  - Adapt Existing Systems to Acquire and Evaluate NPP Products
  - Perform functional testing of operational code
  - Acquire and manage various preflight instrument characterization data sets provided to the Science Team
  - Support Interface Confidence Tests, Functional Thread Tests, and NPP Compatibility Tests
  - Support (as needed) generation of test data sets for software and algorithm testing
  - Support (as needed) Data Format Reviews and Various Design preparations
  - Add Processing and Storage Capacity As Needed
- **Post-Launch**
  - Nominally, acquire all RDRs, selected SDRs, EDRs and associated ancillary data
  - Process RDRs to SDRs and EDRs
    - using adapted or wrapped operational software
    - using alternative calibration LUTS
  - Process SDRs to EDRs using revised or alternative algorithms, as directed by ST
  - Support browse and distribution of locally generated xDRs to ST
  - Perform match-ups and evaluation of EDRs with other Mission and In Situ Data, e.g., MODIS, SeaBASS
  - Support SDR Evaluation for Long-term stability
  - Produce "*Research-Grade*" OMPS Limb SDR & EDR. Manage OMPS Limb Calibration for Mission Life.
  - Produce CERES Products & Inst. Cmd Loads, & Managed Inst. Cal

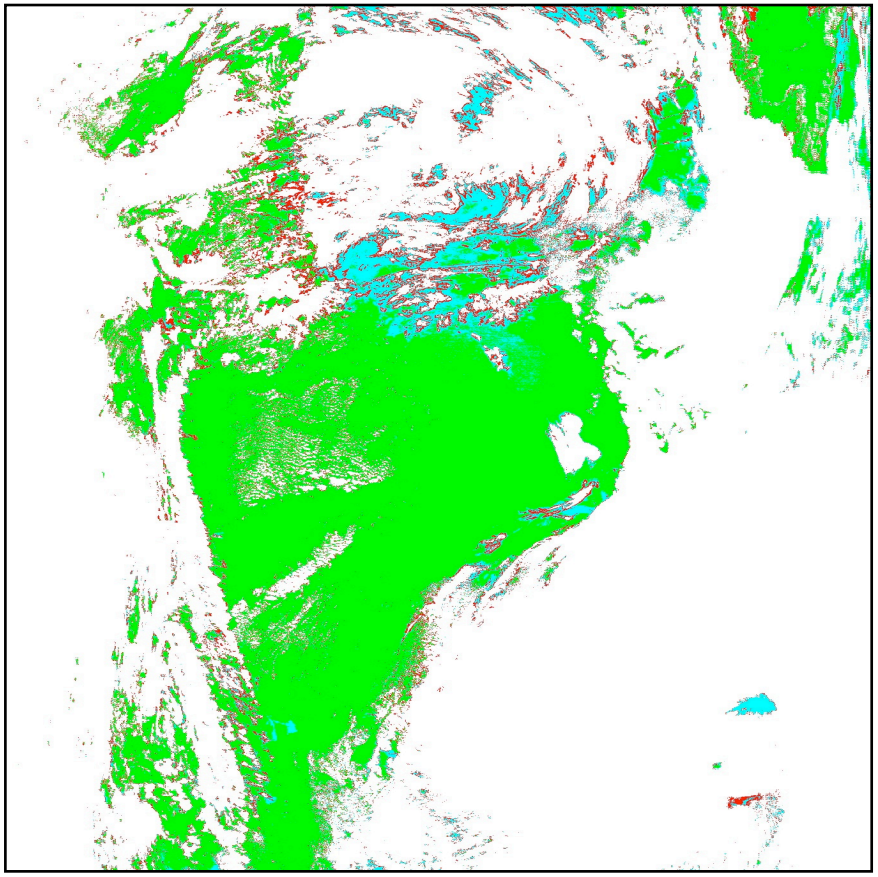
Documentation Landscape

- **From Various Sources (VOAT, O3OAT etc)**
  - ATBD Documents
- ***From IPO/NGST et al***
  - *EDR-IR, EDR-PR, OAD,*
- ***From IPO/NGST***
  - NPOESS to SDS ICD
  - NPOESS to NOAA ICD
  - NPOESS CDFCB Volume 1 Overview
  - NPOESS CDFCB Volume 2 RDR Format
  - NPOESS CDFCB Volume 3 SDR & TDR Format
  - NPOESS CDFCB Volume 4 (Parts 1- 4) EDR Format
  - NPOESS CDFCB Volume 5 Metadata
  - NPOESS CDFCB Volume 6 Ancillary Data Messages, & Reports
  - NPOESS CDFCB Volume 7 Data formats for the NPOESS application packets
  - NPOESS Common Interfaces and Services ICD
  - NPOESS Internal DFCB Volume III – Retained Intermediate Product Formats
- **From NOAA**
  - *NOAA CLASS to User Community IRD*
- **From NPP Project Office**
  - Mission Data Format Control Book
  - NPP System Integration and Test Plan
  - NPP Mission Operations Management Plan
  - NPP Mission Requirements Specification

Example Product (ATMOSPHERE PEATE)

MODIS
Visible Image

MODIS C5
Cloud Mask

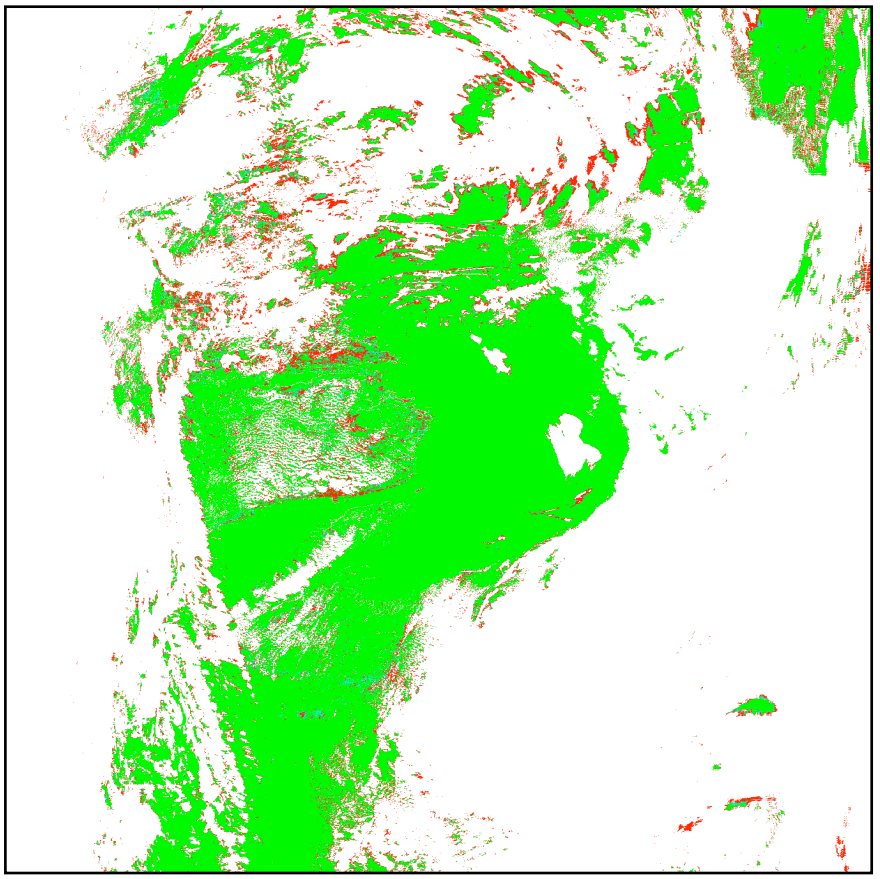


Aqua MODIS, 2006 day 240, 16:30 UTC

Example Product (ATMOSPHERE PEATE)

