

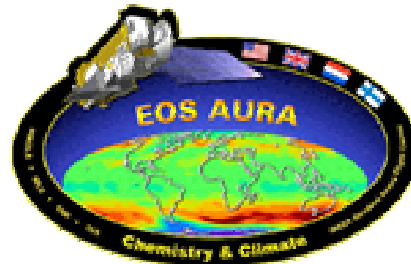
# AURA

## Mission Operations Working Group

Den Haag, The Netherlands

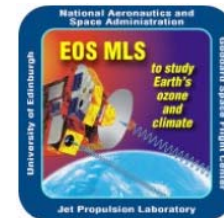


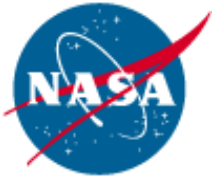
November 8-10, 2005



# MOWG Report to the Aura Science Team

Angelita (Angie) C. Kelly  
Science Interface Manager  
Earth Science Mission Operations (ESMO) Project  
NASA/Goddard Space Flight Center  
Greenbelt, Md. U.S.A. 20771  
[angelita.c.kelly@nasa.gov](mailto:angelita.c.kelly@nasa.gov)





# MOWG MEETING

## Nov 9, 2005

### AGENDA



|              |   |   |
|--------------|---|---|
| <b>9:00</b>  | <b>Welcome/Introduction</b>   | A. Kelly  |
| <b>9:15</b>  | <b>EOS Mission Operations Update</b>  | A. Kelly  |
| <b>9:45</b>  | <b>EOS Aura Spacecraft Status</b>   | B. Guit   |
| <b>10:15</b> | <b>BREAK</b>  |   |
| <b>10:30</b> | <b>Instrument Status</b>  |   |
|              | <ul style="list-style-type: none"><li>• OMIS</li><li>• MLS</li><li>• HIRDLS</li><li>• TES</li></ul> | J. Claas<br>R. Lay / D. Cuddy<br>J. Craft<br>D. Rider |
| <b>11:50</b> | <b>LUNCH BREAK</b>  |   |
| <b>1:00</b>  | <b>Ground System Update</b>   | C. Gomez / A. Kelly<br>D. Linebarger / A. Kelly       |
|              | <ul style="list-style-type: none"><li>• EDOS</li><li>• EMOS (IST, PDB Update, etc)</li></ul>        |   |
| <b>2:00</b>  | <b>OMI Direct Broadcast/Finland Ground Station Status</b>   | O. Aulamo   |
| <b>2:15</b>  | <b>Other Items</b>  |   |
| <b>2:30</b>  | <b>Action Items</b>   |   |



