NPP VIIRS Aerosol Products: Overview and early cal/val results

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ICAP IV: Frascati, Italy
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NPP Visible Infrared Imaging Radiometer Suite (VIIRS)

0130, 1330 local time orbits

"Early afternoon slot"

October 28 2011

Credit: NASA

Heritage Operational and R&D Sensors

Operational Sensors

OLS

- 74 kg
- 2 bands

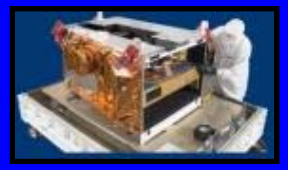
- High Spatial Resolution
- Day/Night Band
- Minimize Resolution Growth Over Scan

- Radiometric Accuracy
- SST Band Continuity

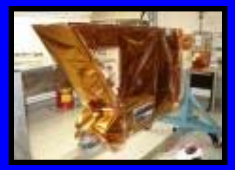
AVHRR

- 33 kg
- 5 bands

VIIRS



OMM



EM

- 275 kg
- 22 bands

R&D Sensors

MODIS

- 220 kg
- 36 bands

- Band Selection/Continuity
- Thin Cirrus Band
- Solar Diffuser
- Earthshine Lessons Learned

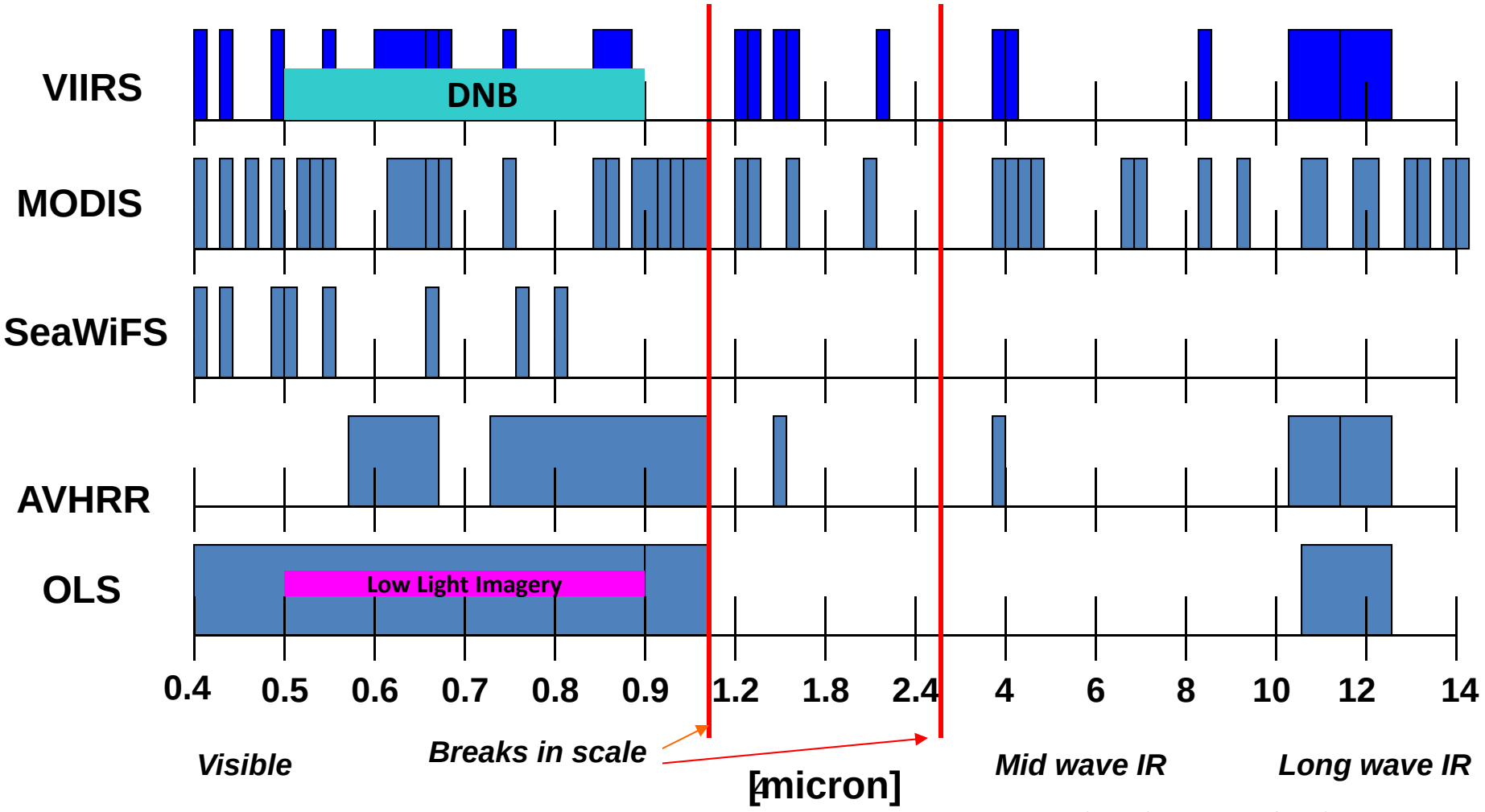
- Ocean Color Bands
- Rotating Telescope

