

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

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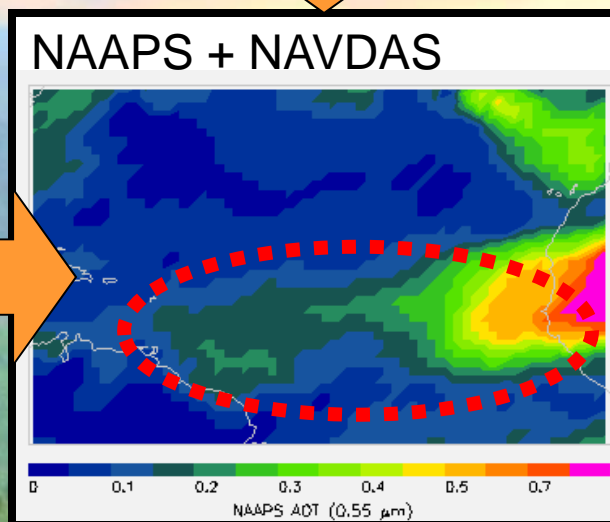
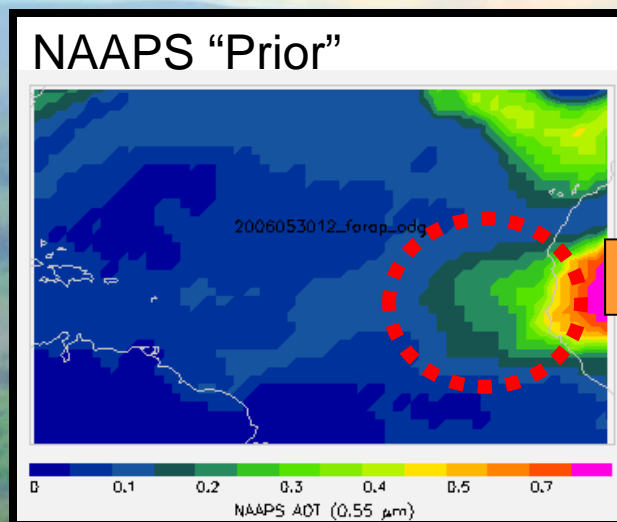
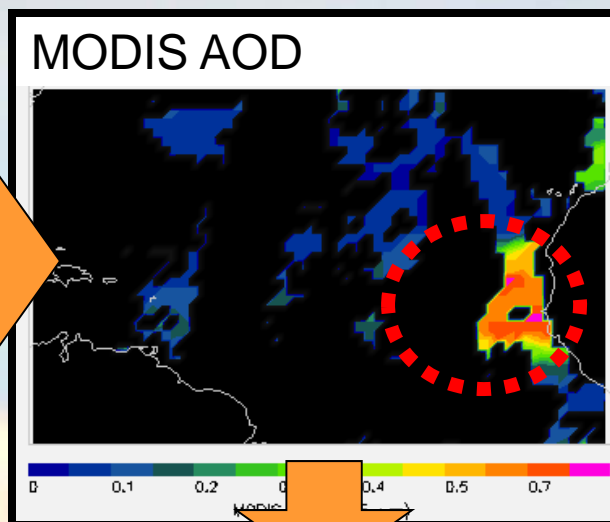
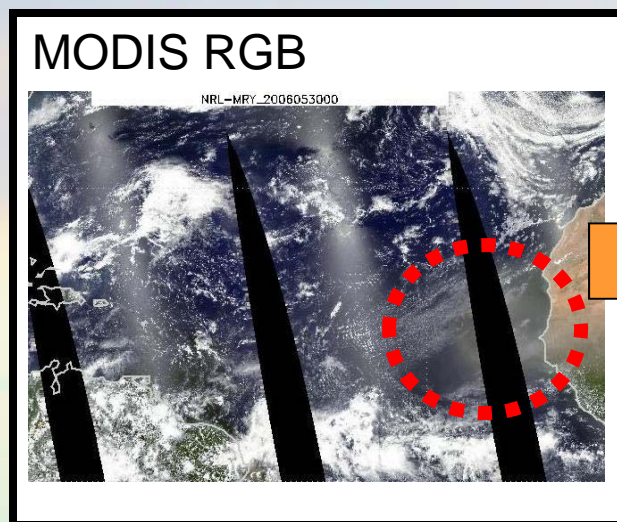
And the JPSS Aerosol Cal/Val Team



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

- J.L. Zhang et al., "A System for Operational Aerosol Optical Depth Data Assimilation over Global Oceans", JGR 2008.

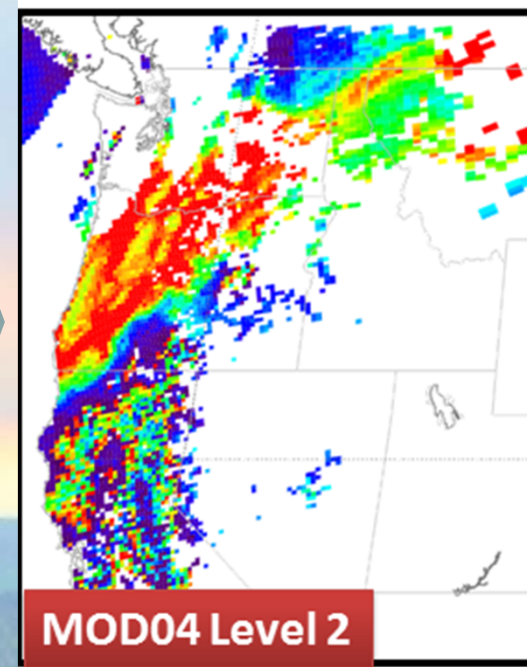
Preparation of Satellite Data for Assimilation