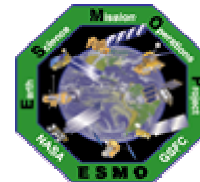
# Spacecraft Status



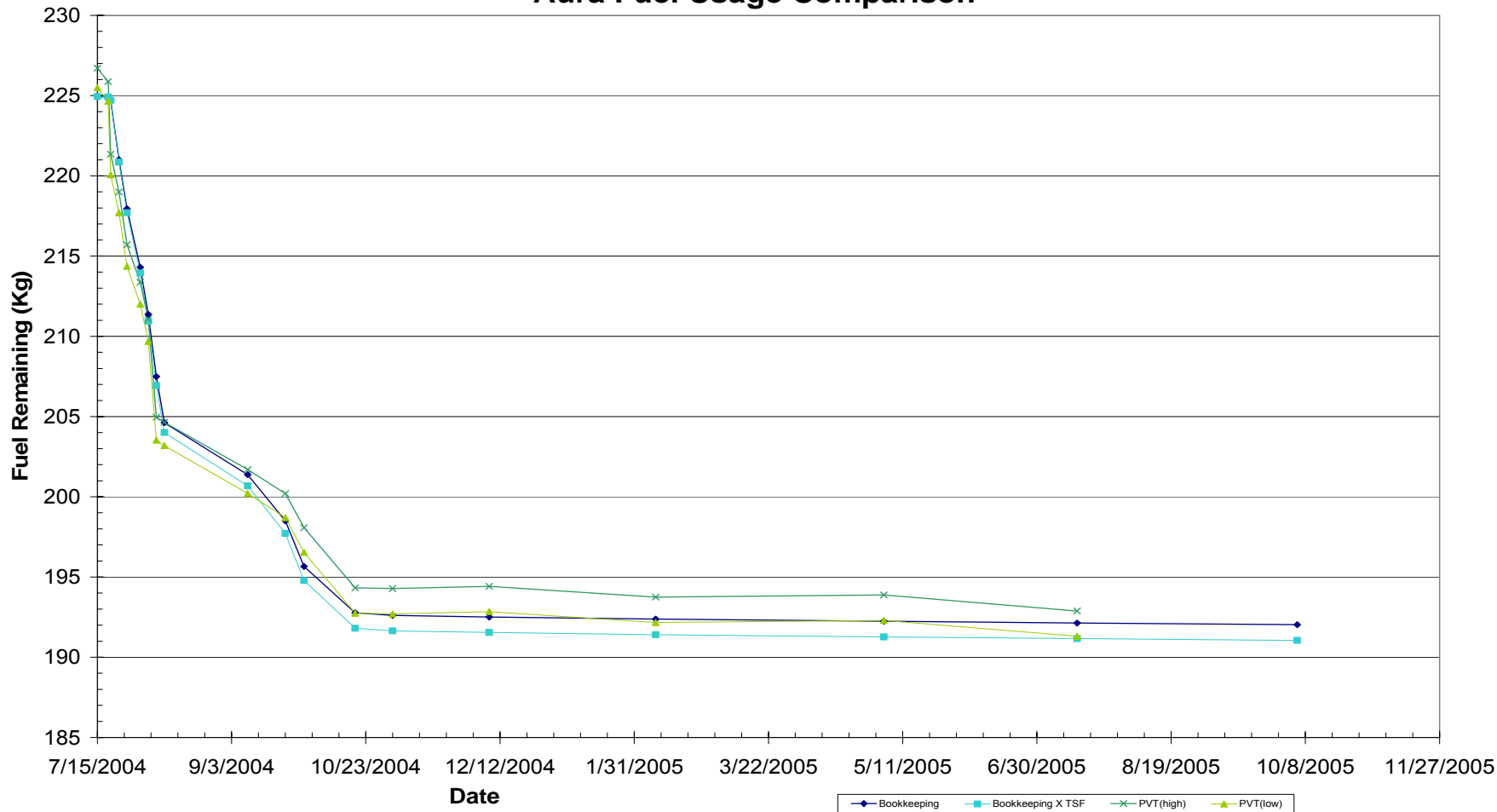
- The Aura Spacecraft is robust and is performing very well.
- The Aura Spacecraft has not gone to Safe or Survival mode since launch.
  - Aura development incorporated lessons learned from Aqua
- All spacecraft subsystems are nominal.
  - Only one anomaly has occurred:
    - » Solar Array Cable connector (initially reported as EPS ARE–3C not supplying power to S/C Bus) on January 12, 2005
    - » Anomaly Review Board Final Report
      - **Most Likely Cause:** Disengaged Solar Array connector (Believed to be an isolated workmanship related problem)
      - » **Impact:** Available End of Life (EOL) power margin dropped from 24% to 17%
      - » **No impact to science operations**
- Spacecraft and instruments have not experienced SAA-related anomaly.



# Propellant Usage



## Aura Fuel Usage Comparison



11/15/2005



# Aura MOWG Report



## INSTRUMENT REPORTS



# MLS Summary



- **Status Summary**
  - **MLS instrument is working excellently**
  - **MLS calibration confirms the health of the instrument**
  - **MLS data processing systems operating smoothly**
  - **All measurements for which the instrument was designed have been demonstrated over an initial, usually broad, altitude range**
  - **All Level 1 and Level 2 files routinely archived & available from GSFC DAAC**



# HIRDLS Summary



- **Instrument Health:** The HIRDLS instrument has been extremely stable since launch. At nearly one and one-half years post launch, all monitored telemetry points (temperatures, currents, cooler % stroke, etc.) have all been well within limits.
  - All electronic boxes continue to operate within operational limits
  - Cooler de-icing is not expected for at least 4 years
  - Scan Mirror Assembly is executing **flawlessly in spite of kapton**
- **Special Activity:** Pitch maneuvers every 4-6 months to continue with cold space calibration and Kapton characterization
- With exception to the Kapton, **HIRDLS operates precisely as designed**