SeaWiFS

- 45 kg
- 8 bands

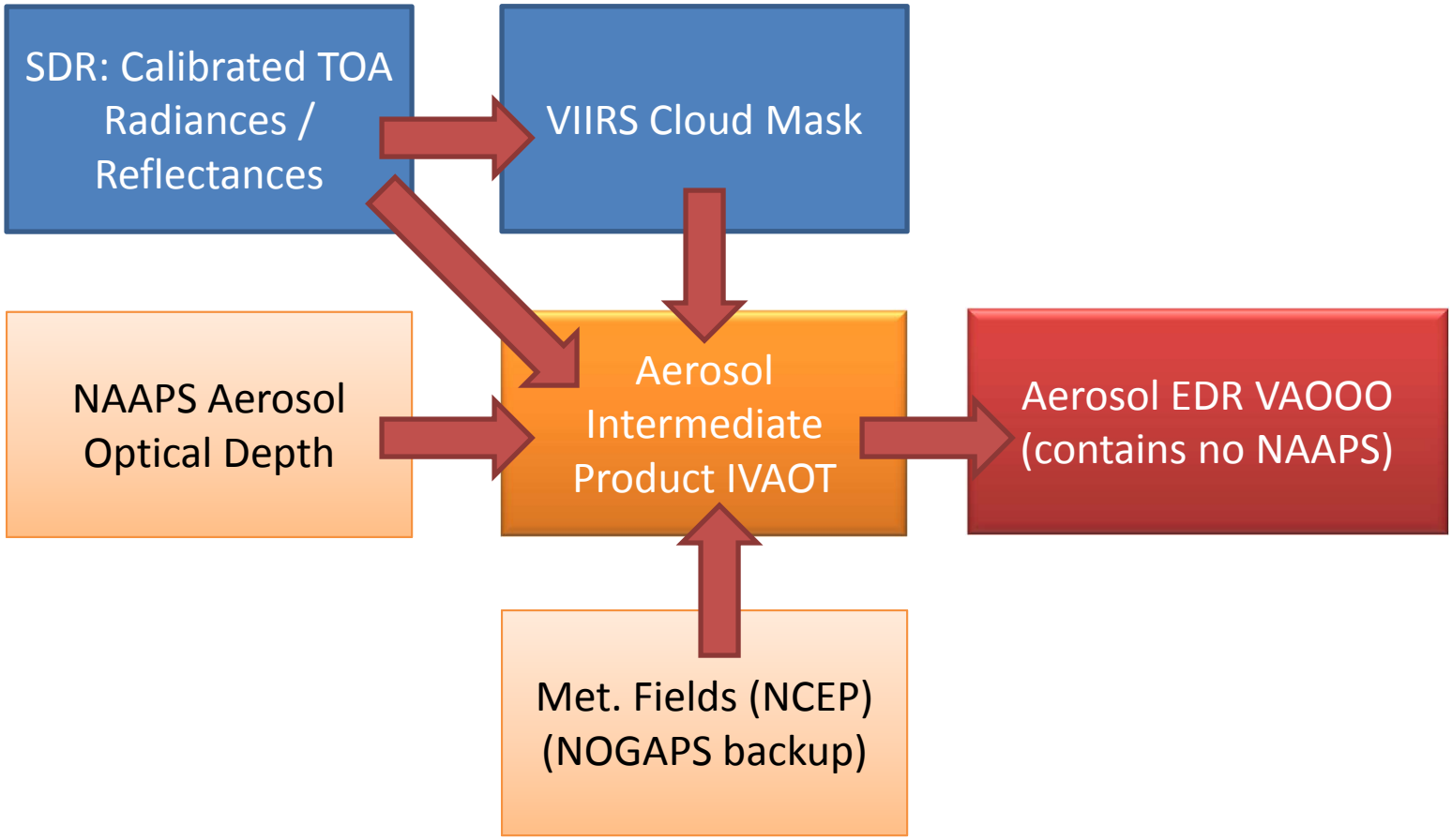
Credit: Northrup Grumman & Raytheon

Heritage Capabilities



Credit: Northrup Grumman & Raytheon

Simplified VIIRS Aerosol Process



VIIRS Aerosol EDR Product

Aerosol EDR
VAOOO

- ~6km resolution
  - 8x8 ~750m pixels
- Retrieved:
  - AOT
  - Angstrom Exponent
  - Suspended Matter Type
- Many Quality Flags:
  - Cloud (incl. adjacent)
  - Glint and other geometry
  - Input data quality

- Retrieval is based on LUTs generated with 6S
- Heritage is MOD09 Surface Reflectance
- Over-ocean similar to MOD04
  - Fine-coarse mixture retrieved explicitly
- Over-land uses different aerosol models
  - Single model (fine+coarse) is retrieved via LUT

Status of Aerosol Cal/Val

- Aerosol EDR is sum of Parts:
  - VIIRS SDR radiances/reflectances: Beta as of April, Provisional in July
  - VIIRS Cloud Mask: 30-day spinup in March-April, basic tuning complete
- Aerosol EDR is scheduled for 'Beta' once cloud mask becomes "Provisional" (expected July)
- Interaction between cloud mask and aerosol is focus of efforts

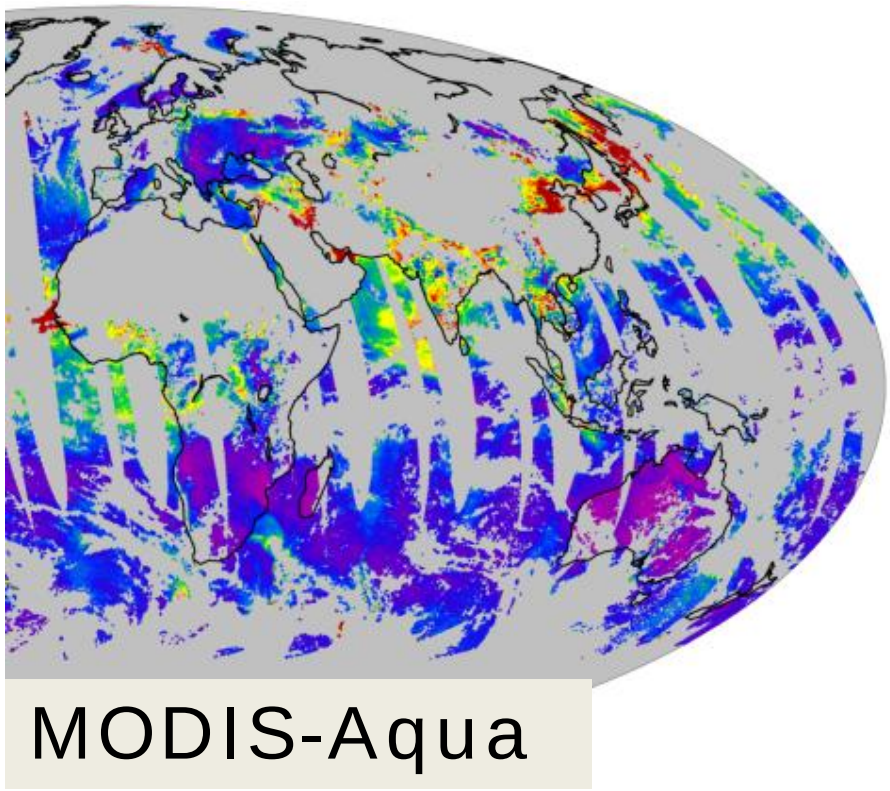
VIIRS VIS/NIR degradation anomaly

- Reduction of sensitivity caused by contamination of mirrors
- Peak absorption around 1μm
- VIIRS M7 (865nm) most strongly affected
  - M8 (1240nm) next most
- Degradation has slowed but not yet stopped
  - Modeling accurately predicts effects, weekly updates made to calibration F-tables
  - Daily updates coming soon
- Signal/Noise ratio is expected to remain above spec for all bands

