Preparation for assimilation of aerosol optical depth data from NPP VIIRS in a global aerosol model

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And the JPSS Aerosol Cal/Val Team
In This Talk

• Data Requirements for Aerosol Assimilation
• Preparation of NPP VIIRS products for assimilation
• Observations of processed VIIRS data
• Conclusions / Prospects
Navy Global Aerosol Forecasting

- Navy Aerosol Analysis and Prediction System (NAAPS) operational since 2005
- Navy Variational Data Assimilation System for AOD (NAVDAS-AOD) Operational at FNMOC from September 2009 (MODIS over ocean)
- Global MODIS is assimilated operationally as of February 2012
Preparation of Satellite Data for Assimilation

Level 2 MOD04 (NASA) or VAOOO EDR (JPSS) data is generated by upstream data centers – spatial resolutions of a few km.
Preparation of Satellite Data for Assimilation

AOD data process developed by NRL and UND, includes:
- Aggressive cloud filtering
- Ocean wind speed correction
- Land albedo correction
- Land surface and snow filters
- Microphysical AOD bias correction

0.5 degree product distributed to public via NASA LANCE (MxDAODHD)

This is the process developed for MODIS Collection 4&5

How much pre-processing will be required for Suomi NPP VIIRS?
NPP VIIRS pre-processor

- 1-degree, 6-hour
  - **Operational NAAPS now 1/3°**, 1° used for testing
- “fullQA” uses information packaged with EDR granules
  - QA = ‘High’ (highest EDR QA value)
  - Cloud mask, cloud proximity, snow flags, glint flags
  - No textural filtering (this is a cal/val experiment, not an operational candidate)
- Results shown using 12 months of data
  - 2013.01.24.00 to 2014.01.12.00
VIIRS ‘fullQA’ coverage vs NRL-UND Level 3 MODIS-- Land

- NRL/UND Level 3 MODIS is stringently filtered
- VIIRS potentially delivers much more data vs 1 MODIS
  - Almost as much as 2 MODIS
Global patterns match very well
VIIRS has smaller excluded area, greater coverage
VIIRS ‘fullQA’ AOD vs NRL-UND Level 3 MODIS-- Ocean

VIIRS is higher in low-AOD areas (land and ocean)
VIIRS ‘fullQA’ AOD vs NRL-UND Level 3 MODIS -- Ocean

- VIIRS shows elevated AOD in this region
- Very few retrievals pass QA
- 4 days in August, 23 1-degree grid cells, 500+ EDR retrievals with QA=‘High’ have means ~= 1.0
We are testing a heavily filtered VIIRS aerosol dataset based on IDPS products. All data:

- Best QA
- All granule ancillary data used to filter
  - (cloud adjacency, etc.)
- Textural filtering for clouds (limit on local variability of AOD)

Over-land:
- MCD43 snow filter used
  - (adapted from NRL/UND MODIS processing)

Over-ocean
- Excluded above 65N

Products have been generated at UW PEATE, assimilation testing is now underway at NRL.
Attempt at DA-ready VIIRS AOD

NPP VIIRS Aerosol Product Status

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VIIRS with JPSS QA only
VIIRS with NRL filters
1-degree products vs AERONET

(left) White bar indicates % of data within 0.05+/−20%, gray bars indicate % above or below. At low AOD, positive errors dominate.

VIIRS product from JPSS has truncation problem at low AOD
- AOD retrieval is uncertain: MODIS permits negative AOD values
- When aggregated, zero truncation results in positive bias
- We’ll get to high optical depths momentarily
- This is not a problem that can be fixed with filtering
Comparison for high-AOD case

- Massive midsummer Siberian fires
- Episodic, intense plumes
- Signal in VIIRS is much lower than MODIS
Comparison for high-AOD case

- IDPS VIIRS Aerosol algorithm does not retrieval optical depths above 2
- This results in a truncation effect on averaged data

- Data in region shown from 2013.07.23 to 2013.08.23
- Suomi NPP VIIRS ‘fullqa’ vs MODIS-Aqua C5 NRL/UND L3

JPSS Cal/Val team is discussing a fix that would extend valid range of AOD to match MODIS (-0.05 to 5.0). This would mitigate this problem.
Results and Next Steps

• NPP VIIRS AOD requires additional filtering of EDR to improve analysis and forecast
• Cal/Val Team has further improvements to over-land AOD data underway
• Additional analysis of over-ocean VIIRS AOD data is needed
• Assimilation testing of candidate DA-ready VIIRS AOD products is underway
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