MODIS RGB

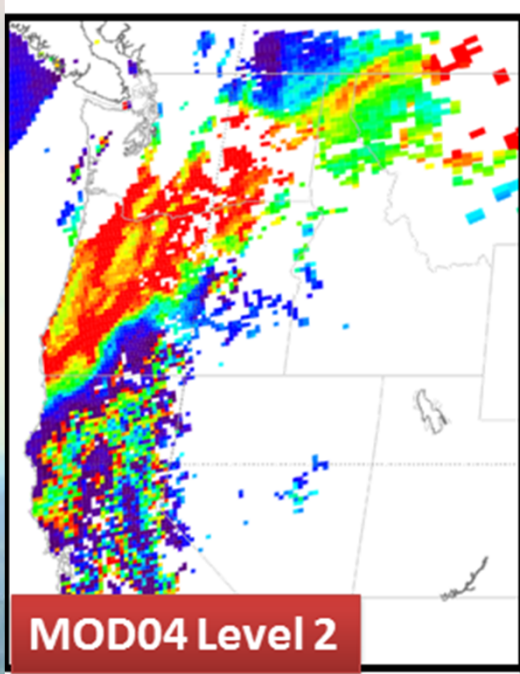
September 24, 2012

Level 2 MOD04 (NASA) or
VAOOO EDR (JPSS) data is
generated by upstream
data centers – spatial
resolutions of a few km



MOD04 Level 2

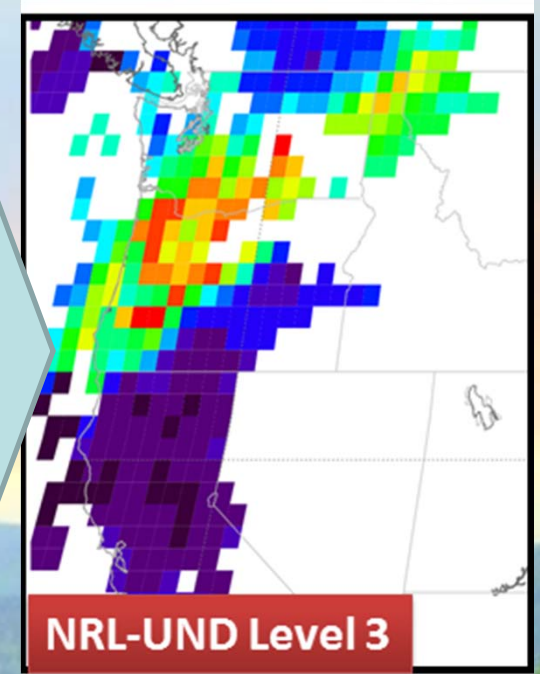
Preparation of Satellite Data for Assimilation



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

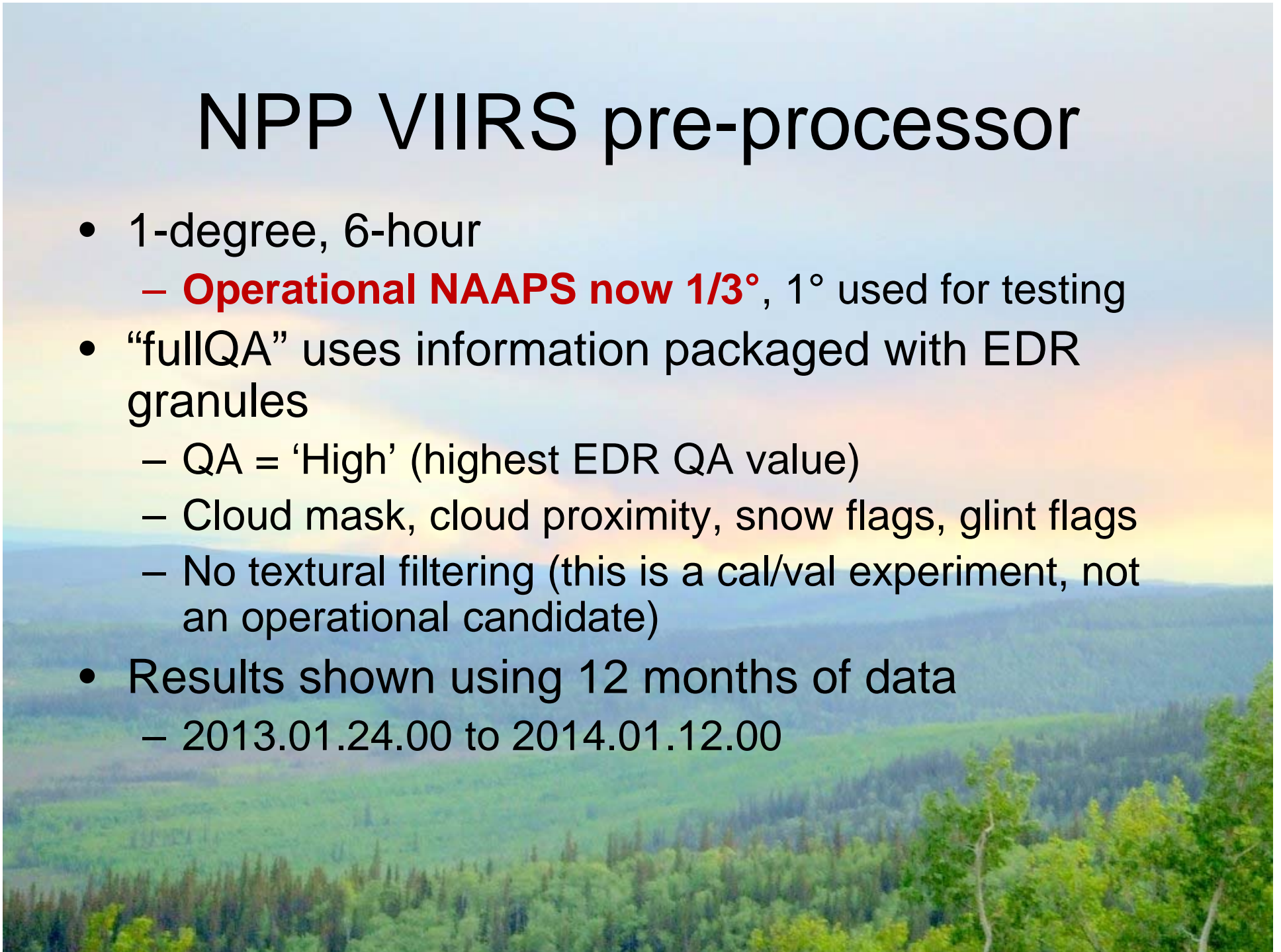
0.5 degree product distributed to public via NASA LANCE (MxDAODHD)