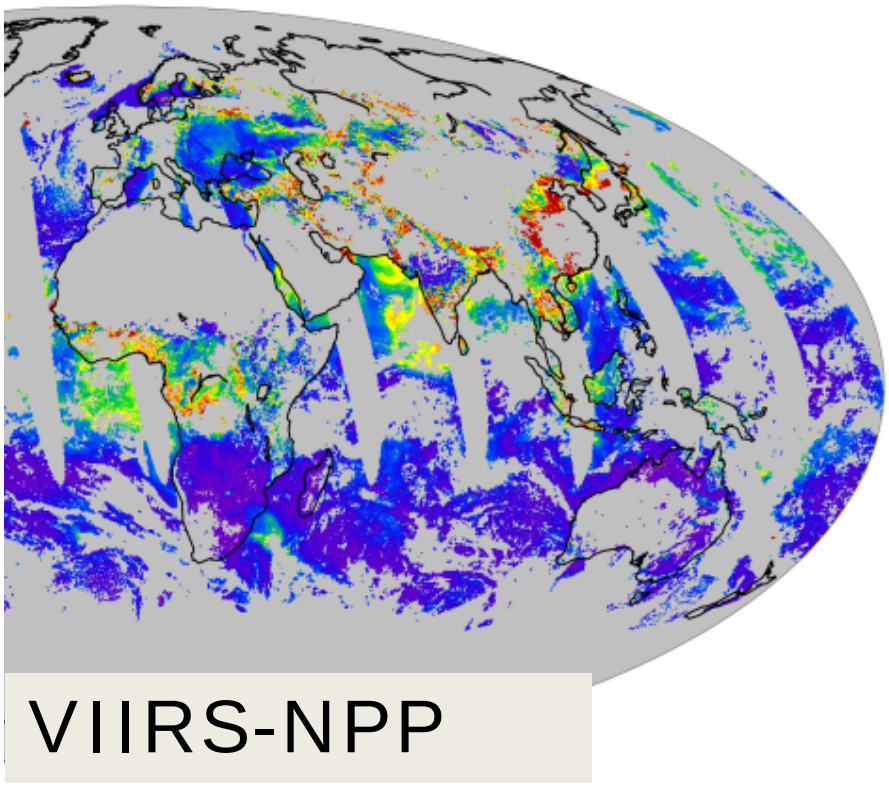
Aerosol Product Results: VERY PRELIMINARY!

These results were generated after stabilization of the SDR calibration, but before final tuning of the VIIRS cloud mask. As such, they represent only a “snapshot” of the VIIRS aerosol product in a an early stage.

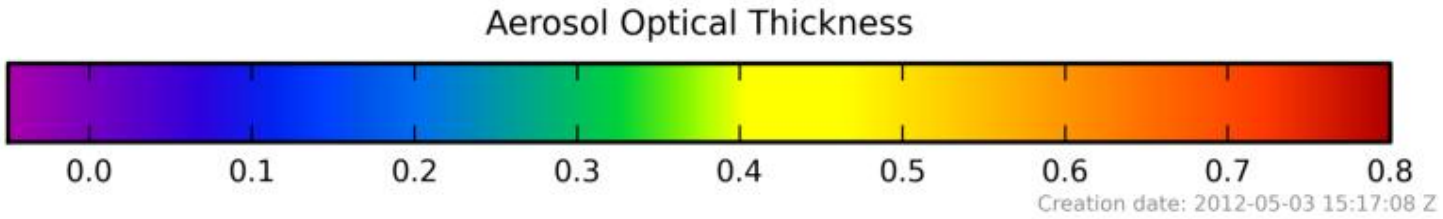
MODIS and VIIRS AOD



MODIS-Aqua



VIIRS-NPP



Credit: Min Oo, Bob Holz, Atmospheres PEATE, University of Wisconsin
http://peate.ssec.wisc.edu/flo/npp/gridding?date=2012%2F04%2F29

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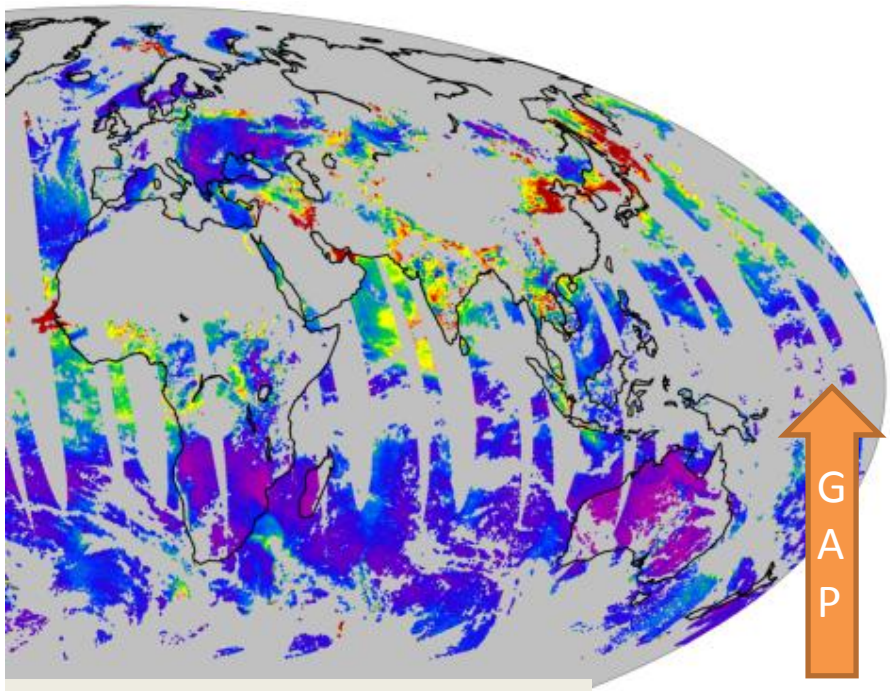
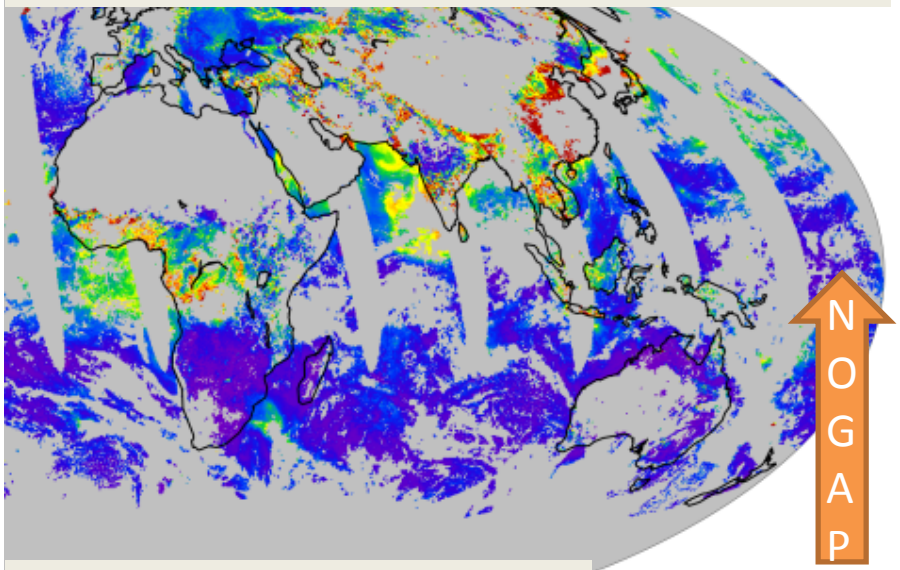
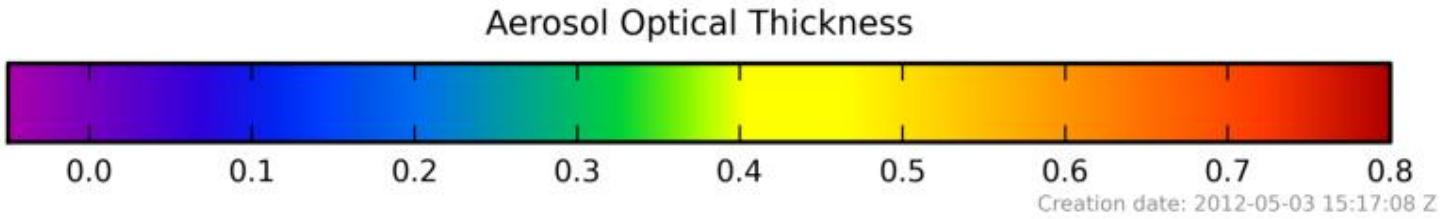