# OMI SUMMARY



- **The OMI instrument has operated very well for 482 days; it has not experienced an anomaly since launch.**
- **Temperature behavior: The OMI temperature is at operational level and stable.**
- **The active CCD heater control works very well since both CCD temperatures are very stable.**
- **The Interface Adapter Module is also operating nominally; no multi-bit errors have been seen since a memory scrub was performed in early fall 2004**





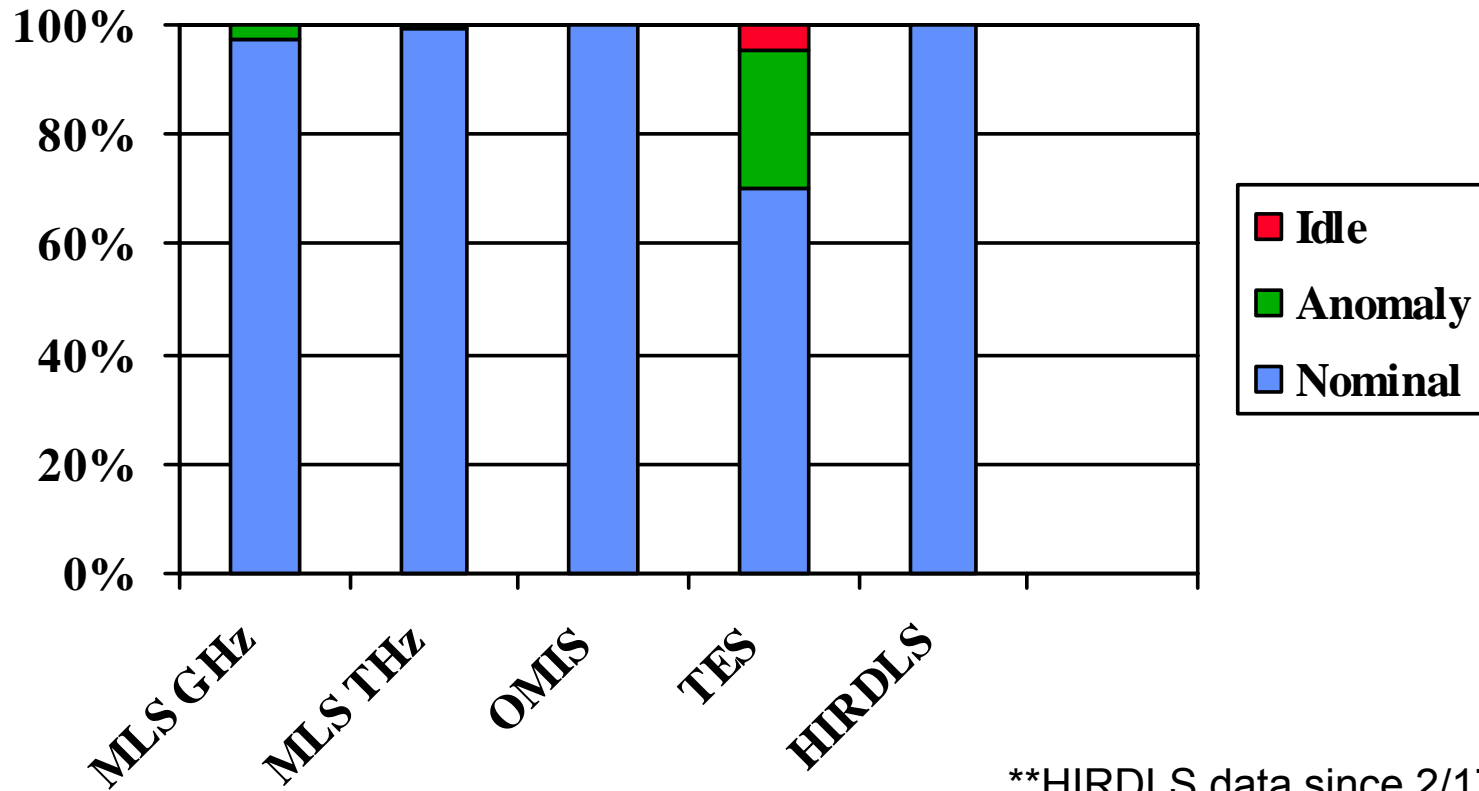
# TES SUMMARY



- **TES is in nominal science operations mode.**
- **TES temperatures are within their expected ranges and no abnormalities have been observed.**
- **Global surveys have been adjusted to prolong the life of the instrument. The Global survey now consist of 3 nadir scans.**
- **Limb scans will be performed for special activities and field campaigns.**
- **De-ice activities and anomalies have resulted in a science duty cycle of < 100 %.**
- **Optical Bench warm-up to improve the CO product is scheduled to start on Nov 29th**



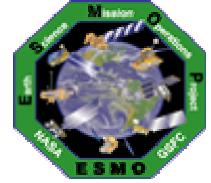
# Aura Science Data Duty cycles Oct. 1, 2004 - present



\*\*HIRDLS data since 2/17/05



# Near Term Activities



- **TES Optical Bench Warm Up**
  - Starts Nov 29<sup>th</sup>
- **A-Train: CloudSat/CALIPSO Launch**
  - December 2005
- **Handling of Leap Second**
  - December 31st
- **Test and Implement New IST Interface**
  - December - February
- **Drag Make-up Maneuver #7**
  - January 2006
- **Support Aura Validation Campaign, as needed**



# Leap Second

Handling the Leap Second on January 1, 2006



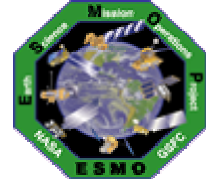
- At the end of the year a positive leap second will be introduced into UTC time.
- Instead of the normal day transition from 23:59:59 to 00:00:00, December 31, 2005 will be one second longer.
- On January 1, 2006, UTC time will transition as follows:

**23:59:59 → 23:59:60 → 00:00:00**

- IOTs and ground system teams are preparing to handle leap second.



# Aura MOWG Report



## GROUND SYSTEM UPDATE



# Ground System Reengineering Activities



- **EDOS and EMOS reengineering activities are underway to:**
