Status Update and New Aerosol Products From MODIS and VIIRS Using Deep Blue Aerosol Algorithm

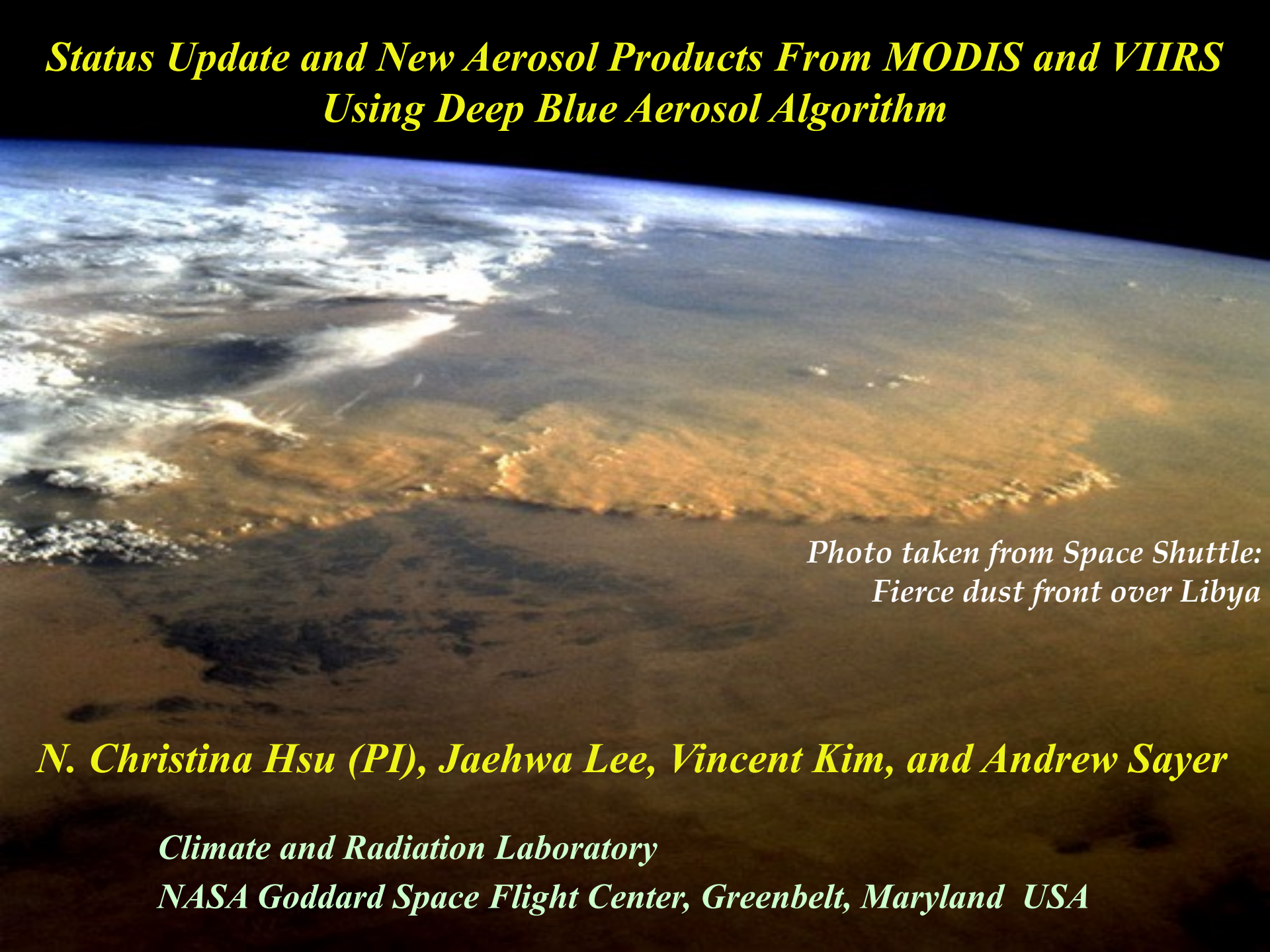

Photo taken from Space Shuttle: Fierce dust front over Libya

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Multi-Sensor Long-Term Deep Blue Aerosol Products

➢ *Science Objectives*:

- Our primary goal is to produce consistent long-term aerosol climate data record using multiple satellite sensor data from AVHRR (historic) to SeaWiFS and MODIS (EOS-era) to VIIRS (JPSS-era) as well as latest GEO sensors (such as AHI and ABI) for diurnal cycle
- Our VIIRS and GEO aerosol products are generated based upon *Deep Blue* algorithm (over land) (previously applied to AVHRR, SeaWiFS and MODIS) and SOAR algorithm (over ocean) (applied to AVHRR and SeaWiFS)

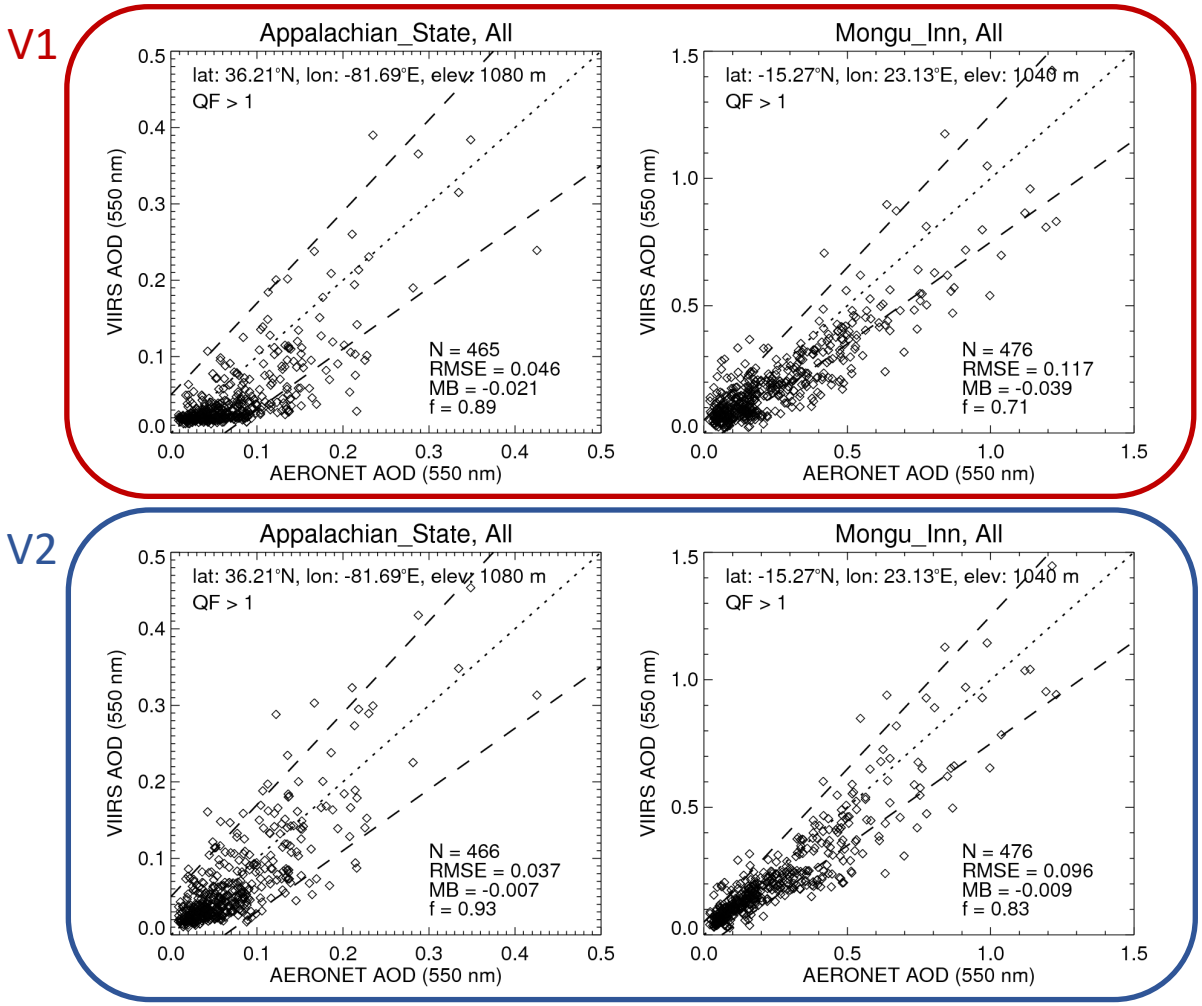
➢ *Status of the VIIRS Deep Blue aerosol products*:

- ✓ Standard and NRT VIIRS Version 1.1 L2 and L3 Deep Blue products have been operational and available at LAADS in 2021.
- ✓ VIIRS Version 2.0 Deep Blue algorithm is finalized, and the products will be processed at SIPS in the mid 2022.
- ✓ The implementation of the VIIRS calibration adjustments has been completed for both SNPP and NOAA20. VIIRS V2.0 products for these two sensors will be released to the public at the same time.
- ✓ In support of the MODIS C7 reprocessing, the effort of backporting VIIRS V2.0 Deep Blue algorithm to MODIS C7 has started.