MODIS
Visible Image

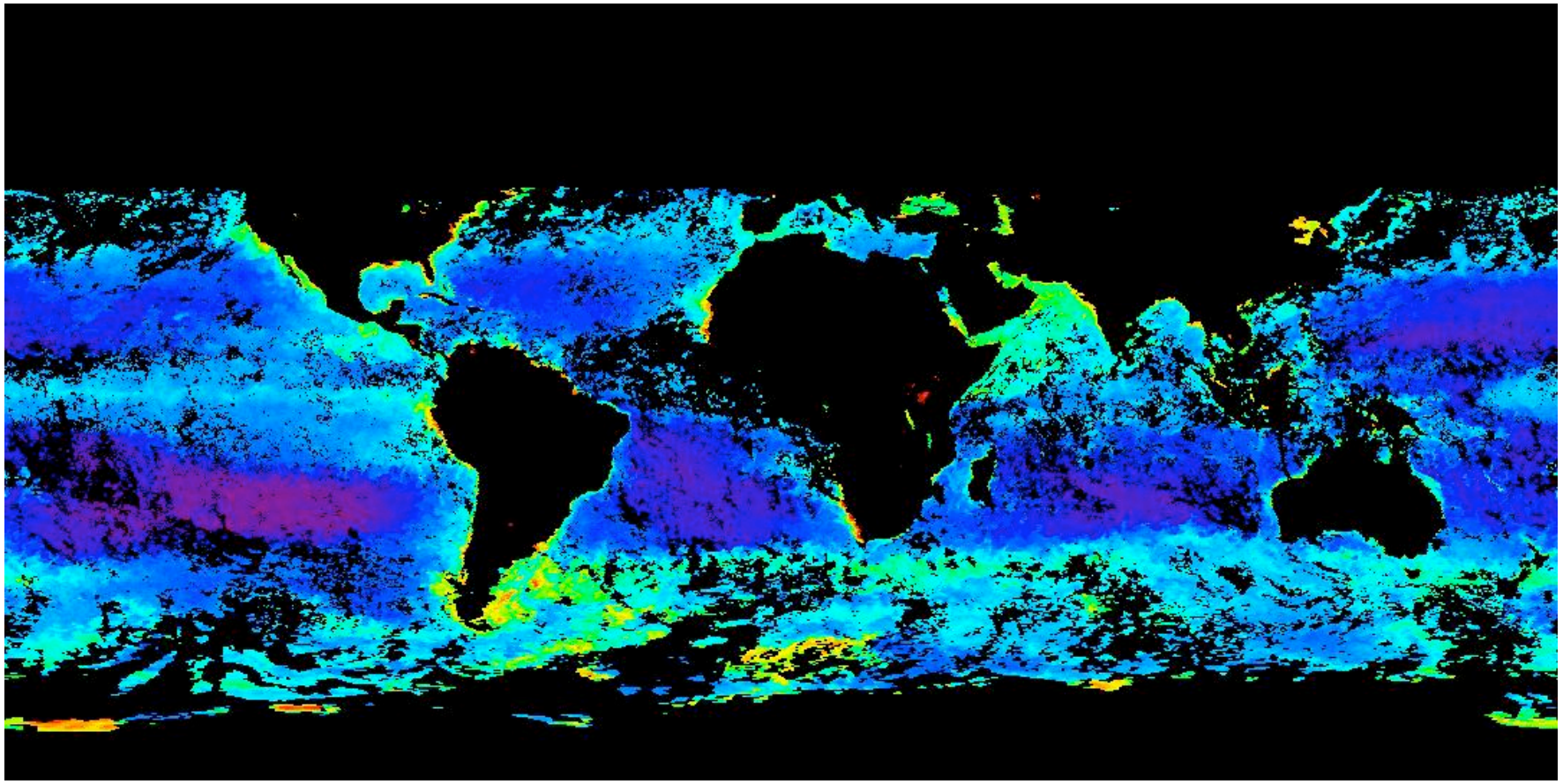
VIIRS Cloud Mask
Algorithm



Aqua MODIS, 2006 day 240, 16:30 UTC

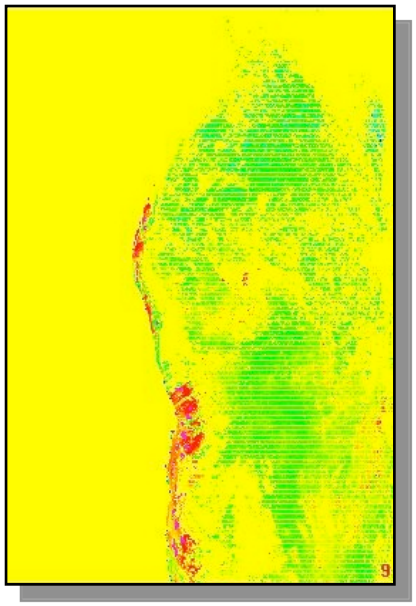
Example Product (Ocean PEATE)