  - **Reduce cost**
  - **Reduce risk**
  - **Meet security regulations**
  - **Increase operations efficiency**
  - **Improve maintainability**



# EDOS Reengineering Activities



- EDOS 2005 achievements include:
  - GROUND STATIONS:
    - **New data capture systems** at all Ground Stations with a Hardware/Software solution provided by Kongsberg.
    - **New Ground Station Interface Facility (GSIF) at the Wallops Flight Facility** to support Aqua and Aura.
      - » **Scheduling 3 Aura passes daily at Wallops**
  - CHECKSUM:
    - **Checksum (Unix, MD5) provided with Rate Buffered Data (RBD)s and L0 Production Data Sets (PDSs.** Used by OMI, HIRLDS, Goddard DAAC, Langley DAAC, and NSIDC.
  - NEW MISSION SUPPORT:
    - Added capability to **capture the EO-1 mission data** and transfer the data to the EO-1 Processing Center at GSFC.



# EDOS Plans for 2006 - 2007



## Plans:

- **Data-Driven concept** to be deployed in operations instead of schedule-based data capture
- **“EDOS-in-a-Box”** deployed into operations at the Ground Stations
  - Provides option to deliver RBD and EDS (and in special cases, PDS) data directly from the Ground Stations.
  - This also supports the Remote EOC concept for data production in case of an emergency at GSFC.
- **New capture hardware** to support for dump rates greater than 150MB

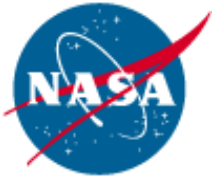




# EMOS IST Reengineering



- **Replace current EMOS Remote IST interface**
  - Current IST interface presents many **security, logistical, and functional issues**.
- **Benefits:**
  - Improve **security posture** (Must meet all GSFC requirements)
  - Improve **maintainability of ISTs**
    - » Remote ISTs will not have to maintain ISTs; Maintenance will be performed at GSFC
  - **Update/Replace obsolete IST hardware/OSs**
    - » Older ISTs (esp. Terra) are on outdated hardware, some with 200MHz processors and 2GB hard-drives
  - Improve IST **network performance**
  - Maintain or **enhance IST capabilities**
  - **Reduce ongoing maintenance costs**
- **Testing and Implementation: Dec 23005 - Feb 2006**



