MODIS Atmosphere Team Summary Report

Steve Platnick
and the atmosphere discipline team

MODIS Science Team Mtg.
College Park, MD
20 May 2011

Outline

- The Atmosphere Discipline Team
  - Who we are: overview of ROSES 2009 Terra/Aqua awards
- Current status of Products, etc.
  - Current Status of MODAPS Processing, Resources for Reprocessing
  - "Special" products
- Collection 6
  - Status of MODAPS Processing, Resources for Reprocessing
  - Nominal Schedule
- Major Science Issues/Efforts
- modis-atmos.gsfc.nasa.gov/team/

Overview from ROSES 2009 Terra/Aqua NRA: 20 funded investigations

Algorithm Refinement (proposal element 2.4)

- 5 funded teams:
  - Aerosol dark target: L. Remer, R. Levy
  - Aerosol deep blue: C. Hsu, R. Hansell, J. Huang, S-C. Tsay
  - Cloud-top, mask, profiles: S. Ackerman, P. Menzel, R. Frey, E. Borbas, B. Baum
  - Cloud optical properties: S. Platnick, M. D. King, R. Pincus
  - Ice cloud models: B. Baum, P. Yang, A. Heymsfield
- 1 previous team not funded (cirrus reflectance, NIR water vapor)

New Algorithm Capability/Products (2.3)

- Cirrus retrievals w/1.38 μm band: K. Meyer, S. Platnick

NRT Capability (2.5)

- Direct broadcast/IMAPP: A. Huang
- Polar winds (MODIS & AIRS): D. Santek

Overview from ROSES 2009 Terra/Aqua NRA:

Science Data Analysis and Data Fusion (2.1, 2.2)

- Multi-spectral approach to evaluating the response of deep c… aerosols: E. Wilcox, D. Posselt, T. Yuan — MODIS, CERES, AMSR-E
- MODIS aerosols in vicinity of clouds: R. Cahalan, A. Marshak, … — MODIS, CALIOP, CERES
- CO and aerosol retrievals, local radiative forcing: David Edwards — MODIS, MOPITT
- Absorbing aerosol impacts on atmospheric heat… melting in Himalayas/Tibetan Plateau: W. Lau, Kyu-Myong, Ritesh, Hsu, Yasunari — MODIS, MISR, AMSR-E, CERES, AIRS
- The dispersal and evolution of volcanic plumes: Vincent R… — MODIS, MISR, AIRS, ASTER
- Aerosol transport and climatic impacts: Hongbin Yu — MODIS, MISR, A-Train
- Trade wind cloud observations w/Terra, Aqua, and other satelli… — MODIS, MISR, ASTER
- Terra/Aqua assessment of midlat ocean GCM cloud co… — MODIS, MISR, AMSR-E, AIRS
- Global constraints on radiative properties of ice clouds usin… Bastiaan van Diedenhoven — MODIS, POLDER, CALIOP
- Global characteristics of marine Sc clouds and drizzle: Sandra Yuter — MODIS, AMSR-E
- MODIS marine BL clouds and LES models: Zhibo Zhang, S. … — MODIS, AMSR-E, CloudSat
- CERES/MODIS to Improve energy balance snowmelt modeling: L. Hink… Pinker, J. Lundquist [participates in Land team too] — MODIS, CERES

Atmosphere Team Breakout Agenda

- Day 1: Collection 6
  - Status of “Testing” system, schedule, etc.
  - L2 Algorithm Plans/Status
  - L3 and ATML2 Plan/Status
  - Ancillary:
    - New BU gap-filled land and snow/ice spectral albedo
    - Ice cloud models for retrievals and data analysis
- Day 2: Science Data Analysis Presentations
  - Science Talks (9)
- Posters
  - 24 Posters

Collection Status

- C5 L1B, cloud mask, profile products
- C51 Atmosphere L2, L3 products
  - Aqua C51 reprocessing completed early 2010
  - Terra C51 reprocessing completed late 2010
- Terra Deep Blue algorithm requires L1B polarization corrections (available only through 2007)

Special Products (1)

MODIS Data for IPCC CMIP5 (Coupled Model Intercomparison Project)

- Previous IPCC assessments have not made good use of observational data for model assessment.
- Program for Climate Model Diagnosis and Intercomparison (PCMDI) at LLNL has reached out to make NASA products more effectively accessible for routine climate model evaluation.
- Two workshops were held (LLNL, Oct. 2010; GSFC, Nov 2010).
- Identified a small number (~12-14) of observational data sets that can be "directly" compared to model output.
- For MODIS: Cloud Fraction (MOD35)
  - Monthly Terra cloud fraction data record from early 2000–Dec 2009
  - netCDF Climate Forecast (CF) compliant naming conventions and metadata plus file structures that can be ingested into existing delivery infrastructure (Earth System Grid (ESG)).
  - Currently working with Gary Fu (MODAPS) and many others (including JPL) trying to achieve CF compliance. Tedious/iterative!