Introducing VIIRS Version 2 Deep Blue Aerosol Products

Major changes include:

- Improved aerosol retrievals over high elevation regions, by accounting for the effect of Rayleigh-aerosol interactions over high elevation surfaces
- Better aerosol models for fine-mode aerosols

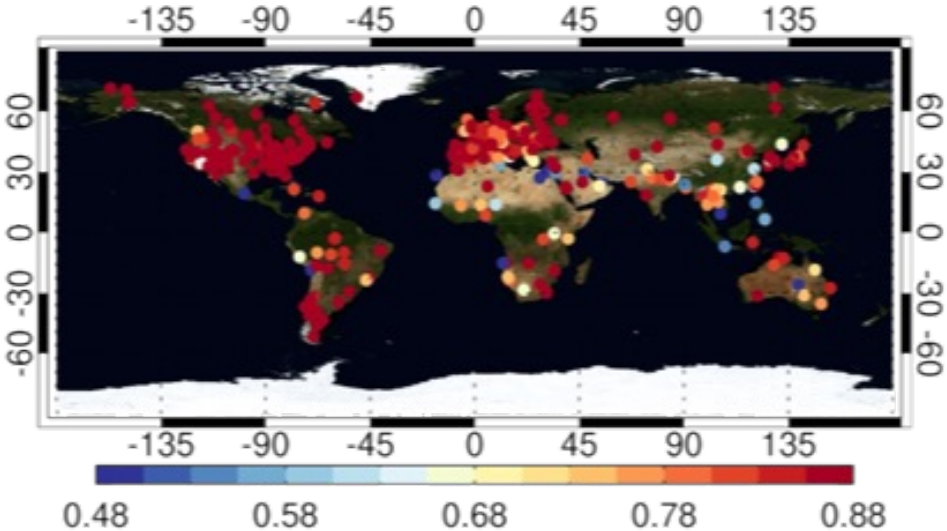


- Comparisons of SNPP *VIIRS AOD at 550 nm retrieved from V1.1 (upper) and V2 (lower) over-land algorithms against AERONET at two high-elevation sites (Appalachian State in the U.S. and Mongu in Southern Africa) from 2012-2017.*

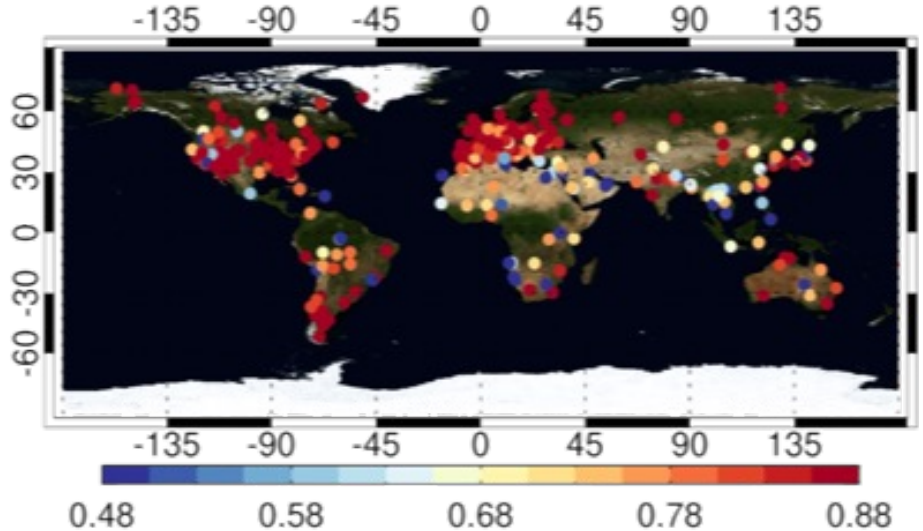
N: the number of data points, RMSE: root-mean-square error, MB: median bias, and f: fraction within expected error, ±(0.05+0.2×AOD) (also represented as dashed lines in the plots).