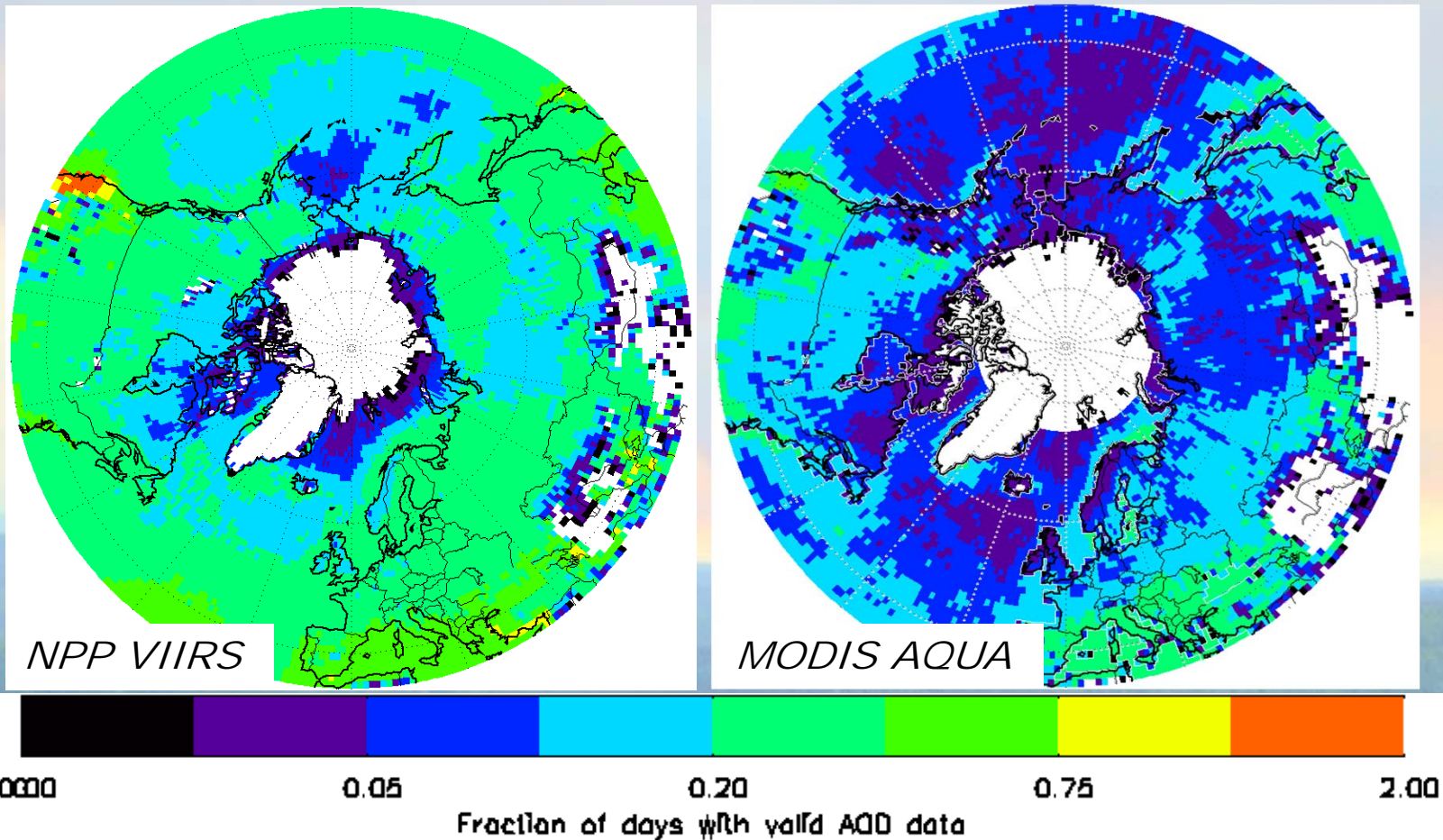
This is the process developed for MODIS Collection 4&5
How much pre-processing will be required
for Suomi NPP VIIRS?

NPP VIIRS pre-processor

- 1-degree, 6-hour
 - **Operational NAAPS now $1/3^\circ$** , 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