Special Products (2)

MODIS Data for CFMIP5 (Cloud Feedback Model Intercomparison Project)

- MODIS Cloud Simulator was developed for COSP (CFMIP Observational Simulation Package)
  - Simulates core MODIS cloud products AND generates L3-like statistics for comparison with MOD08/MYD08.
- Subsetted monthly L3 files corresponding to simulator output and converted to netCDF
  - Full records (all years) for 35 data sets, Terra and Aqua C5.1 individually, and Terra+ Aqua combined (consistent w/other L3 temporal aggregations). Daytime only (most commensurate w/ simulator).
  - ~0.5 GB/year (per Terra, Aqua, or combined data set)
  - Includes netCDF metadata convention (CF compliant)
  - Documentation file provided
  - Archived at: *ftp://ladsweb.nascom.nasa.gov/NetCDF/L3_Monthly/*.

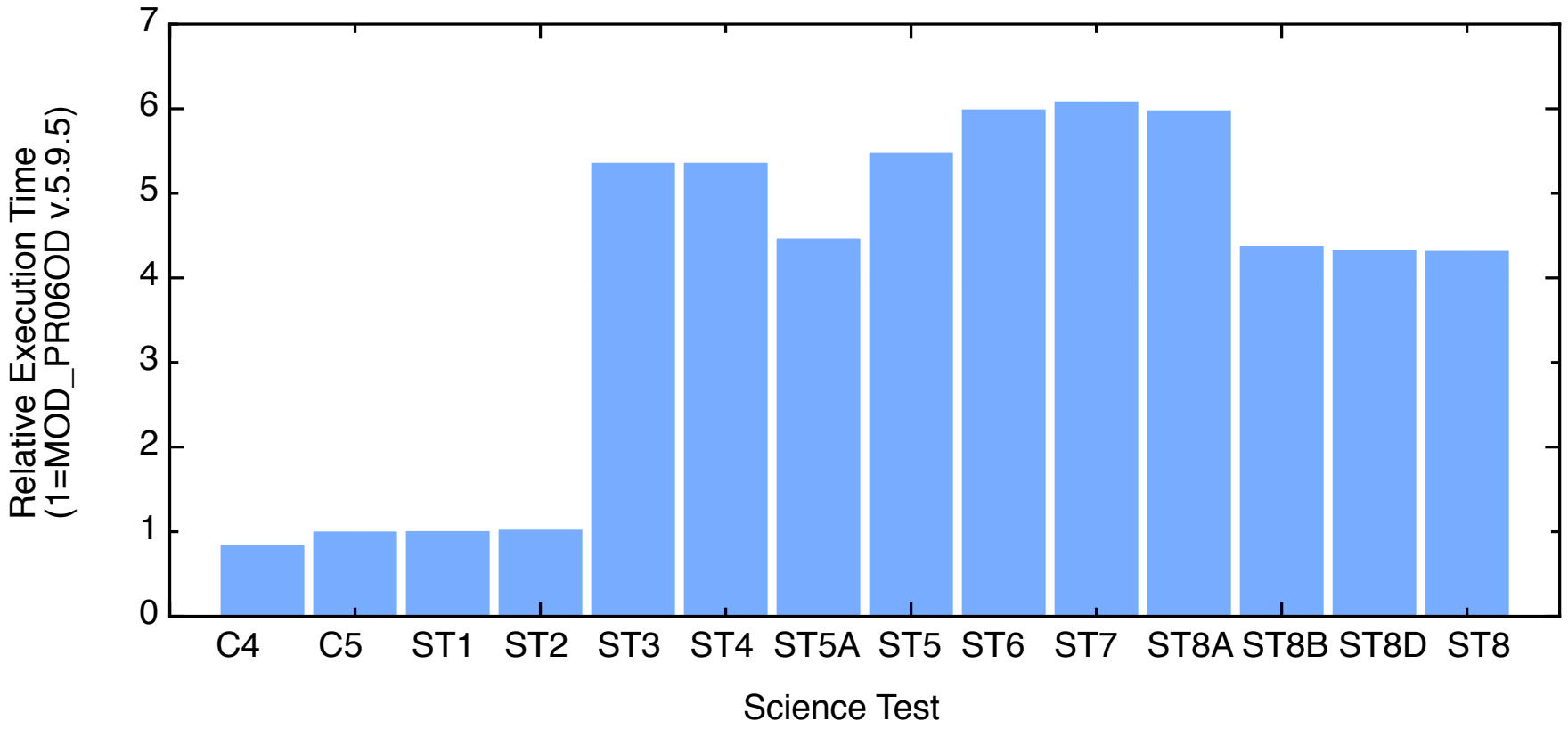
C6 Testing in MODAPS

