

GlobAEROSOL:

A 12 year global aerosol dataset from European satellite instruments

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Outline



- Overview of GlobAEROSOL and what it will provide
- How the aerosol properties are retrieved
- What's left to be done
- *Preliminary* validation results
- Examples from the first full year of data

- GlobAEROSOL provides a unified global aerosol dataset from four European satellite instruments: ATSR-2, AATSR, MERIS and MSG SEVIRI.
- The primary products are aerosol optical depth at 550 and 865 nm, the Ångström coefficient between these two wavelengths and an indication of aerosol type.
- The data set will cover 1995 – 2007.

People and organisations



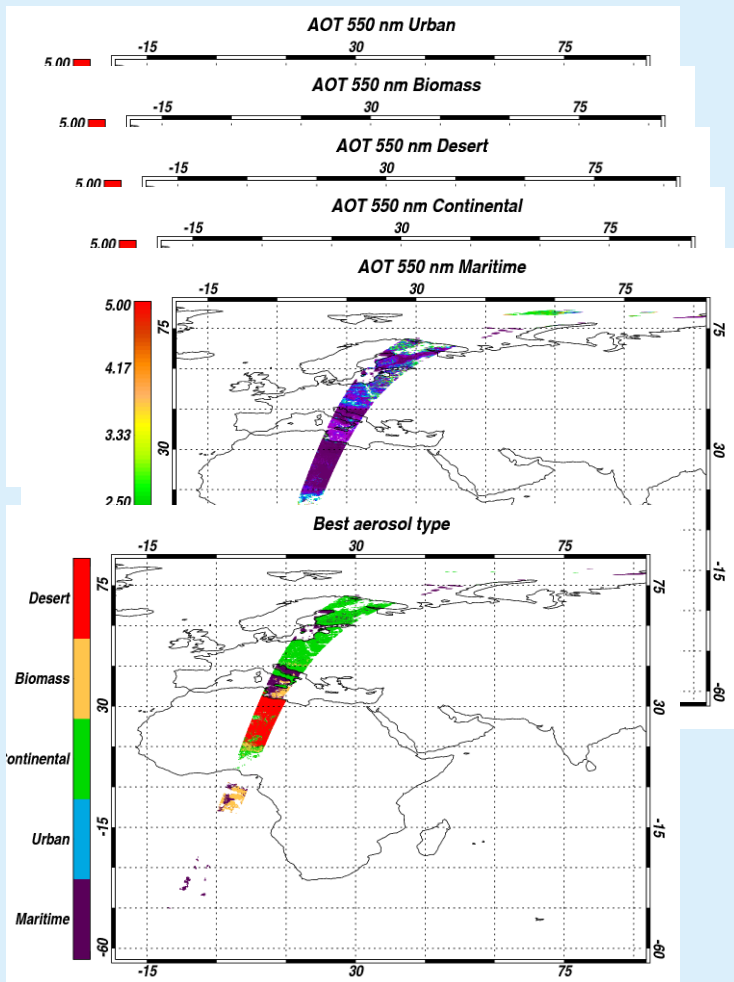
- ESA
 - Simon Pinnock (Technical Officer)
- GMV
 - Óscar Pérez Navarro
 - Óscar Portela Arjona
- Rutherford Appleton Laboratory
 - Richard Siddans
 - Caroline Poulsen
 - Brian Kerridge
- University of Oxford
 - Gareth Thomas
 - Elisa Carboni
 - Don Grainger
- Université de Lille 1-CNRS
 - Pierre-Yves Deschamps

What is GlobAEROSOL?



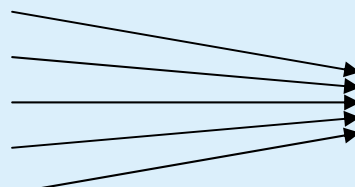
- GlobAEROSOL is not a single product, but a range of products that all have a common format and are all on the same spatial grid
 - “Orbit” files, which contain all the retrieval output, are available for each individual instrument
 - “Daily” files, which contain speciated, quality controlled products for a given day, are available for each instrument individually and in a merged product, in which all retrievals are combined.
 - Monthly composites for each instrument and the merged product are also produced on a 1x1° lat/lon grid.

