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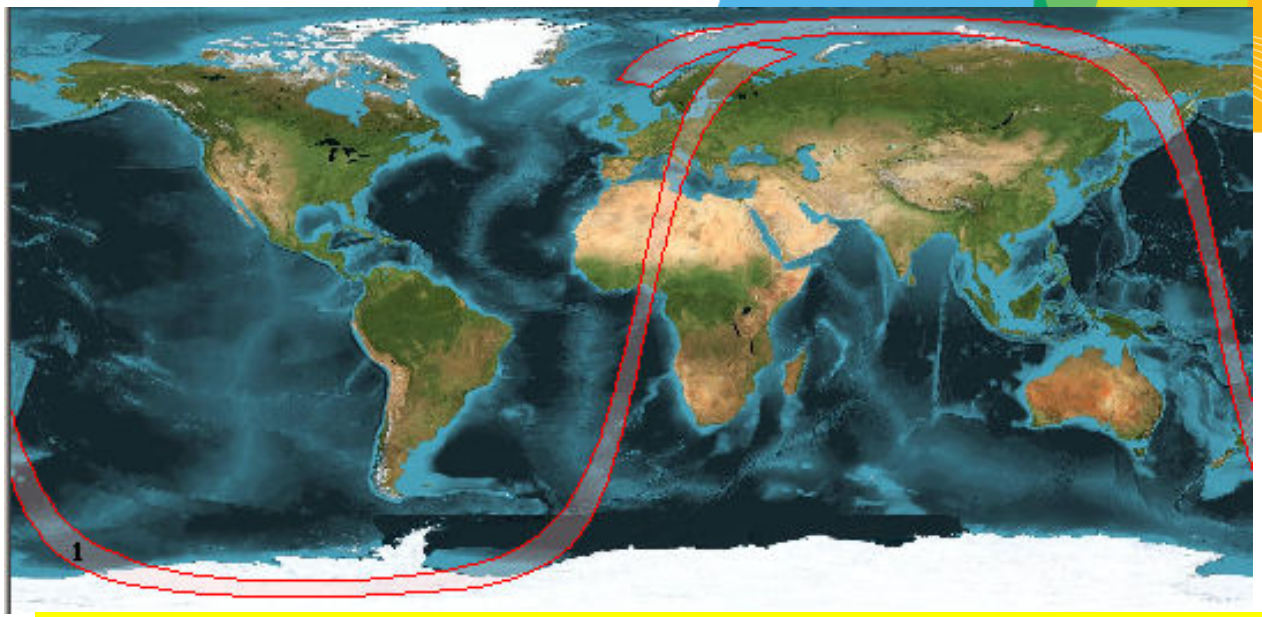
Retrieval of Aerosol and Cloud Properties using the ATSR Dual and Single View algorithms

Gerrit de Leeuw[1,2], Larisa Sogacheva[1], Pekka Kolmonen[1], Giulia Saponaro[1], Timo H. Virtanen[1], Edith Rodriguez[1], Ksenia Atlaskina[2], Anu-Maija Sundström[2]

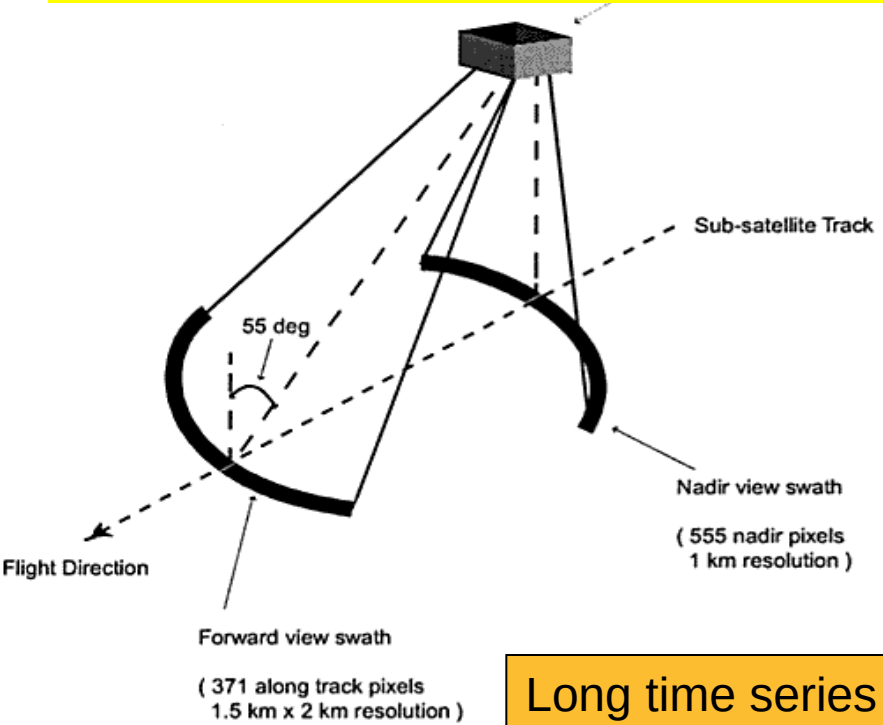
[1] FMI, Climate Change Unit, Helsinki, Finland

[2] Dept. of Physics, Univ. of Helsinki, Finland



- Sun synchronous
- Equator overpass time 10:00
- Swath 500km
- Spectral Channels
  - IR: 1.6, 3.7, 10.85, and 12 μm
  - VIS: 0.555, 0.67, and 0.865 μm
- Spatial resolution 1 x 1 km^2

AATSR lost on 6 April 2012 – SLSTR launch planned on 31 October 2015



- **AATSR has two viewing angles; forward at 55° , and nadir**
- Two viewing angles allow to account for surface effects on TOA radiation
- Over land the dual view aerosol retrieval algorithm (ADV) is used
- Over ocean the two views are used separately: forward and nadir

Long time series started in 1995: ATSR-2, AATSR, SLSTR

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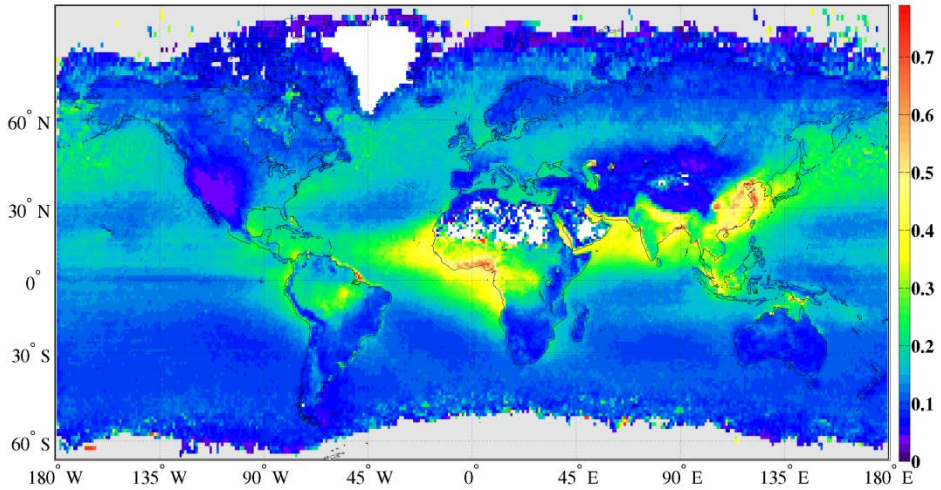
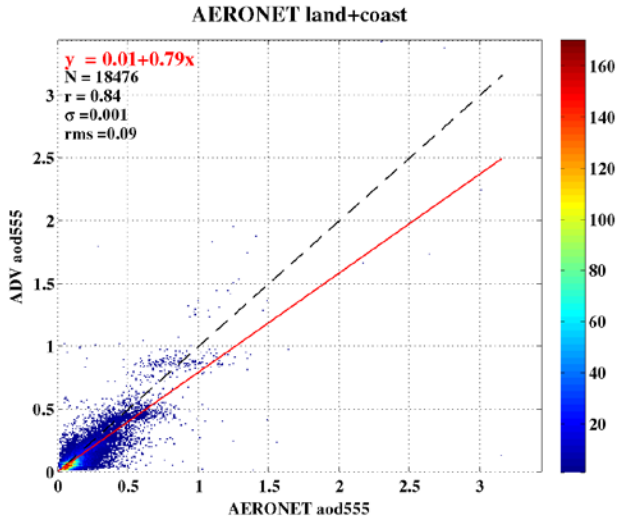
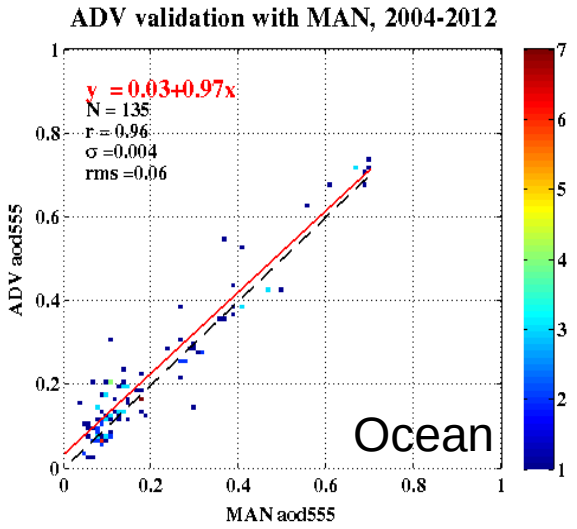
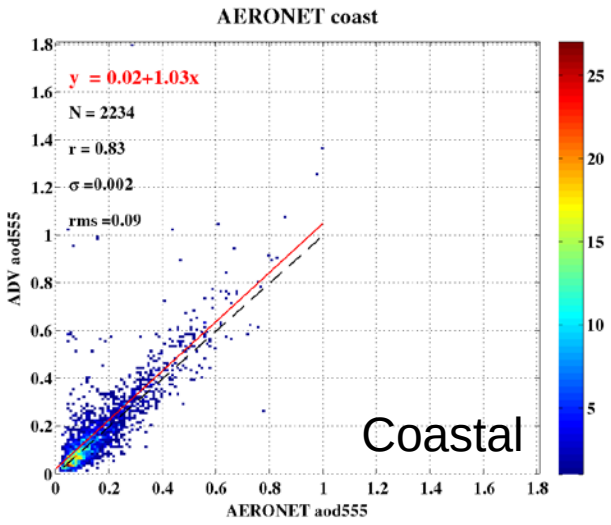
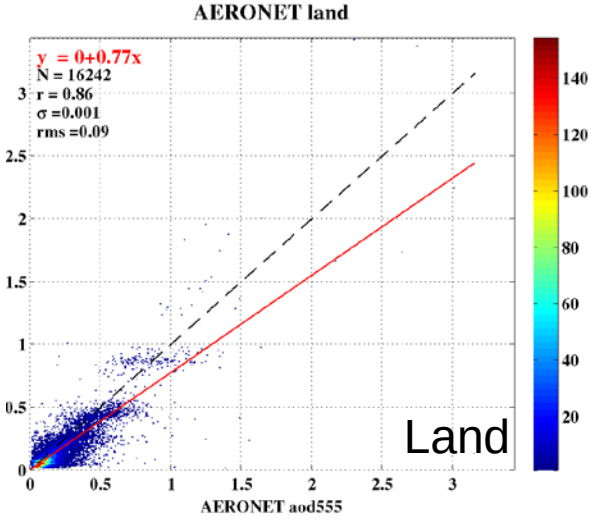
AATSR (2002-2012) aggregated AOD550 & validation