C6 Approach

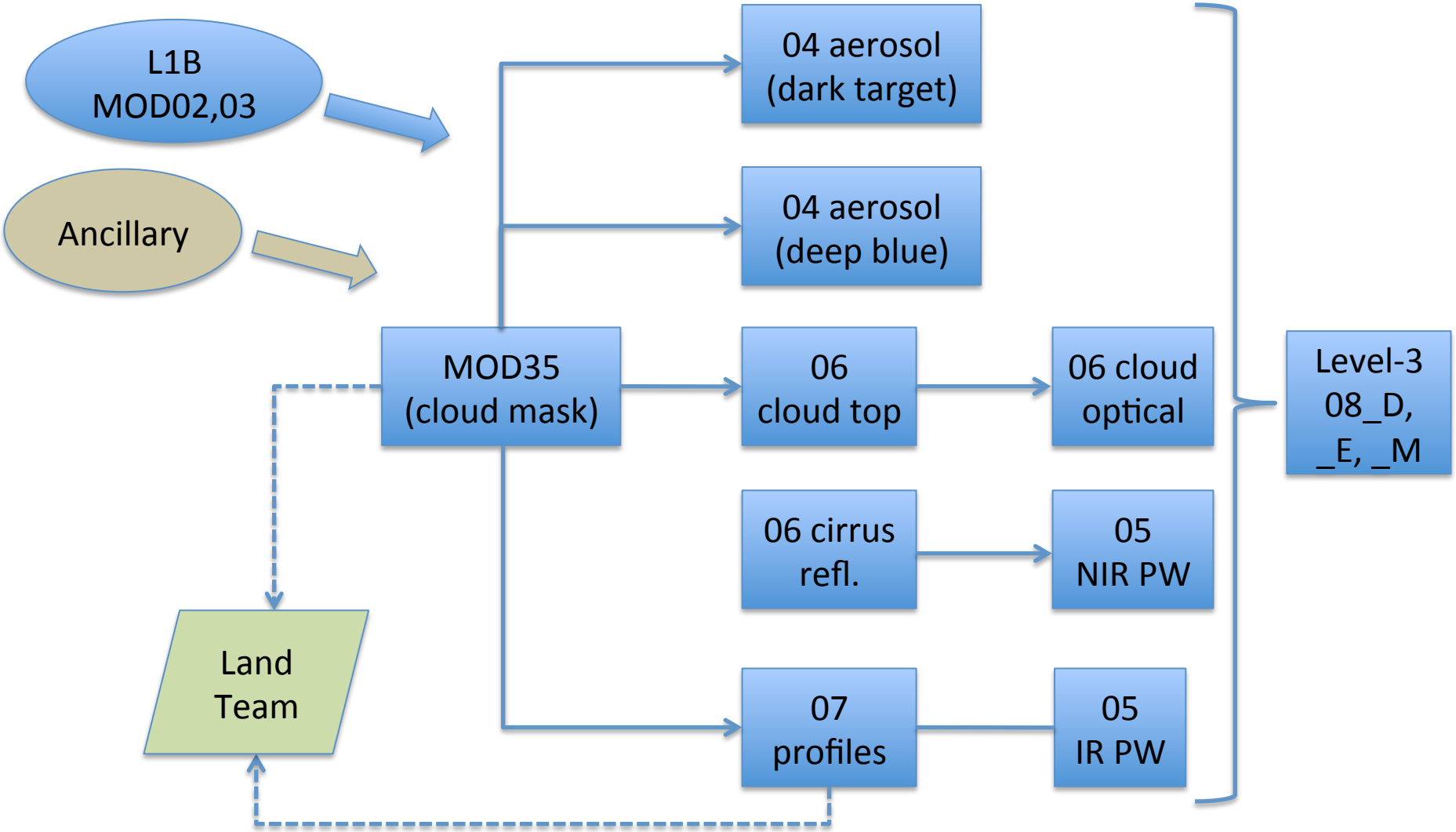
- Algorithm development required a test system (not a production system)
  - minimize delivery overhead, provide a baseline set of fixed input data files, fast turn-around of several months including L3 files. Provide on-line tracking of testing and visualization support (B. Ridgway)
- Science Test Systems for Land / Atmosphere
  - Run Atmosphere codes at 30x with online product archive

MOD_PR06OD Through the Ages

Product execution time for an average granule (70% cloudy)



MODIS Atmosphere Team Algorithm Dependencies



MODIS Atmosphere Team Documents: Science Testing - Archive Set PGE Versions

Updated: 05/16/2011

Contacts | C6 Schedule | Linux OS Tests | PGE03 C6 Tests | PGE04 C51 Tests | PGE04 C6 Tests | PGE06 OO Tests | C6 L1B Tests | PGE Version Tracker