- **EDR to Level-3 processing prototype evaluating Production S/W**

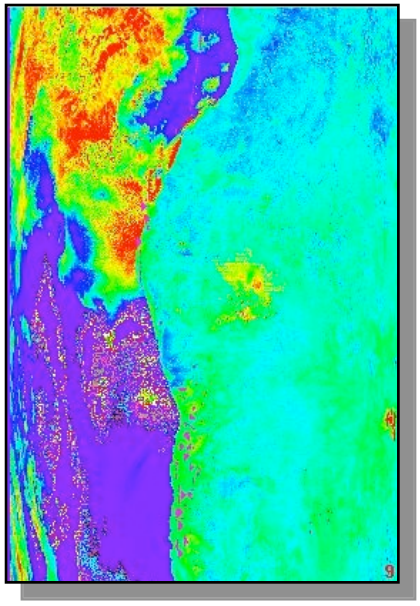


Example Product (Land PEATE)

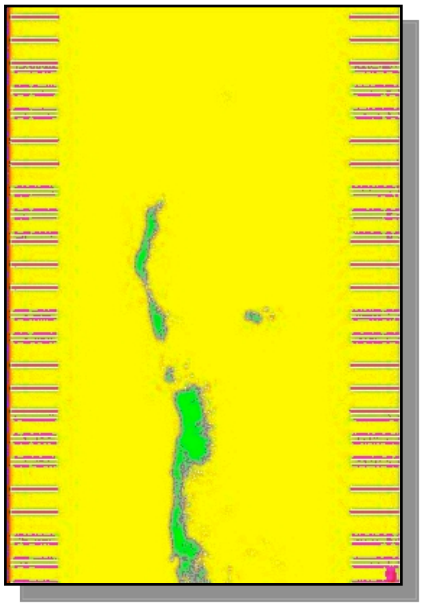
August 10, 2002
12:45GMT Namibia



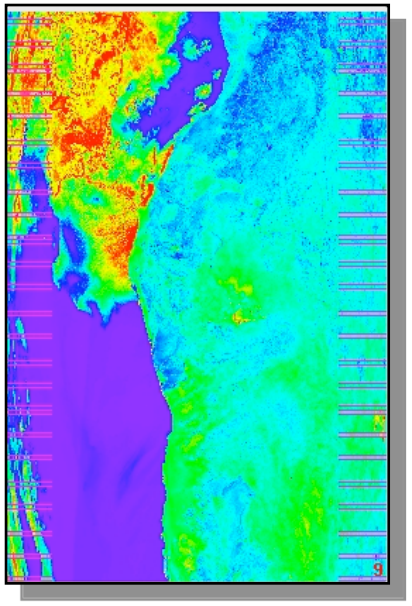
SCIENCE
All flags used to exclude elements from processing