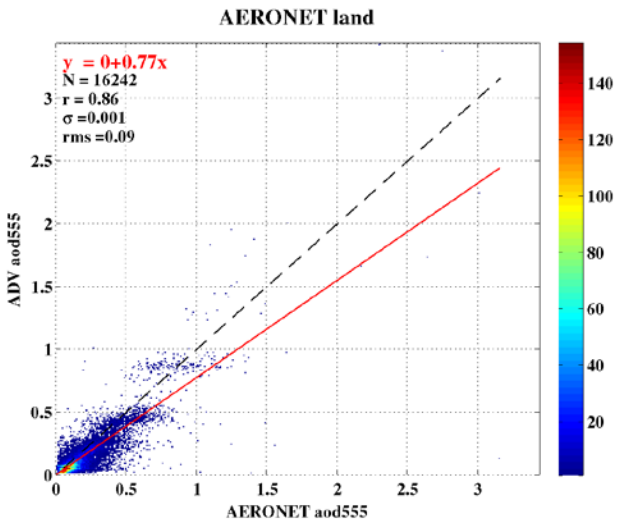


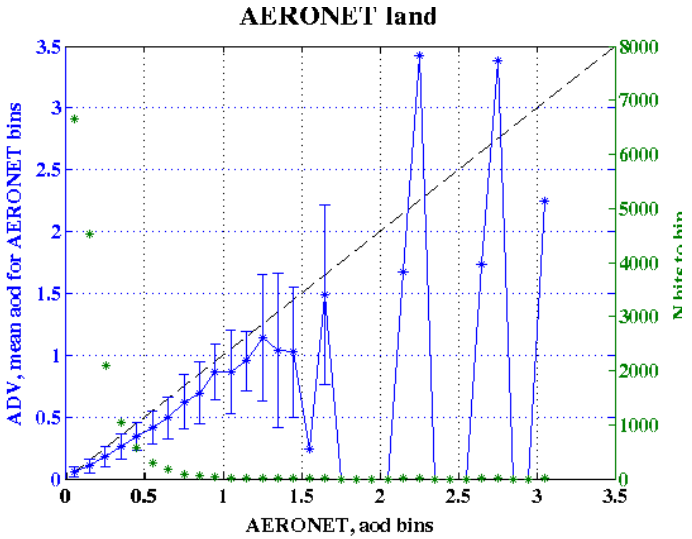


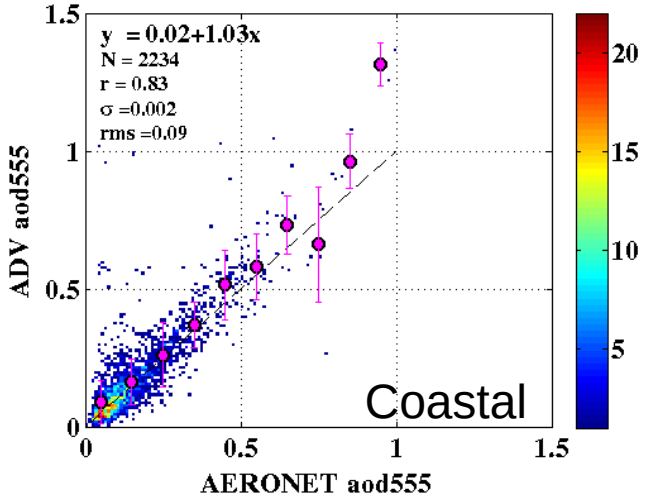


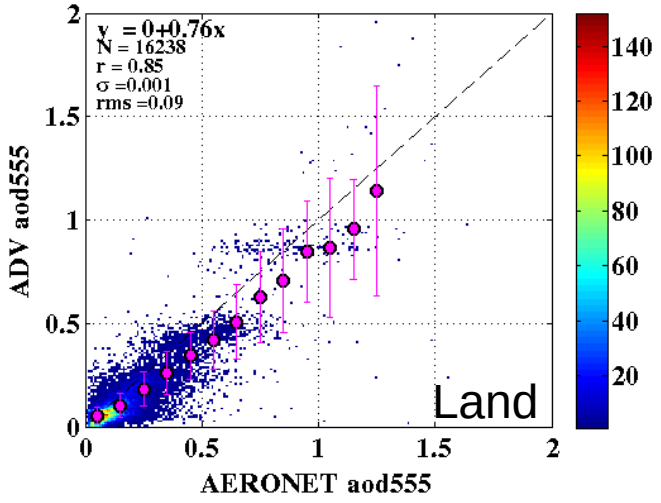


AATSR (2002-2012): validation









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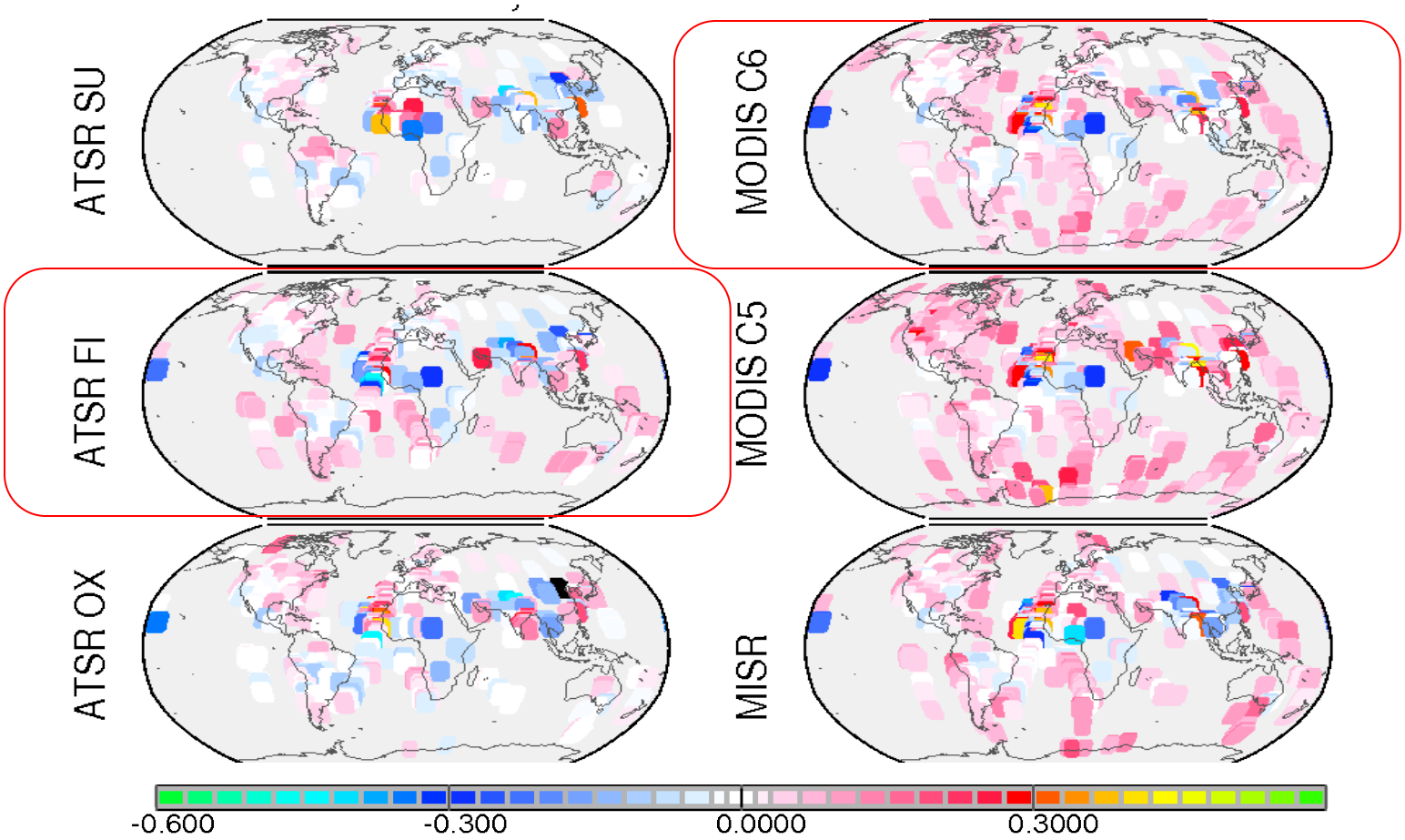
Comparison with other algorithms & instruments (2008)

AOD550 differences: Satellite – AERONET/MAN



Satellite lower <> satellite higher

Comparison ADV with MODIS C6 (2008)

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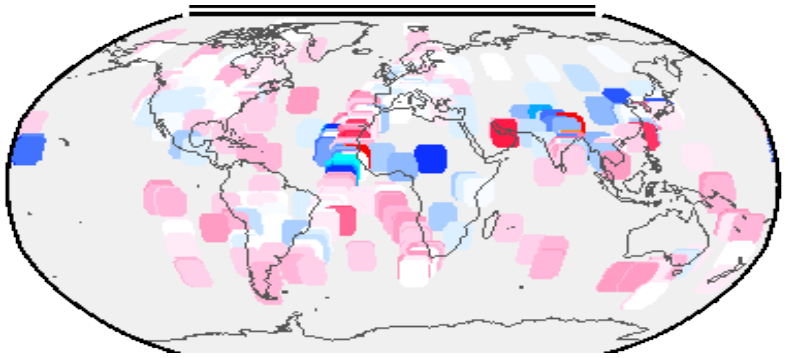