ARCHIVE	MISSION	PGE01	PGE02	PGE03	PGE04	PGE06	PGE56	PGE57	PGE69	PGE70	PGE83
312	Aqua	v5.0.39	v5.0.35.2	v6.0.11	v51.0.11	v51.0.7	v51.0.2	v51.0.1	v51.0.2	v51.0.1	v51.0.1
312	Terra	v5.0.32	v5.0.40.25	v6.0.11	v51.0.11	v51.0.7	v51.0.2	v51.0.1	v51.0.2	v51.0.1	v51.0.1
315	Aqua	v5.0.32	v5.0.37.0	v5.2.6							
315	Terra	v5.0.40	v5.0.44.0	v5.3.1							
318	Aqua			v5.2.6	v51.0.11	v6.0.15	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
318	Terra			v5.3.1	v51.0.11	v6.0.15	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
319	Aqua	v5.0.39	v5.0.35.2	v5.2.6	v51.0.12	v51.0.8	v51.0.2		v51.0.2		v51.0.1
319	Terra	v5.0.39	v5.0.44.8	v5.3.1	v51.0.12	v51.0.8	v51.0.2		v51.0.2		v51.0.1
320	Aqua	v5.0.39	v5.0.35.2	v5.2.6	v51.0.11	v51.0.8	v51.0.2		v51.0.2		v51.0.1
320	Terra	v5.0.39	v5.0.44.8	v5.3.1	v51.0.11	v51.0.8	v51.0.2		v51.0.2		v51.0.1
332	Aqua			v5.2.6	v51.0.11	v6.0.16	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
332	Terra			v5.3.1	v51.0.11	v6.0.16	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
341	Aqua			v5.2.6	v51.0.11	v6.0.20	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
341	Terra			v5.3.1	v51.0.11	v6.0.20	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
350	Aqua			v5.2.6	v51.0.11	v6.0.21	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
350	Terra			v5.3.1	v51.0.11	v6.0.21	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
352	Aqua			v5.2.6	v51.0.11	v6.0.23	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
352	Terra			v5.3.1	v51.0.11	v6.0.23	v6.0.1	v6.0.0	v6.0.1	v6.0.0	
353	Aqua			v5.2.6	v6.0.5	v6.0.23	v51.0.2	v51.0.1	v51.0.2	v51.0.1	
353	Terra			v5.3.1	v6.0.5	v6.0.23	v51.0.2	v51.0.1	v51.0.2	v51.0.1	
354	Aqua	v5.0.40	v6.1.7.3	v5.2.6	v6.0.5	v6.0.23	v51.0.2	v51.0.1	v51.0.2	v51.0.1	
354	Terra	v5.0.40	v6.1.6.3	v5.3.1	v6.0.5	v6.0.23	v51.0.2	v51.0.1	v51.0.2	v51.0.1	
355	Aqua	v6.0.7	v6.1.13.0								
355	Terra	v6.0.7	v6.1.12.0								
361	Aqua										
361	Terra	v5.0.40	v6.1.12.0	v5.3.1	v6.0.5	v6.0.23	v51.0.2	v51.0.1	v51.0.2	v51.0.1	

MODIS Atmosphere Team Documents: C6 Schedule

Updated: 05/16/2011

Contacts | C6 Schedule | Linux OS Tests | PGE03 C6 Tests | PGE04 C5.1 Tests | PGE04 C6 Tests | PGE06 OD Tests | C6 L1B Tests | PGE Version Tracker

This table identifies code deliveries and science tests planned for C6 Terra and Aqua reprocessing. For additional information about test objectives, PGE versions, test products and images, click on appropriate button above.

C6 Algorithm Update	Complete By ?	Status
L1B Calibration	Early June	**Purpose:** Run Collection 51 and Collection 6 algorithms with proposed C6 L1B to assess the impact of new calibration and geolocation changes on all downstream products. **Status:** Tests covering Jan/July 2003, 2008, 2010 are running. Additional days generated for Deep Blue algorithm analysis. (Data available via LAADS private archive.) **Note:** Significant calibration changes were included in April L1B code deliveries. RVS corrections are based on stable 'Earth View' desert scenes. The RVS corrections impact Bands 1,2,3,8.
Cloud Mask	Completed 2010	PGE03 v6.0.13 has been fully tested by Atmosphere and Land teams. Results in AS312 with baseline AS256
Dark Target Aerosol	Late Summer	PGE04: 3km test successful. Continuing L1B sensitivity studies. Reference LAADS AS 308, 309, 310, 311, 353, 354, 361.
Deep Blue Aerosol	Uncertain	PGE04: Assessing L1B calibration, no delivery yet
Near-IR Water Vapor	Completed	PGE05: Delivered, testing complete
Clear Sky Radiance	Uncertain	PGE85: testing at Wisconsin
Cloud Top Properties	Uncertain	MOD_PR06CT: testing at Wisconsin
Cirrus Reflectance	Completed	PGE06: Delivered, testing complete
Cloud Optical Properties	Late summer	MOD_PR06OD: Have completed approximately 8 of 12 tests of C6 Optical Properties code
Joint ATML2 Product	Uncertain	Delivery approximately 60 days after L2 code frameworks finalized.
L3 Products	Uncertain	First test of templates that include C6 MOD06 SDS additions successful