SCIENCE
Only night flag used to exclude elements



OPS
All flags used to exclude elements from processing

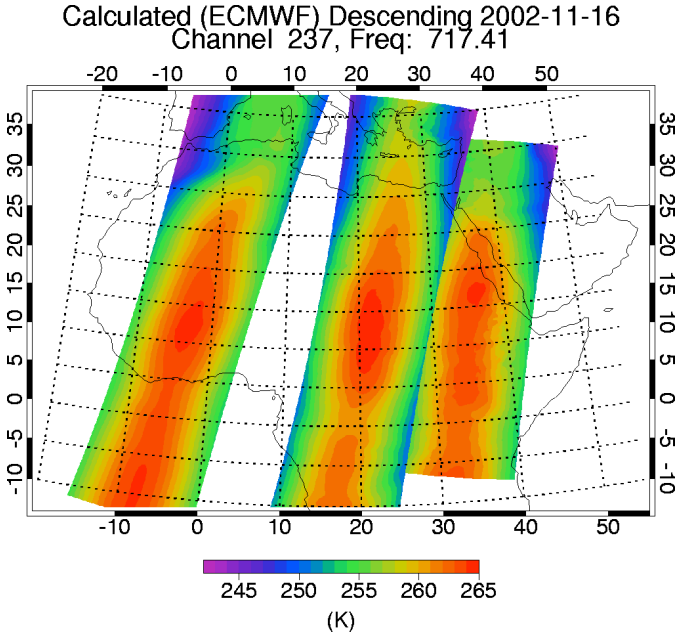


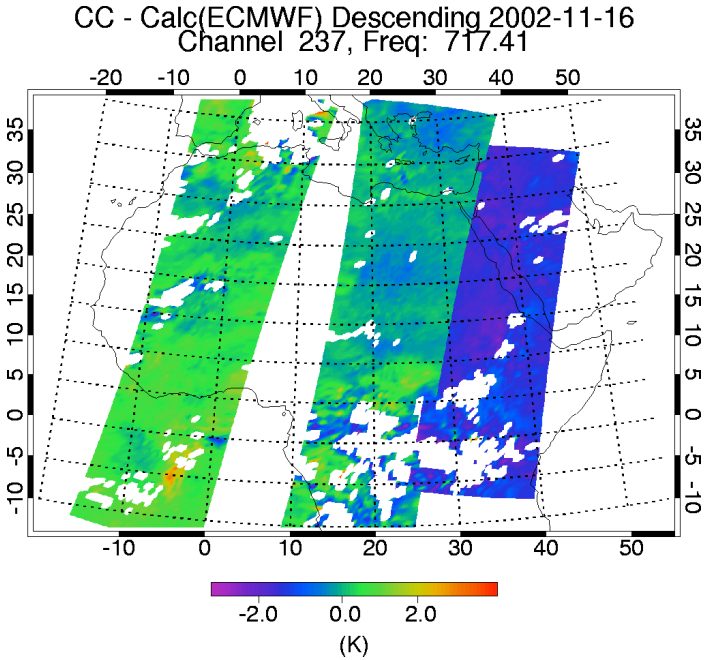
OPS
Only night flag used to exclude elements

EXAMPLE: SURFACE REFLECTANCE OUTPUT

AIRS Cloud-cleared (Sounder PEATE)

- **Channel 237, 717.41 cm^{-1} , 690 hPa**

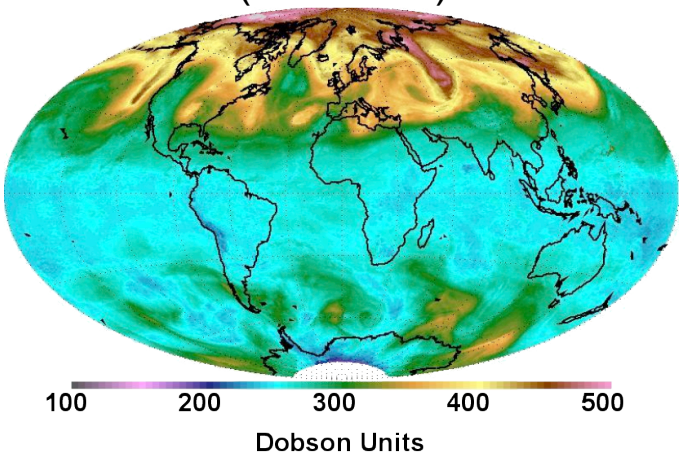




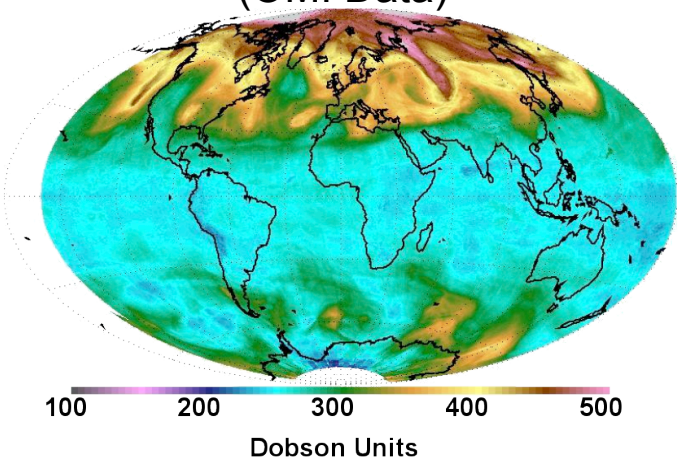
This figure depicts images of calculated radiances and radiance residuals (cloud -cleared - calculated) for a temperature sounding channel in the lower troposphere.