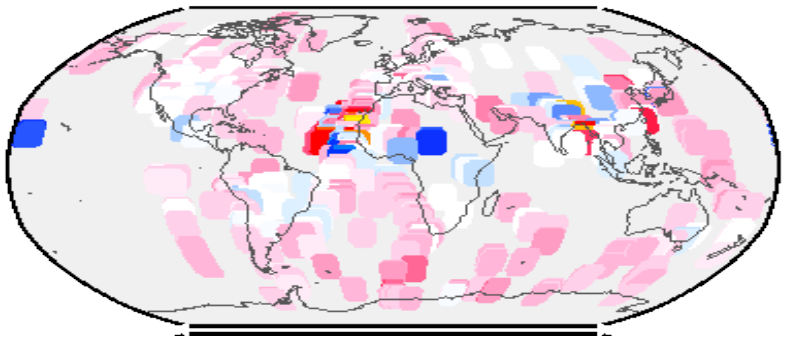
AOD550 differences: Satellite – AERONET/MAN

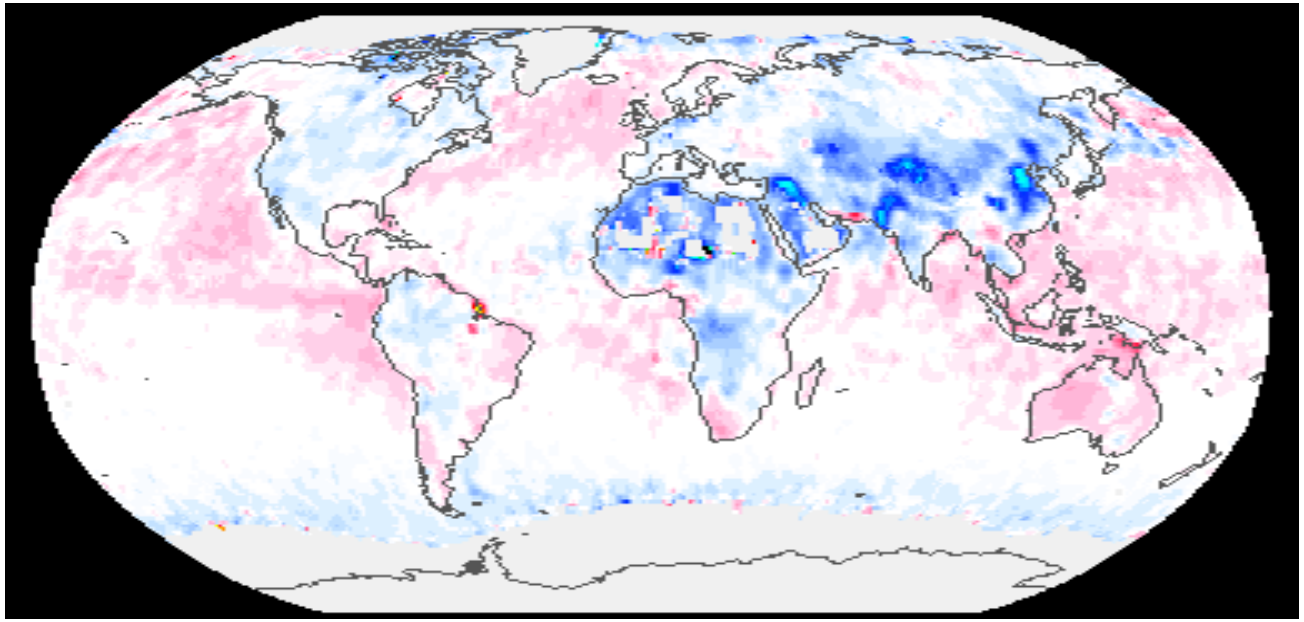
ATSR FI



MODIS C6



ADV/ASV - MODIS C6



ADV/ASV lower <> ADV/ASV higher

Global AOD555 difference: -0.08

Land: MODIS generally higher

Ocean: AATSR overall a bit higher

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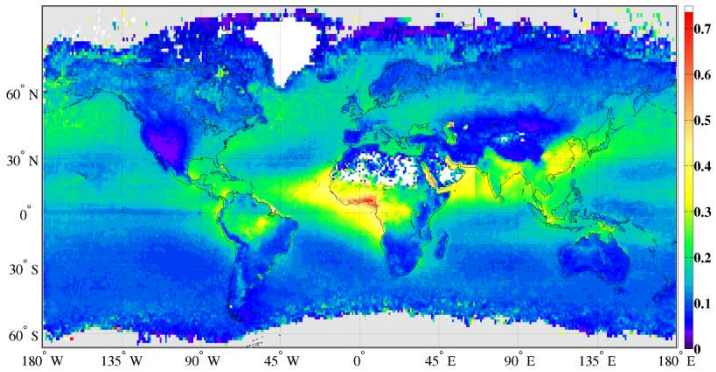
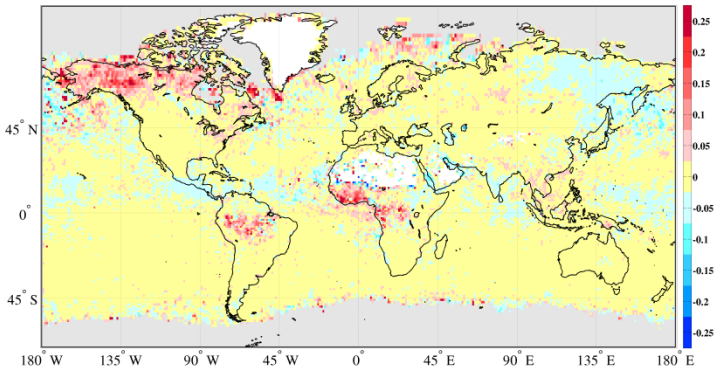
Interannual variations: year minus 10-year aggregate