KEY

Completed	Started	Planned

Atmosphere Collection 6 Planned Updates: Link to PDF Document

Please submit updates and corrections to: Bill.Ridgway@NASA.gov

Responsible NASA Official: Steven.E.Platnick@NASA.gov

MODIS Atmosphere Team Documents: PGE06 OD Tests

Updated: 04/25/2011

Contacts | C6 Schedule | Linux OS Tests | PGE03 C6 Tests | PGE04 C5.1 Tests | PGE04 C6 Tests | PGE06 OD Tests | C6 L1B Tests | PGE Version Tracker

This table provides links to archived Science Test data (LAADS) and images (PGE TEST NAME). The primary baseline period for these tests is April 2005. Monthly test products are produced for single Terra and/or Aqua months. A large cross-section of two dimensional (360x180) monthly mean products are displayed along with difference maps with respect to a prior baseline test.

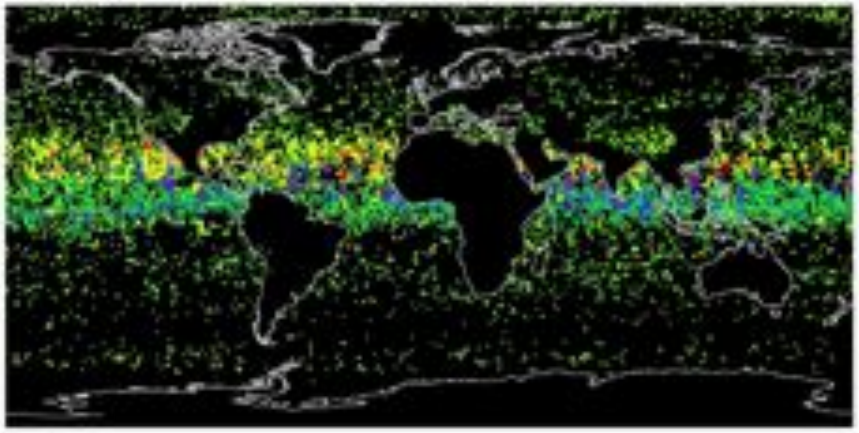
TEST	PGE TEST NAME	CODE	LAADS	DATE	DESCRIPTION
8	Full 3.7um Tc iteration Reference Document Link to Images (planned)	PGE06 v6.0.24	TBD	TBD	**Purpose:** Test the full implementation of 3.7um Tc iteration. Cloud top temperature (Tc) is now adjusted iteratively based on retrieved 3.7um optical thickness and effective radius. **Result:** TBD
8D.1	Re-test of 8D with bug fix. Reference Document Link to Images	PGE06 v6.0.23	A5352	04/08/11	**Purpose:** Test bug fix for bug found in assignment of 3.7μm surface albedo over permanent snow/ice. **Result:** Test successful. Continuing towards science test 8.0
8D	New 3.7μm land surface albedo, new column ozone from GDAS, optimized forward library handling Reference Document Link to Images	PGE06 v6.0.22	A5351 (deleted)	04/04/11	**Purpose:** Continued changes to accommodate the UW-Madison IRW retrieval. We use the 3.7μm land surface albedo from a UW-Madison database instead of calculating it as 0.5*As_2.1. We evaluate impact of using spatially and temporally interpolated column ozone from GDAS vs daily TOAST product without any interpolation. **Result:** Overall very good. Small bug found in assignment of 3.7μm surface albedo over permanent snow/ice. Retesting.
8C	Correcting McGarrah 1KM Cloud Top Product Reference Document Link to Images	PGE06 v6.0.21	A5350	04/04/11	**Purpose:** Testing fix made to U. Wisconsin IRW retrieval where the interpolation/extrapolation of GDAS profiles from 26 levels to 101 levels was found to return non-physical values from 1000 and 1100 mb for cases when surface pressure is greater than 1000 mb. **Result:**Test successful. Continuing towards science test 8.0.
8B.1	Bug fix for Scienc Test 8B. Reference Document Link to Images	PGE06 v6.0.20	A5341	03/18/11	**Purpose:** Re-Test of Science Test 8B to fix surface level handling bug in multilayer cloud algorithm. **Result:**Test successful. Will continue progress towards science test 8.0
8B	Spatially interpolated surface temperature and T2M instead of TSFC GDAS field use. Also further infrastructure changes. Reference Document Link to Images	PGE06 v6.0.17	A5336 (removed)	03/04/11	**Purpose:** Further structural changes to accommodate incoming IR Window retrieval of low cloud temperature. Surface temperature data is now coming from GDAS T2M instead of TSFC field as per Wisconsin comment that T2M field has better quality. **Result:** Overall good result for 3.7 micron changes that were the focus of this test. However handling of surface level in multilayer cloud algorithm appears to have a bug. False positives appeared at high elevations. There will be a re-test.
8A	New Ancillary Infrastructure Reference Document Link to Images	PGE06 v6.0.16	A5332	02-22-11	**Purpose:** This test is in preparation for integration of UW-Madison IRW retrieval as part of iterative 3.7 micron effective radius retrieval to account for cloud emissivity. **Result:** Test successful. No code problems.
7.0	GDAS temporal interpolation and increased vertical resolution Reference Document Link to Images	PGE06 v6.0.15	A5318	01-31-11	**Purpose:** Examine the effect of GDAS temporal interpolation to granule time instead of nearest time being selected. Collection 5 ancillary module improperly discarded available GDAS pressure levels, downsampling instead of downgrading. For this test we will use all available GDAS pressure levels to perform atmospheric correction and multilayer cloud detection. **Result:** Test successful. 3.7 micron retrieval clearly shows the effect of using a model that becomes stale as time progresses, particularly for Aqua.