MODIS-Aqua

VIIRS has wider swath– complete overlap even at equator



VIIRS-NPP



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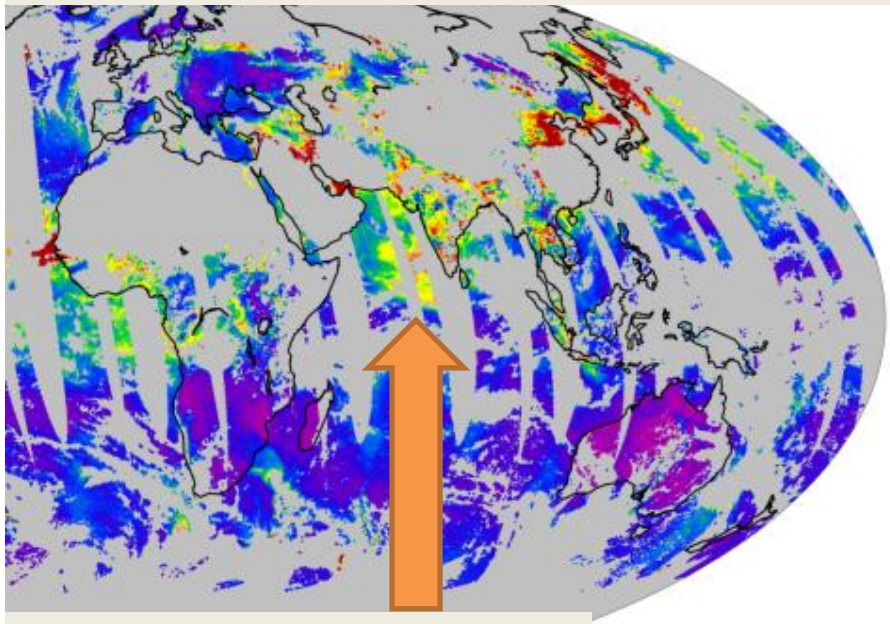
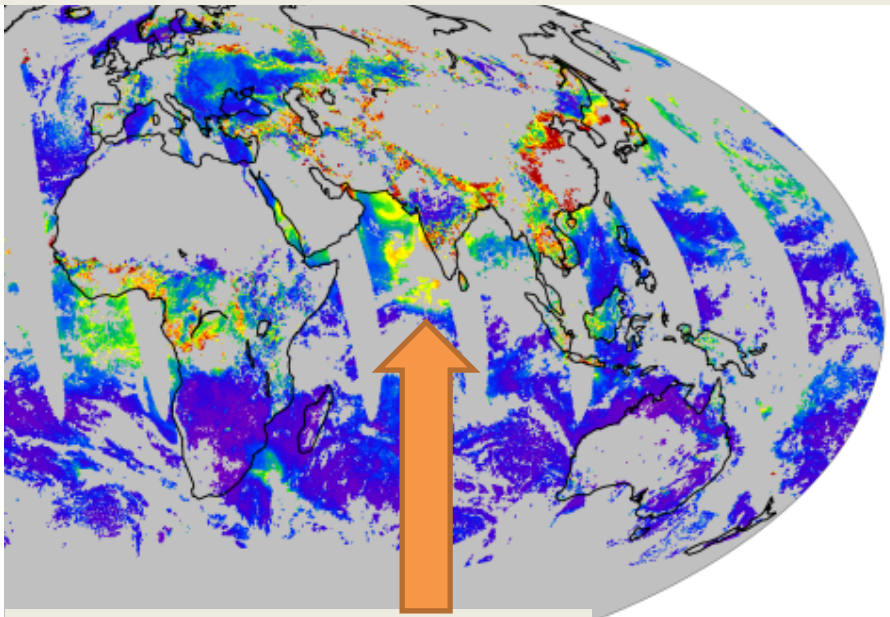
MODIS and VIIRS AOD

VIIRS and MODIS show broad agreement in large features



MODIS-Aqua



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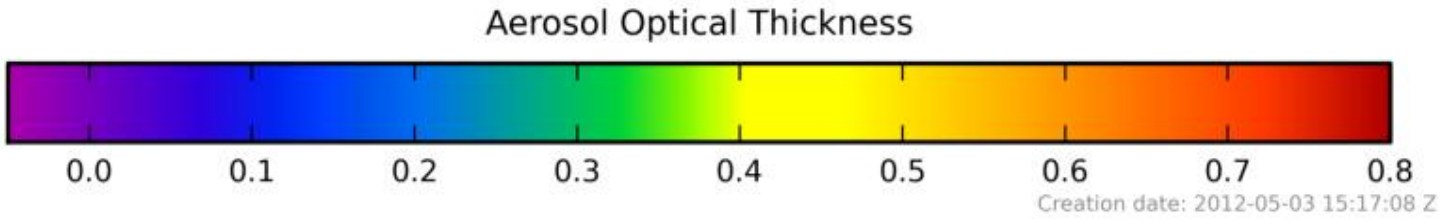