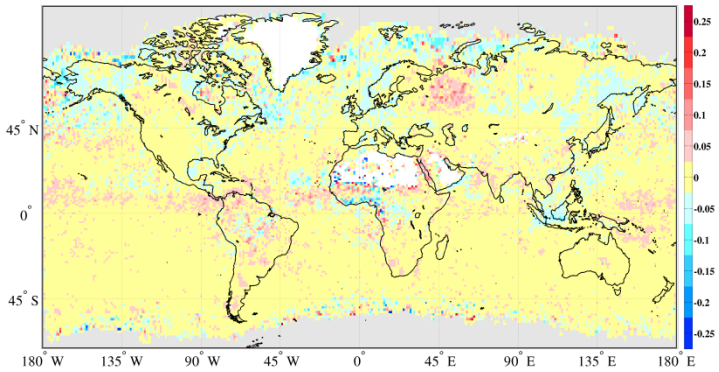
Aggregate 2002-2011



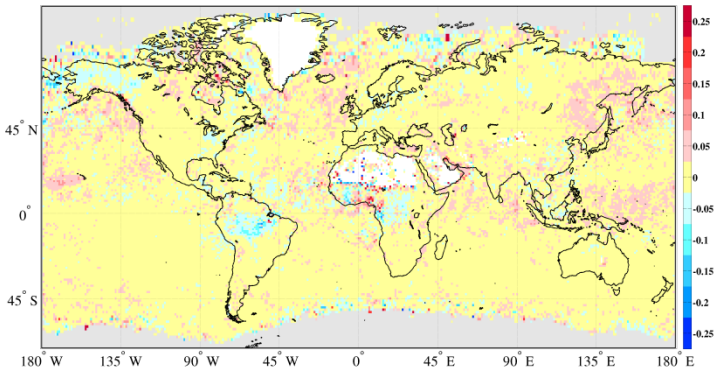
2004



2010

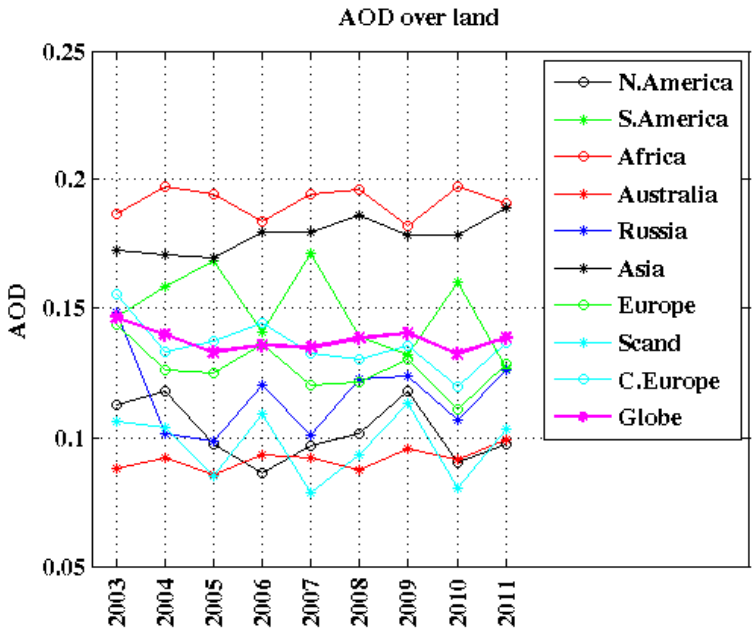


2008

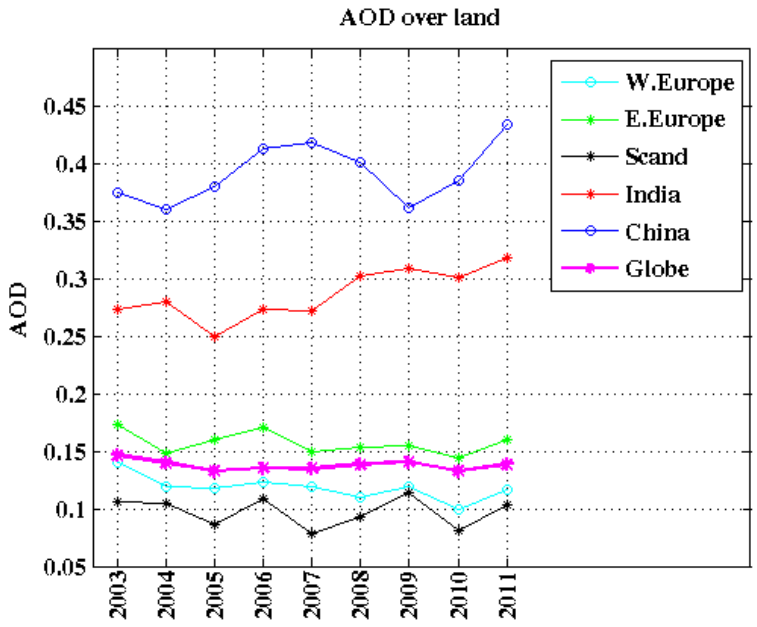


Time series: year-to-year

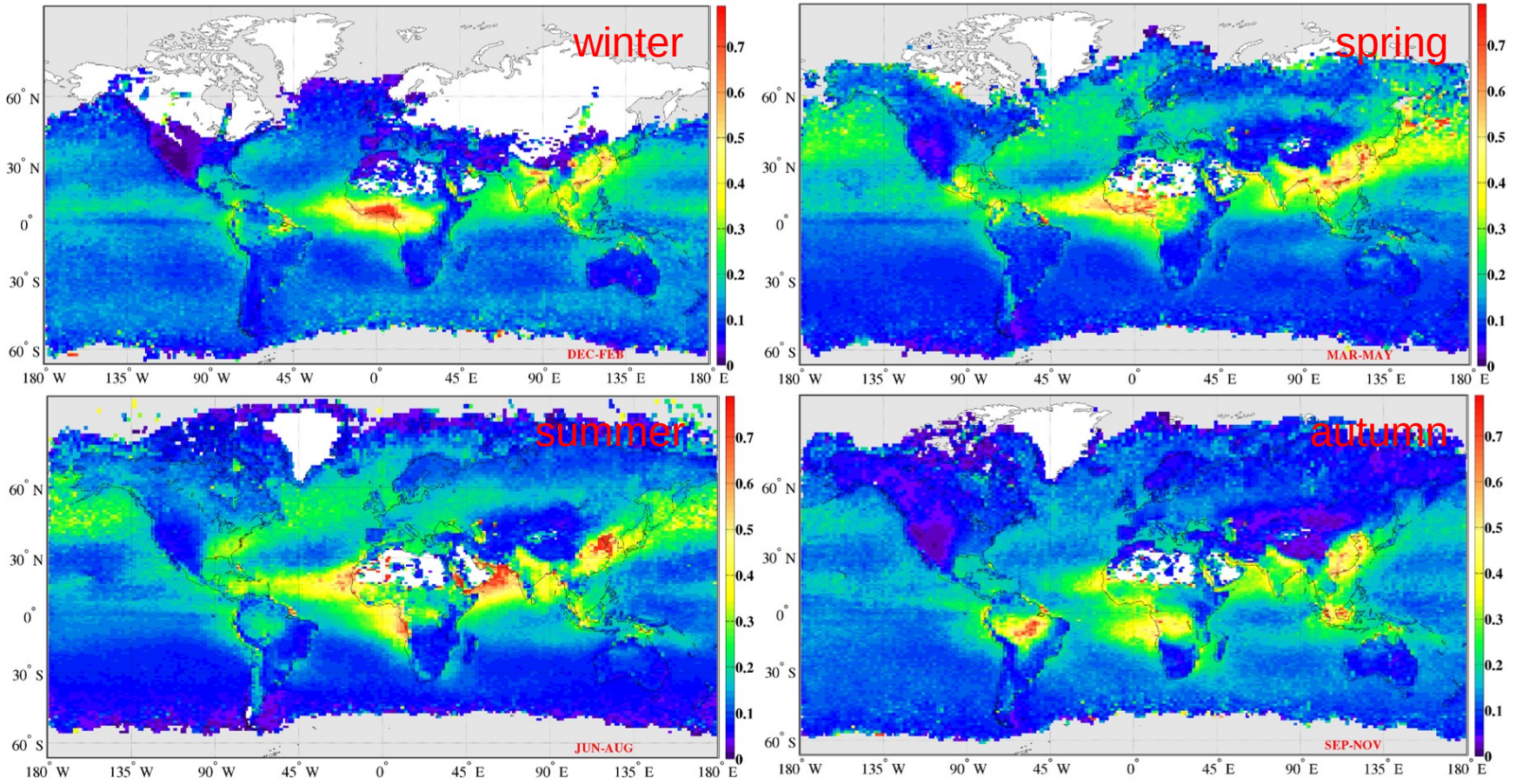
Continents



Regions

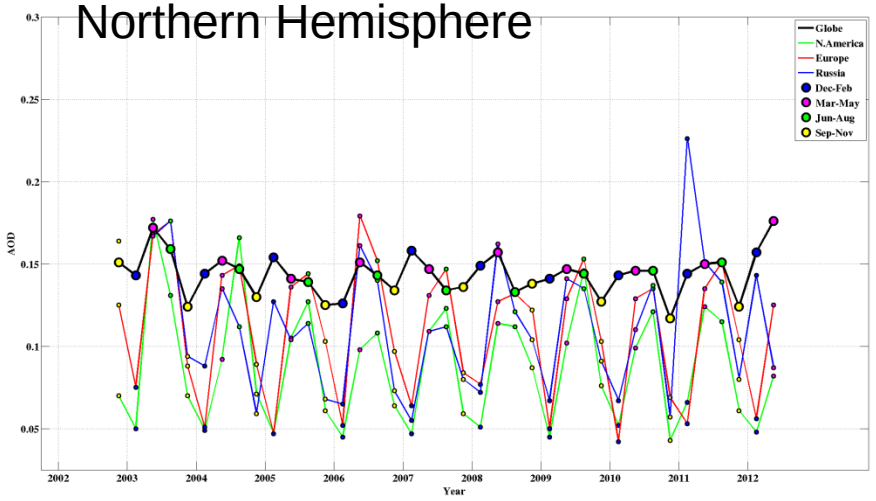


Global AOD: seasonal

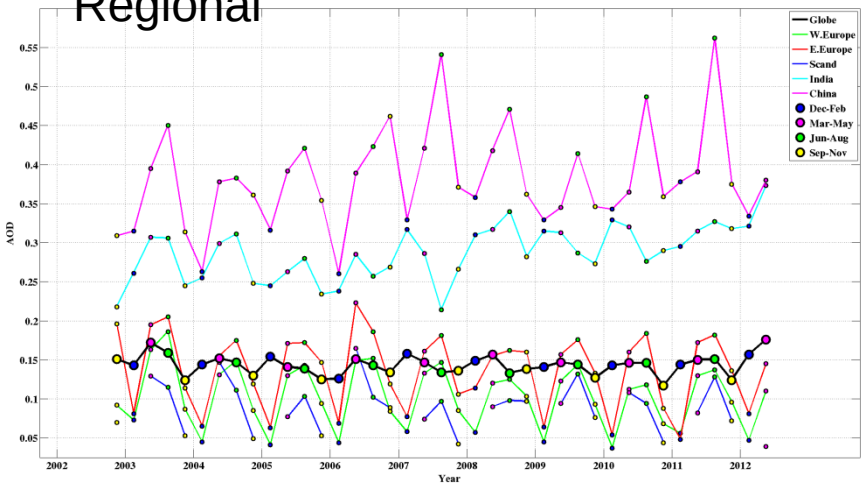


Seasonal time series