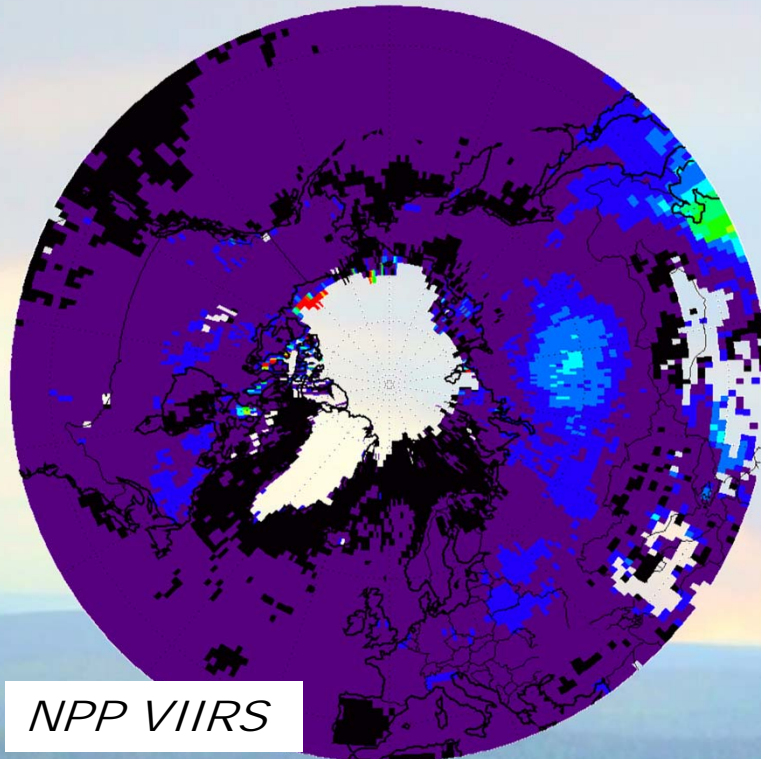


VIIRS 'fullQA' coverage vs NRL-UND Level 3 MODIS-- Land

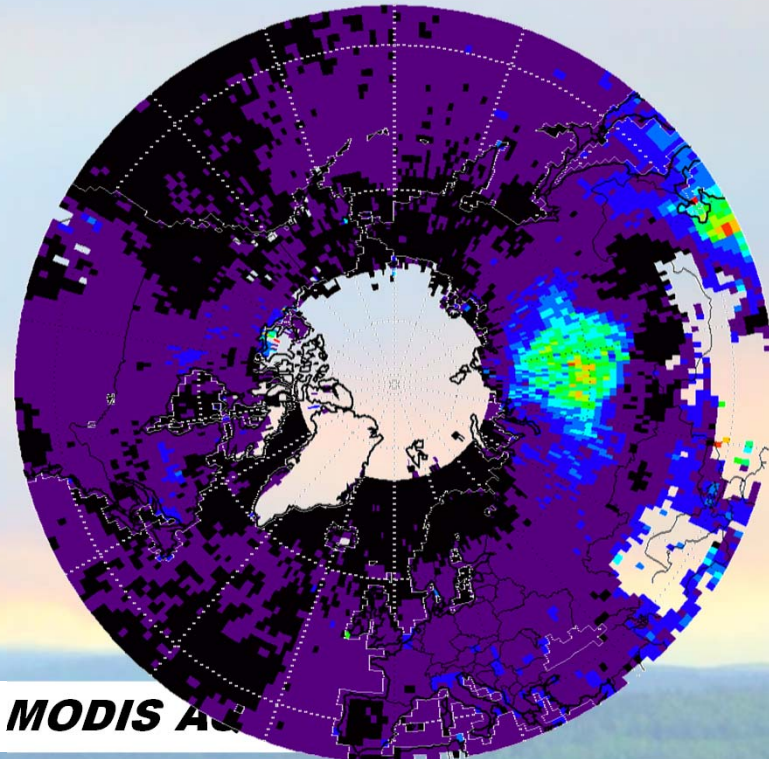


- NRL/UND Level 3 MODIS is stringently filtered
- VIIRS potentially delivers much more data vs 1 MODIS
 - **Almost as much as 2 MODIS**

VIIRS 'fullQA' AOD vs NRL-UND Level 3 MODIS-- Ocean



NPP VIIRS

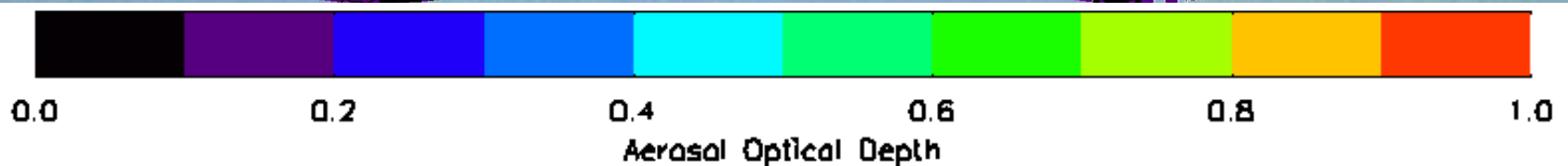
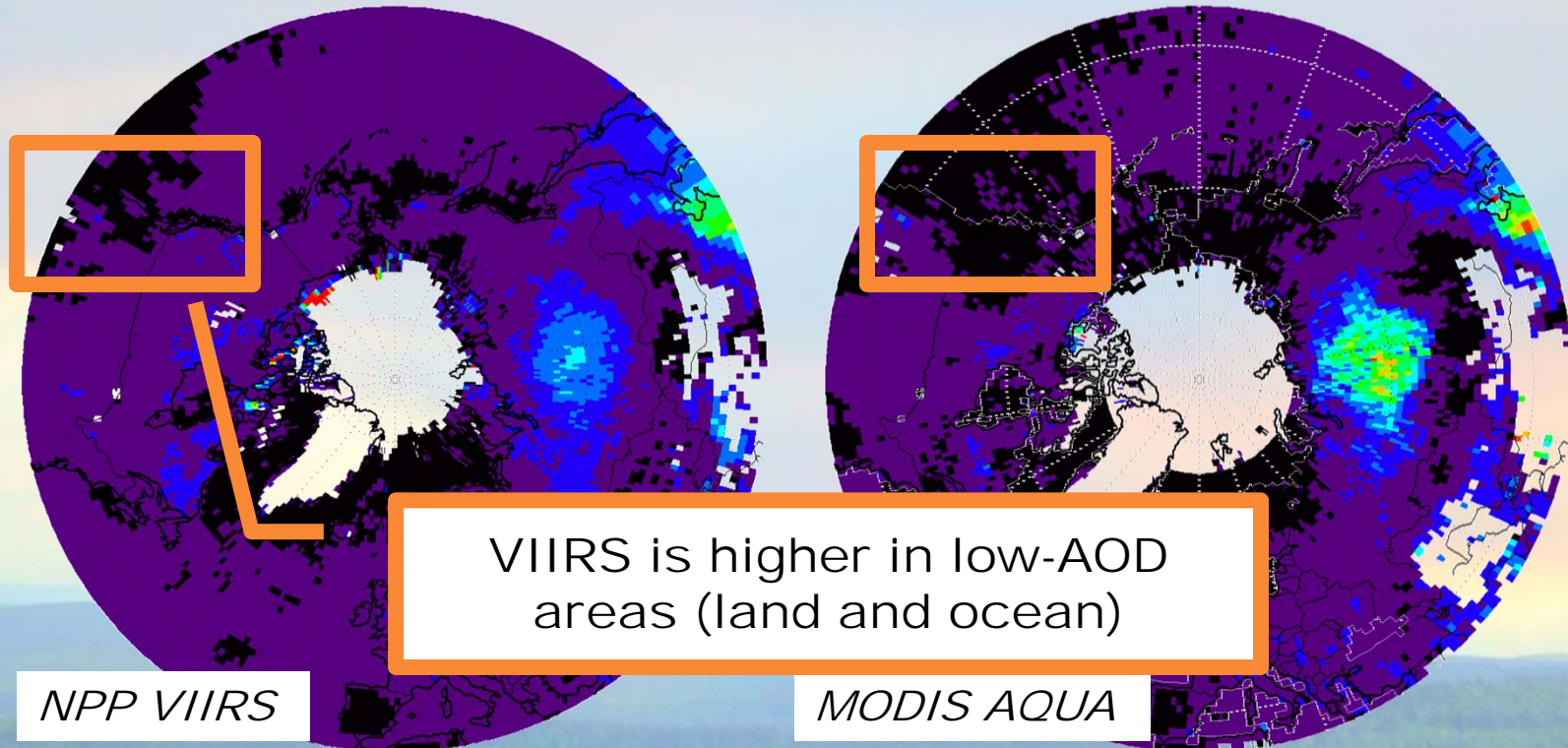