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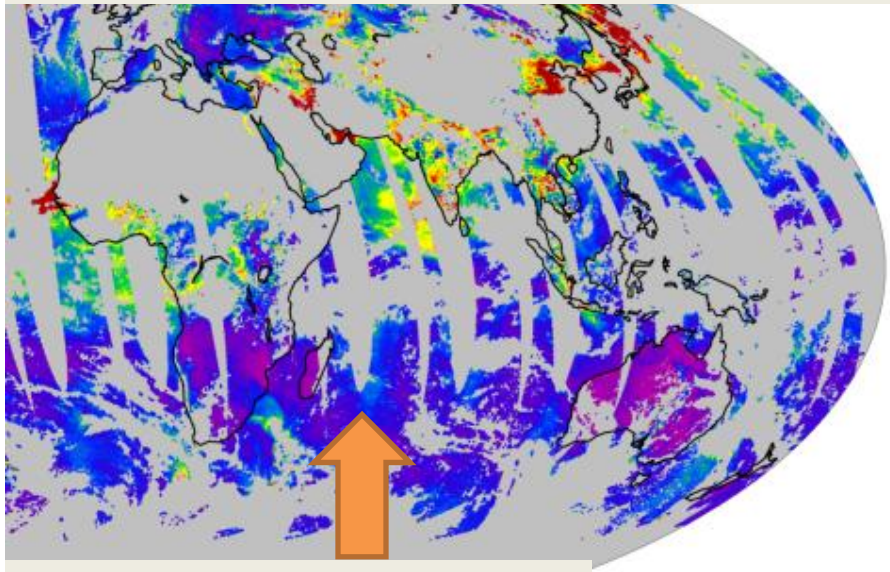
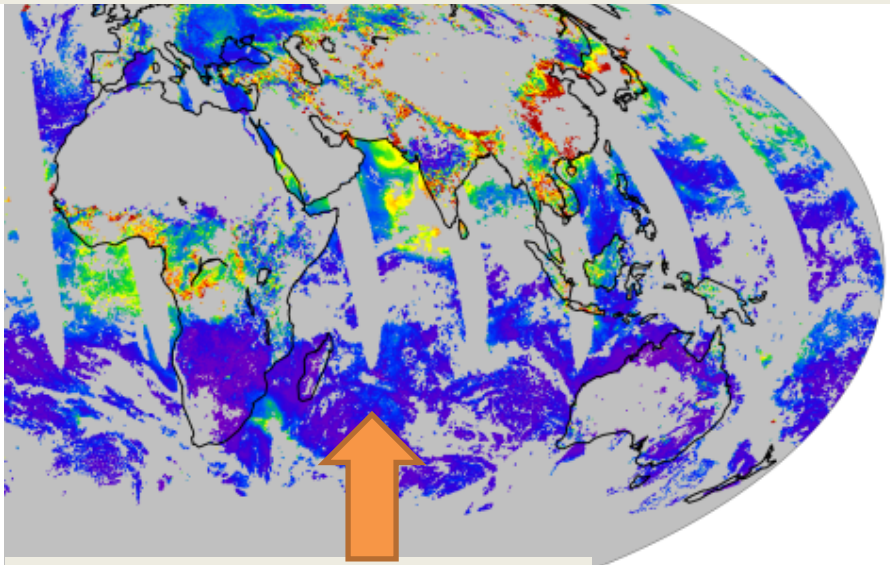
MODIS and VIIRS AOD

VIIRS and MODIS have different cloud screening– VIIRS is still being characterized. Both products must avoid clouds for accurate retrieval.



MODIS-Aqua



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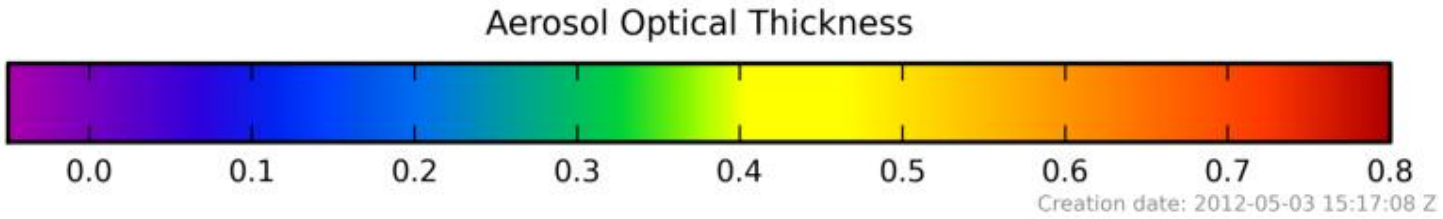

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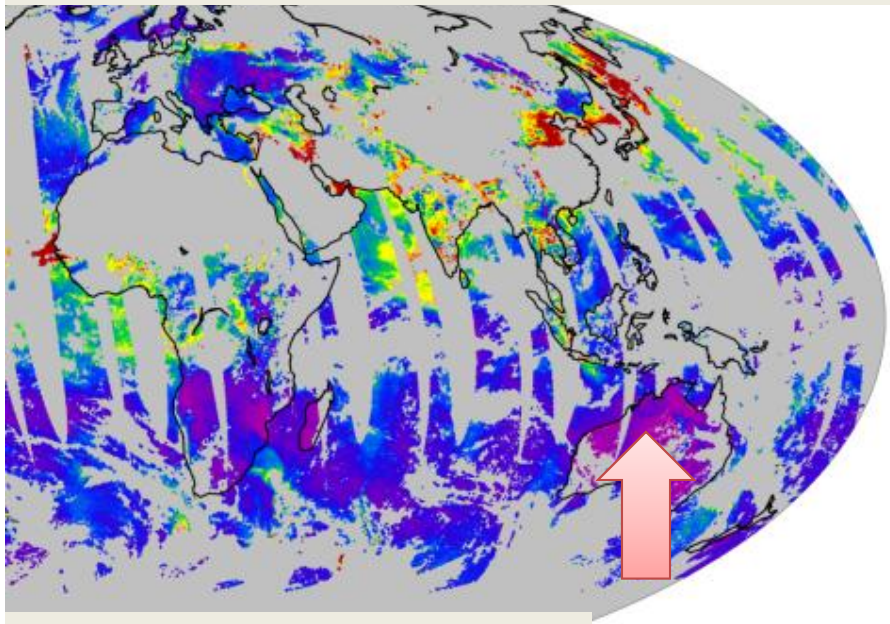
MODIS and VIIRS AOD

