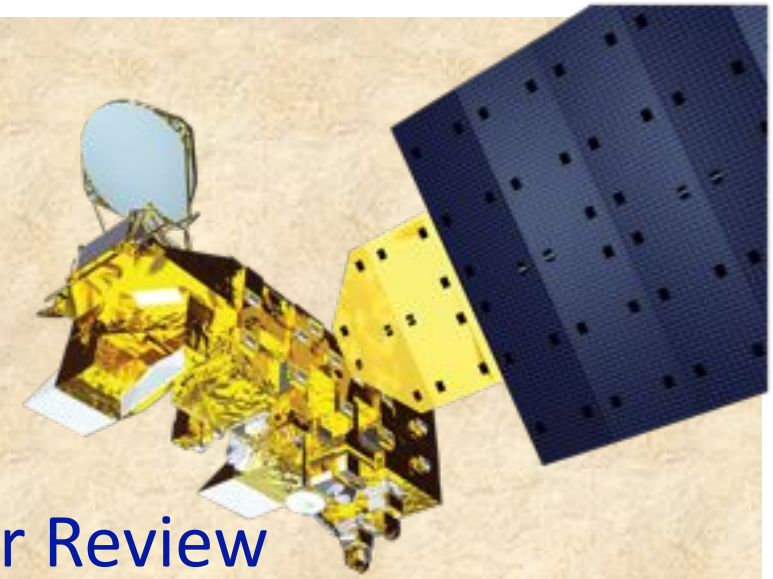


The 2009 Aqua Senior Review
(with some comments also on Terra)

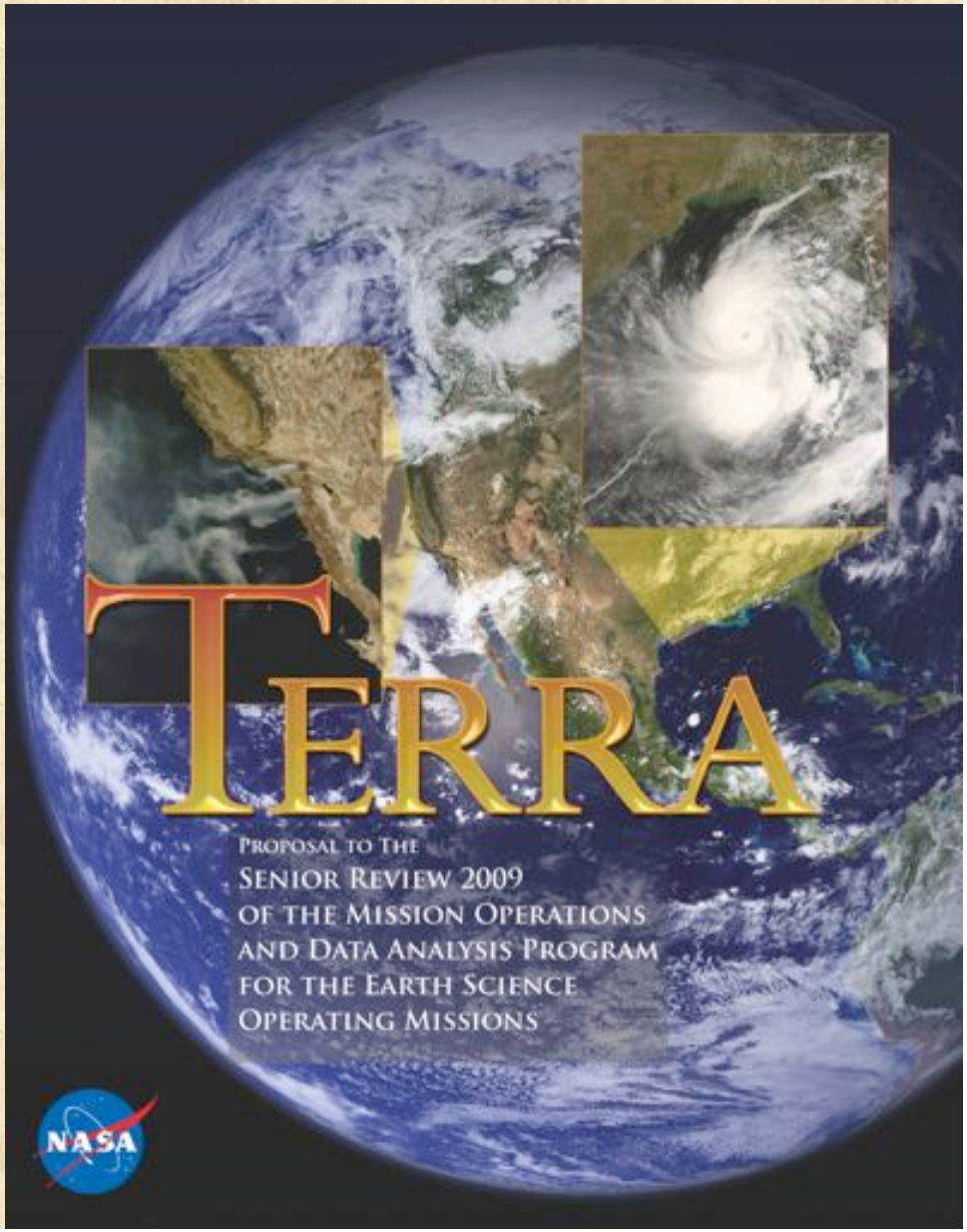
Claire L. Parkinson
Aqua Project Scientist