## Aura Direct Broadcast Activities in Sodankyla, Finland



- **The Sodankyla Ground Station captures and processes 3 orbits of Direct Broadcast OMI data daily**
- **The Very Fast Delivery product has been compared with the product generated from the SSR playback data that are processed at KNMI and the results agree. Both facilities use the same software**
- **The station also captures and processes MODIS DB data from Terra and Aqua**
- **Additional hardware enhancements are planned**



# Nov 2005 MOWG Action Items



- **Prepare to handle Leap Second (ALL)**
- **Review Instrument Survival Recovery procedures (ALL)**
- **Provide Advance Notice/Schedule of Field Campaigns or new operations mode/configuration to ESMO (IOTs)**
- **Provide Online Aura Documentation (ESMO)**
- **Clarify ESMO Configuration Management System/Process (ESMO)**
- **Separate EDOS RBD ICD for HIRDLS and OMI (ESMO/EDOS)**
- **Investigate latency of RBD data from the Wallops ground station (ESMO)**
- **Provide software tool to test IST interface (ESMO/EMOS)**
- **Provide periodic information regarding EDOS and EMOS activities (ESMO)**
- **Determine impact (if any) of new security plan guidelines on IOTs (ESMO)**
- **Determine if updates to Operational Agreements are needed (FOT)**



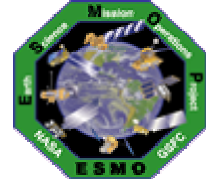
# SUMMARY



- **SUCCESSFUL FIRST YEAR OF AURA MISSION OPERATIONS**
  - **Spacecraft Status - GREEN**
  - **Instrument Status - GREEN**
  - **HIRDLS, MLS, OMI, & TES: Operations Nominal**
    - » producing great science
  - **Data Capture/L0 Processing Status – GREEN**
  - **SSR Data Capture to 10/31/2005: ~ 99.987 %**
    - Only one data loss occurrence (OMI data/ on July 7 due to operator error)
- **Continue to look at ways to perform cost-efficient mission operations**
- **Continue close coordination among the IOTs, ESMO, and the FOT for Aura mission success**



