

GEOS-5 During ORACLES: Status Update

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ORACLES Science Team Meeting

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Outline



□ GEOS-5 Model Status:

➤ Forward Processing:

- » September 2016 → August 2017
- » Recent development (cloud & aerosol μ physics)

□ Aerosol vertical structure

➤ Tracking down low placement of plume

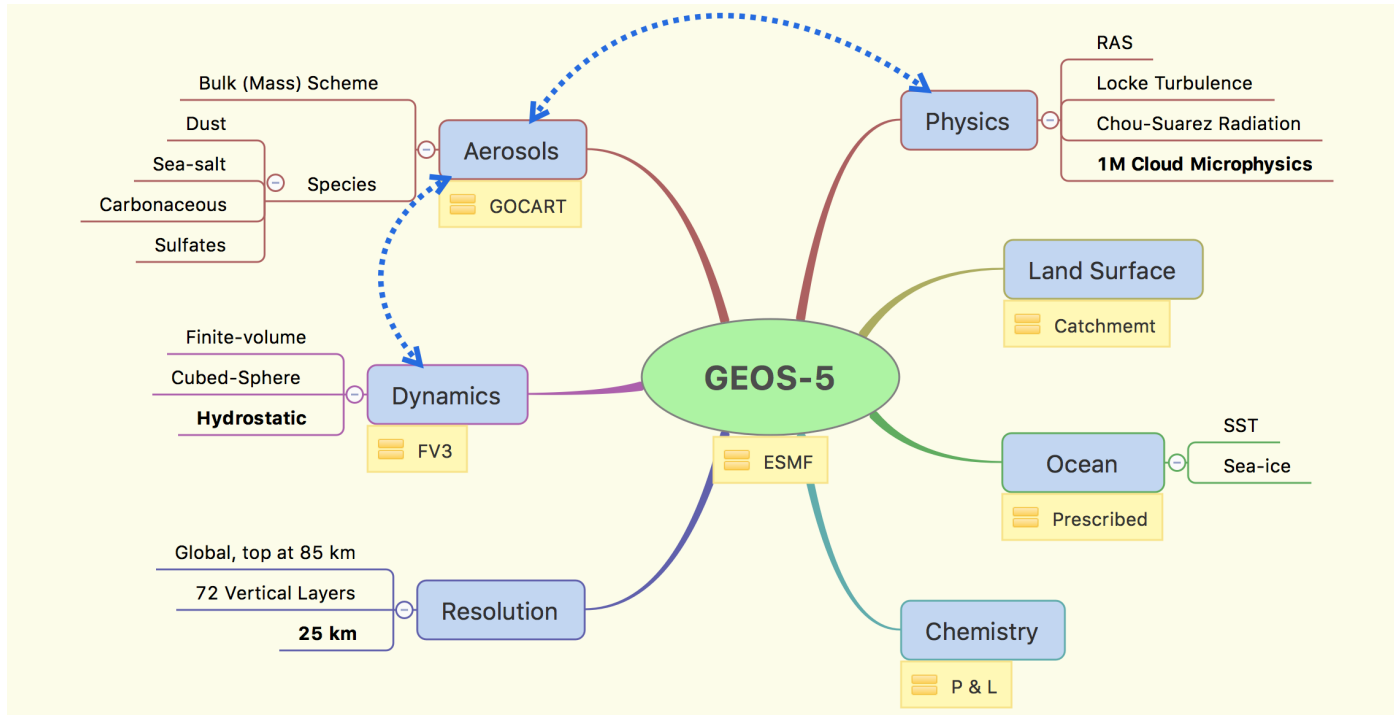
□ Cloud cover: spatial distribution and diurnal cycle

□ Plans for mini-reanalysis

➤ Evaluating Aerosol Above Cloud Retrievals: OSSE study

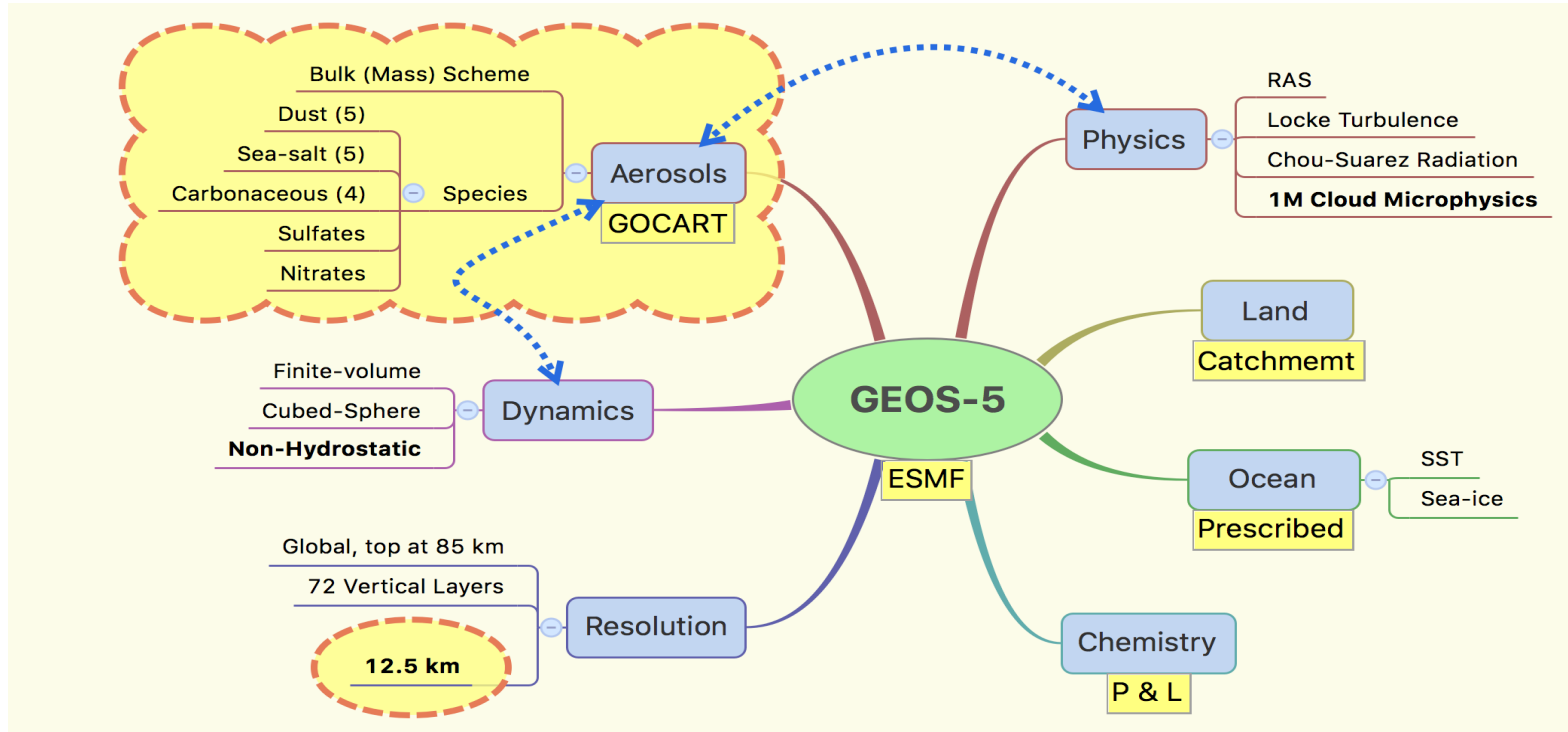
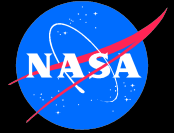
□ Concluding remarks

GEOS-5 Model Configuration during ORACLES 2016



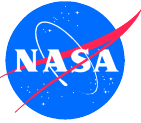
Global, 25 km, 72 Levels, top at 0.01 hPa