VIIRS and MODIS show significant differences over land



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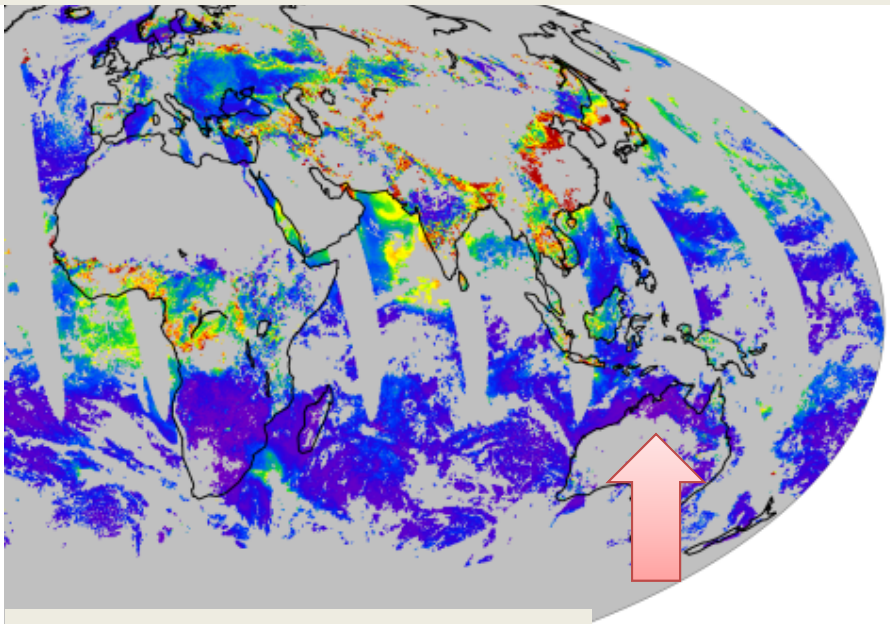

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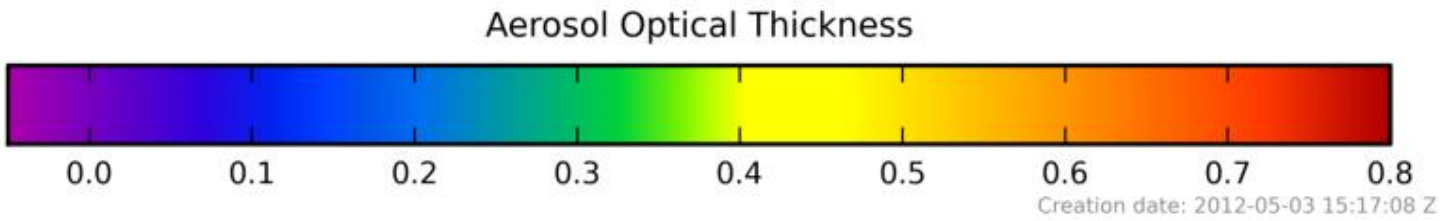

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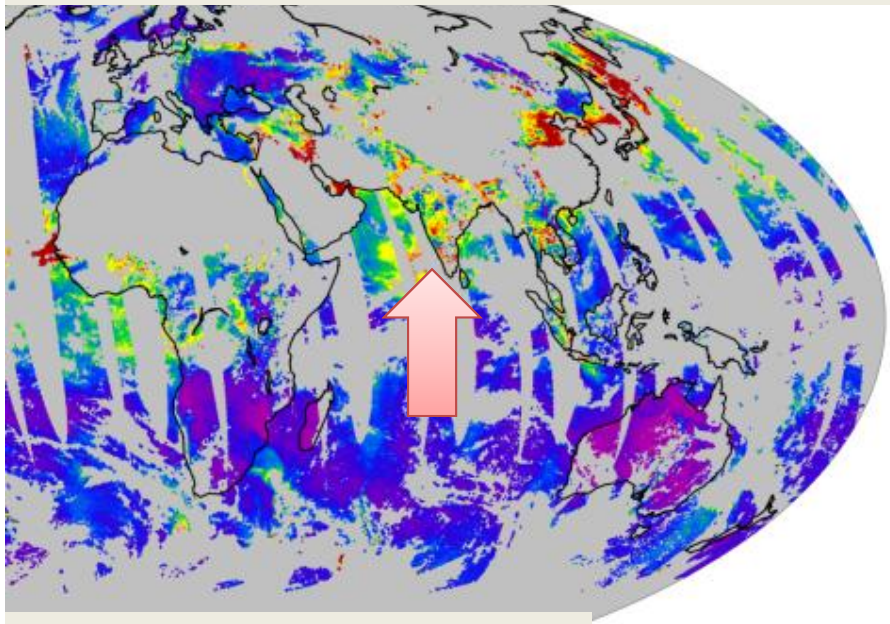
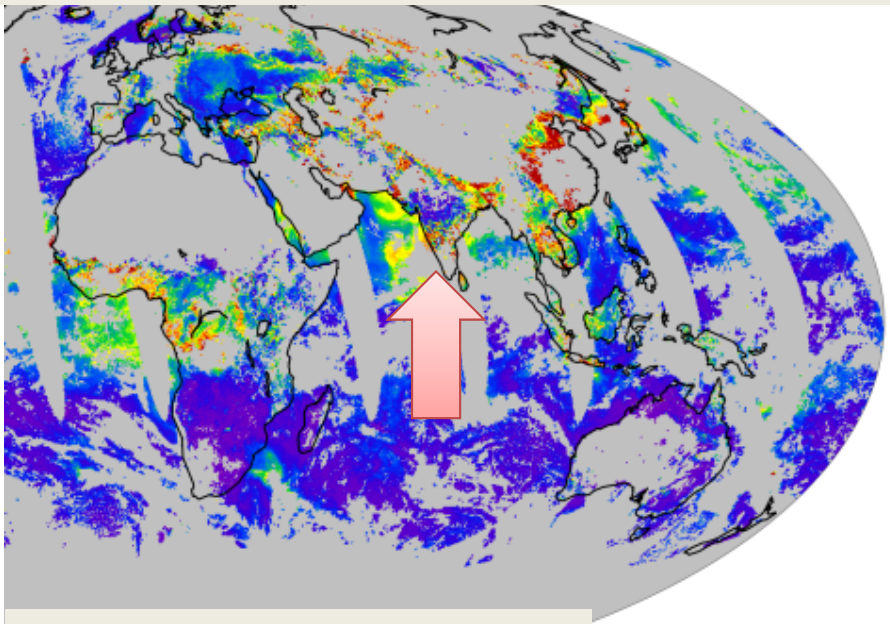


MODIS-Aqua



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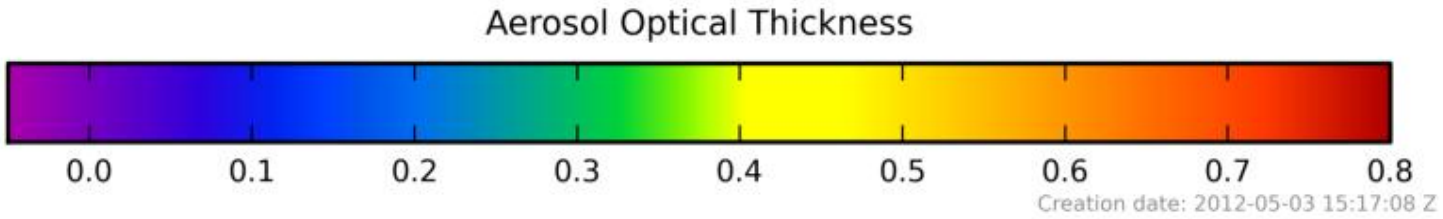