MODIS AOD

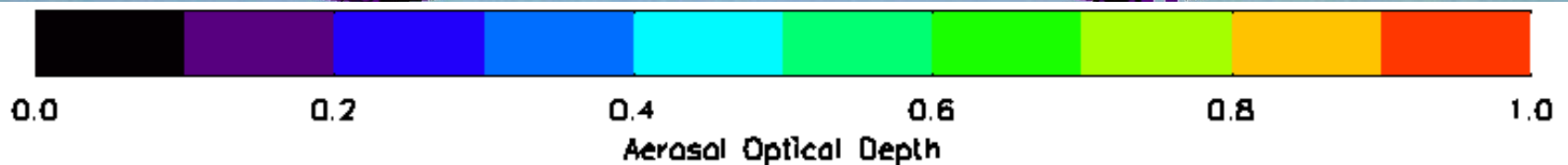
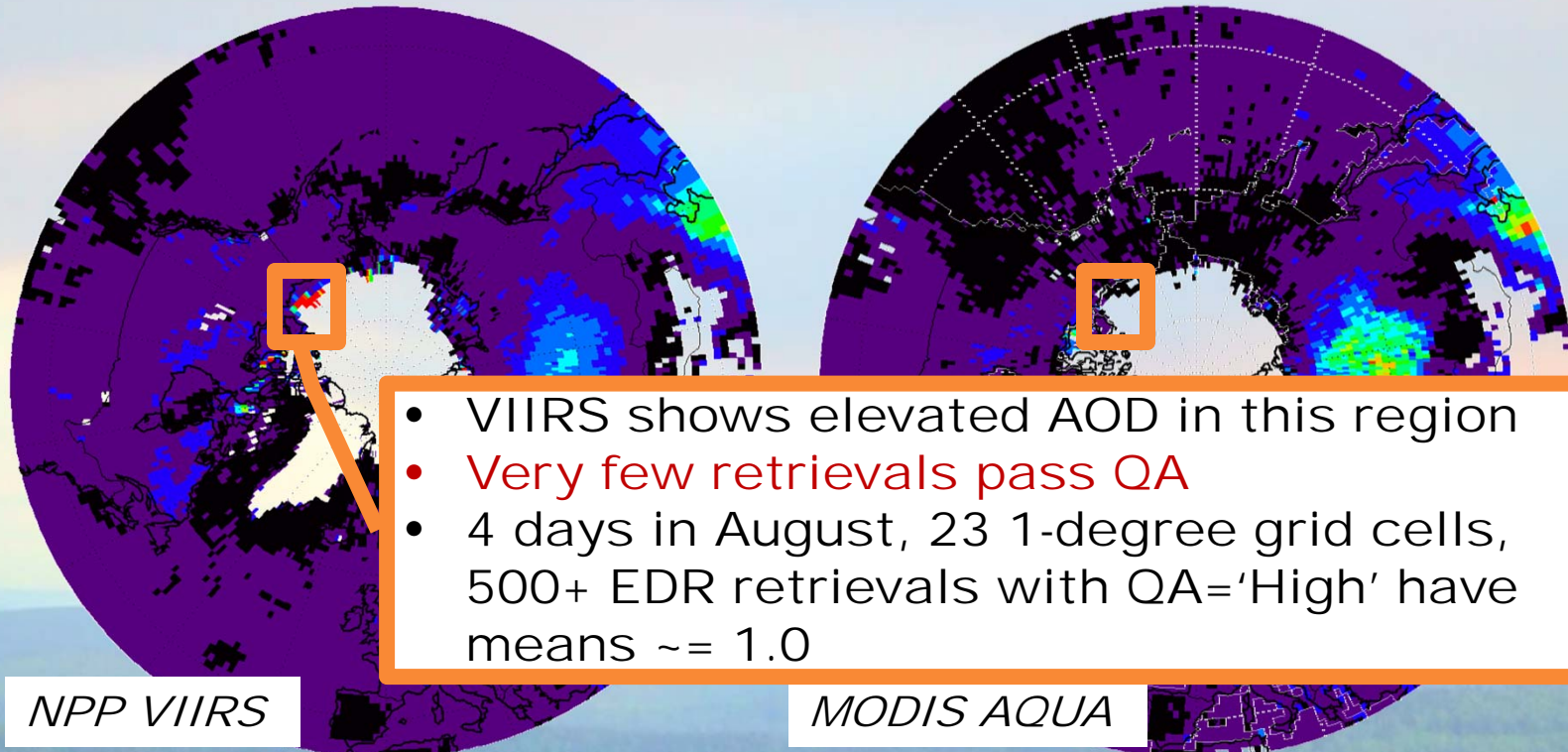


Global patterns match very well
VIIRS has smaller excluded area, greater coverage