GEOS-5 Model Configuration for ORACLES 2017



Global, 12.5 km, 72 Levels, top at 0.01 hPa

GEOS Hybrid 4D-EnVar Implemented December 2016



□ FV³ Dynamical Core

□ Goddard Physics

□ GOCART Aerosols

□ Hybrid GSI

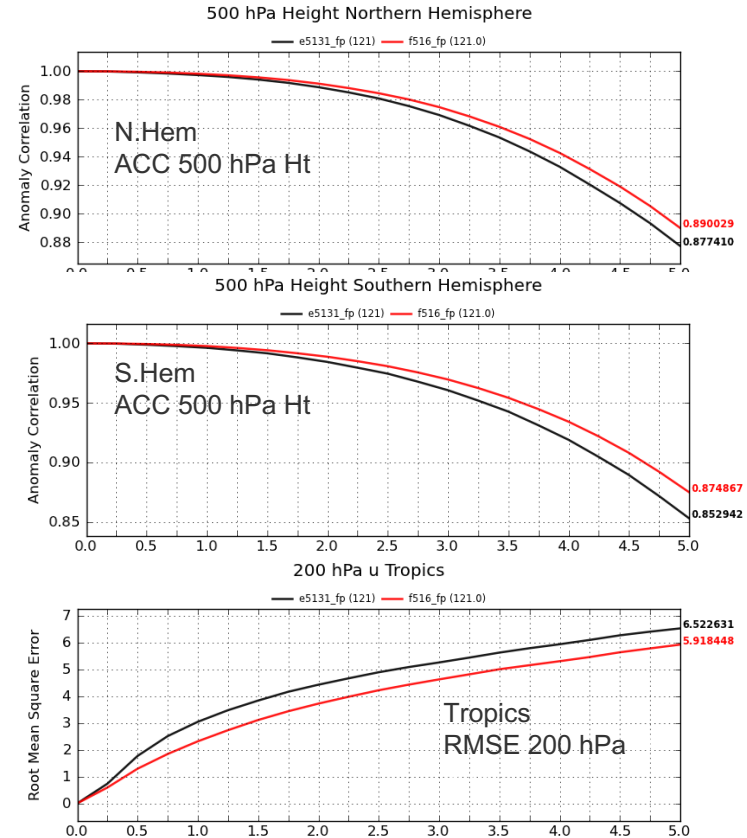
- GCM: C720 L72 (12.5 km)
- GSI: 1152x721 L72 (25 km)
- EnKF: 32xC180 L72 (50 km)
- Semi-coupled skin SST analysis
- Aerosol data assimilation
 - » NNR 3: MODIS C6, including Deep Blue
 - » NRT AERONET L1.5: coming soon

Forecast Skill Significance

— 25km 3D-Hybrid

— 12.5km 4D-EnVar

Dec. 2016 – Mar. 2017



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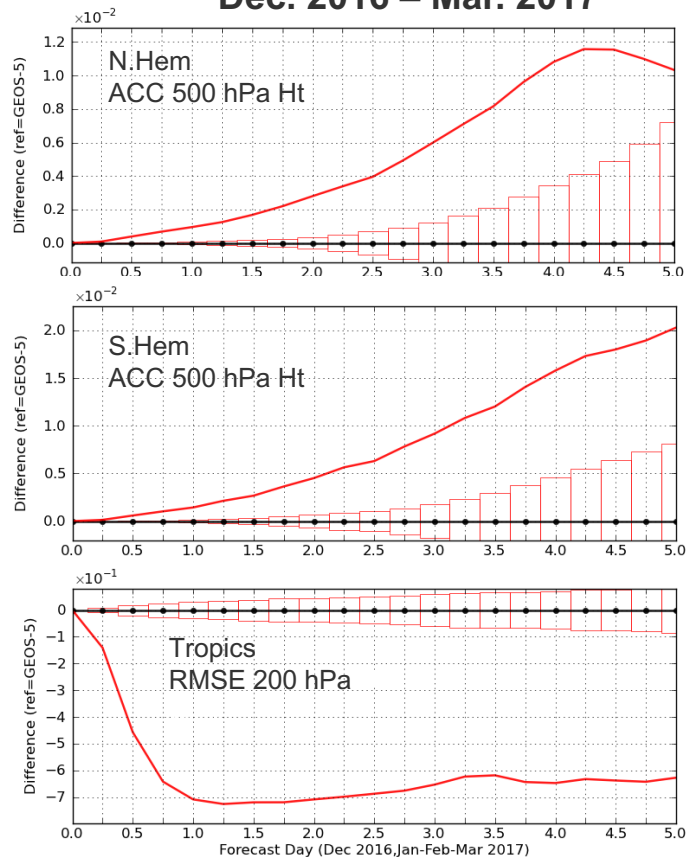
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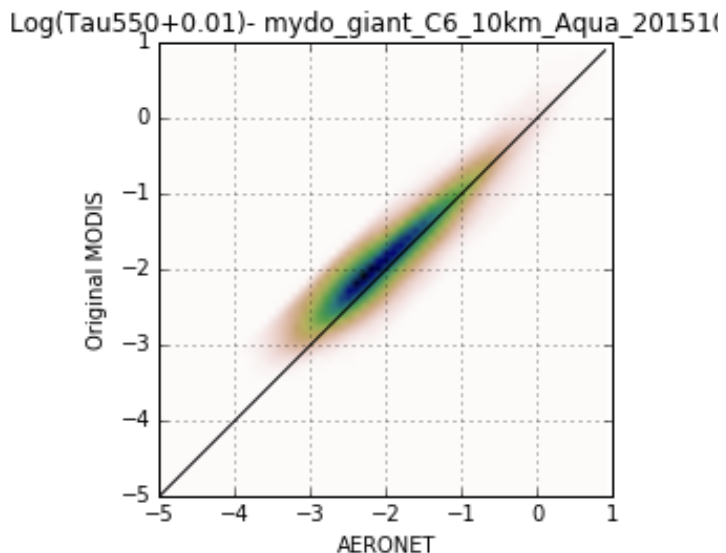