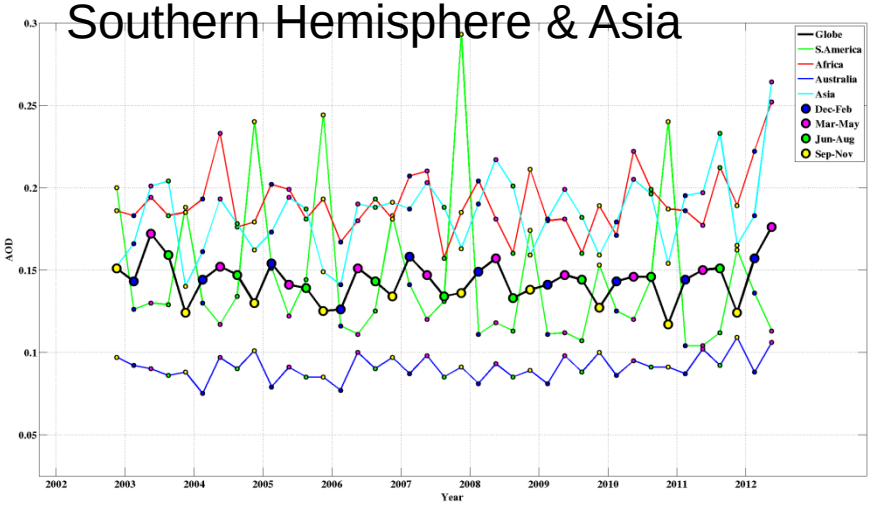
Northern Hemisphere



Regional



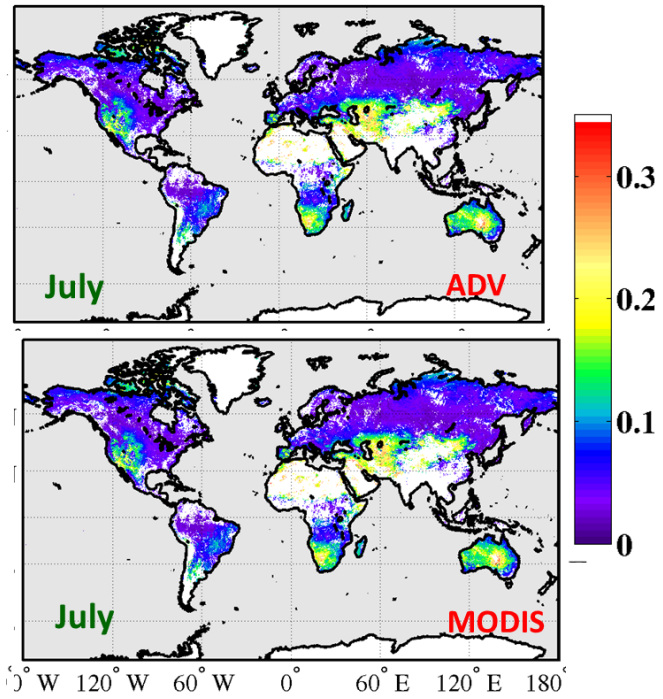
Southern Hemisphere & Asia

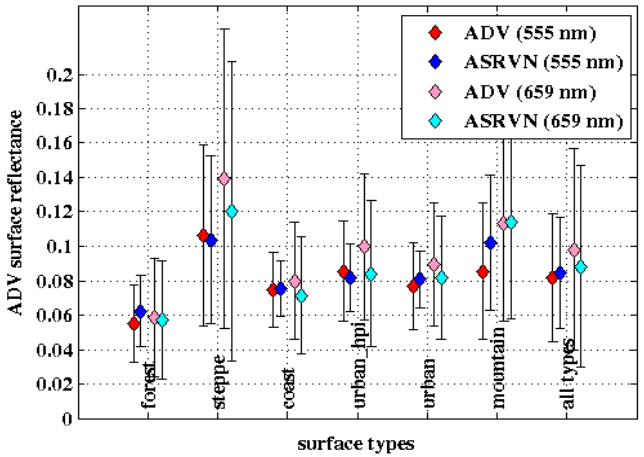


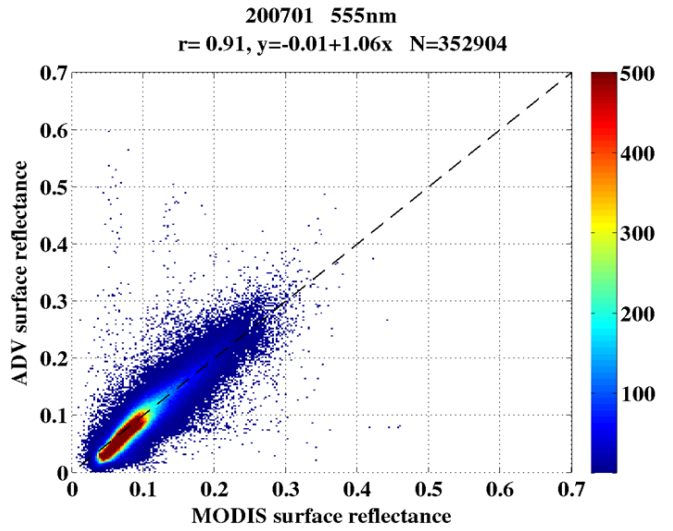
Note: these data are time series showing AOD550 changes for different regions, from year to year and over the seasons. For trend analysis not only longer time series are needed, but also data need to be further evaluated