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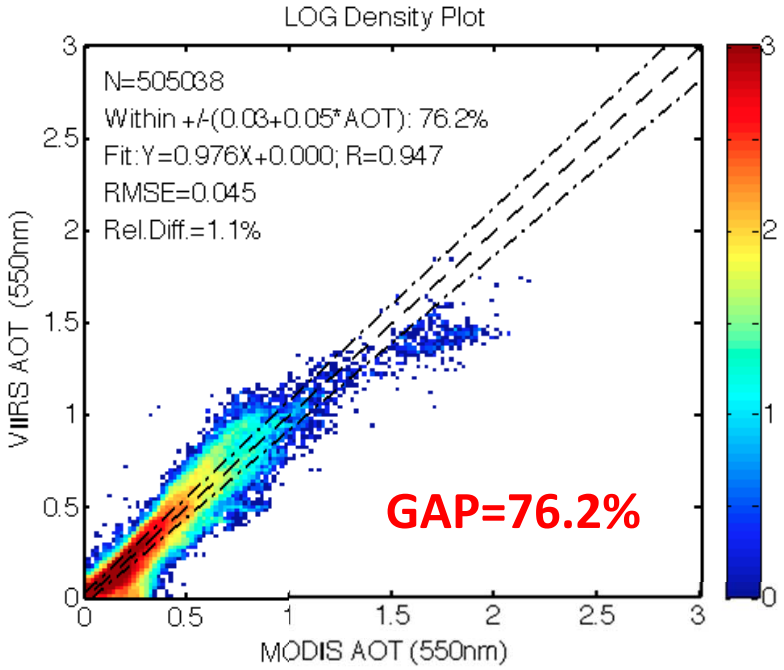
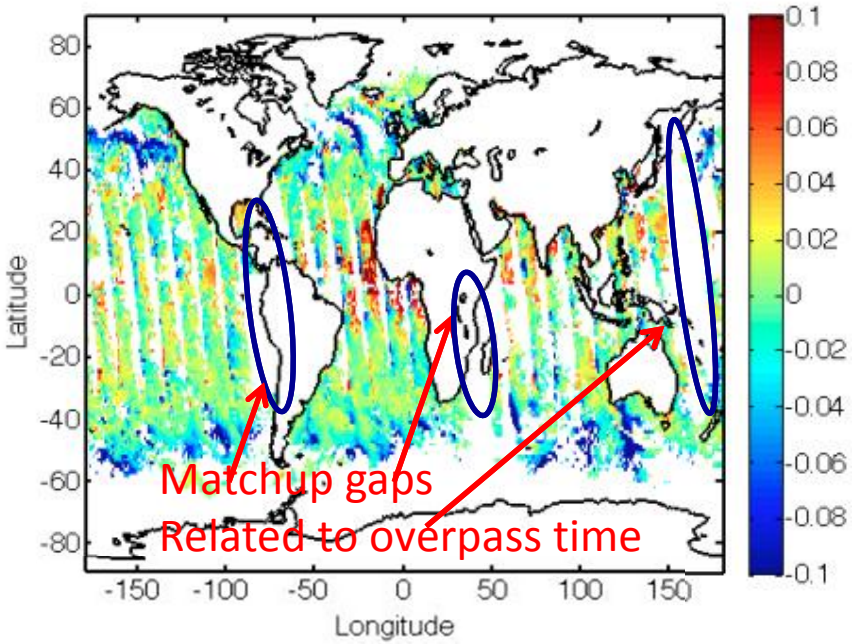




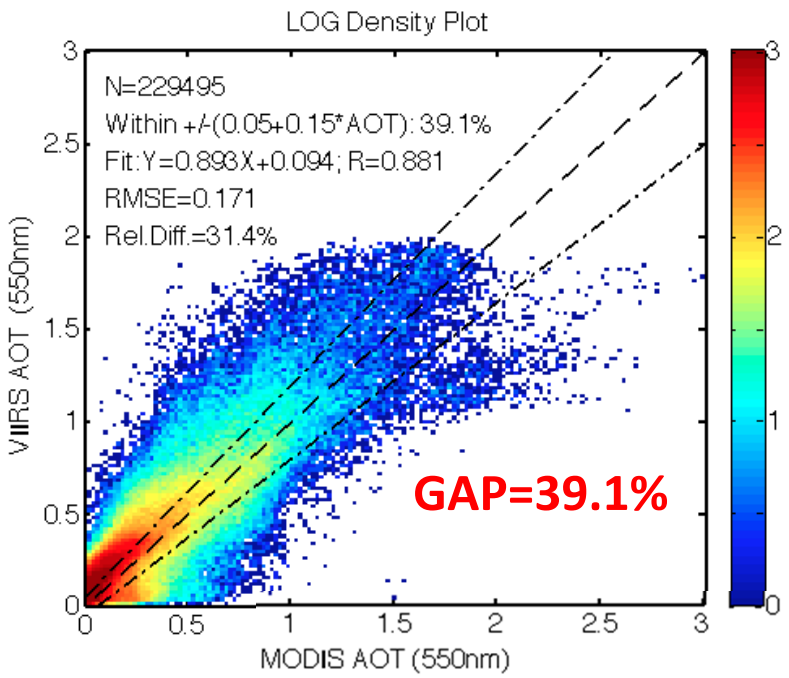
Ocean, 03/02/2012-04/16/2012

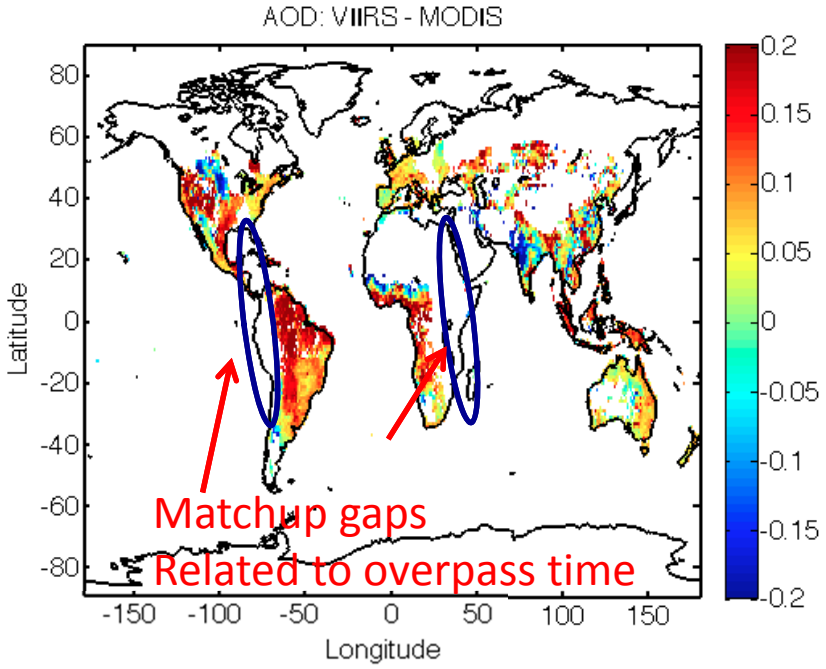
Over ocean, VIIRS and MODIS reach very good overall agreement:

GAP (good agreement %) = 76.2% within ±(0.03+0.05×AOD).