Presented at the MODIS Science Team meeting, L'Enfant Plaza Hotel, Washington, D. C., January 26, 2010

2009 NASA Earth Science Senior Review

- Purpose: Determine which of the reviewed missions warrant continued operation and how much funding each should receive.
- Missions involved: ACRIMSAT, Aqua, Aura, CALIPSO, CloudSat, EO-1, GRACE, ICESat, Jason-1, QuikSCAT, SORCE, Terra, and TRMM (i.e., 13 missions, all beyond their prime mission lifetimes).
- Period covered: FY2010 – FY2013, with funding results for the last two years considered preliminary.
- Proposal requirements: science section, technical/budget section, appendices providing a data product inventory, budget spreadsheets, references, and a list of acronyms.
- Key Dates:
  - March 24, 2009, proposals due to NASA Headquarters (HQ).
  - May 12-14, 2009, meeting of the Senior Review Panel (Aqua presentation May 13).
  - September 1, 2009, letter received from Mike Freilich (Director for Earth Science, NASA HQ) regarding the Senior Review results.
  - September 24, 2009, Aqua response provided to NASA HQ.

2009 Aqua and Terra Senior Review Cover Pages



2009 Aqua Senior Review Table of Contents

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Compelling Aspects of the Aqua Proposal

- Strong science
  - Four productive science teams (AIRS/AMSU/HSB, AMSR-E, CERES, and MODIS).
    - Over 600 publications using Aqua data in each of the last two years.
    - Over 7,000 citations to publications using Aqua data in each of the last two years.
  - Significant contributions to each of NASA's six interdisciplinary Earth science focus areas (especially the first five).
  - Role in extending many key climate data records.
- Many contributions to National Objectives/Applied Science
  - Many Aqua data products being used in weather forecasting.
  - Contributions to each of NASA's 12 Applied Science Program Elements.
  - Value of the Aqua data to the U.S. Forest Service, USDA, EPA, FAA, NOAA, DOD, USAID, USGS, U.S. Coast Guard, Dartmouth Flood Observatory, Washington Volcanic Ash Advisory Center, Alaska Volcano Observatory.
- Healthy spacecraft and instruments
- Enough fuel to last at least through 2018
- Cheap to continue relative to the initial investment

May 13, 2009 Meeting with the Senior Review Panel

- Excellent panel, chaired by Steve Ackerman.
- Very nice opening and closing compliments from the Panel regarding the Aqua mission and the proposal.
- Presentation centered on answering 8 sets of questions provided ahead of time by the Panel.