VIIRS 'fullQA' AOD vs NRL-UND Level 3 MODIS-- Ocean



VIIRS 'fullQA' AOD vs NRL-UND Level 3 MODIS-- Ocean

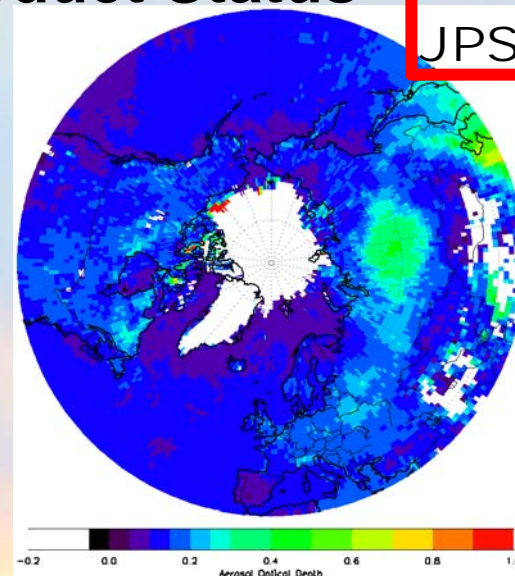


Attempt at DA-ready VIIRS AOD

NPP VIIRS Aerosol Product Status

VIIRS with
JPSS QA only

- 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**



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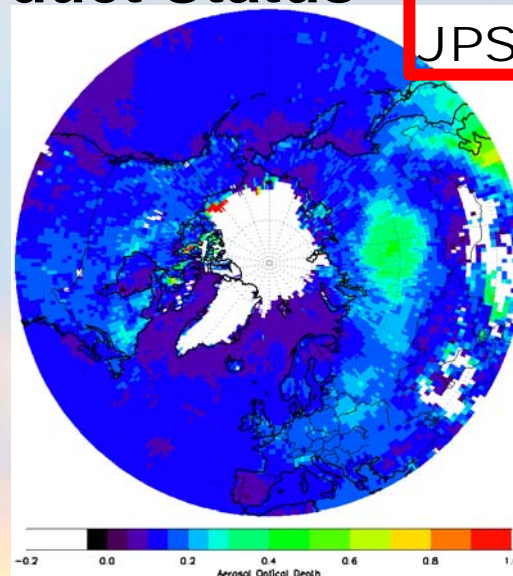
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Over-ocean

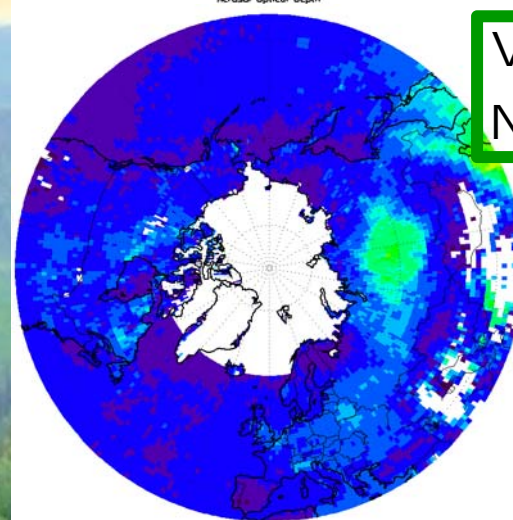
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VIIRS with
NRL filters