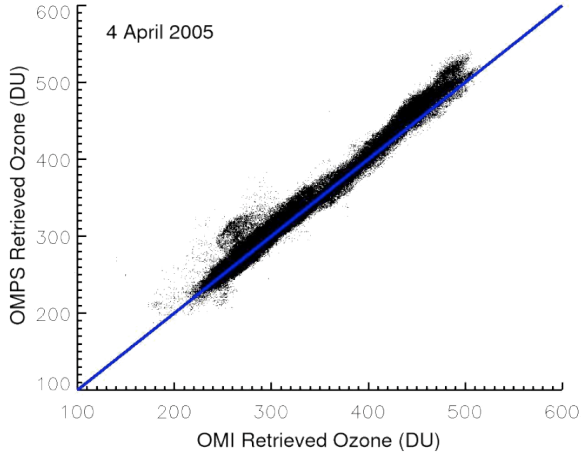
Example Product (Ozone PEATE)

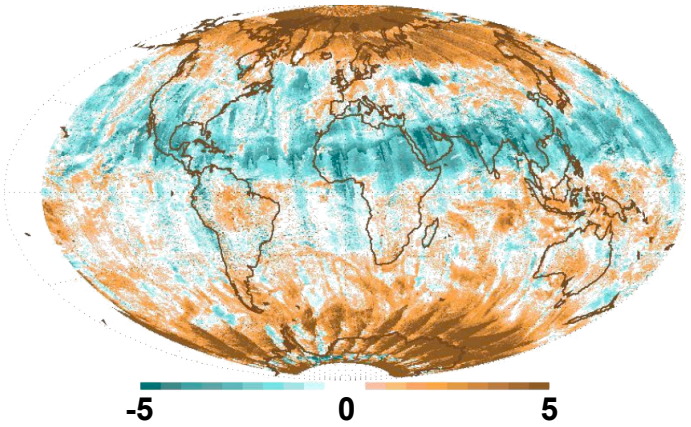
OMI Algorithm Retrieval
(OMI Data)



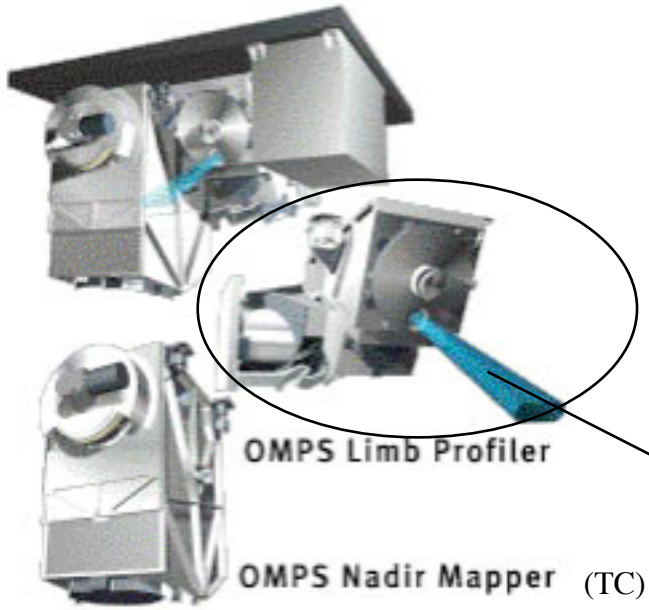
OMPS Algorithm Retrieval
(OMI Data)