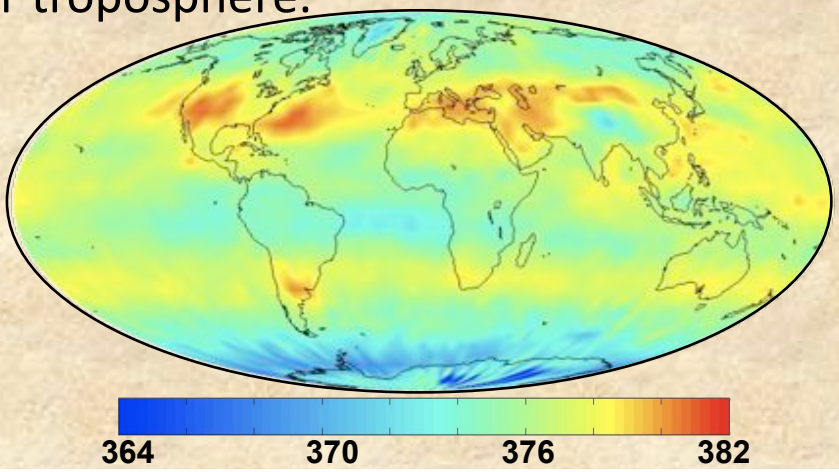
Question Set #1

" ... present your optimal proposal budget; describe the additional work which will be funded ..., and justify the additional budget requested. "

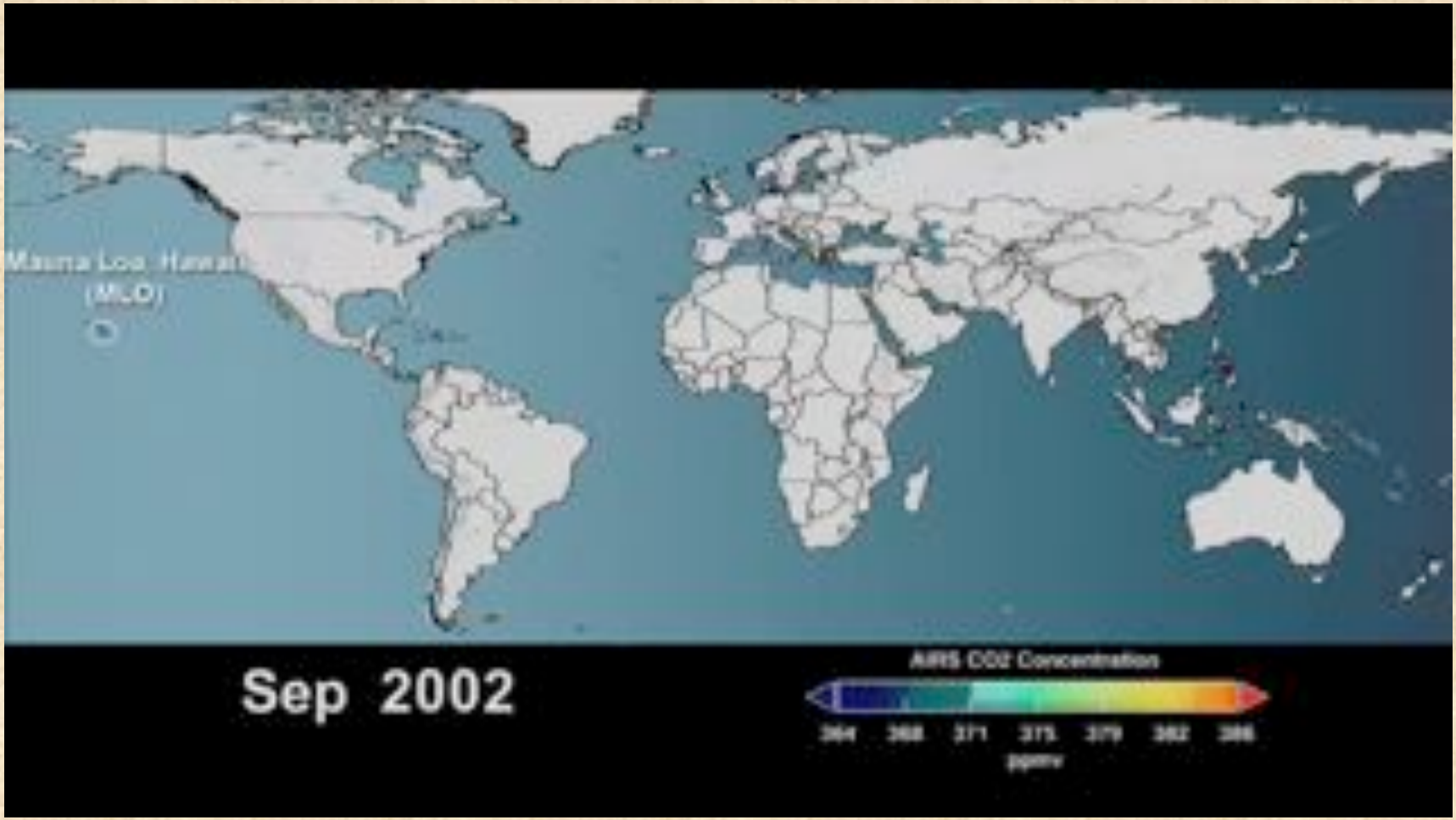
Abbreviated Answer, p. 1:
'Optimal' Additions for Mission Operations (ESMO) and AIRS/AMSU