Orbit files and Daily products



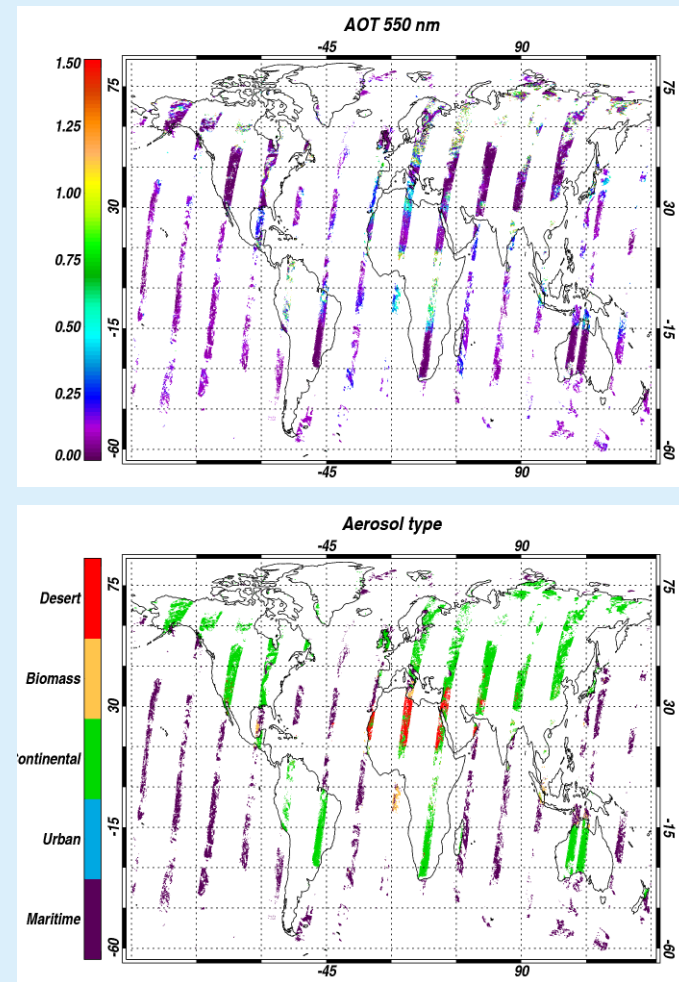
Orbit file

14 orbits per day



Retrievals of five aerosol types

Quality control
and speciation



Daily product

Multi-sensor merged products

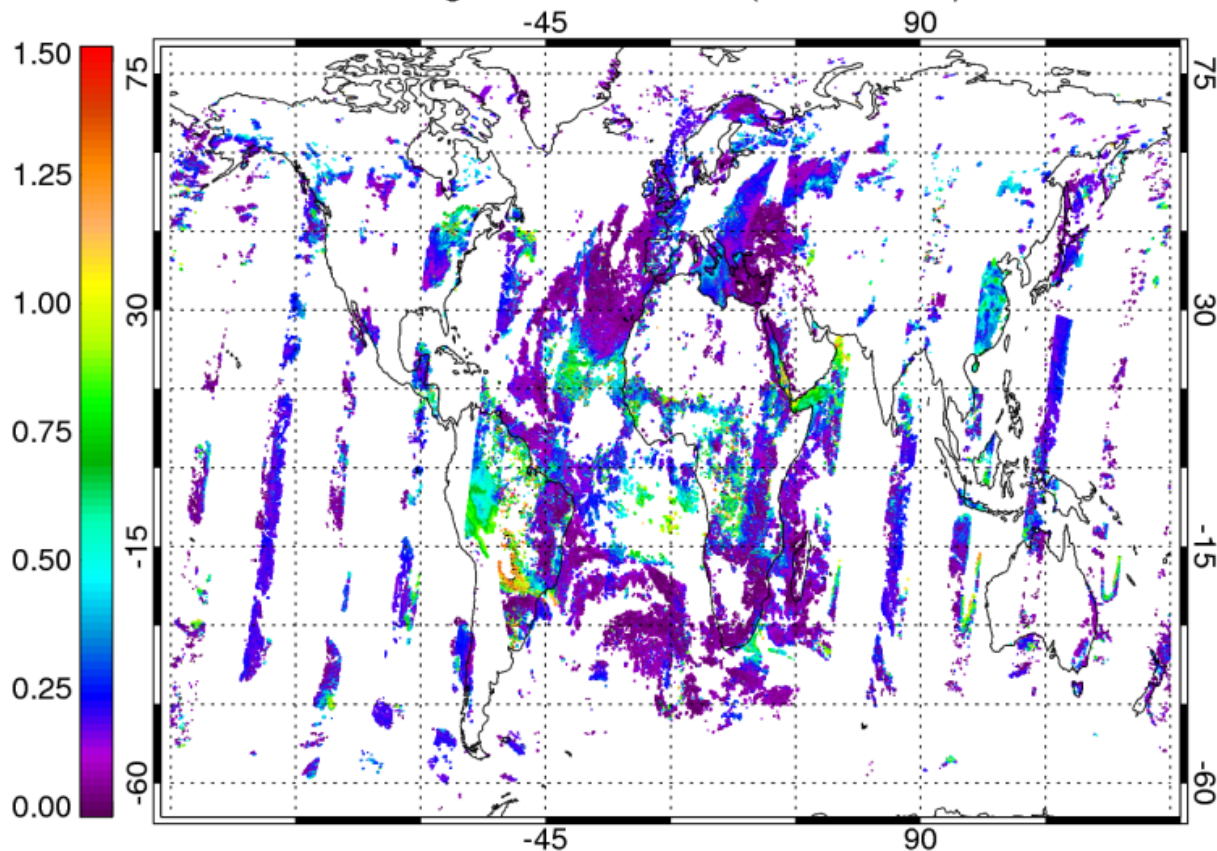
Individual sensor
daily products:

AATSR

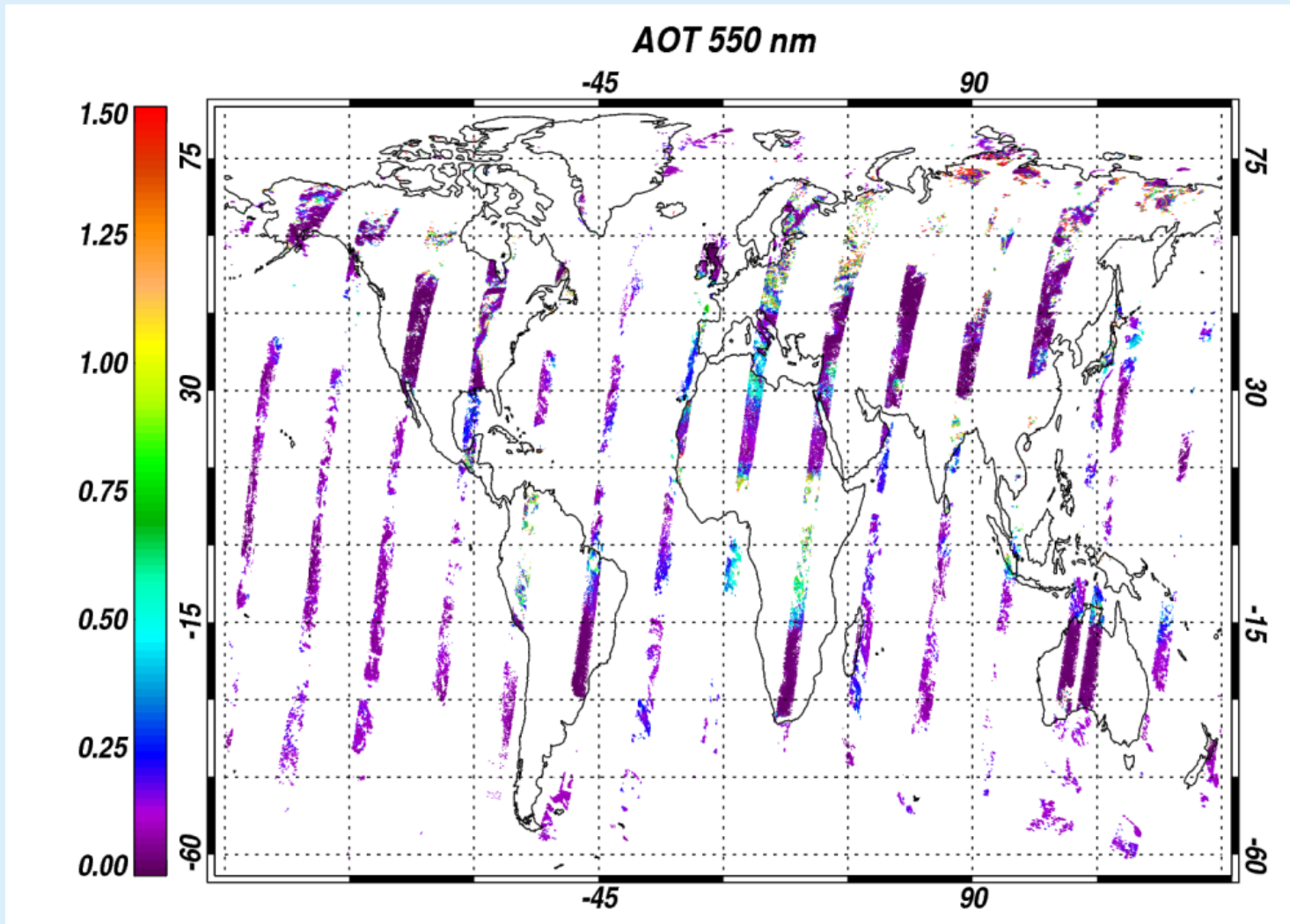
MERIS

SEVIRI