Science Test Image Archive

Aerosols | Cloud_Top | Cloud_Thickness | Particle_Radius | Uncertainty | Cloud_Water_Path | Water_Vapor | Other

Cloud_Optical_Thickness_1621_Ice_Mean_Mean

AS 352 - 350



Test Data - Baseline Data

units = "none"

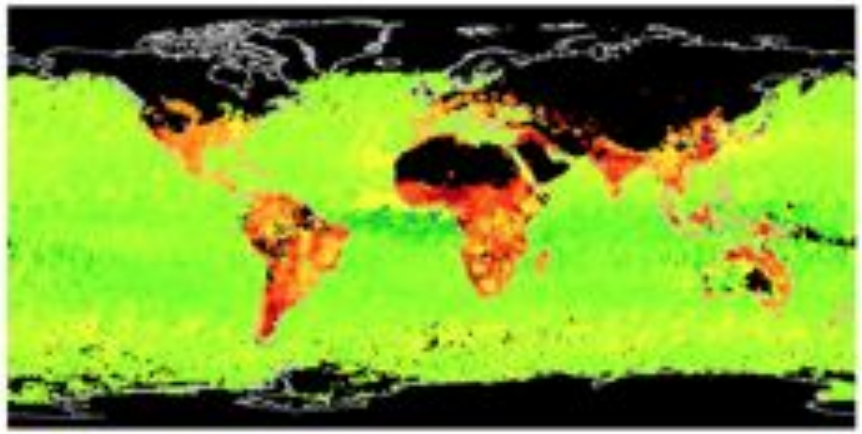
Cloud_Thickness

base	test	diff	Cloud_Optical_Thickness_1621_Ice_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_1621_Ice_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_1621_Liquid_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_1621_Liquid_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_IL_Ice_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_IL_Ice_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_IL_Liquid_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_IL_Liquid_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Combined_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Combined_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Combined_QA_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Combined_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Ice_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Ice_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Ice_QA_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Ice_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Liquid_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Liquid_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Liquid_QA_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Liquid_QA_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Undetermined_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Undetermined_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Undetermined_QA_Log_Mean_Mean
base	test	diff	Cloud_Optical_Thickness_Undetermined_QA_Mean_Mean

Science Test Image Archive

Aerosols | Cloud_Top | Cloud_Thickness | Particle_Radius | Uncertainty | Cloud_Water_Path | Water_Vapor | Other

Optical_Depth_Land_And_Ocean_Mean_Mean



AS 361 - 354

0.050
0.033
0.017
0.000
-0.017
-0.033
-0.050

Test Data - Baseline Data

units = "none"

Aerosols

base	test	diff	
base	test	diff	Angstrom_Exponent_1_Ocean_Mean_Mean
base	test	diff	Angstrom_Exponent_1_Ocean_QA_Mean_Mean
base	test	diff	Angstrom_Exponent_2_Ocean_Mean_Mean
base	test	diff	Angstrom_Exponent_2_Ocean_QA_Mean_Mean
base	test	diff	Angstrom_Exponent_Land_Mean_Mean
base	test	diff	Angstrom_Exponent_Land_QA_Mean_Mean
base	test	diff	Dark_Target_Deep_Blue_Combined_Aerosol_Optical_Depth
base	test	diff	Dark_Target_Deep_Blue_Combined_Aerosol_Optical_Depth_Case
base	test	diff	Deep_Blue_Aerosol_Optical_Depth_550_Land_Mean_Mean
base	test	diff	Deep_Blue_Aerosol_Optical_Depth_550_Land_QA_Mean_Mean
base	test	diff	Deep_Blue_Angstrom_Exponent_Land_Mean_Mean
base	test	diff	Deep_Blue_Angstrom_Exponent_Land_QA_Mean_Mean
base	test	diff	Effective_Radius_Ocean_Mean_Mean
base	test	diff	Effective_Radius_Ocean_QA_Mean_Mean
base	test	diff	Number_Pixels_Used_Ocean_Mean_Mean
base	test	diff	Effective_Optical_Depth_Average_Ocean_Mean_Mean
base	test	diff	Optical_Depth_Land_And_Ocean_Mean_Mean
base	test	diff	Optical_Depth_Ratio_Small_Land_And_Ocean_Mean_Mean
base	test	diff	Optical_Depth_Ratio_Small_Land_Mean_Mean
base	test	diff	Optical_Depth_Ratio_Small_Land_QA_Mean_Mean
base	test	diff	Optical_Depth_Ratio_Small_Ocean_Mean_Mean
base	test	diff	Optical_Depth_Ratio_Small_Ocean_QA_Mean_Mean