- ESMO: Additional funds for FY10 to complete key security upgrades to the ground systems.
- AIRS/AMSU: 2.1 FTE/yr to enhance the AIRS CO_2 product, to produce retrievals in the stratosphere and lower troposphere.

AIRS mid-troposphere CO_2 concentrations (ppm) for July 2003 (from Mous Chahine and the AIRS Science Team).



AIRS/AMSU Mid-Tropospheric CO_2 Product
September 2002 – July 2008

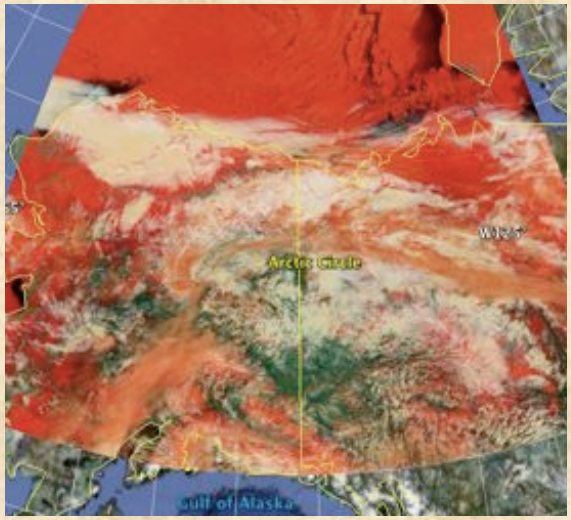


(animation from Mous Chahine, the AIRS Science Team, and the NASA GSFC Scientific Visualization Studio)

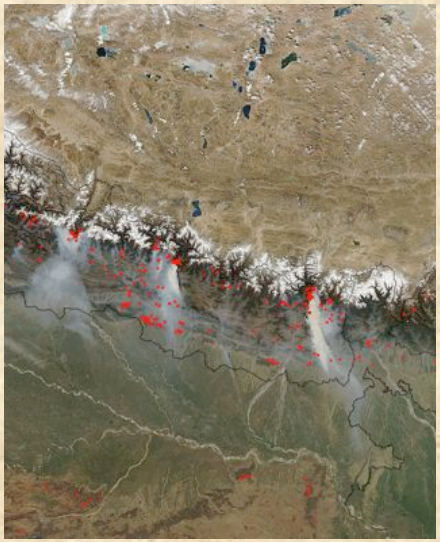
‘Optimal’ Additions: AMSR-E, CERES, and MODIS