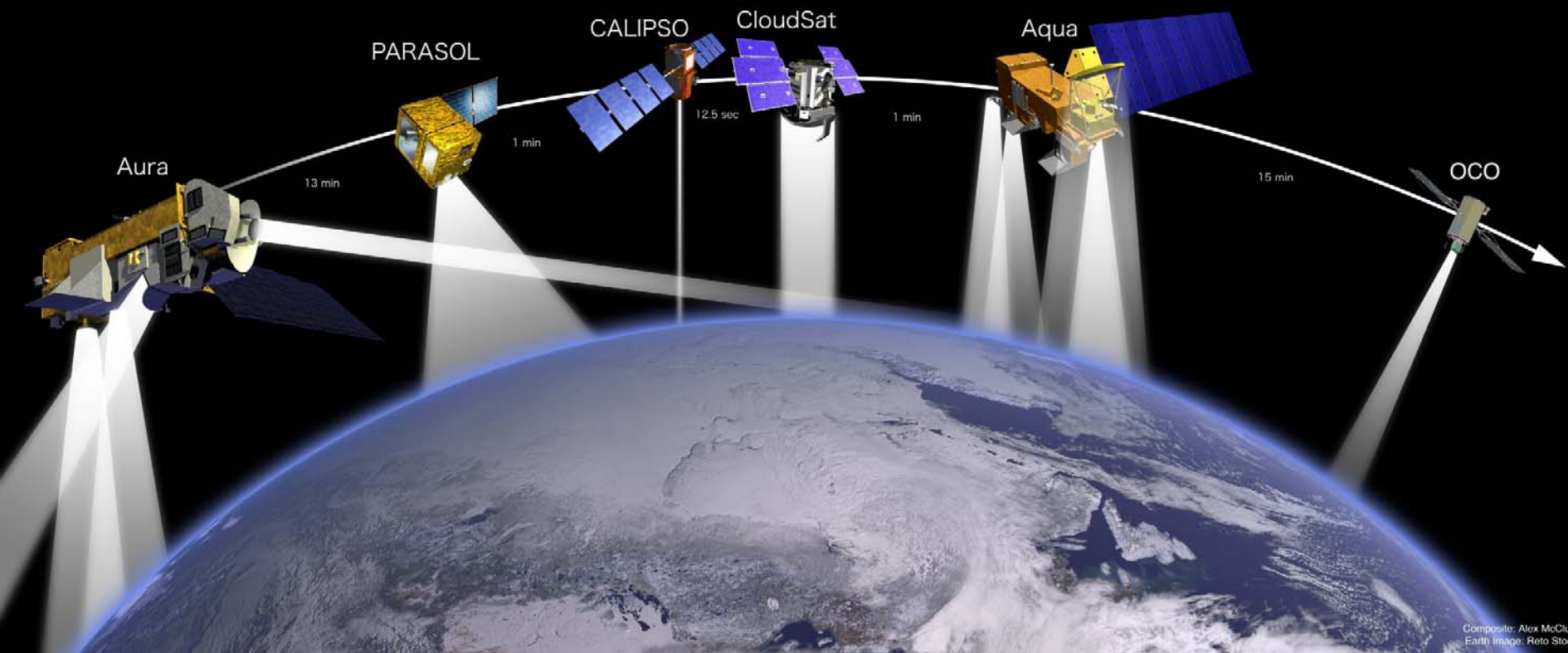
# Aura MOWG Report



## Afternoon Constellation

# Earth Science Afternoon Constellation Activities

## The A-Train





# Afternoon Constellation Activities



- The joint NASA/CNES mission, **PARASOL**, launched 18 December 2004 from Kourou, French Guiana
  - Joined Constellation on 8 September 2005
  - Valuable L&EO lessons learned for the constellation
- Agreements signed by all Constellation parties. Constellation operations will be performed in accordance with the:
  - **Afternoon Constellation Operations Coordination Plan**
  - **Afternoon Constellation Operations Contingency Procedures**
- **Afternoon Constellation Data working group** discussions started in February 2005 (B. Wielecki, G. Stephens, D. Winker, D. Vane, D. Tanre, J. Pelon). S. Kempler, GES DAAC, is working with the science teams