Dec. 2016 – Mar. 2017

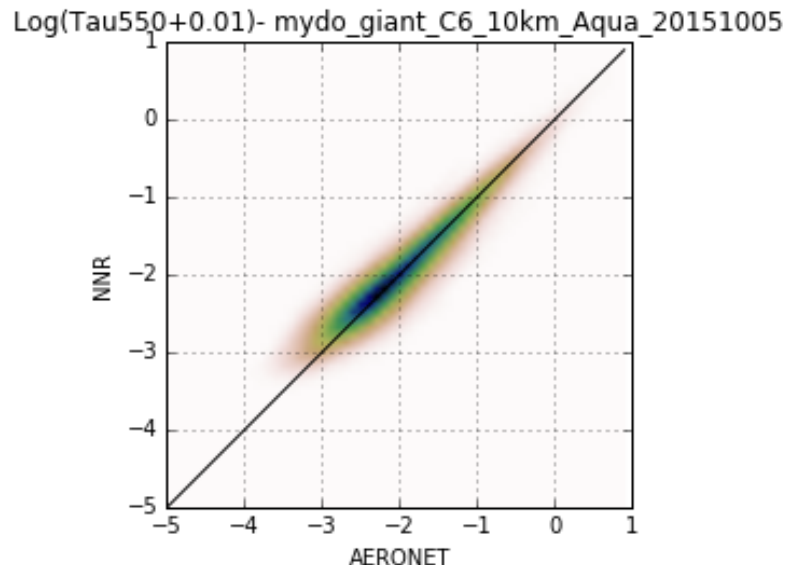


Observational Bias

Original MODIS C6 AOD

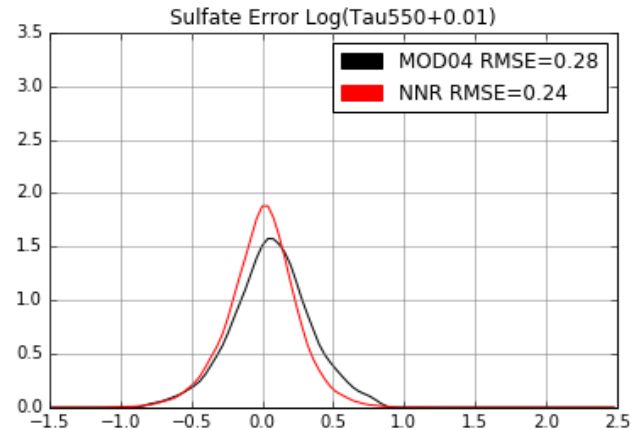
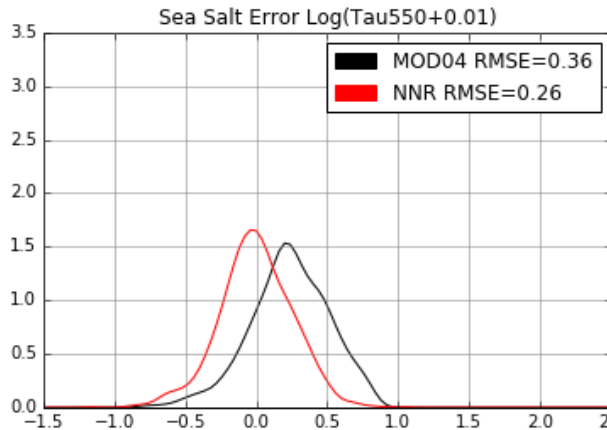
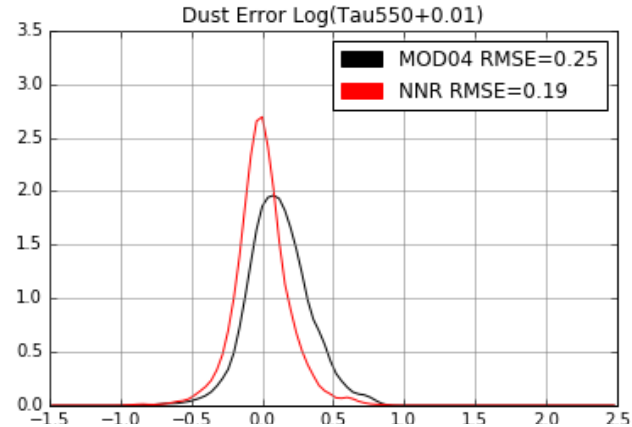
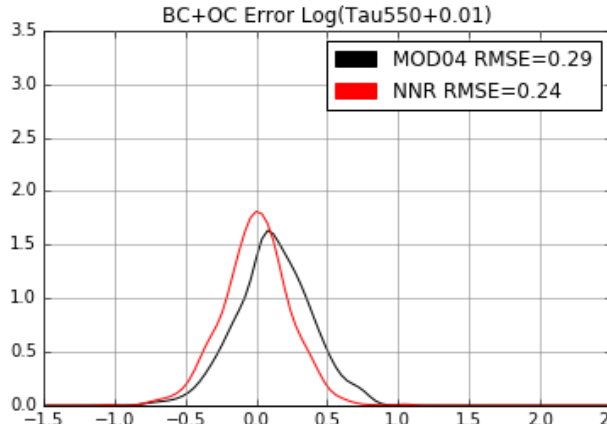
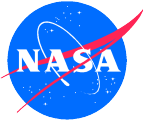


Bias Corrected AOD

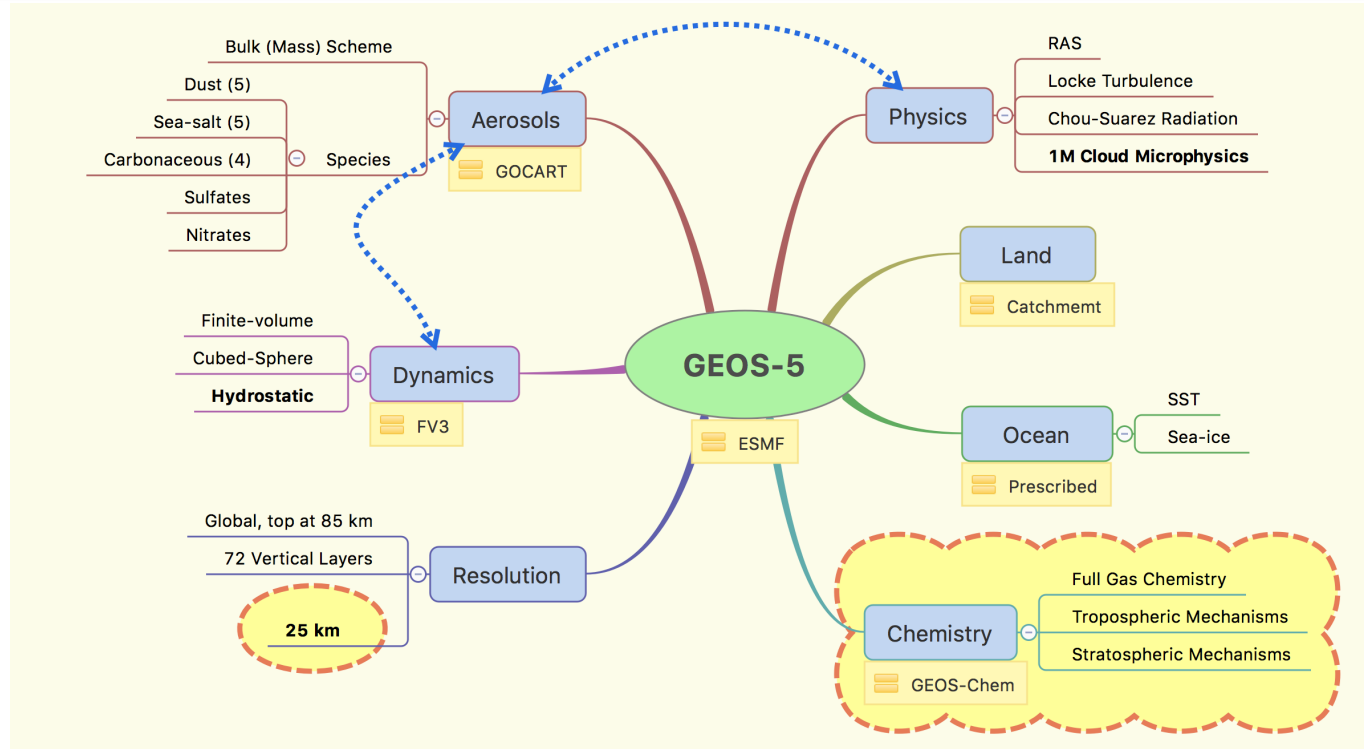


MODIS Neural Net AOD Retrievals trained on AERONET

MODIS Collection 6: Aqua

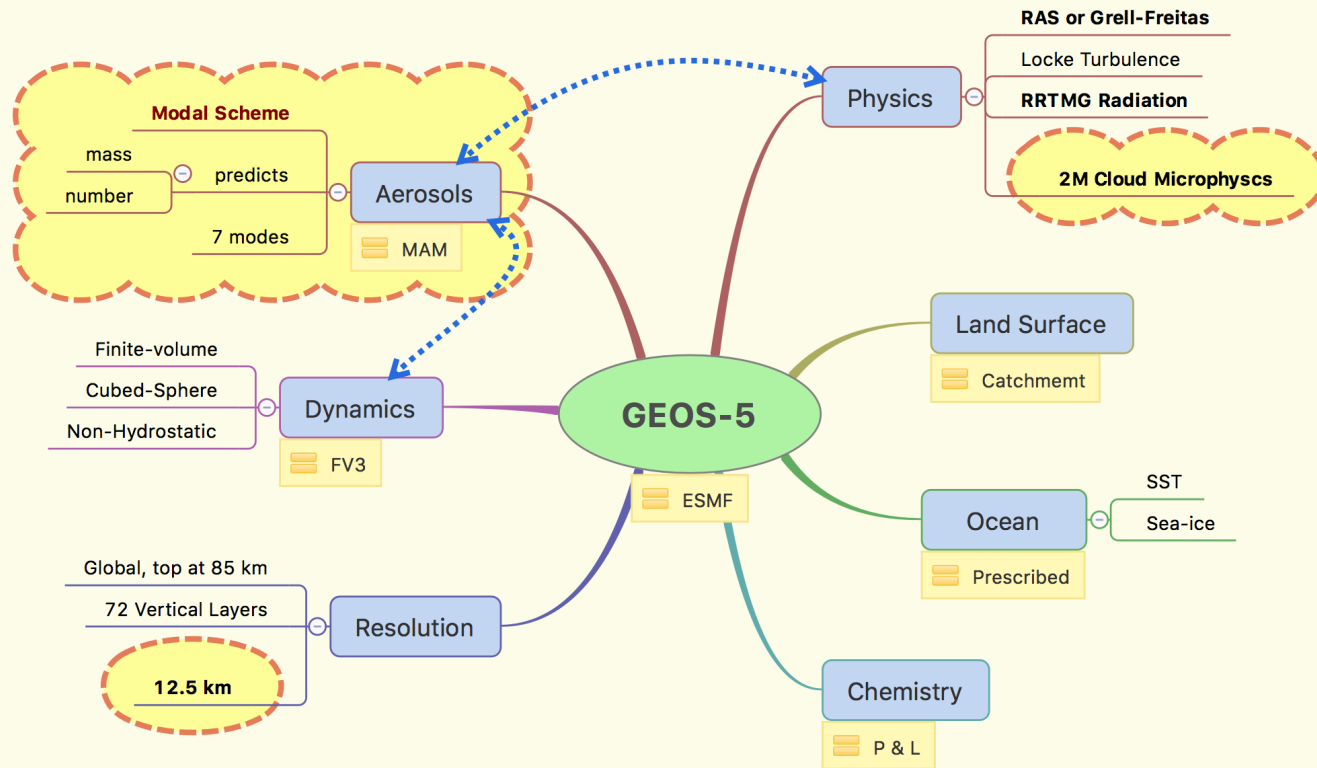
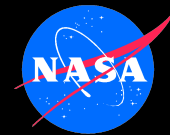