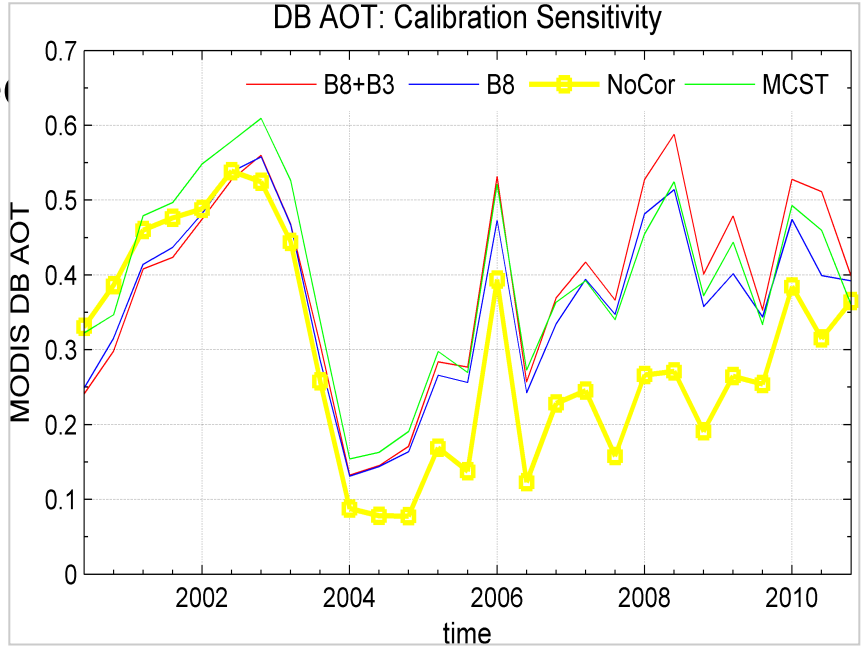
Nominal Schedule for Atmosphere C6 Development, Testing and Reprocessing

June 2011	L1B calibration assessments
June-Sept 2011	L2 delivery and testing cycle continues
July-Sept 2011	C6 L1B & Cloud Mask reprocessing
Sept 2011	FileSpec for L2 products finalized
Oct-Nov 2011	L3 delivery and testing
Nov-Dec 2011	Final PGE science testing
Jan 2012	C6 reprocessing ready to start ?
Apr 2012	C6 reprocessing complete

