Introduction
The Suomi-NPP satellite was launched late in 2011, carrying several instruments designed to continue the biogeophysical data records of current and previous satellite sensors. The Visible Infrared Imaging Radiometer Suite (VIIRS) aboard Suomi-NPP is being used, among other things, to determine aerosol optical depth (AOD), and related activities since launch have been focused towards validating and understanding this new dataset through comparisons with other satellite and ground-based products. The operational VIIRS AOD product is compared over land with AOD derived from Moderate Resolution Imaging Spectrometer (MODIS) observations using the ‘Deep Blue’ (DB) algorithm from the forthcoming Collection 6 of MODIS data.

Data used
The analysis period extends from May 1st to October 14th, 2012. Prior to this the VIIRS aerosol data were in a state of flux due to calibration/cloud mask updates. A bug introduced in a VIIRS processing update renders aerosol data from October 15th to November 27th 2012 inclusive unusable. In all cases only AOD at 550 nm is considered. Three datasets are used:

- MODIS Deep Blue (Hsu et al., 2004, 2006) Collection 6
- VIIRS aerosol Environmental Data Record (EDR)

The new MODIS Collection 6 will become available in 2013. The main changes made to the Deep Blue (DB) algorithm for Collection 6 are 1) Extended coverage to vegetated areas, as well as bright land; 2) Improved surface reflectance models, aerosol microphysical models, and cloud screening; and 3) Simplified quality assurance (QA) flags (integer rather than bitwise), for easier use. Validation of the current MODIS Deep Blue test data suggests an absolute uncertainty better than 0.05±20% under typical conditions for QA=2 and QA=3 retrievals (used here). A very similar algorithm is currently in use for the SeaWiFS Deep Blue aerosol products and performs well (Sayer et al., 2012).

VIIRS aerosol data are in beta, and the performance of the MODIS and VIIRS aerosol products is still being evaluated. Among other things, the authors acknowledge the VIIRS Atmospheres PEATE for provision of VIIRS data. The AERONET PIs are thanked for creation and stewardship of the AERONET dataset. The authors acknowledge the MODIS calibration science team for their continued effort in maintaining the high quality of Level 1 MODIS data.

Comparison of AOD percentiles
MODIS level 3 (daily/monthly) products are often used to examine regional/global AOD. It is relevant to ask how such maps would look if constructed from VIIRS data. As well as mean AOD, percentiles of the AOD probability distribution function (PDF) are examined, to provide additional insight into differences. Note that these statistics are across different months.

Such a comparison is presented to the left. Daily level 2 Deep Blue and VIIRS data are gridded to 2° resolution and statistics of the AOD PDF saved. Only retrievals over land are used. Days in which both Deep Blue and VIIRS contained 20 or more retrievals in a given grid cell are collated, to examine the mean of these statistics from such collocated data. MODIS DB data are shown in the top row, VIIRS in the second row, and the difference distribution function (PDF) are examined, to provide additional insight into differences. Note that no level 3 equivalent products are available from VIIRS, so they must be created manually.

Joint AERONET validation
Scatter density histograms of MODIS Deep Blue/VIIRS are shown to the right, using the three-way matchup protocol described in the ‘data box’ above. Also shown is the fraction of matchups at each site where the AERONET satellite absolute AOD difference is within 0.05±20% of the AERONET AOD, thus being a typical satellite AOD retrieval uncertainty. Only sites with 5 or more matchups are mapped.

- Only data over land are used.
- MODIS Deep Blue performs better overall, but tends to have a lower bias in high-AOD conditions.
- In contrast, the VIIRS data more frequently have a high bias. VIIRS data are in beta, and the performance of VIIRS is expected to improve in the future, as the algorithm matures.

References

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