Surface reflectance

- ADV retrieves aerosol information w/o prior knowledge of surface reflectance
- Hence results can be used as independent information for the surface albedo retrieval
- Comparison with MODIS







Sogacheva et al., AMT 2015

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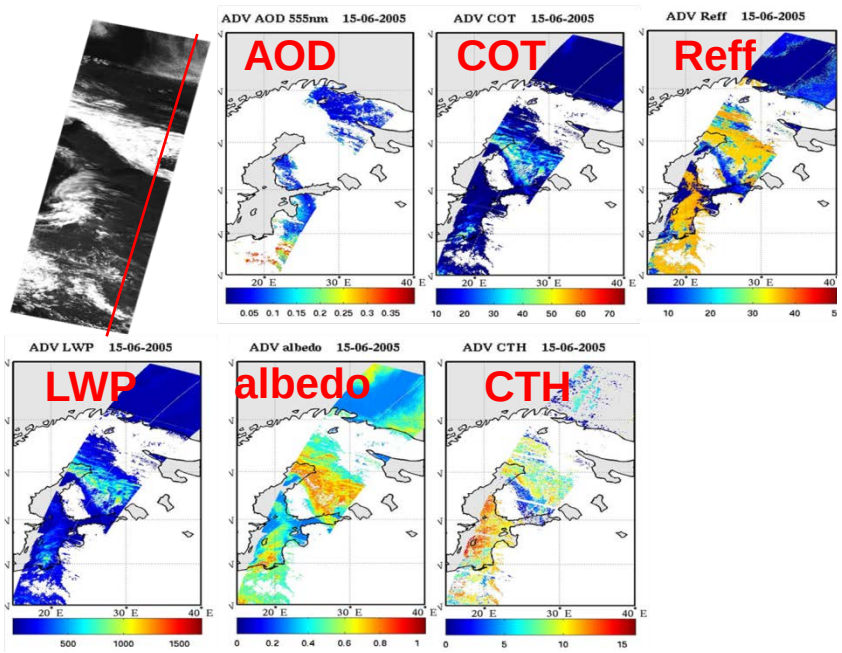
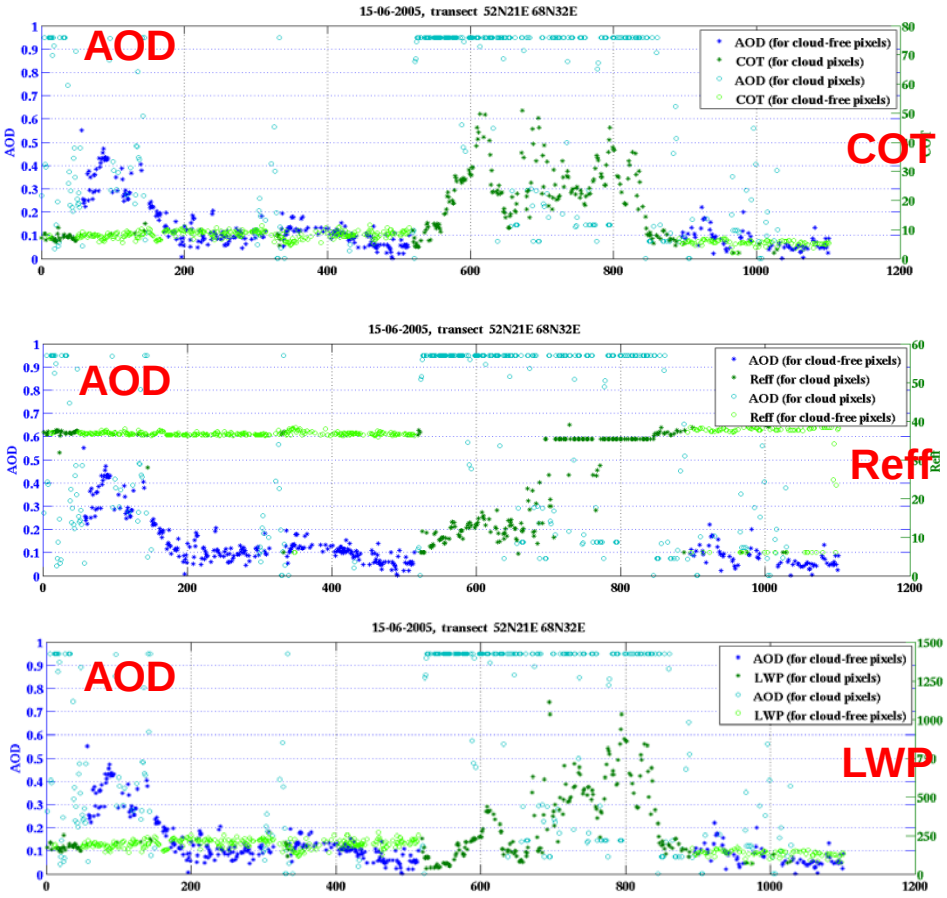
AATSR Dual View algorithm ADV & SACURA: aerosol & Cloud properties

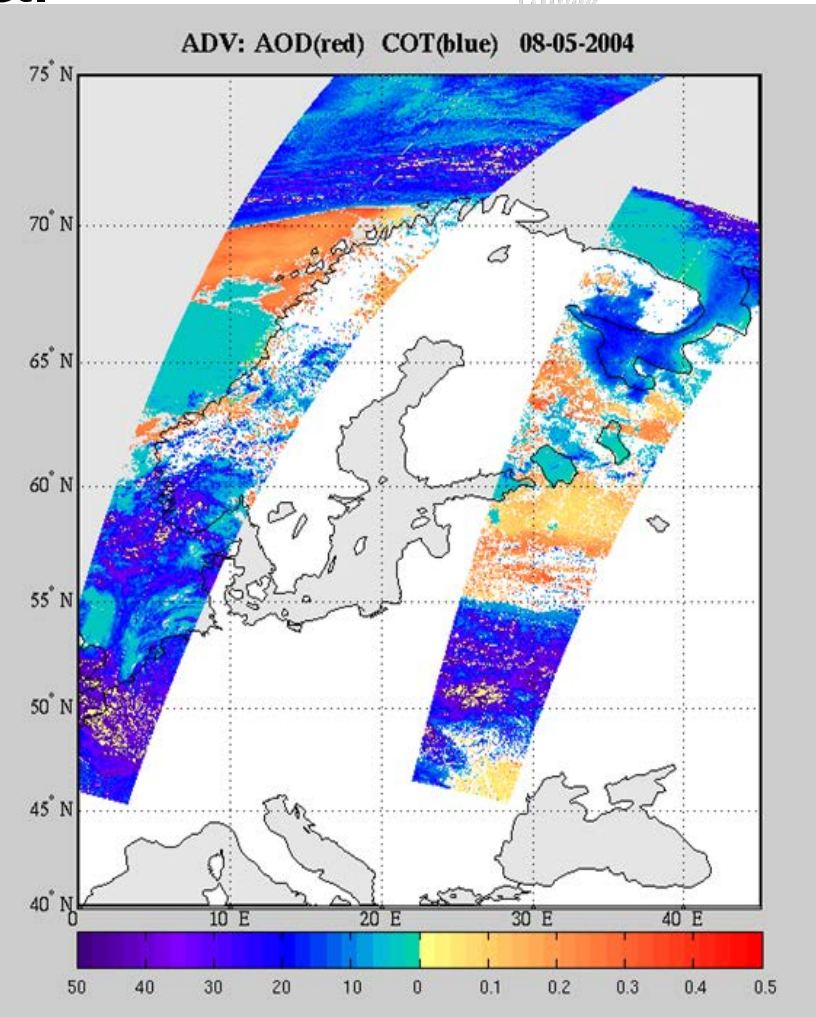




Left: AATSR maps run w separate cloud and aerosol retrieval
Right: transects with and w/o cloud mask: continuous in transition zone

