Aerosol retrievals over oceans from MSG/SEVIRI for the use in GERB radiation budget analyses
(Manuscript in preparation for Remote Sensing of Environment)

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Aerosol Product from SEVIRI in RMIB GERB Processing (RGP)

Meteosat-8 launched 28 Aug 2002
- GERB: Sister-instrument to CERES
- RMIB GERB Processing (RGP) operational at RMIB
- Aerosol product on GERB datasets needed for aerosol forcing studies

AVHRR-like Aerosol product from SEVIRI: Incorporated in RGP
- SEVIRI: AVHRR-like imager (Aerosol bands 0.63, 0.83, 1.61 μm)
- AVHRR-like aerosol product
  - 3 AODs independently derived in 3 bands using single-channel algorithm
  - Angstrom exponent estimated from spectral AODs
  - Extensively tested with AVHRR and MODIS; Reported on TRMM (primary) and Terra and Aqua CERES SSFs (back-up product)
  - Tested with SEVIRI for dust cases (Brindley and Ignatov 2006)
Outline of talk

1. Validation of AVHRR-like Aerosol Product from SEVIRI against AERONET in confidently clear-sky conditions
2. RMIB Cloud Mask & Comparison with MPEF & SAFNWC CMs
3. Examples of RGP SEVIRI aerosol products
4. Comparisons with Terra/Aqua MODIS
5. Conclusion and future work
Validation of SEVIRI AOD1 and AOD2 against AERONET (confidently clear conditions)

Case studies comparisons with AERONET/MODIS: SEVIRI Aerosol reasonable. However:
- Dust (Cape Verde): Low bias. Insufficient aerosol absorption (Brindley Ignatov 2006)
- Low Aerosol (Lampedusa): High bias (SEVIRI calibration?)
- Spectral dependence in SEVIRI product suppressed (SEVIRI cal? Aerosol model?)
RMIB Cloud Mask over oceans

- Threshold Cloud Optical Depth @0.83 μm ~0.6 (Ipe et al., 2004)
- Use dust tests to restore “cloud” to “clear” (Brindley Russell 2006)
  (NB: No restoral tests for other aerosol categories with high AOD, such as smoke)
- Use 11-12 μm brightness temperature difference to identify cirrus

MPEF (Meteorological Product Extraction Facility; Lutz 1999) and SAFNWC (Satellite Application Facility in support of NOWcasting and very short forecasting; Derrien and Legleau 2005)

- Threshold solar reflectances and their inter-band differences
- Threshold brightness temperature and their inter-band difference
  (including using RTM to set up thresholds, dynamically)
- Spatial uniformity tests
- Test for sun-glint and snow
6 March 2004 12:00 UTC

AOD1 (0.63 μm)

AOD2 (0.83 μm)

AOD3 (1.61 μm)
Effect of proximity to cloud on AOD and Angstrom Exponent

RMIB CM was selected for operational GERB Processing because it:
- Compares well with SAFNWC & Outperforms MPEF CM
- Simple, robust, computationally efficient, easy to maintain/improve
Seasonal maps of AOD2 from 21 Dec 2005 – 20 Dec 2006

Winter

Spring

Summer

Fall

04/26/2007

CERES2 STM-7, 24-26 April 2007

Newport News, VA

Winter

Spring

Summer

Fall

04/26/2007

CERES2 STM-7, 24-26 April 2007

Newport News, VA
SEVIRI versus MODIS (10km)
28 Feb – 12 Mar 2004, AOD1 (0.63 \(\mu\)m)

Comparisons done in “double-rectified” conditions (cloud-free pixels in both products.) May not tell a complete story.

- Globally, SEVIRI agrees well with MODIS
- SEVIRI AOD is noisier than MODIS

04/26/2007 CERES2 STM-7, 24-26 April 2007
Newport News, VA
SEVIRI versus MODIS (10km)  
28 Feb – 12 Mar 2004, AOD2 (0.83 μm)

Comparisons done in “double-rectified” conditions (cloud-free pixels in both products.) May not tell a complete story

- Globally, SEVIRI agrees well with MODIS
- SEVIRI AOD is noisier than MODIS
- SEVIRI Band 2: Cal biased high w/rt to Terra/Aqua?
SEVIRI versus MODIS (10km)
28 Feb – 12 Mar 2004, AOD3 (1.61 μm)

Comparisons done in “double-rectified” conditions (cloud-free pixels in both products.) May not tell a complete story

- Globally, SEVIRI agrees well with MODIS
- SEVIRI AOD is noisier than MODIS
- SEVIRI Band 3: Cal biased high w/r/t to Terra/Aqua?
Conclusion

- End-to-end SEVIRI Aerosol product integrated in RMIB GERB Processing
  - It is based on RMIB Cloud Mask; and
  - NESDIS 3rd gen AVHRR-like Aerosol Algorithm
  - Better suited to start looking into direct aerosol forcing (indirect forcing limited)

- High spatial and temporal GEO resolution & Spectral AOD and AE
  - Resolves fine structure and dynamic of aerosol concentration and size
  - Helps suppress noise (particularly important for Angstrom Exponent)

- Comparison with AERONET & MODIS
  - SEVIRI Aerosol product looks reasonable
  - Possible improvements
    - Cloud Mask: Better handle of non-dust high-AOD cases
    - SEVIRI Calibration (Bands 2-3 high with respect to MODIS)
    - Aerosol model (dust AOD underestimated)
Future work

- Cloud Mask for SST/Aerosol for GOES-R/ABI
  - Use MSG/SEVIRI as prototype for GOES-R/ABI
  - Explore CLAVR-x based AVHRR Clear-Sky Processor for Oceans (ACSPO)
  - Explore Pat Minnis’s group Cloud Mask for SEVIRI

- Calibration in SEVIRI Aerosol bands
  - Use AVHRR-like AOD from SEVIRI for diagnostic
  - Explore Angstrom Exponent which is very sensitive to Cal errors

- Fine-tune AVHRR 3rd gen aerosol model
  - Explore non-spherical model of Dubovik (cf. Brindley and Ignatov 2006)

- Communicate/Sync new developments with RMIB/GERB and EUMETSAT colleagues
Back-Up slides
PDF of proximity to cloud for 3 cloud masks

From 17-21% aerosol pixels are within one pixel of cloud boundary; from 14-16% are within 2 pixels, etc.
3 March 2004 11:00 UTC
Red: RGB(256,0,0)
RMIB says “cloud”
MPEF/SAFNWC both say “clear”

Green: RGB(0,256,0)
MPEF says “cloud”
RMIB/SAFNWC both say “clear”

Blue: RGB(0,0,256)
SAFNWC says cloud
RMIB/MPEF both say “clear”