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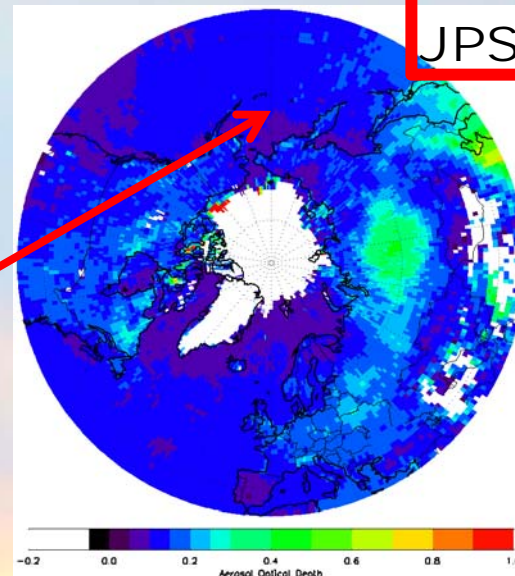
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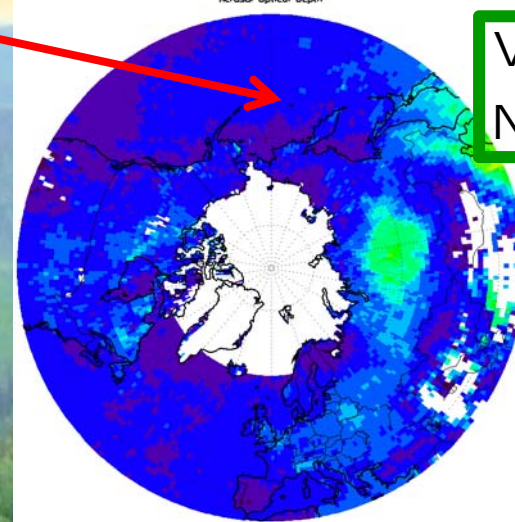
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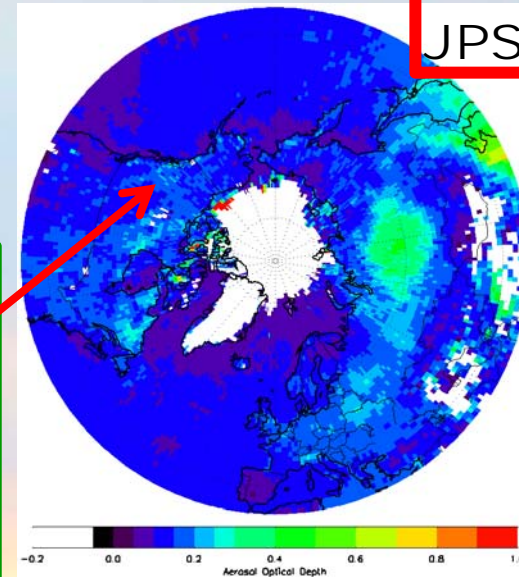
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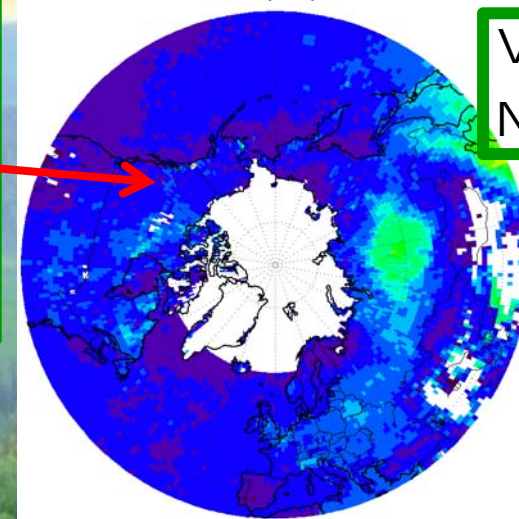
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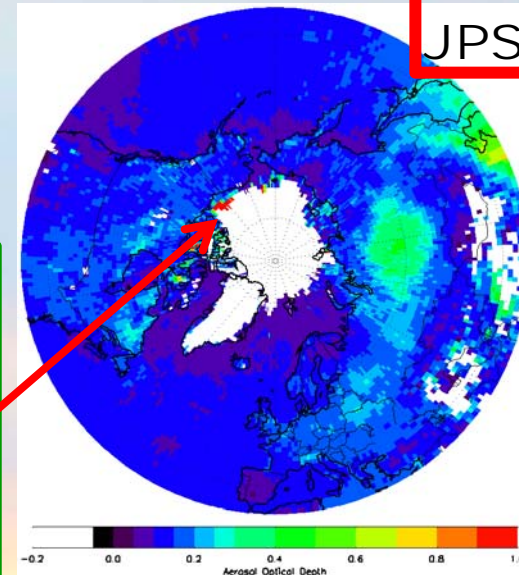
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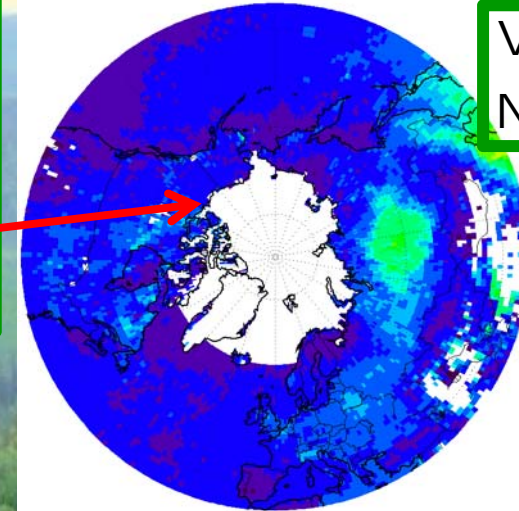
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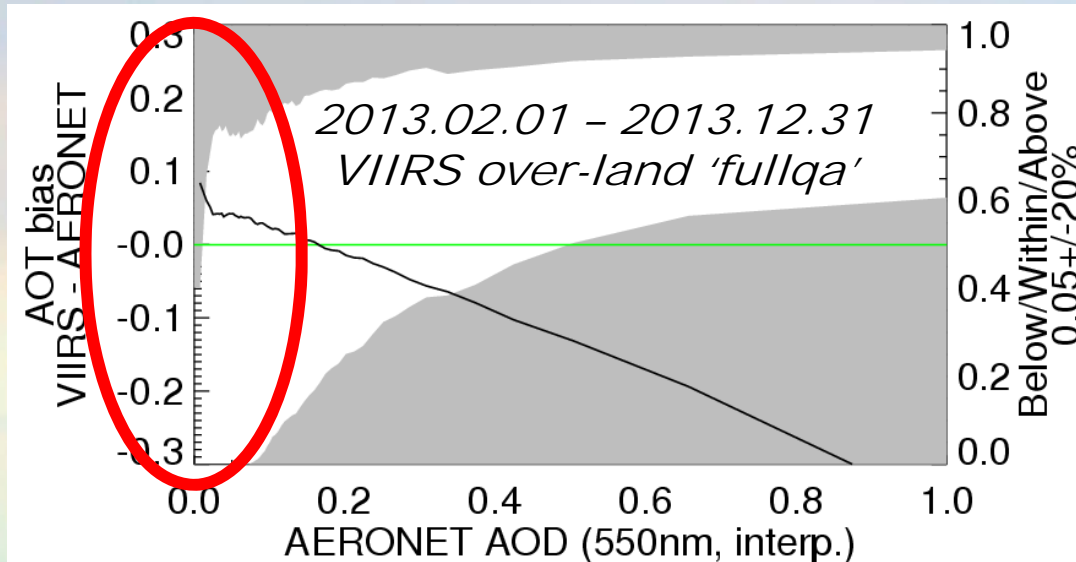
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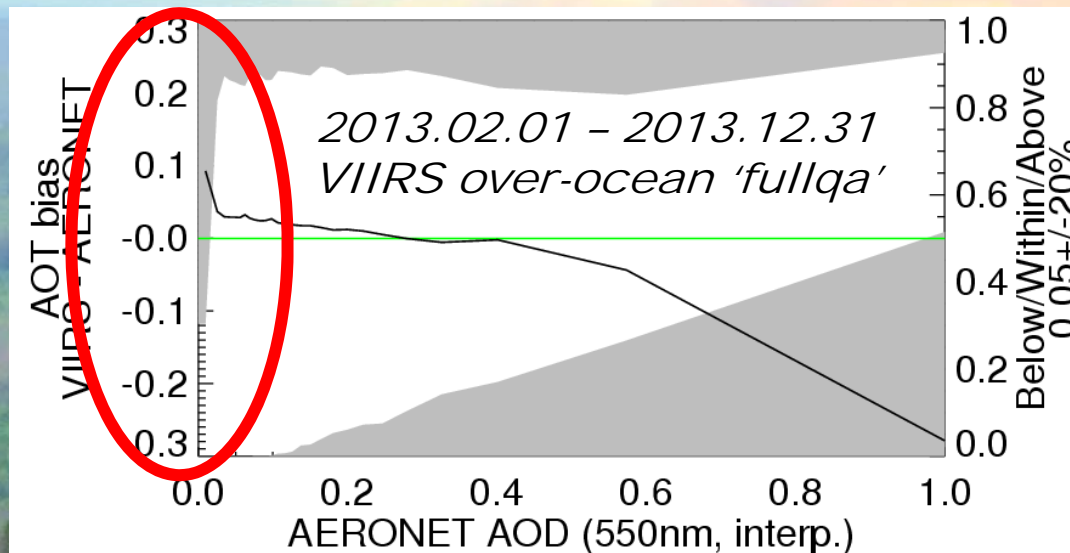
1-degree products vs AERONET