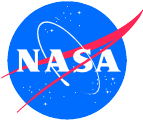
GEOS-5 with Full Chemistry for ORACLES 2017 (NRT Tentative)



Global, 25 km, 72 Levels, top at 0.01 hPa

GEOS-5 with Cloud/Aero μ Physics (for ORACLES Mini-Reanalysis?)

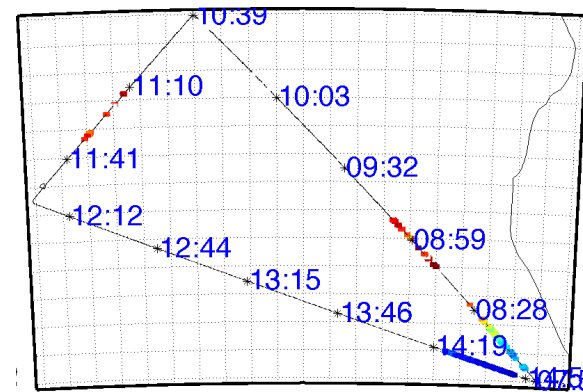
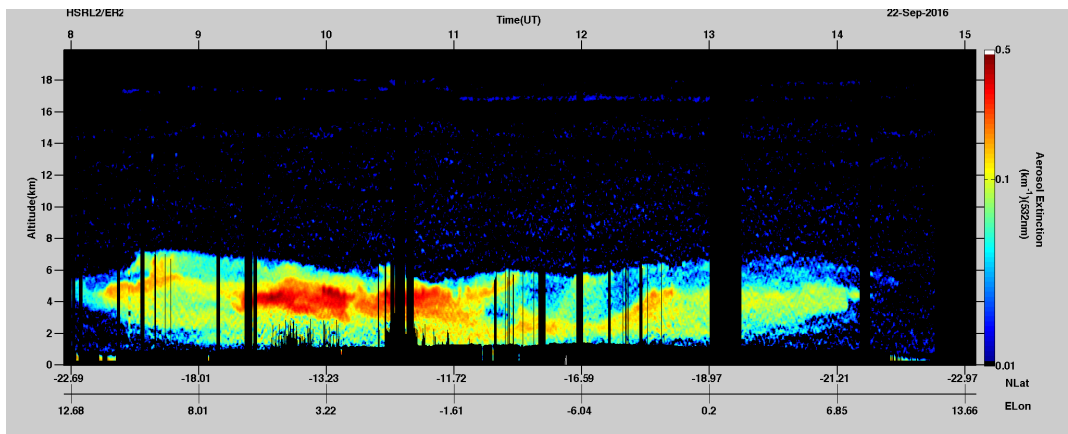




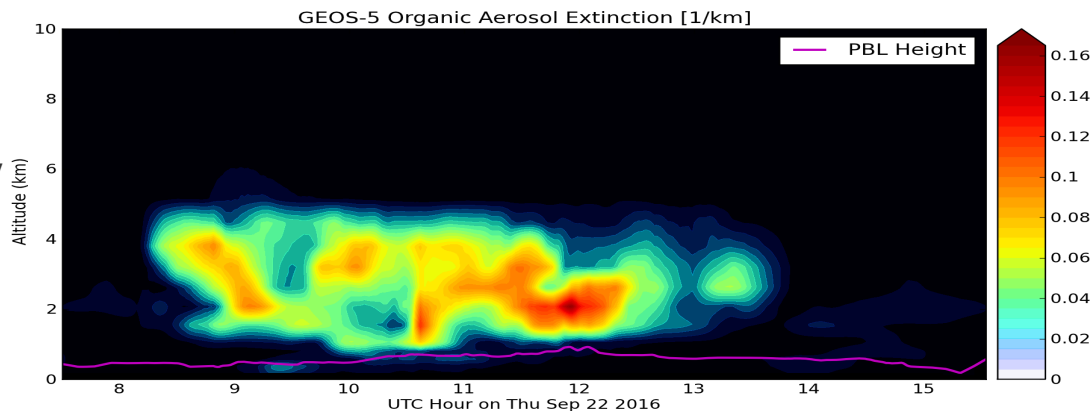
GEOS-5 Issues

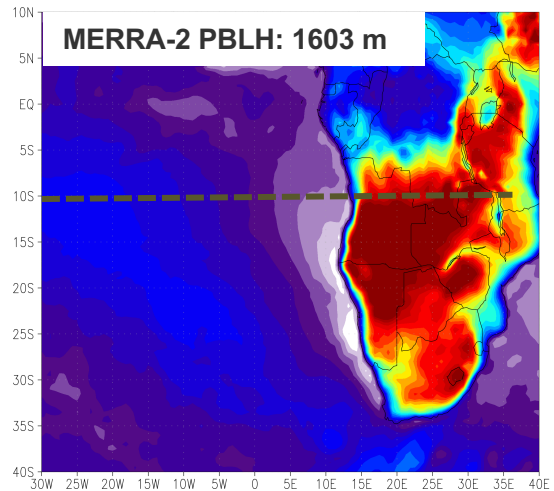
SMOKE AEROSOL: PLUME VERTICAL EXTENT

Aerosol 532 Extinction: 9/22/2016

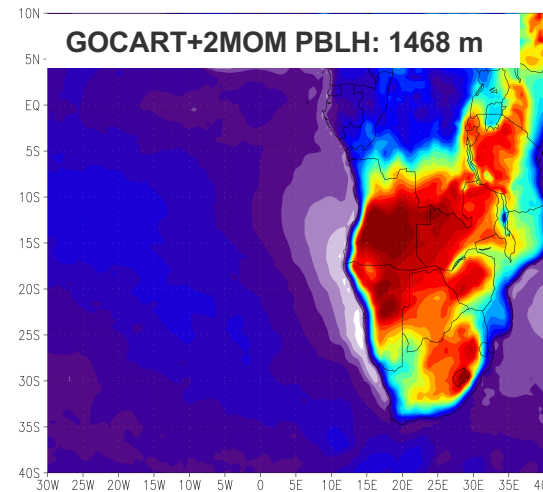
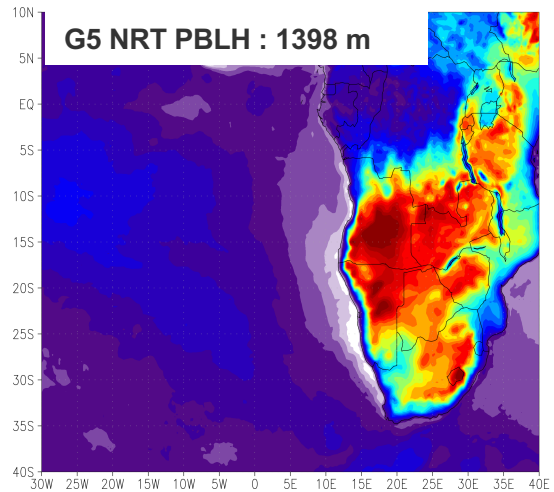
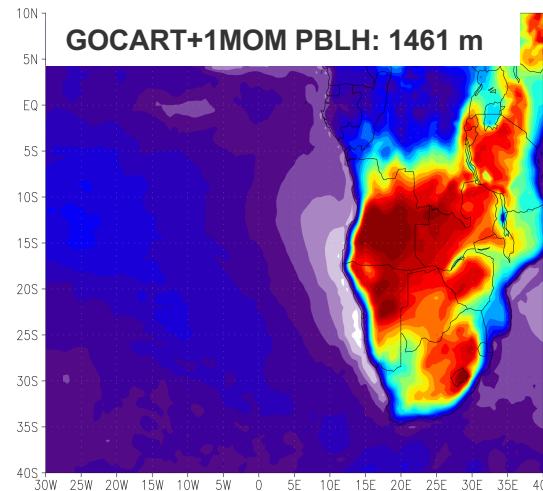