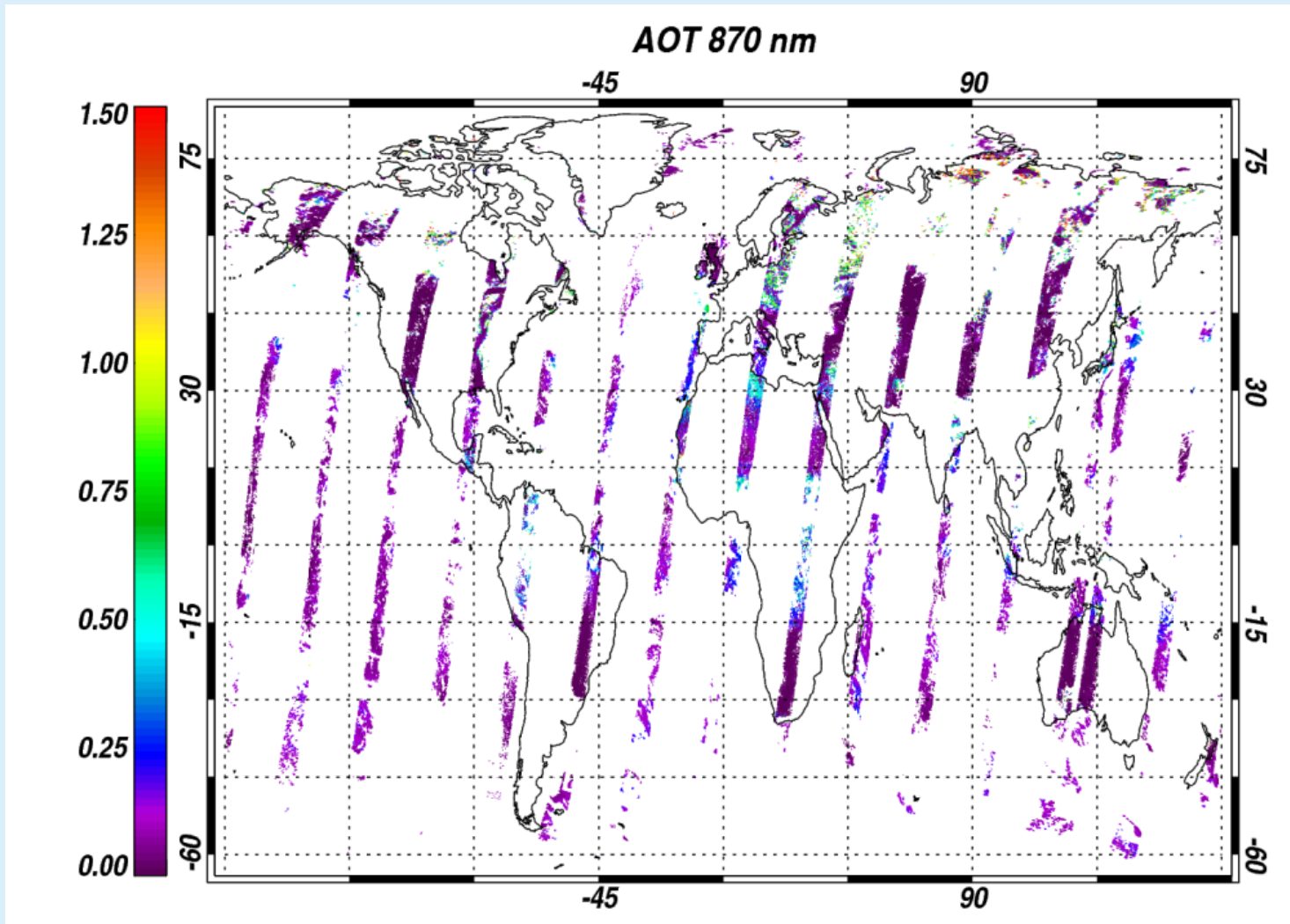
Merged AOT 550 nm (15/09/2004)