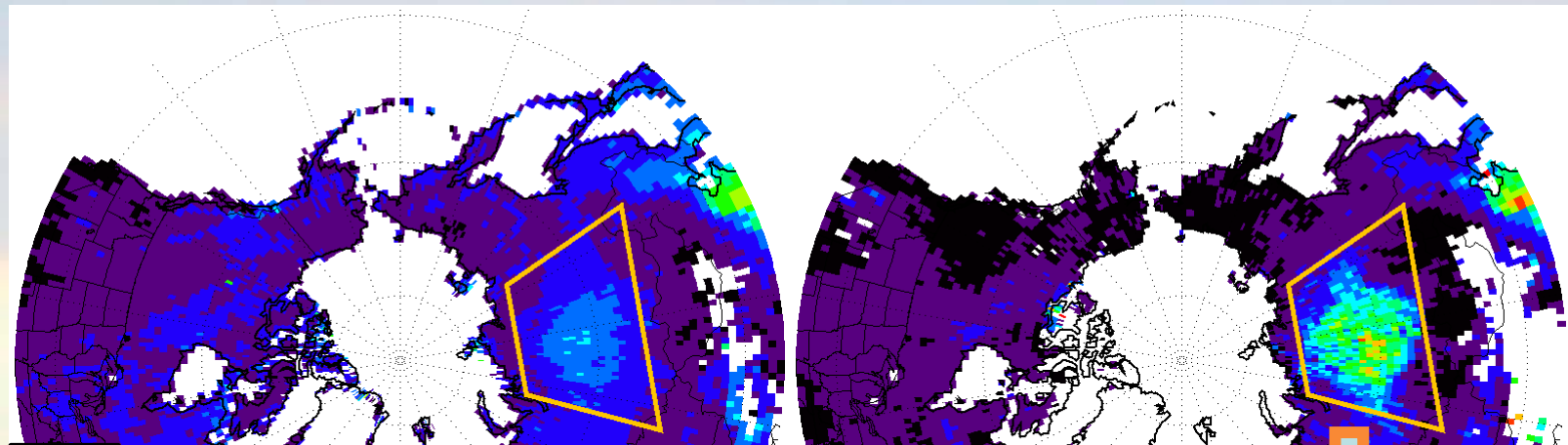
(left) White bar indicates % of data within $0.05 \pm 20\%$, gray bars indicate % above or below. At low AOD, positive errors dominate.

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



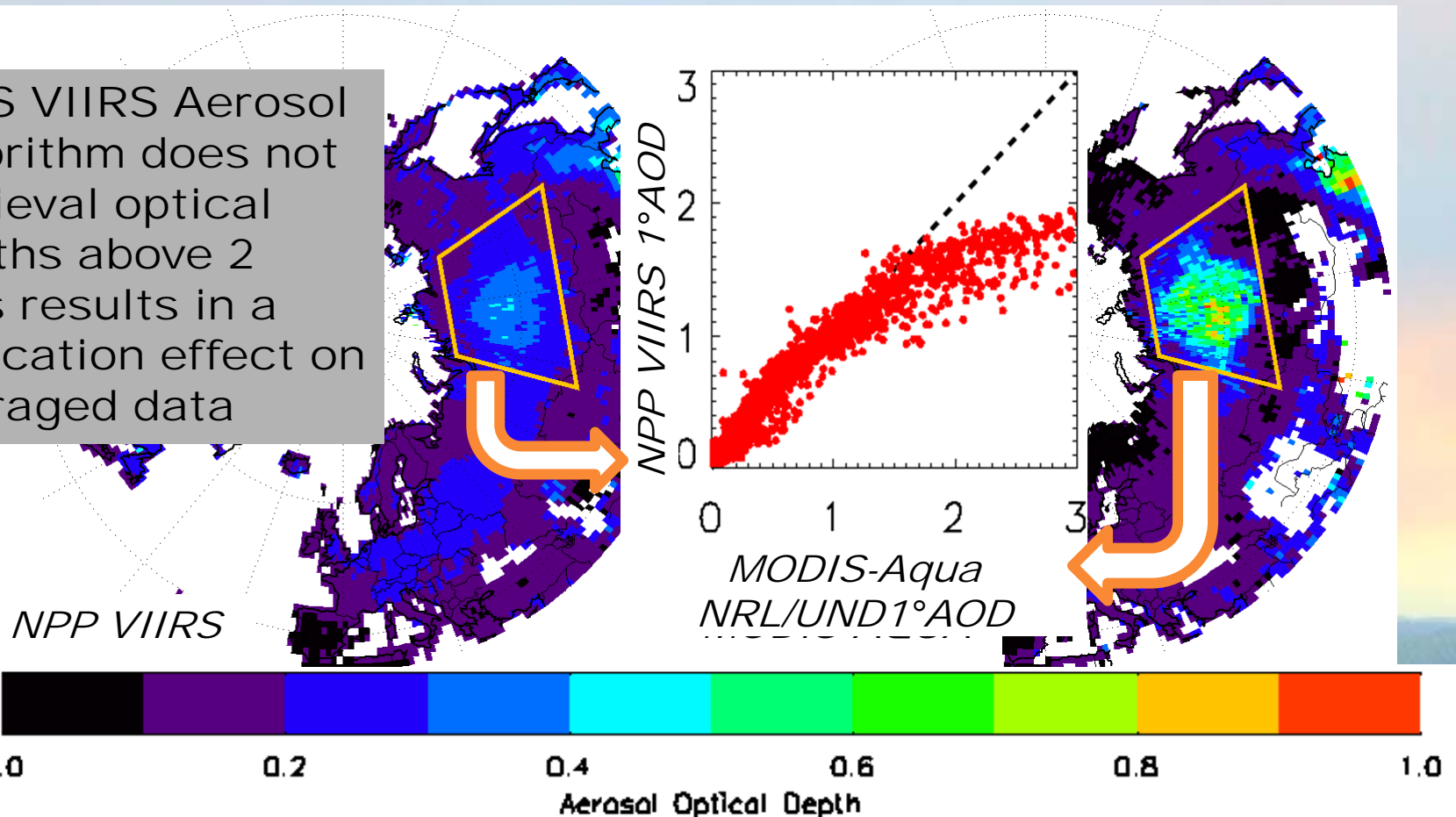
NASA LANCE Worldview
MODIS Aqua 3 August 2013

- Massive midsummer Siberian fires
- Episodic, intense plumes
- Signal in VIIRS is much lower than MODIS

1.0

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
- Thank you to sponsors: JPSS, NASA AQAAT, NRL