During the campaign, GEOS-5 Smoke Plume was systematically Lower than observations



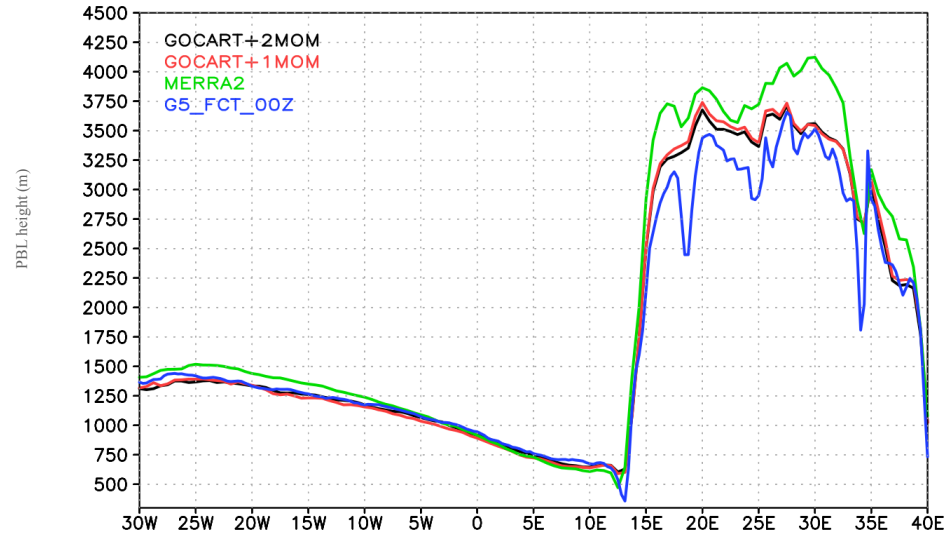
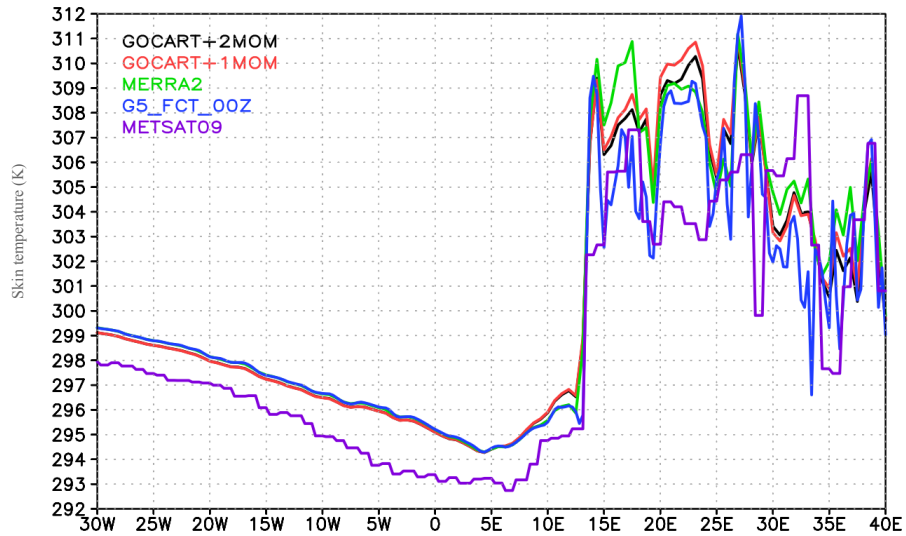


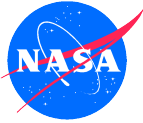
PBL height ASL (m) September 2016





Skin temperature (K) and PBL height ASL (m) September 2016

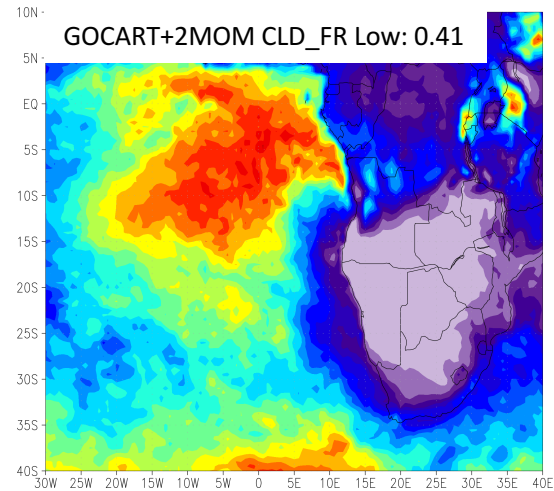
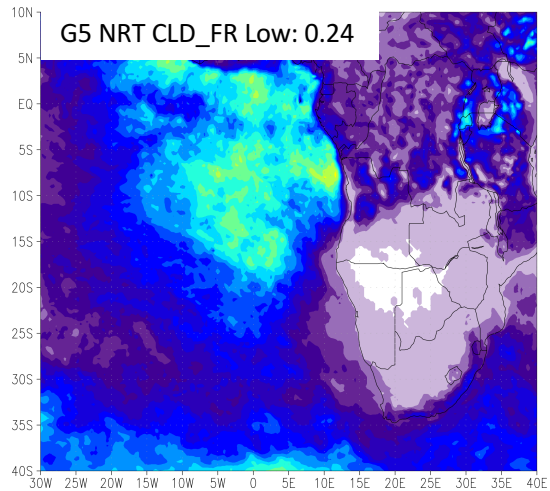
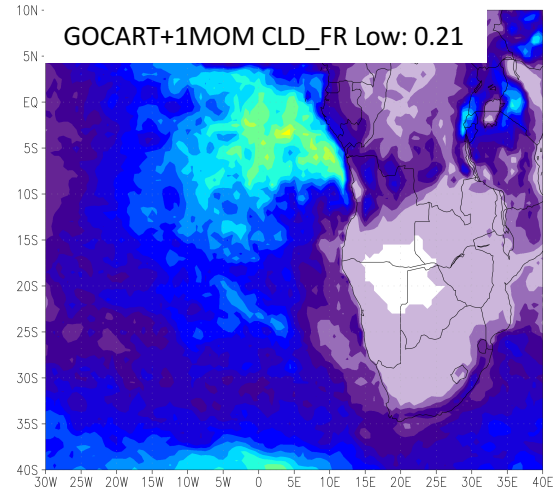
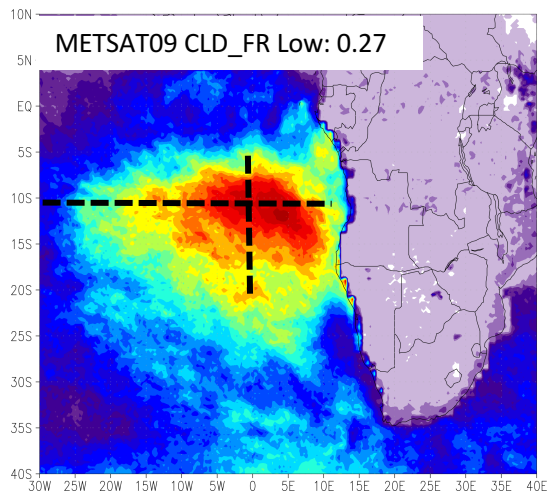
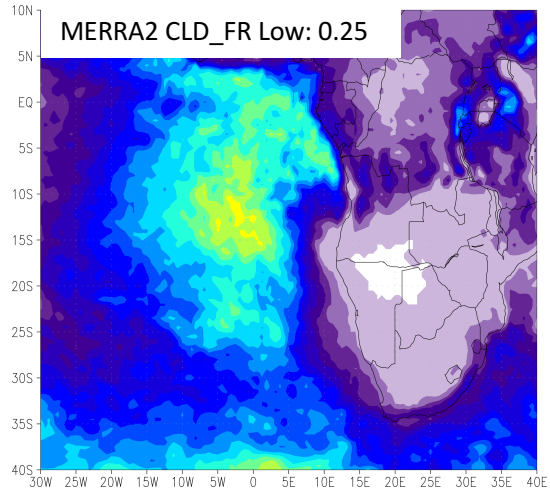