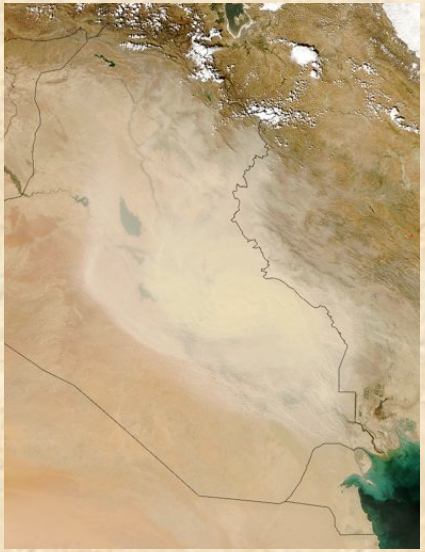
- AMSR-E: 0.6 FTE/yr to increase the Team Leader Science Computing Facility (TLSCF) staffing to 2 full-time people.
- CERES: 1.75 FTE/yr to return the CERES Data Management Team to its level of staffing prior to funding cuts begun in FY08, increasing the efficiency of CERES data processing.
- MODIS: 0.75 FTE/yr from Aqua and 0.75 FTE/yr from Terra for the MODIS Rapid Response effort, to bring to full funding the sole Rapid Response scientist and add 1.0 FTE for software development (website redesign, vector imager processing, etc.).

Sample Rapid Response Imagery



ARCTAS image over Alaska, 5/08


Fires in Nepal, 3/12/09


Dust storm in Iraq, 9/16/08

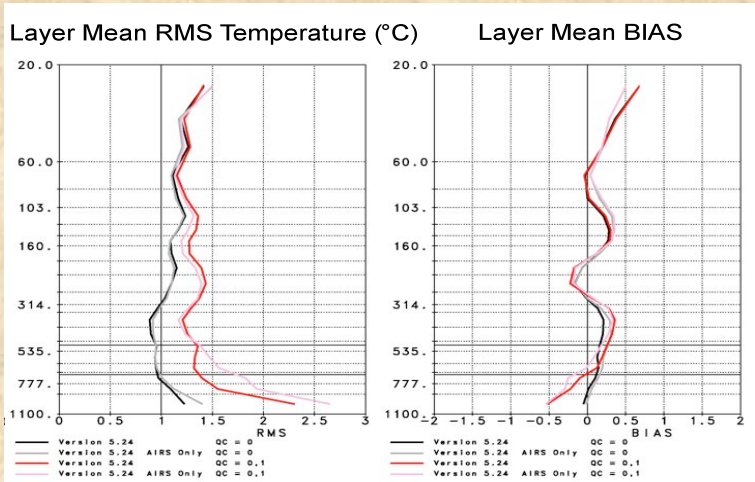

Ash plume, Chaiten volcano, Chile, 5/28/08

Question Set #2

" … The AMSU instrument has experienced anomalies … it is unclear how AIRS product quality and accuracy would be affected by the loss of AMSU … Could AMSR-E provide a similar role as AMSU in the production of AIRS retrievals? "

Abbreviated Answer

- Several studies indicate that AIRS-only results show only minor degradation versus the AIRS/AMSU Version 5.0 algorithm (see plots).
- AMSR-E would not be able to replace AMSU because of not viewing the same air mass at the same time and viewing angle.
- AMSR-E data help the AIRS team in other ways.



Comparisons for global averages on 9/6/2002, 1/25/2003, and 9/29/2004 (plots courtesy of Susskind, Blaisdell, Iredell, and Molnar)

Question Set #3

"… the shortwave channel on CERES FM-4 ceased to operate properly in 2005 … Does this failure affect continued product generation, product accuracy and the full range of variable retrievals? … which of these two modes (cross-track or rotating azimuth) is currently used and does this activity perform synergistically with CERES on Terra? "

Abbreviated Answer

- The failure of the FM-4 shortwave (SW) channel has no effect on continued product generation, product accuracy, or the full range of variable retrievals.
- Aqua's FM-3 is operating in cross-track mode.
- There is no effect on the synergistic Terra and Aqua measurements.