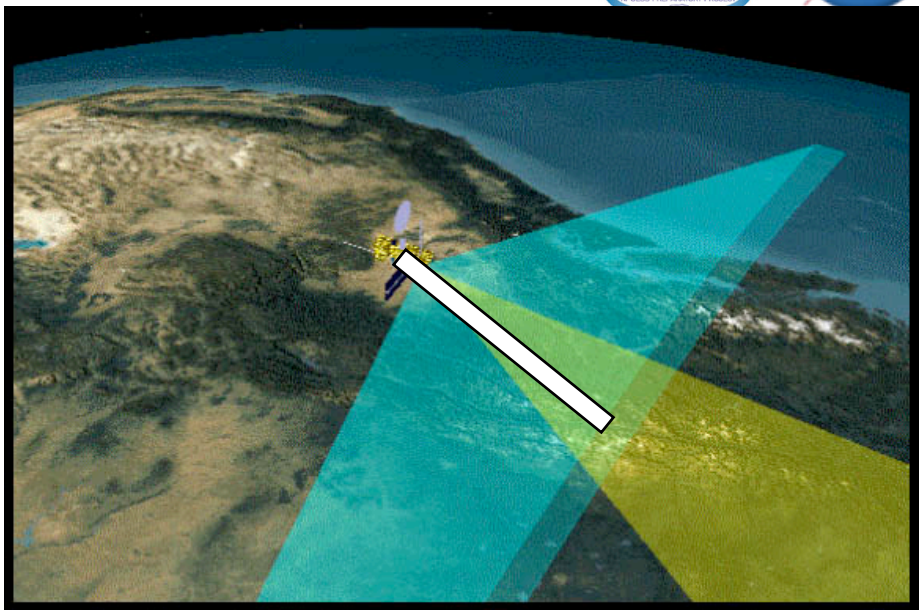


OMPS Limb (Ozone PEATE)

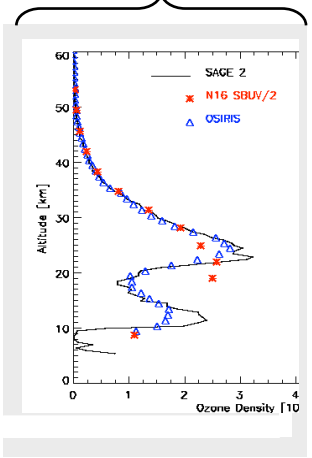


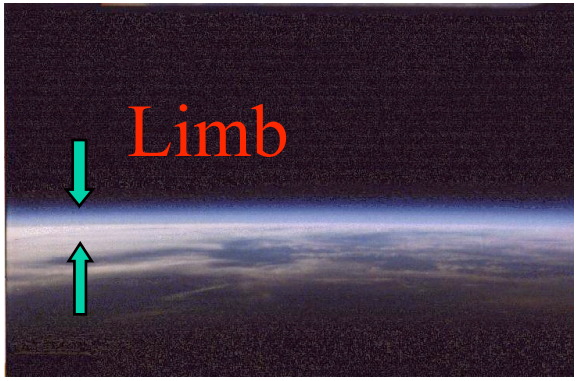
(TC)