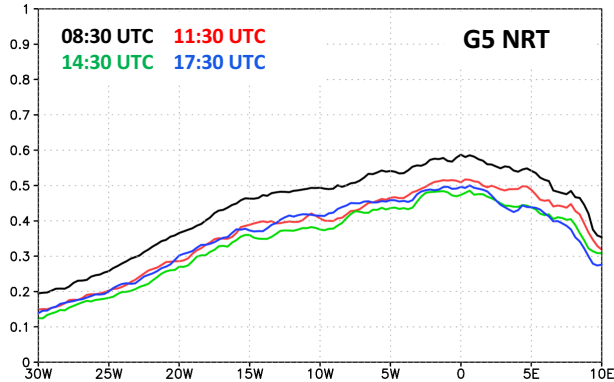
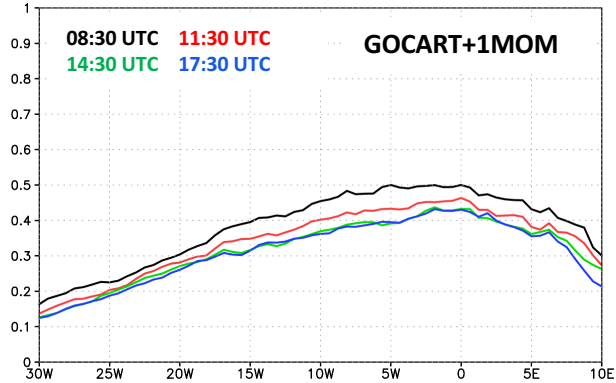
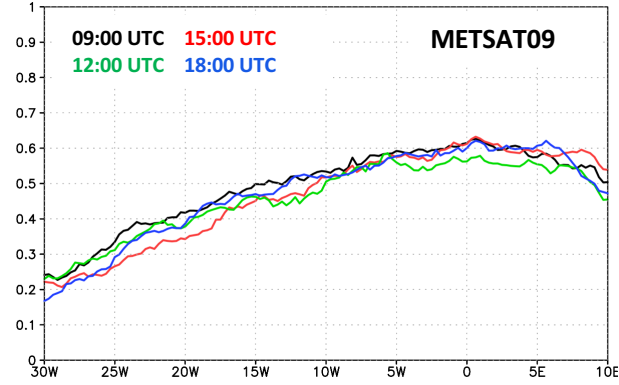
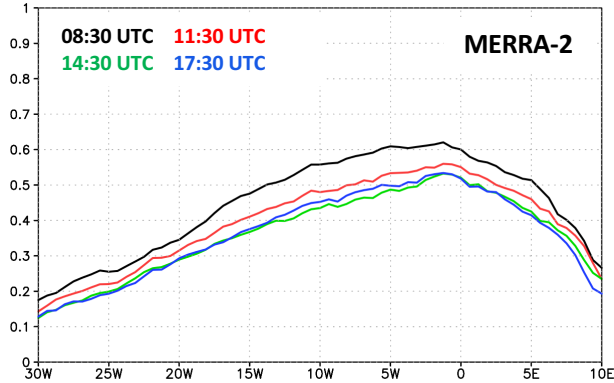
GEOS-5 Issues

LOW-CLOUD COVER

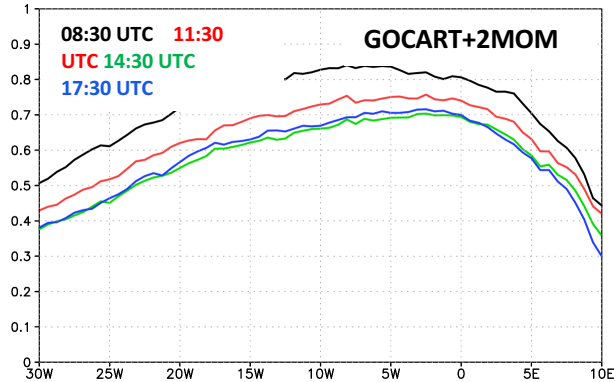
Low-cloud Fraction September 2016



Low-cloud Fraction (20S-5S)



Diurnal Cycle
September 2016





Observation System Simulation Experiment (OSSE)

AEROSOL ABOVE CLOUD RETRIEVALS

with Gala Wind, Kerry Meyer, Steve Platnick





MODIS Cloud & Aerosol Retrieval Simulator

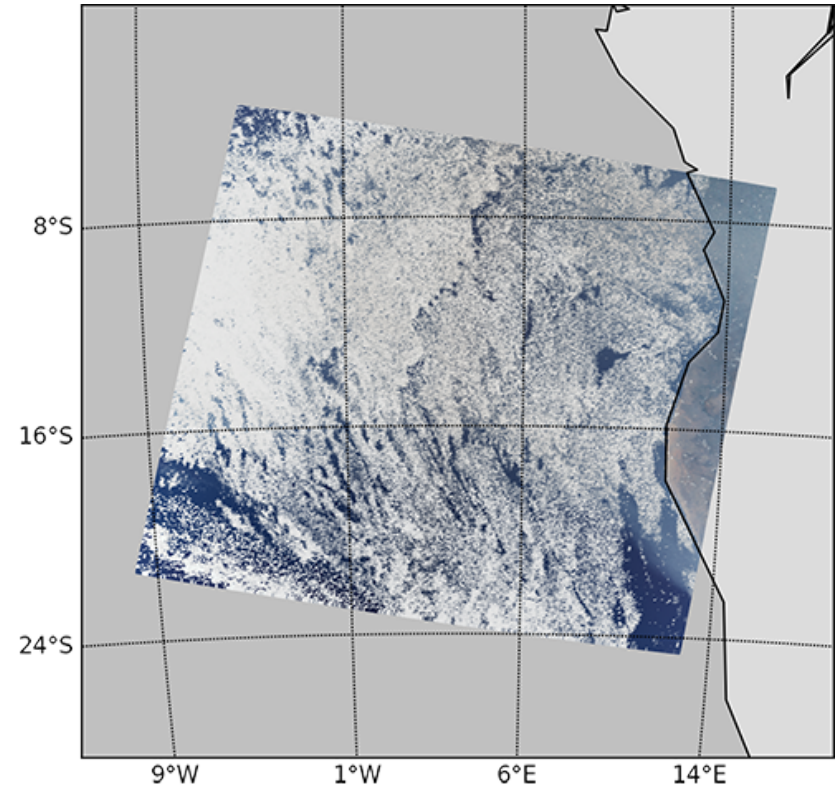
- ❑ Algorithm proofing sandbox
- ❑ 1km MODIS sensor geometry + 7km GEOS-5 Nature Run + Total Water PDF sampling to go from 7km to 1km
- ❑ 25 MODIS channels (410nm – 14.2 μ m)
- ❑ Correlated-k atmospheric transmittance model
- ❑ DISORT-5 radiative transfer core
- ❑ Output to standard 1-km MODIS radiance file
- ❑ Any data product code runs as if presented with real data, no awareness of radiance source
- ❑ Can examine retrieval code in fine detail
- ❑ Supercomputing application (400 processors, 8.5 hours wall-clock-time, 32 streams per granule)