Question Set #4

" There are currently 36 core MODIS products ... Most of these products are listed at stage II maturity; there are also two provisional products and eight other products at stage I maturity. Are there specific plans to bring these products to stage III maturity during the proposed mission continuation? "

Abbreviated Answer

Three slides were shown, one providing definitions of four levels of validation (provisional and stages 1, 2, 3) and the other two listing each of the MODIS data products, with their current level of maturity and eventual final level of maturity. For most, the validation activities are funded through ROSES.

Question Set #5

" The AMSR-E and CERES core product algorithms are listed in the proposal as mature; does this mean that the resulting products ... require algorithm maintenance only? Can more detailed information be provided ...? "

Abbreviated Answer

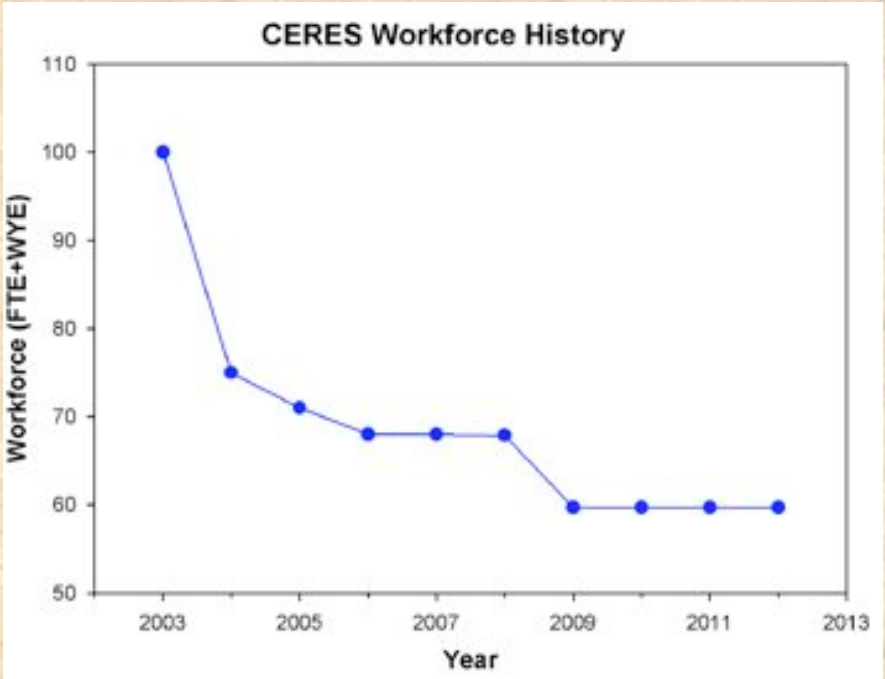
Details were provided on the maturity level of each of the AMSR-E and CERES data products, many of which were listed as having reach Stage 3 maturity. However, for many of the products, algorithm refinements continue to be made, necessitating more work than 'algorithm maintenance only', the primary exception being the CERES Edition 2 products.

Question Set #6

" ... the minimum staffing request (60 FTE/yr) for CERES is roughly twice the level requested for MODIS. Why? "

Abbreviated Answer

- CERES is a PI instrument, and hence the CERES Senior Review budget includes support for an integrated instrument-algorithm-validation science team covering all CERES data products (Levels 1-3).
- In contrast, MODIS is a Facility instrument, with Level 2 and 3 algorithm improvement and validation funded separately through ROSES.