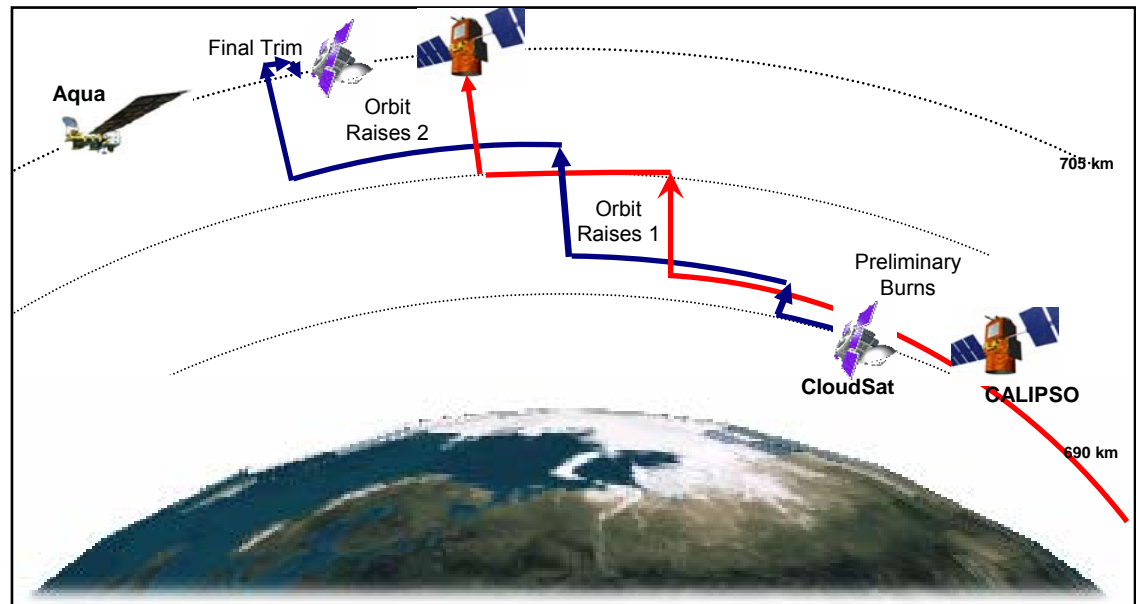


# Afternoon Constellation Activities

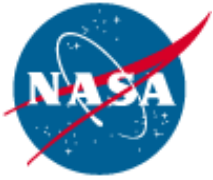
## CloudSat / CALIPSO Launch Preps



- **CloudSat/CALIPSO** scheduled to launch in the near future (Dec 2005).
- To ensure a safe entry into the Afternoon Constellation, several **CloudSat/CALIPSO** rehearsals were conducted this year.
- The final **Ascent Plans** were also simulated, involving CNES, Kirtland AFB, and the NASA Centers at JPL, Langley, and Goddard







# Afternoon Constellation Activities

## GLORY Mission



- **GLORY mission planning to join the Afternoon Constellation (10.8 minutes behind Aqua)**
- Overall science objectives:
  - Perform aerosol research
  - Perform continued measurements of total solar irradiance.
- Project Scientist: Dr. H. Maring at GISS
- Lifetime: 3 year requirement; 5 year goal
- Managed by NASA GSFC
- Integrated by Orbital Sciences Corporation (OSC)
- Mission Operations at OSC / Dulles facility
- Target launch date: Late 2008





# Afternoon Constellation Activities

## GLORY Mission Background Info



**Glory** is a remote sensing spaceflight mission designed to

- Collect data on the chemical, microphysical, and optical properties, and spatial and temporal distributions of aerosols; and
- Continue collection of total solar irradiance data for the long-term climate record.

**Glory** accomplishes these objectives by deploying two separate instruments

- **Aerosol Polarimetry Sensor (APS)** - SORCE heritage
- **Total Irradiance Monitor (TIM).**

The **APS** collects global aerosol data based on along-track, sub-satellite polarimetric measurements taken within the solar reflective spectral region (0.4 to 2.4 microns). Measurements of spectral radiance are restricted to the sunlit portion of the orbit and, since clouds can have a significant impact on the quality of polarimetric measurements, an onboard cloud camera is used to distinguish between clear and cloud filled scenes.

The **TIM** collects high accuracy, high precision measurements of total solar irradiance (TSI) using an active cavity radiometer that monitors changes in incident sunlight to the Earth's atmosphere. Because the TIM is designed to operate nominally in a solar-viewing orientation, it is mounted on a gimbaled platform that accommodates targeting independent of the spacecraft's nadir viewing attitude.

# Earth Science Morning Constellation Activities





# Terra Emergency Debris Avoidance Maneuver



- A close approach between Terra and a piece of Object 14222 (Scout G-1 debris) was predicted to occur on October 23 with a high probability of collision ( $P_c$ ).
  - Without any maneuver,  $P_c$  was on the order of 1 in 12.
  - Nine consecutive  $P_c$ 's of about 1.2% - 8.1% were predicted over a 5-day span leading up to closest approach
- An emergency Delta-V Avoidance Maneuver (DAM) was successfully performed on October 21 at 22:30:00
  - Burn duration of 2.736 seconds increased the predicted miss distance from **~50-60 meter** to around **4.6 Km**



# Earth Science Morning Constellation Activities



- **SAC-C:** CONAE performed 3 pairs of maneuvers (on July 27, August 5, and August 10) to raise SAC-C's orbit by 2.3 km to avoid a close approach with Landsat-7 and EO-1. This resulted in a 9-day repeat cycle.
- **EO-1** started lowering its orbit by 10 km in late September as a step to meeting its 25-year re-entry requirement.
  - EO-1 has insufficient fuel to continue formation flying with Landsat-7
- **Terra** and **Landsat-7** remain in their current locations