Comparisons of SNPP VIIRS V2 AOD against AERONET

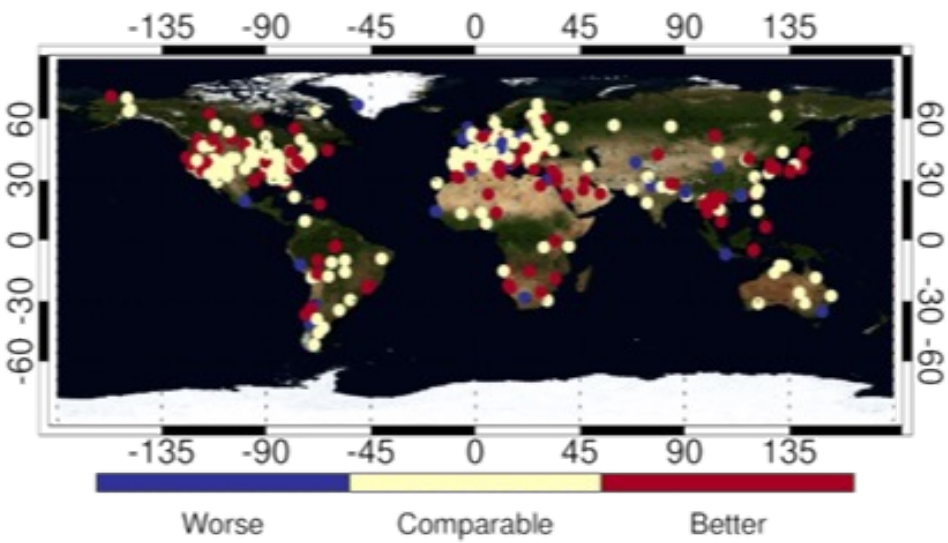
V2 Fraction within Expected Error



V1.1 Fraction within Expected Error



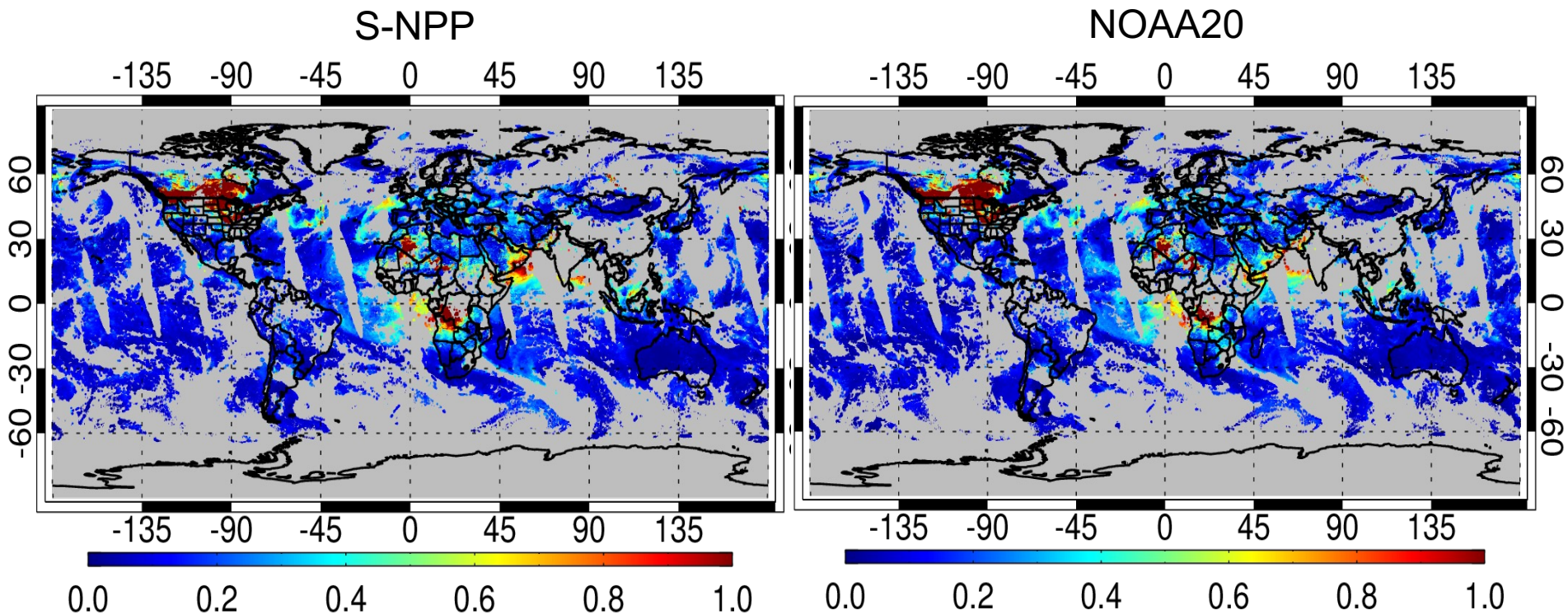
V2 vs. V1.1 performance



- Compared to V1, the performance of VIIRS V2 AOD against AERONET is generally much improved, particularly over high elevation regions. Expected error = ±(0.05+20%) ;
- In support of MODIS C7 reprocessing, we will also apply VIIRS V2 DB algorithm to MODIS for Terra and Aqua.

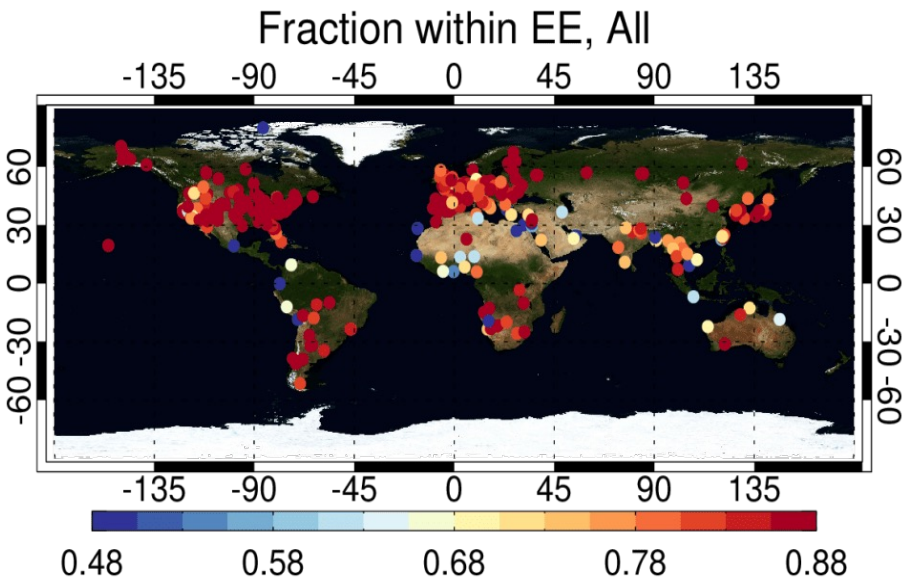
Producing VIIRS aerosol products from NOAA20