AATSR ADV
aerosol and cloud retrieval

- **First, cloud screening is done for both nadir and forward AATSR views for each pixel of 1-km resolution**
- **If pixel is cloud-free, we retrieve aerosol properties (AOD, mixture, surface reflectance, ets.) – yellow to red colors on the plot**
- **If pixel is cloudy, we retrieve cloud properties (COT, Reff, LWP, albedo) – blue colors on the plot**
- **The area which is cloud-screened by *only* nadir of forward view ("safety" zone) is not considered here – white color on the plot along the track**



cloud <> aerosol

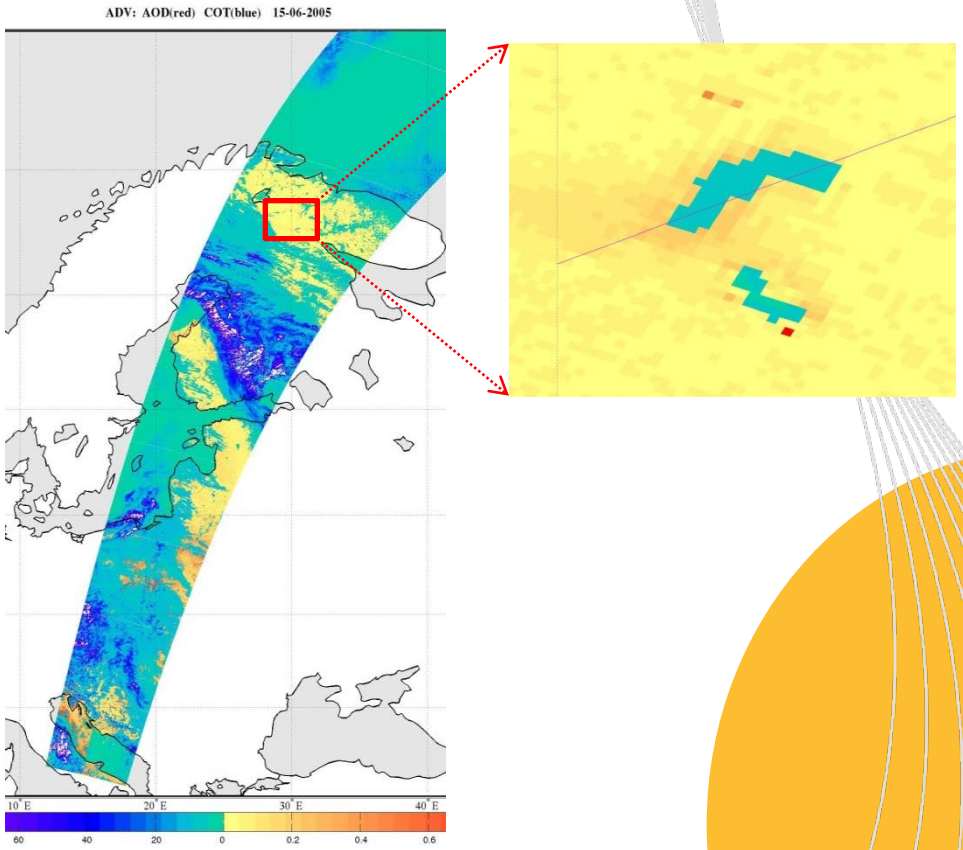
AATSR ADV aerosol and cloud retrieval in “safety” zone

Test studies:

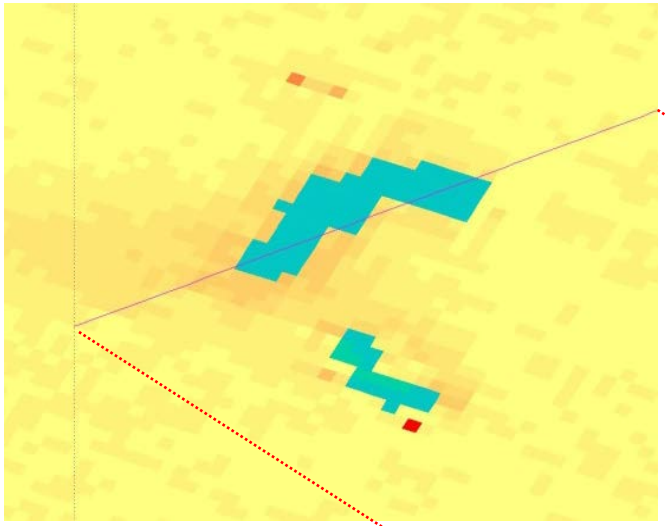
- **Cloud properties are retrieved in “safety” zone -> no “white” zones on the plot anymore. In such a case we hope to see the changes in aerosol loading/properties towards the clouds and cloud properties in the cloud edges**

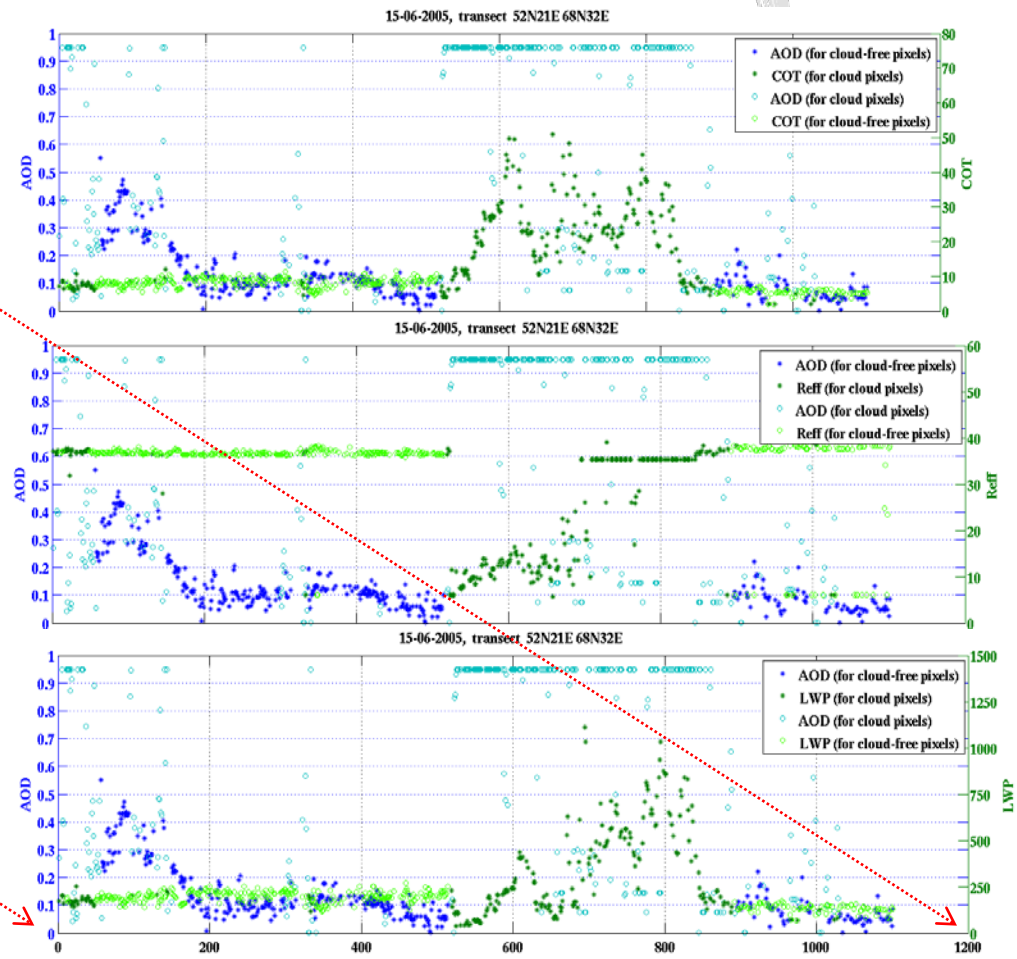
- **Aerosol properties are retrieved for all pixels to check if cloud screening is too strict for high aerosol loading cases (e.g. biomass burning, dust, volcanic ash)**

- **Cloud properties are retrieved for all pixels to check if cloud screening is not strict enough for, e.g., thin clouds**



AATSR ADV
aerosol and cloud properties along the transect





Further development of the cloud retrieval and cloud screening is needed!

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Summary

ATSR:

Dual view over land

Single view over water

L2 with 10x10 km^2 resolution

L3 with 1x1^o resolution

Other resolution for case studies

Validation metrics similar to those of other instruments / algorithms

Swath 500 km

ATSR-2 & AATSR provide 17 years

Good comparion during overlap period

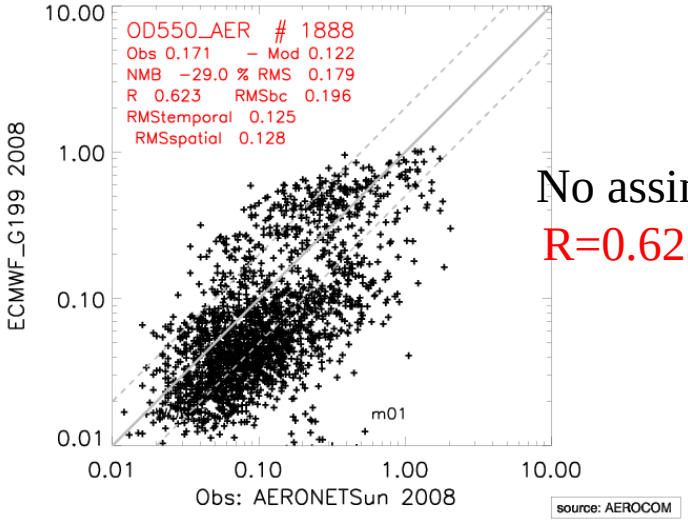
Extension with SLSTR on Sentinel3: wider swatch, more channels

Gap?