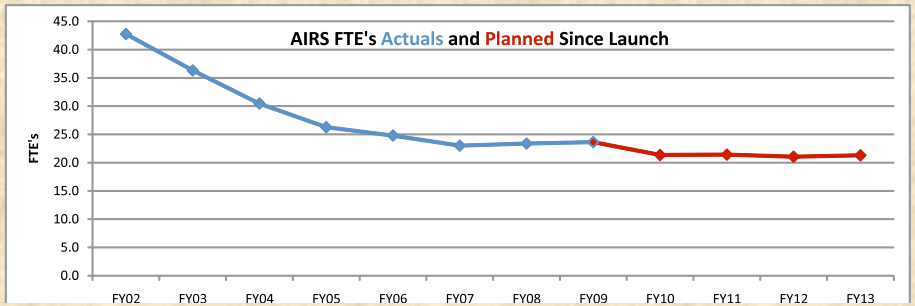


Question Set #7

" The budget request for AIRS/AMSU for science algorithm development and processing is significantly higher (9.8 FTE/yr) than other Aqua instruments. Why isn't this covered through ROSES ...? The AIRS/AMSU team is requesting an additional 2.1 FTE/yr to enhance the utility and achieve quality retrievals of CO_2 in the stratosphere and boundary layer; how is this request different from the proposed science algorithm development activities? "

Abbreviated Answer

- Terminology differences were explained. The relevant funding for the AIRS Project is for science integration, testing, and validation (4.6 FTE/yr) and software and data operations (5.2 FTE/yr).



- Maintenance of the mid-tropospheric AIRS CO_2 product is part of the in-guide budget. Nine activities (channel selections, retrieval optimization, etc.) were listed for the development of CO_2 products for the stratosphere and near surface, as part of the 'optimal' effort.

Question Set #8

" There are large differences in the number of publications, data users, and data volume downloads between MODIS and other Aqua sensors. There are many potential reasons for these differences, including the broad range of products and user communities addressed by MODIS. However, are there other reasons ... ? "

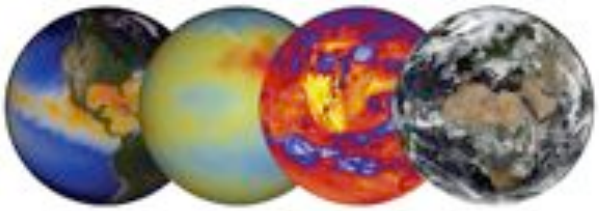
Abbreviated Answer

- The MODIS science team is by far the largest.
- The MODIS publication numbers cover Terra as well as Aqua.
- The Terra MODIS has been operating since February 2000, whereas no AIRS or AMSR-E was in space until May 2002.
- The CERES science team is focused on long-term climate information, whereas the MODIS team also has a considerable focus on much shorter-term events.
- MODIS has the highest resolution of the Aqua instruments, allowing local details that have generated great interest and usage, e.g., for imagery of forest fires, dust storms, and phytoplankton blooms.

Senior Review Panel Report: Aqua Results

- Both the Science and National Interests Panels gave Aqua their highest ratings ('Outstanding' and 'Very High Utility' respectively).
- Many very complimentary statements were included. For example:
  - "Continuation of the Aqua platform and data series is critical for continuity of many Earth system data records ... NASA should undertake any and all efforts necessary to sustain this irreplaceable mission."
  - "... the proposed Aqua mission continuation plan is robust with no apparent weaknesses."
  - The in-guide budget was "at a bare bones level".
- Several suggestions were made.
  - Add CH_4 to the AIRS/AMSU core product list.
  - Identify the root causes of any operator errors.
  - Redouble efforts to make the AIRS/AMSU and AMSR-E data available and useful to the broader scientific community.
  - Document MODIS Rapid Response product quality and usage guidelines, and have the MODIS Rapid Response Team work directly with the NASA Applied Sciences Program Director.
- Funding recommendations: Fund at the requested 'optimal' level with the sole exception of funding the AIRS/AMSU CO_2 enhancement efforts only for the first two years, shifting the effort to ROSES funding after FY2011.