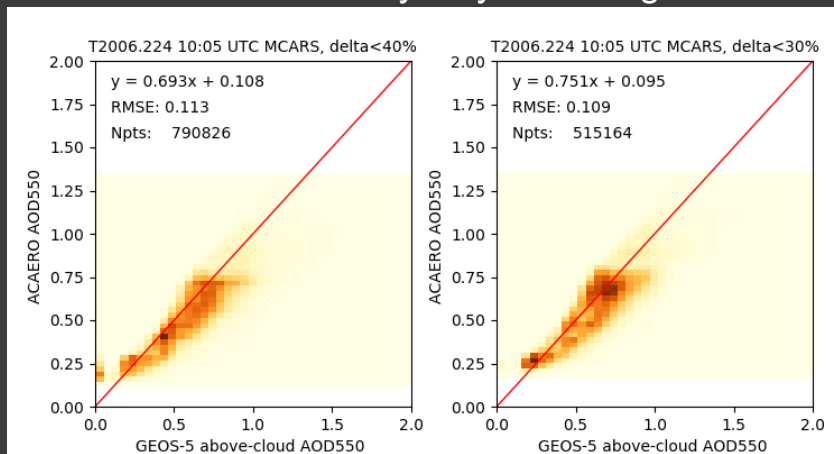
MODIS ACAERO Algorithm Evaluation



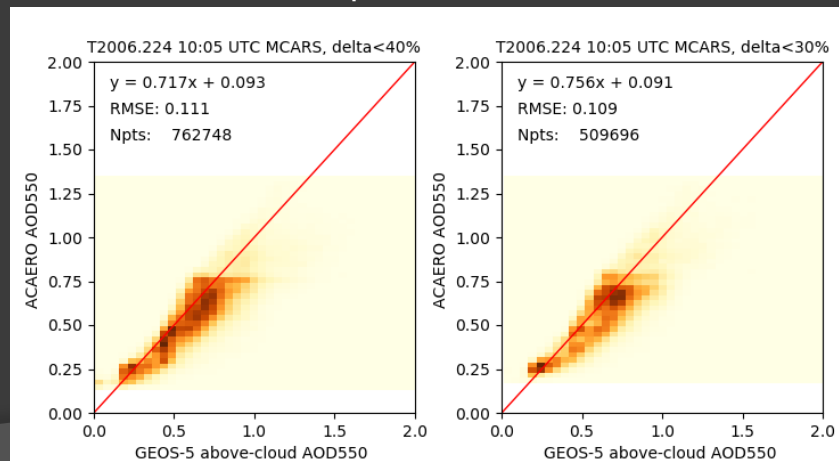
- ❑ MODIS Above-Cloud Aerosol Optical Properties by K. Meyer
- ❑ Returns aerosol optical depth, cloud optical thickness and cloud effective radius with pixel-level uncertainty at 1km resolution
- ❑ Uses 6 MODIS channels (440nm – 2.1 μ m)
- ❑ MODIS Dark-Target operational absorbing aerosol model
- ❑ Above-cloud retrievals over marine boundary layer clouds
- ❑ Uses MODIS Cloud product for cloud top pressure and cloud thermodynamic phase information
- ❑ Ran during ORACLES campaign as a near-real-time (NRT) product