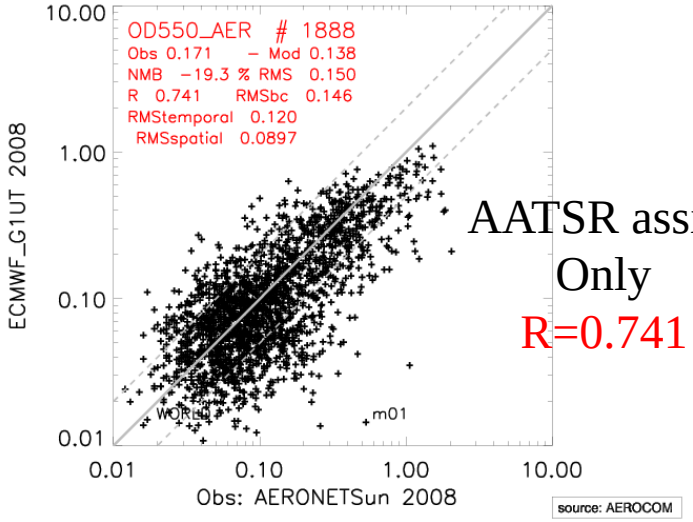
Products:

- Aerosol Optical Depth AOD
- Ångström Exponent AE
- Fine Mode Fraction FMF
- Mixing Fractions
- Single scattering albedo ssa under evalution
- Surface reflectance
- Cloud optical thinkness COT
- Cloud effective radius CER
- Liquid water path LWP
- Cloud Albedo
- Cloud Top Height CTH

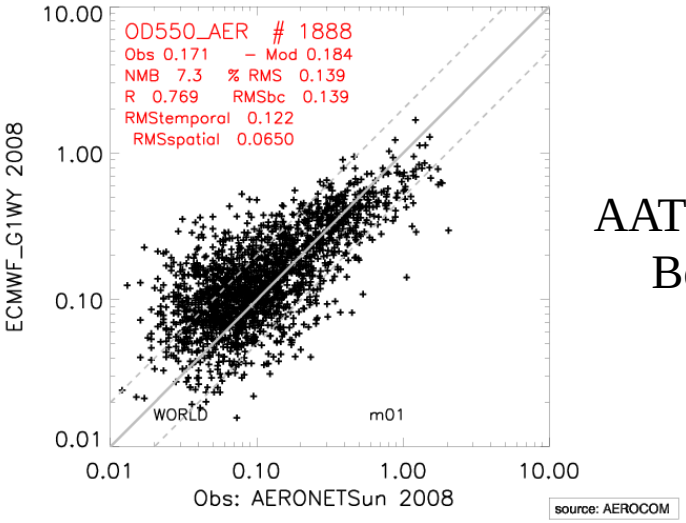
Assimilation of 1 month of Aerosol_cci AOD (ADV) into the ECMWF IFS model



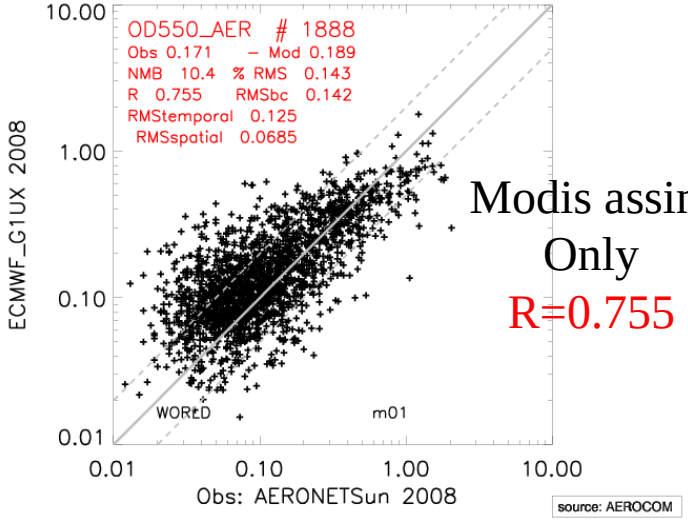
No assim
R=0.623



AATSR assim Only
R=0.741



AATSR & MODIS assim
Both bias corrected
R=0.769



Modis assim Only
R=0.755

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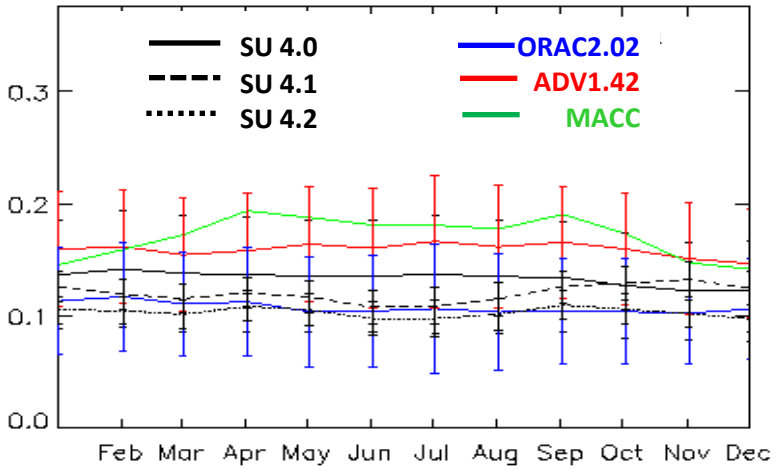
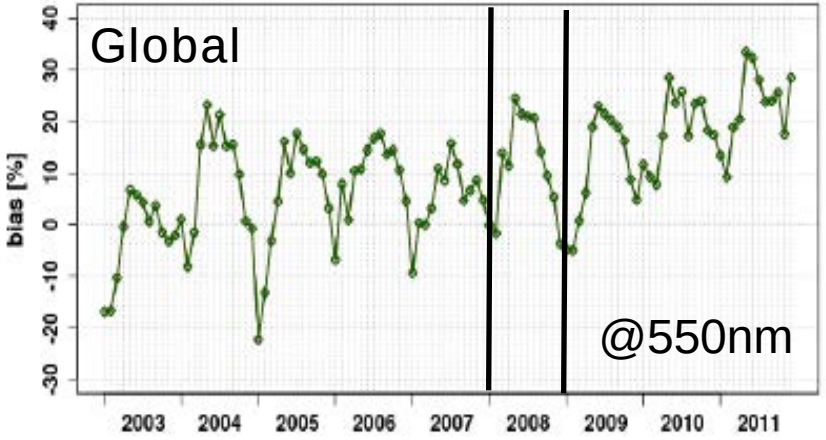
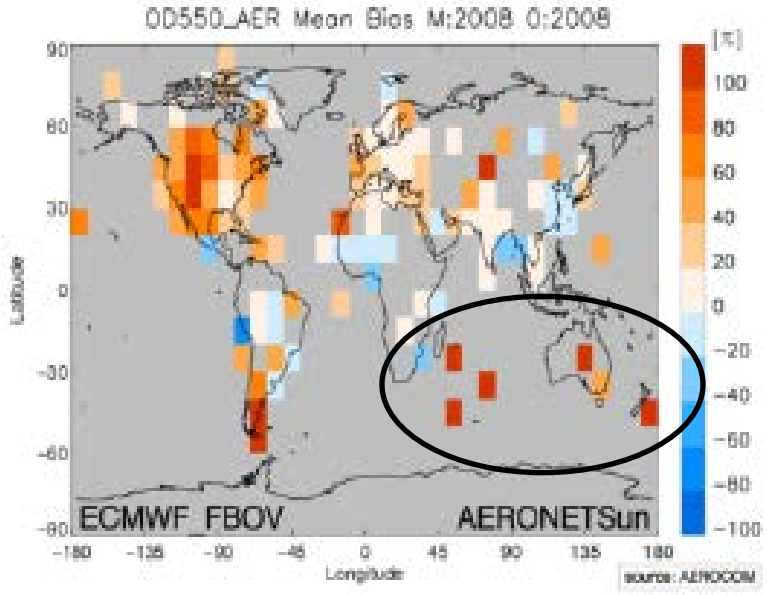
Assimilation of ADV-AOD improves MACC models







- **Assimilation could improve future AOD reanalysis**
- **Preliminary results based on one month of ADV AATSR assimilation by MACC team show**
  - good synergy with MODIS;
  - the AATSR+MODIS AOD analyses have the best fit to AERONET data compared to the analyses constrained with either MODIS or AATSR.

R. Dragani, ECMWF, CMUG 4th Integration meeeting, 6/2014