OMPS NADIR Profiler



Source: http://www.ipo.noaa.gov/Technology/omps_summary.html

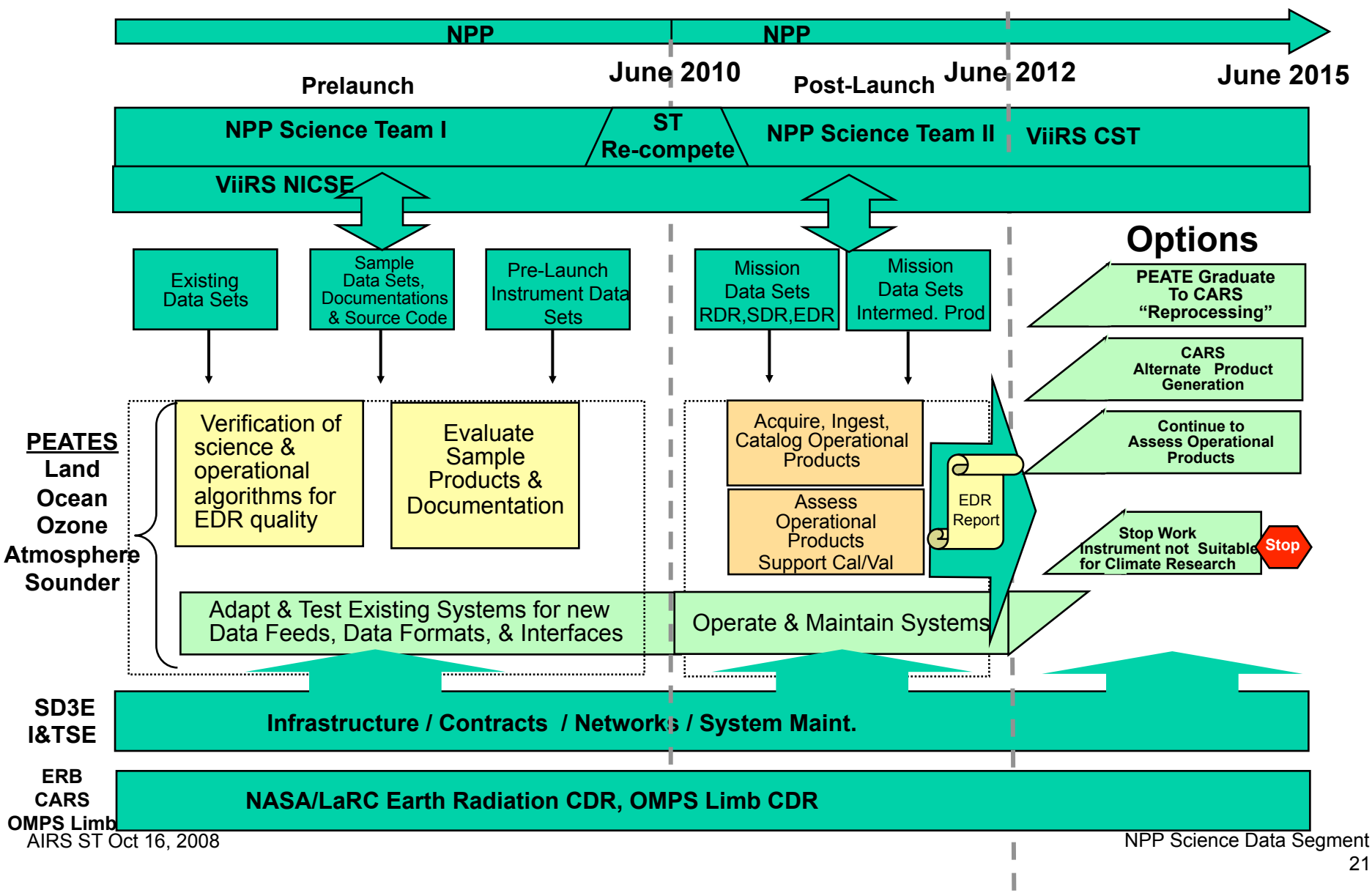




SDS Historical Milestones

		Launch Readiness Date
• February 6, '01	NPP SDS SRR	10/06
• August 26, '03	NPP Confirmation Readiness Review	10/06
• October 28, '03	Signed Level 1 NPP Requirements	10/06
• April 28, '04	SDS Steering Committee Meeting @ HQ	10/06
• June 23, '04	NPP SDS Approach Confirmation Review	10/06
• October 1, '04 10/06	NPP SDS SRR Reloaded	
• April 21, '05	NPP SDS SRR Take 3	8/08
• August 15-17, '05	NPP Pre-MOR	8/08
• Fall 2005	NPP SDS Peer Design Reviews	8/08
• Sept 19, '06	NPP SDS PDR	9/09
• Oct 31 - Nov 1, '07	NPP SDS CDR	9/09
• Jan 16, '08	CERES approved & Launch Delay	6/10
• June 5 '08	Atmosphere PEATE, CDR	6/10
• June 9, '08	Ozone PEATE, Delta Design Review	6/10
• Aug. 26, '08	NPP SDS dCDR for CERES	6/10
• Aug. 27-28, '08	SDS Peer MOR, All Elements	6/10
• Oct. 7, '08	Peer Security MOR, SDS Supported	6/10

NPP SDS Way Forward (Notional)



Conclusion

- **The NPP SDS Measurement Based Processing Model marks a change from mission-centric approach**
  - The NPP SDS leverages off of existing data processing centers
  - Using the resources of existing systems
    - eliminates the need to build entire data systems from scratch
    - affords the program the ability to tap the expertise of the science investigators
    - reducing system startup and development costs