Goddard Space Flight Center
Aqua Project Science Office
aqua.nasa.gov



Aqua E/PO
Implementation Plan

Prepared for: Dr. Ming-Ying Wei, Earth Sciences Division, NASA Headquarters
Ms. Stephanie Stockman, Science Mission Directorate, NASA Headquarters

Prepared by: Steven Graham, Aqua Outreach Coordinator
Dr. Claire Parkinson, Aqua Project Scientist

With contributions from:
Dr. Lin Chambers, S'COOL Project Director, NASA Langley Research Center
John Godfrey, ViewSpace Production Team Lead, Space Telescope Science Institute
Sharon Ray, AIRS Outreach Coordinator, NASA Jet Propulsion Laboratory

September 29, 2009

Aqua E/PO Implementation Plan

- Submitted September 29, 2009
- Key outreach components
  - Dynamic Planet
  - ViewSpace
  - S'COOL
  - AIRS Outreach
  - Aqua Vodcast Series
  - Earth & Sky Radio Show
  - E/PO budget (over half is for AIRS E/PO)
  - Collaborations with the other EOS E/PO efforts
- Accepted December 2009, with revisions needed only in the AIRS section.

Obama and the Dynamic Planet, 11/23/09

The Dynamic Planet at the Fall AGU, 12/09. Photos by Steve Graham

Earth & Sky Aqua Radio & Podcast Series

(available as podcasts at http://www.earthsky.org)

- 90-second radio program, and 90-second and 8-minute podcasts.
- Completed interviews, with radio broadcast dates
  - Claire Parkinson, on Aqua, September 7, 2009.
  - Mous Chahine, on AIRS CO_2, September 14, 2009.
  - Lorraine Remer, on MODIS aerosols and public health, October 26, 2009.
  - Norman Loeb, on CERES climate data records,November 30, 2009.
  - Chelle Gentemann, on AMSR-E ocean studies, December 14, 2009.
- Upcoming interview of Graeme Stephens on the A-Train.

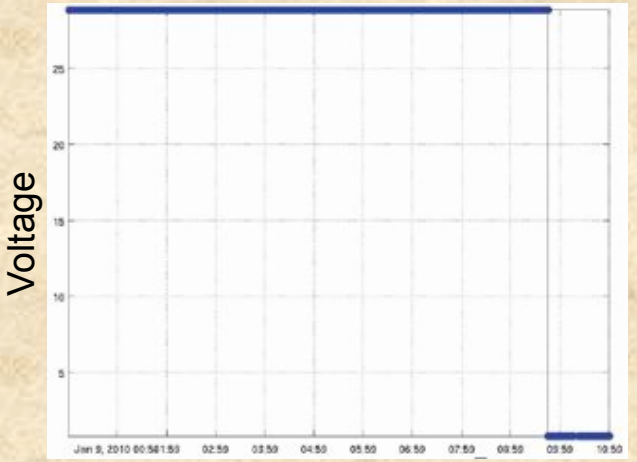
View from the EarthSky website

Earth & Sky Aqua Radio Series: L. Remer

Aqua Update

- Over 7.5 hugely successful years so far.
- Spacecraft nominal.
- January 9, 2010 AIRS anomaly.
  - Abrupt power supply drop from 28 V to 0.8 V in the Actuator Drive Module (ADM).
  - First major anomaly for AIRS since launch.
  - Tremendous job by Mission Operations and the AIRS instrument operations team (IOT) in immediately addressing the problem.
  - Instrument restarted January 19-20; now undergoing calibration.

AIRS ADM Power Supply Voltage, 1/9/10



(figure from the AIRS IOT)

- Status of other instruments
  - AMSR-E nominal except motor current and torque spikes since 5/2007.
  - AMSU nominal except failure 11/2007 of Channel 4.
  - HSB failed 2/5/2003.
  - Both Aqua CERES nominal except failure 3/30/05 of the shortwave channel on FM-4.
  - MODIS nominal.

A-Train Update

- PARASOL exited the A-Train, December 2, 2009.
- Glory launch date no earlier than November 11, 2010.
- Japan's Global Change Observation Mission – Water (GCOM-W) launch no earlier than November 2011.
- Possible Orbiting Carbon Observatory (OCO) replacement mission (following the failed February 2009 attempted launch), no earlier than 2012.