VIIRS DB AOD (550 nm) on 18 August 2018

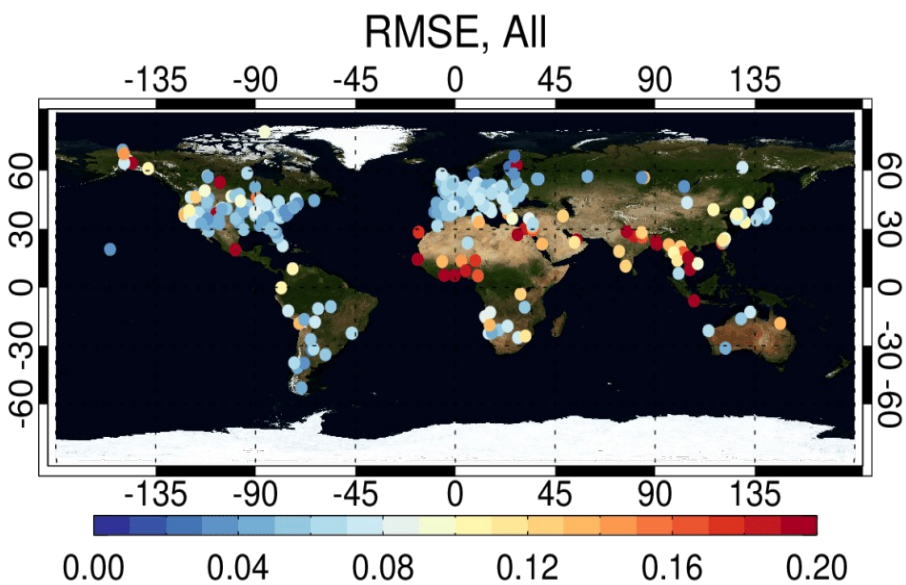


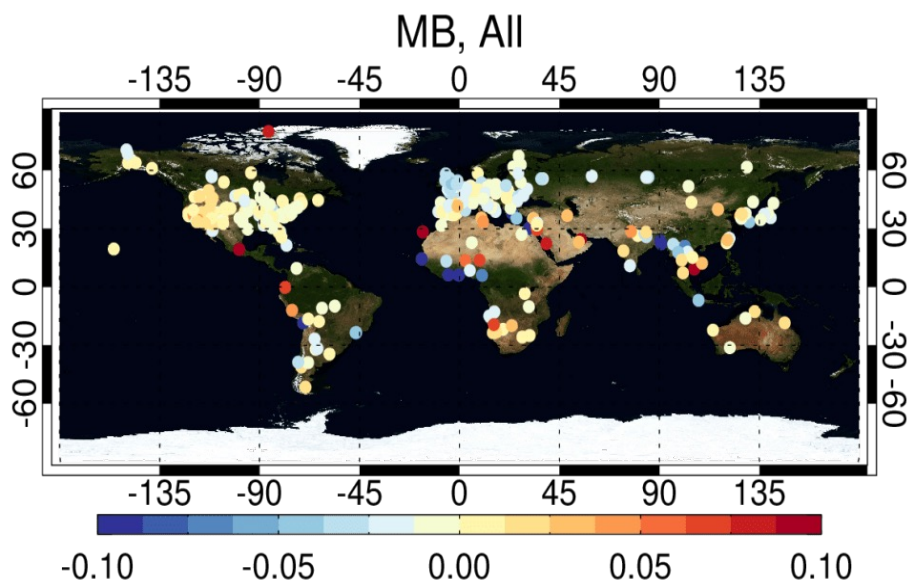
- There are significant calibration differences between SNPP and NOAA20 VIIRS. We have minimized these differences by normalizing both sensors to MODIS Aqua, using VIIRS/MODIS Aqua matchup files generated by A-SIPS.
- After applying these calibration adjustments to VIIRS L1B data, the global distributions of AOD from SNPP and NOAA20 are now comparable.

Comparisons of NOAA20 VIIRS AOD at 550 nm against AERONET over land from 2018-2020



- The performance of NOAA20 VIIRS AOD product against AERONET is comparable to that for SNPP, after applying calibration correction;
- Most of the sites have more than 80% of retrieved data fallen into the expected error of ±(0.05+20%) with small mean bias (MB) and RMSE compared to AERONET AOD.





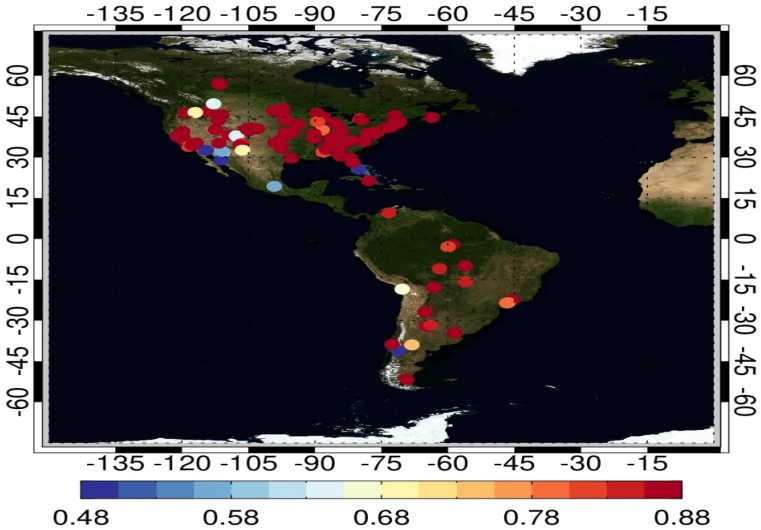
Fusing GEO with LEO Satellite Observations to Infer Diurnal Properties of Global Aerosols