Key Issues/Efforts: Instrument

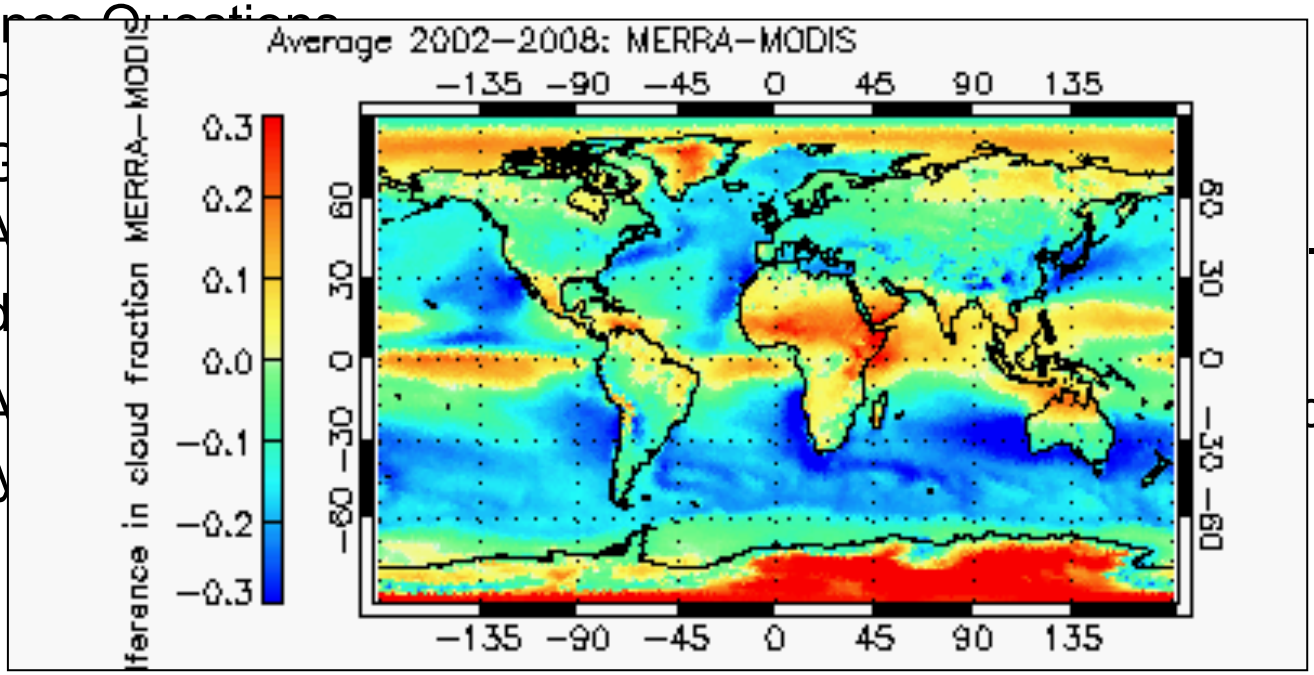
Instrument

- Band 1, 2, 3 RVS trends.
  - MCST “Approach 2” promising
- Band 8 polarization
  - “Differences between MCST and OBPG calibration methods for C6 are small in terms of DB retrieved parameters.” R. Hansell, C. Hsu
- Characterization support more ne
  climate quality data records!



Key Issues/Efforts: Low Marine Clouds

- Retrieval Issues
  - Spectral effective radius discrepancies [Zhang]
  - 3D radiative transfer and role of drizzle [Zhang, Di Girolamo]
- Scien
  - P [Yuter]
  - G
  - A .]
- Field
  - A oud
    ty



Difference in average cloud fraction for 2002-2008 between MERRA and MODIS-Terra (courtesy C. Naud)

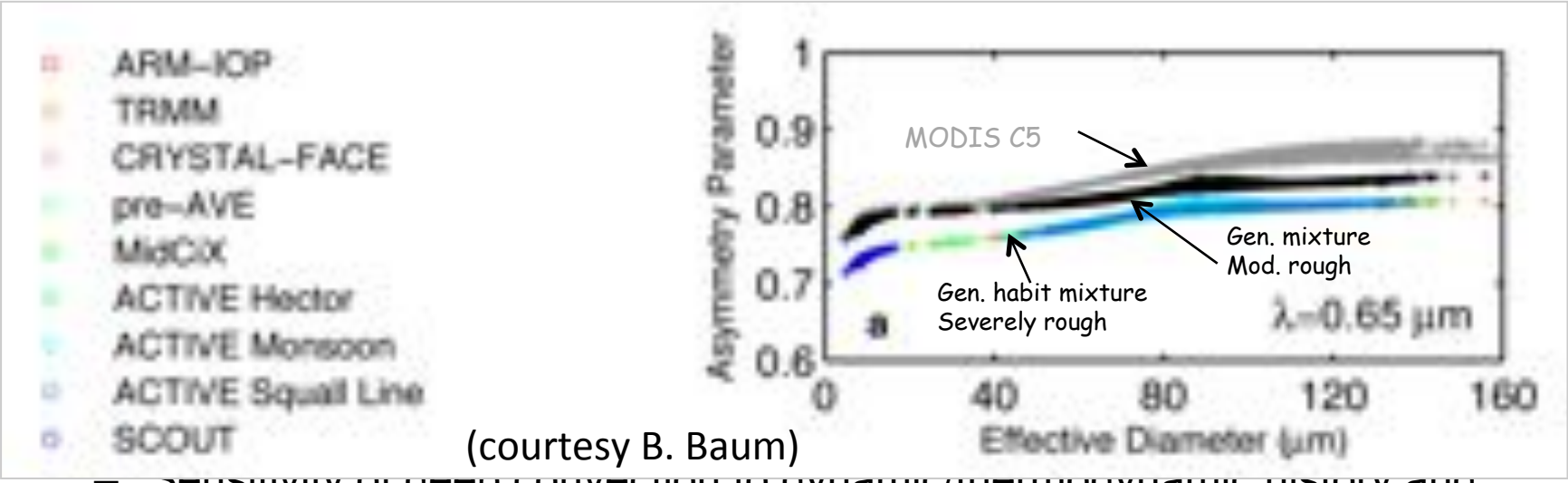
Key Issues/Efforts: Ice Clouds

- Retrieval Issues

  Ice Cloud Radiative Models

  – Tuesday workshop held at Goddard with CALIPSO and MODIS team members.

  – Radiative Transfer: Improved scattering calculations [Ping Yang], habits and size distributions [Baum, A. Heymsfeld]



(courtesy B. Baum)

  – Sensitivity of deep convection to dynamic/thermodynamic history and aerosols [Wilcox]

Major Science Issues/Efforts: Aerosol Transport and Radiative Effects

- CO and aerosol retrievals, local radiative forcing: David Edwards
- Absorbing aerosol impacts on atmospheric heating and accelerated snowpack melting in Himalayas/Tibetan Plateau: W. Lau, Kyu-Myong, Ritesh, Hsu, Yasunari
- The dispersal and evolution of volcanic plumes: Vincent Realmuto
- Aerosol transport and climatic impacts: Hongbin Yu