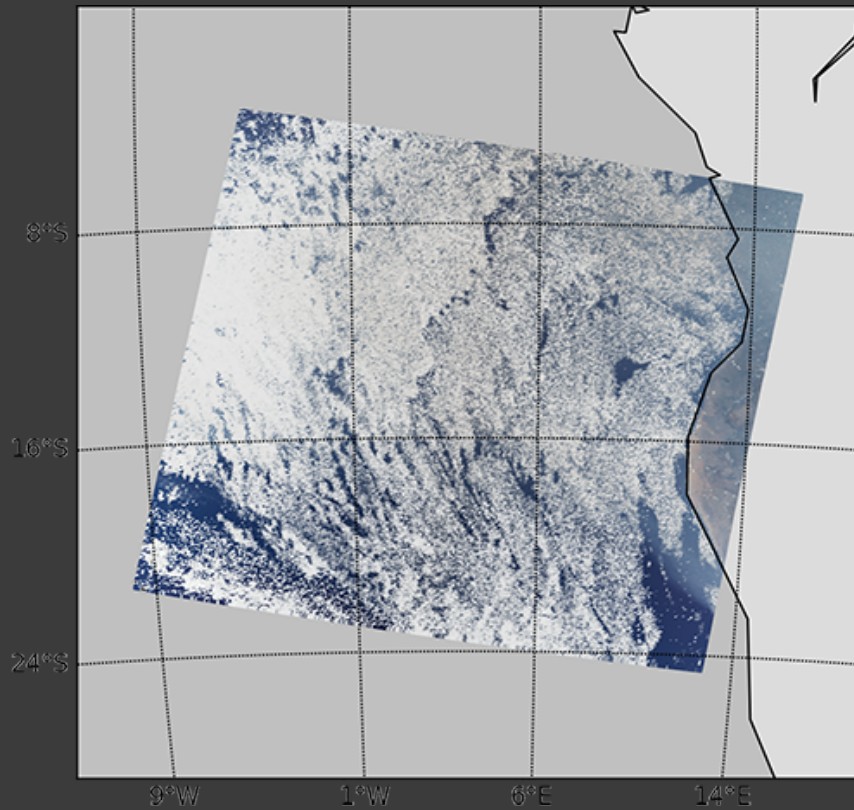
Uncertainty-only screening



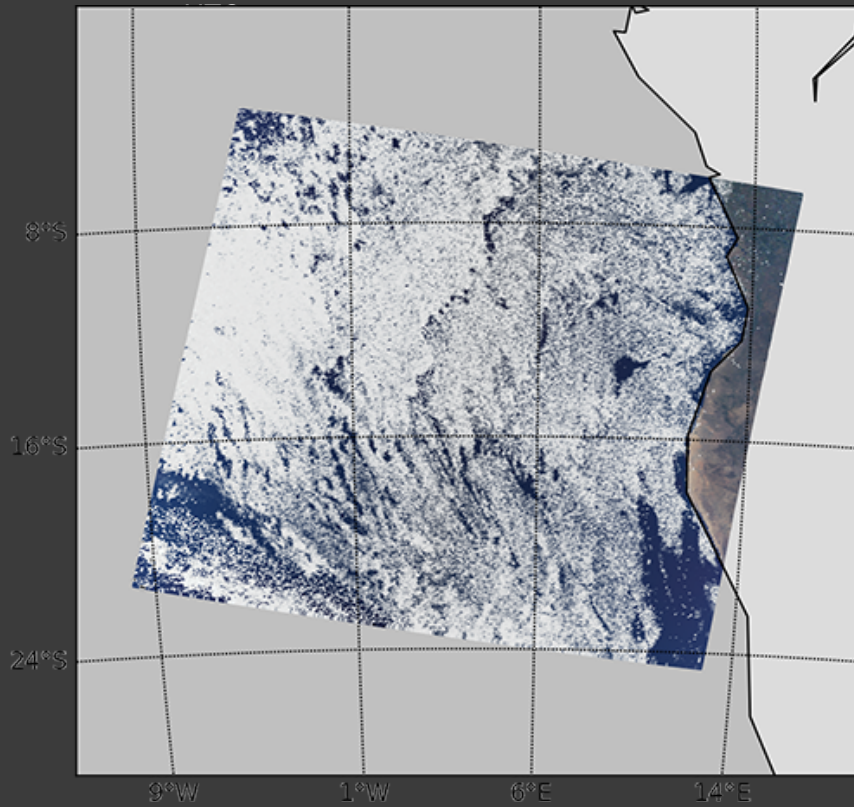
Uncertainty Cloud Optical Thickness > 4



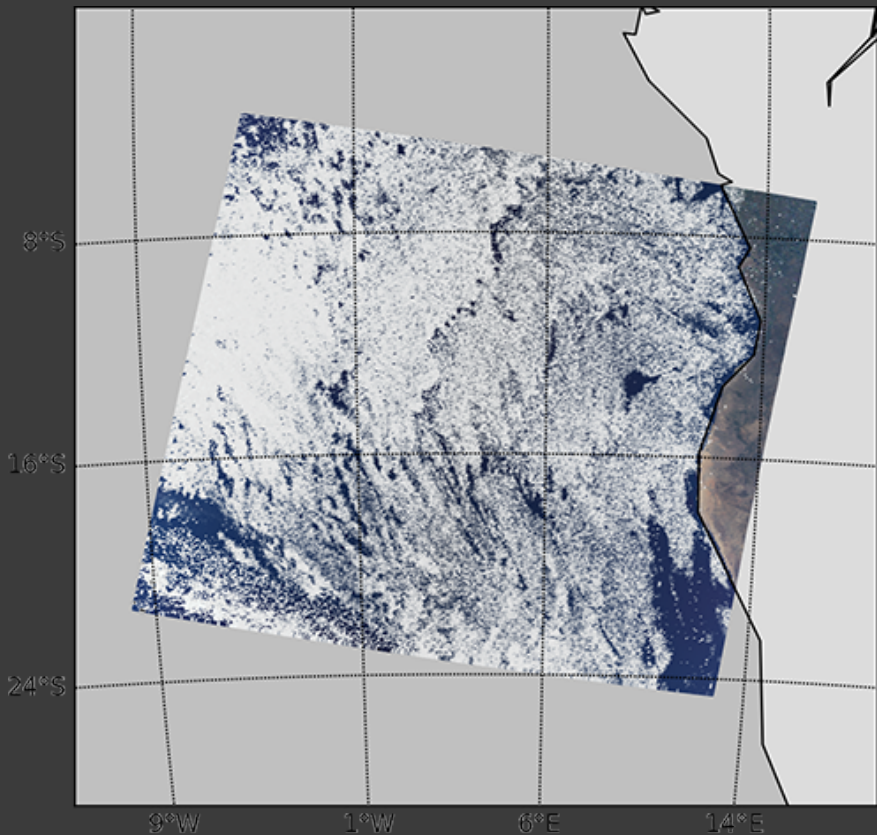
MCARS Terra MODIS 12 Aug 2006 10:05 UTC



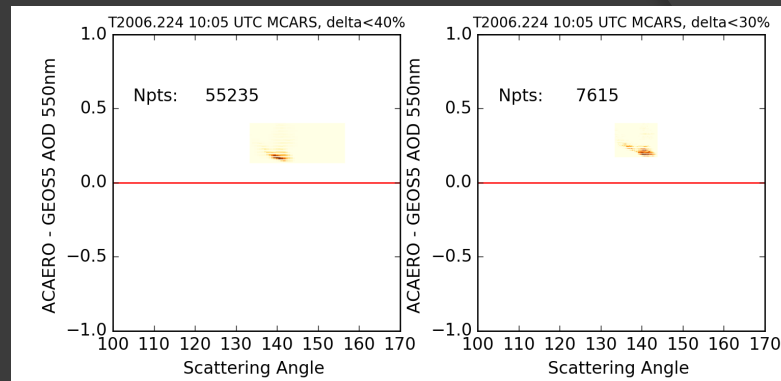
MCARS Terra MODIS 12 Aug 2006 10:05



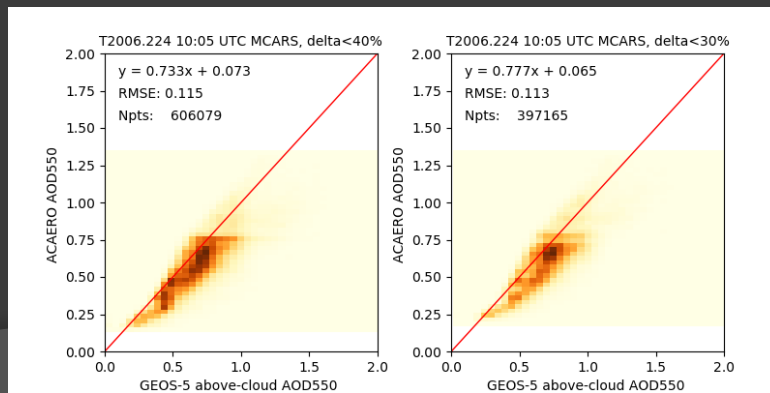
MCARS Terra MODIS 12 Aug 2006 10:05 UTC



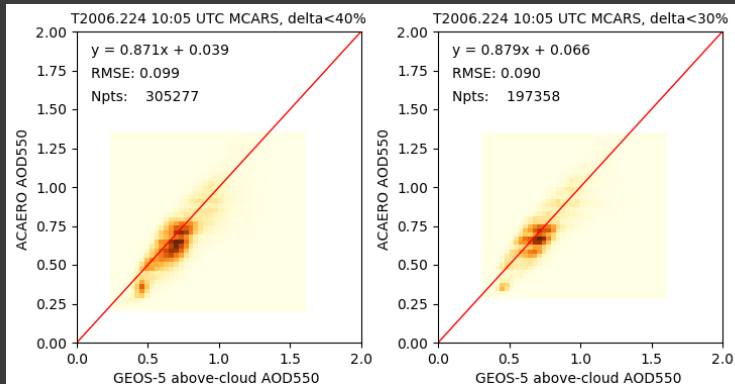
False positives as a function of scattering angle



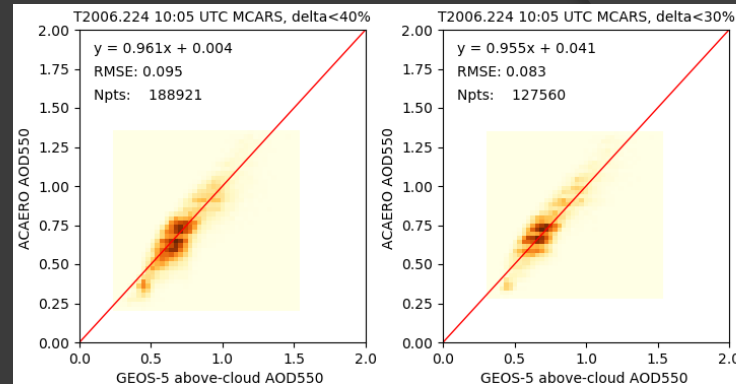
Uncertainty Cloud Optical Thickness > 4 Exclude the rainbow angle



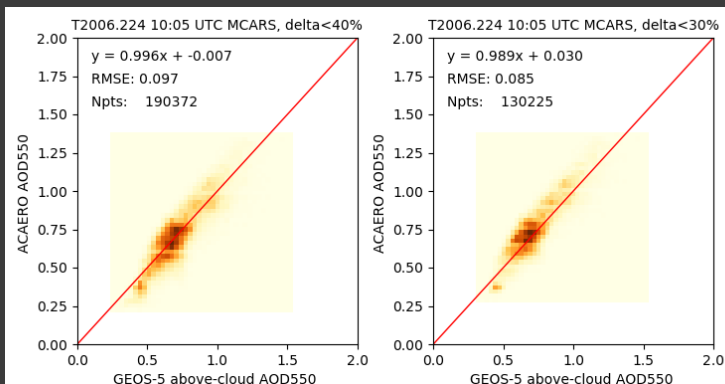
Add screening by sensor zenith < 30 degrees



by sensor zenith < 20 degrees



Add GEOS-5 input as ancillary



Recipe

Assimilate points with:

1. Pixel-level uncertainty < 40%
2. Cloud optical thickness > 4
3. Avoid the rainbow scattering angle
4. Select pixels with sensor zenith < 20°



Concluding Remarks

❑ For ORACLES 2017 GEOS-5 will have

- Higher resolution (12.5 km), retuning
- Improved met assimilation & skills
- NNR 3 MODIS C6 AOD, AERONET
- Nitrates

❑ New GEOS-5 with Full Chemistry (25 km)

❑ Finalizing test of cloud aerosol μ physics (2M & MAM-7) implementation:

- Tuning of aerosol optical properties (BrC absorption in particular)
- ORACLES measurements will be critical

❑ Perform mini-reanalysis for Sep 2016:

- Met assimilation: Hybrid 4DEnVar
- Aerosol assimilation:
 - » **Current LDE scheme:** NNR 3 AOD
 - MODIS (Ocean, Dark & Bright Targets)
 - AERONET
 - » **New Aerosol EnKF:**
 - multi-wavelength NNR 3.1
 - AERONET, MODIS ACAero
- Sampled datasets to be uploaded to archive