New Deep Blue Geostationary Aerosol Products from Himawari-8 and GOES-16/17

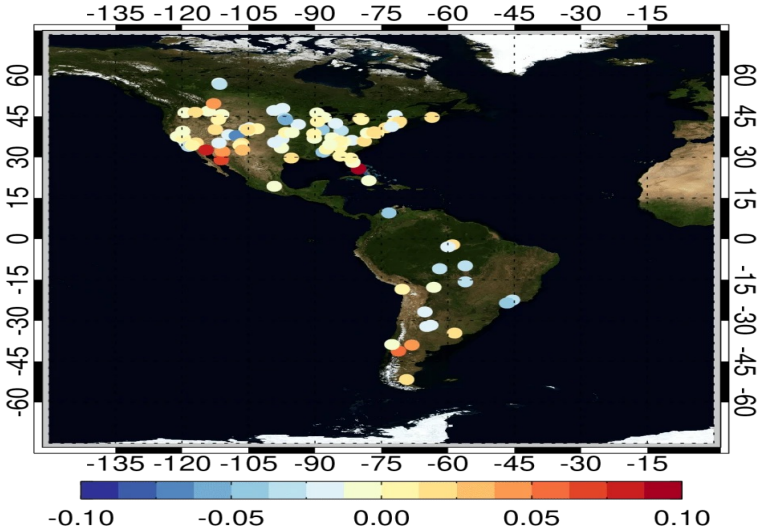
Comparisons of GEO DB AOD at 550 nm against AERONET