1. **VIIRS tends to have higher African dust AOD than MODIS over Atlantic**
2. **VIIRS tends to have lower AOD than MODIS at high latitude (>40°)**

Credit: Jingfeng Huang and Christina Hsu, NASA Goddard





Land, 03/02/2012-04/16/2012

Over land, VIIRS has higher AOD retrievals than MODIS overall:

GAP (good agreement %)=39.1% within ±(0.05+0.15×AOD).

1. **VIIRS tends to have higher AOD than MODIS over Amazon, Western US, Central Africa, Maritime Continents, Northeastern India, and Russia;**
2. **VIIRS tends to have lower AOD than MODIS over Sahel, Western India, and Some regions of Canada.**

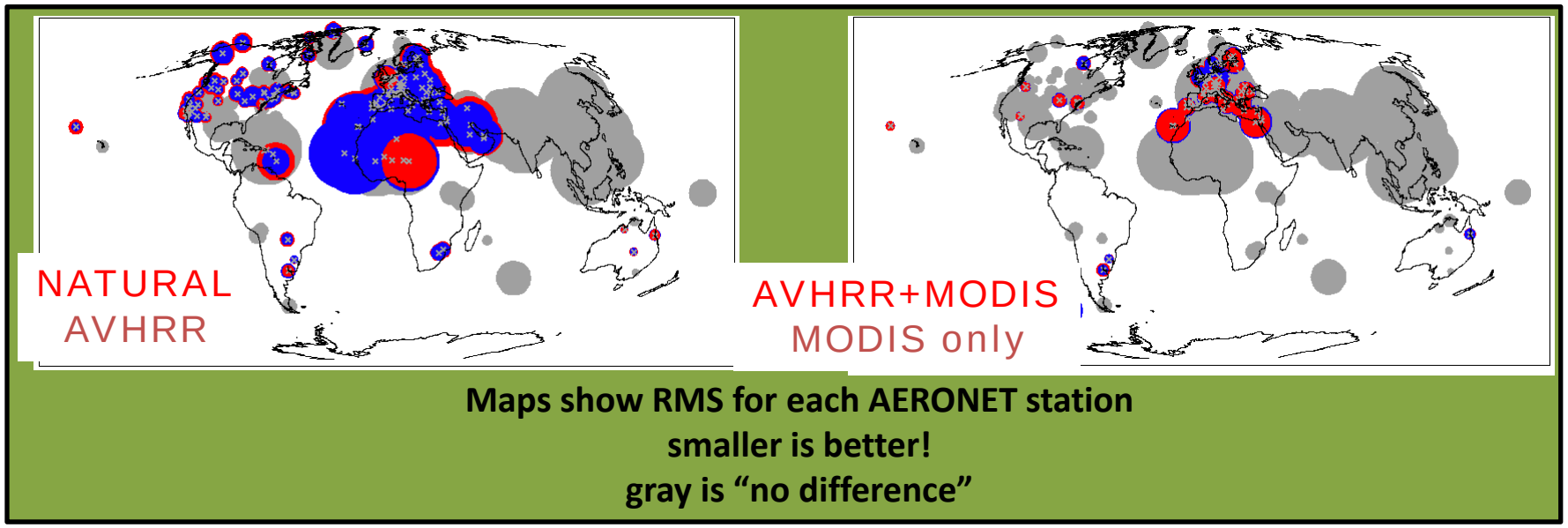
Credit: Jingfeng Huang and Christina Hsu, NASA Goddard

Summary

- VIIRS aerosol products now being produced
- VIIRS Cal/Val efforts are very intense right now
  - SDR radiances have largely stabilized
  - Cloud mask still being refined
- Global quick-looks available from Wisconsin PEATE: http://peate.ssec.wisc.edu/flo/npp/gridding
  - Can easily compare MODIS to VIIRS

Bonus Slide 1:
AOD products from AVHRR for assimilation

If we lost MODIS, AVHRR would help… **…but AVHRR+MODIS offers small gains**



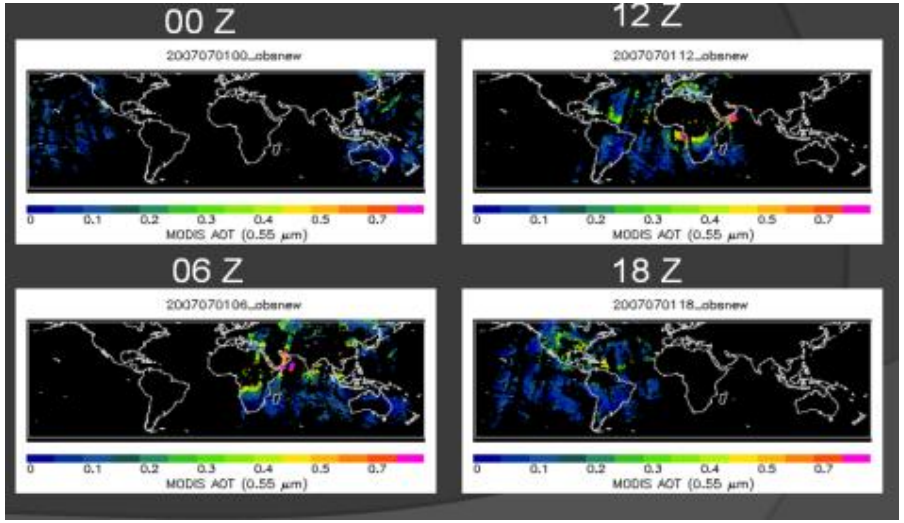
Maps show RMS for each AERONET station
smaller is better!
gray is "no difference"

1. NESDIS (ACSPO) product, built for SST, includes Stowe & Ignatov single-wavelength AOD
2. Feedback from NRL to NESDIS resulted in improved glint capture, better QA treatment in ACSPO product
3. METOP-A delivers AOD at native 1km with 0930LST equatorial overpass (before MODIS-Terra)

Bonus Slide 2:
MODIS DA-ready AOD from LANCE

http://usgodae.org/cgi-bin/datalist.pl?Data_Type=ALL&Parameter=ALL&Provider=nrl&meta=Go#nrl_modis_l3

- Will be NRT from LANCE (<4 hours from overpass)
- 0.5 degree, HDF format, GEOS-5 winds
- Will announce via ICAP list



Available at GODAE with Latency= 24 hours