ABI – GOES16

Fraction within EE

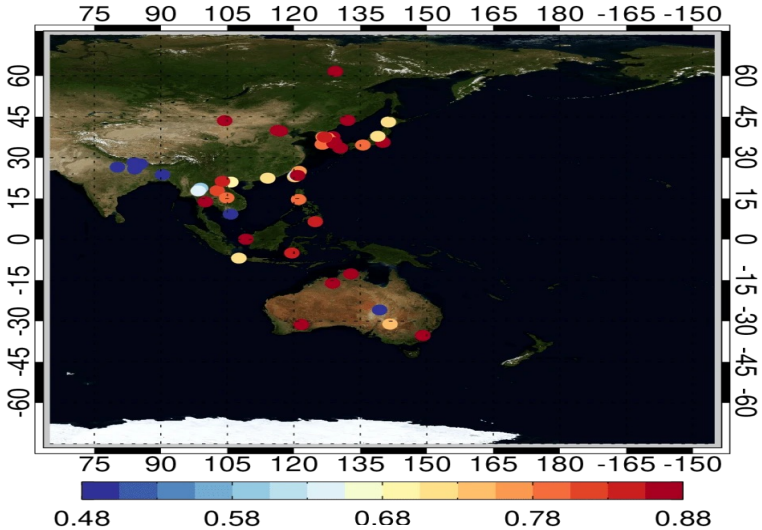


Mean Bias

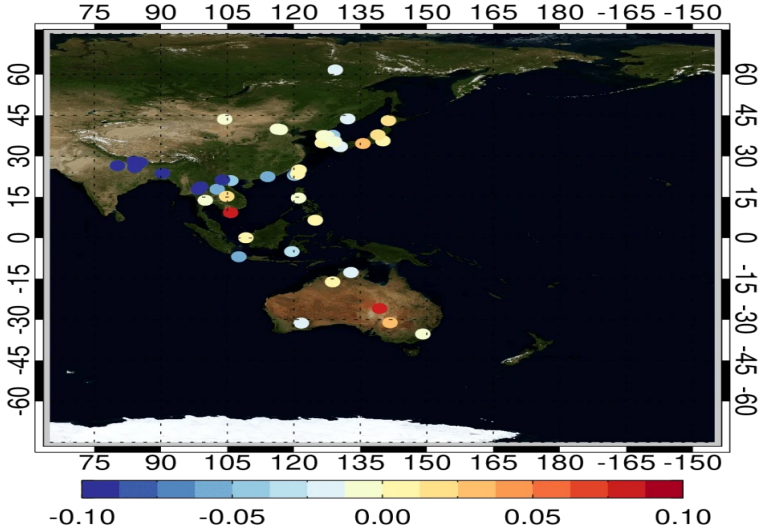


AHI – Himawari8

Fraction within EE



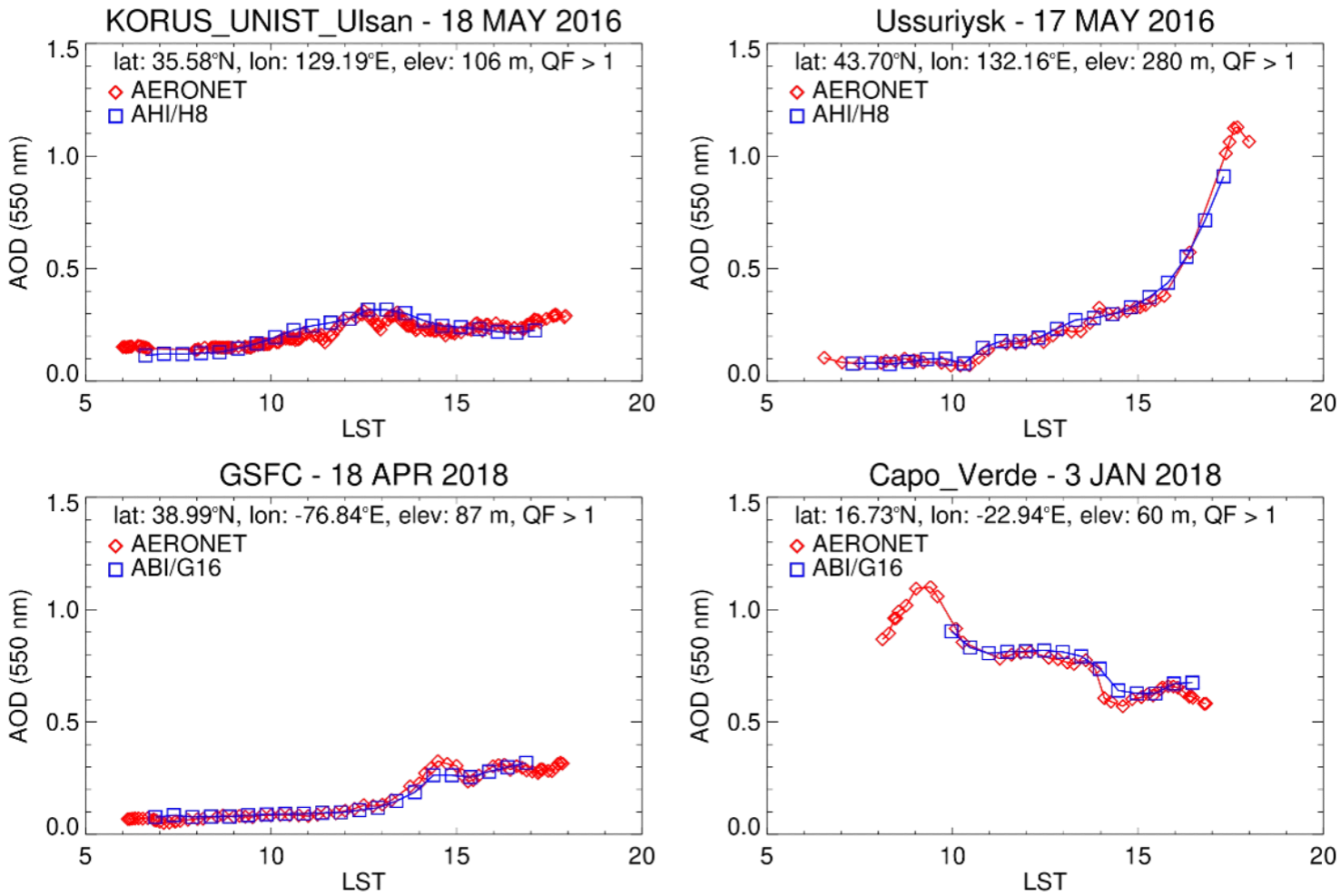
Mean Bias



Diurnal cycles of GEO DB AOD at 550 nm against AERONET

AHI/ Himawari-8

ABI/ GOES-16



Summary

- ✓ VIIRS Version 2.0 Deep Blue algorithm is finalized and the testing of the algorithm will begin at SIPS soon. Compared to V1.1, the changes made in V2.0 include the improvement of AOD retrieval over high elevation regions and for fine-mode aerosols.
- ✓ The calibration differences between SNPP and NOAA 20 VIIRS have been minimized by normalizing both VIIRS sensors to MODIS Aqua. After applying sensor calibration adjustments, the time series from these two sensors are now comparable.
- ✓ V2 VIIRS DB aerosol products for SNPP and NOAA20 will be available at the same time in fall 2022.
- ✓ Efforts of backporting all the improvements made in VIIRS to MODIS Collection 7 are also underway.