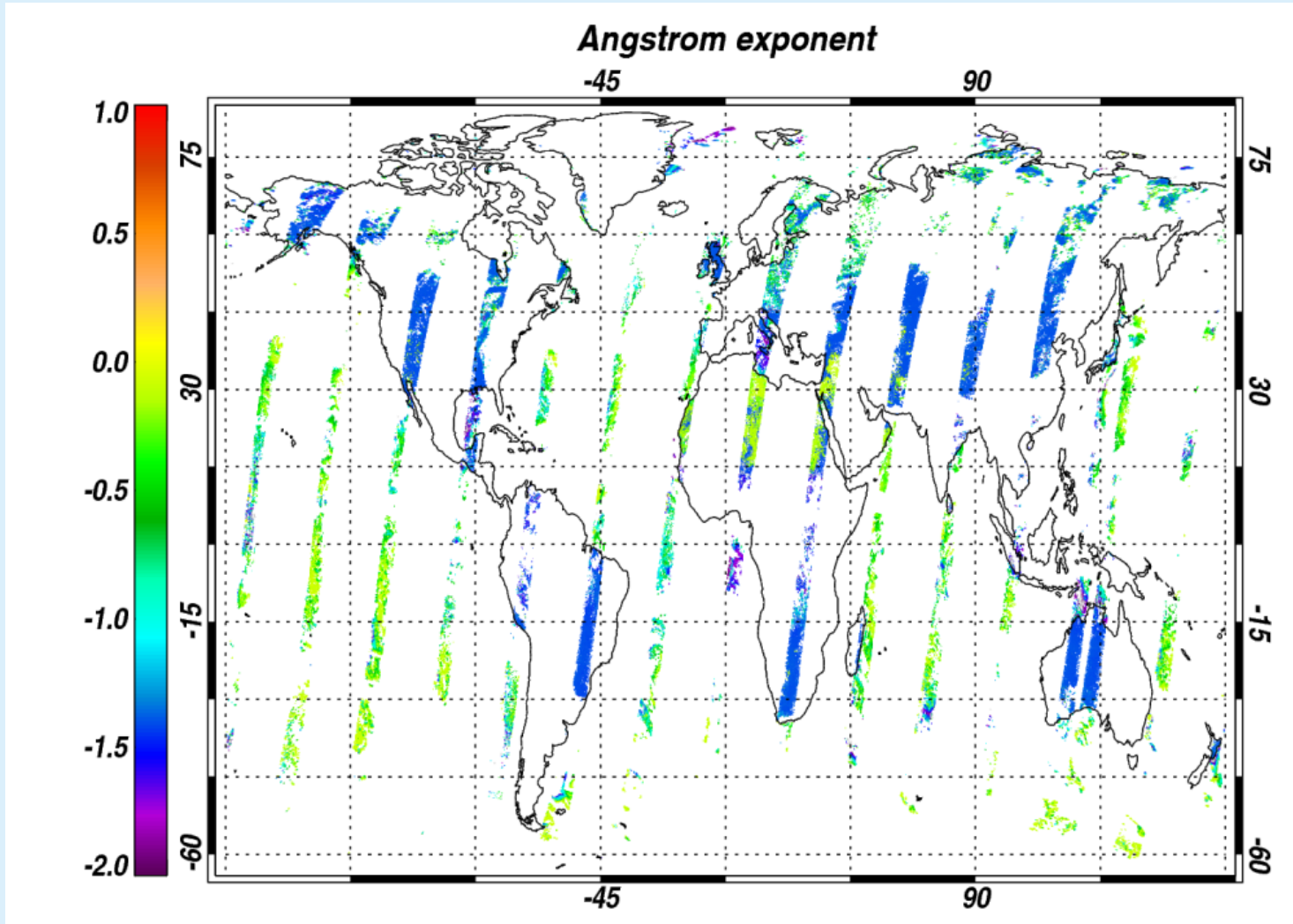
GlobAEROSOL aerosol properties



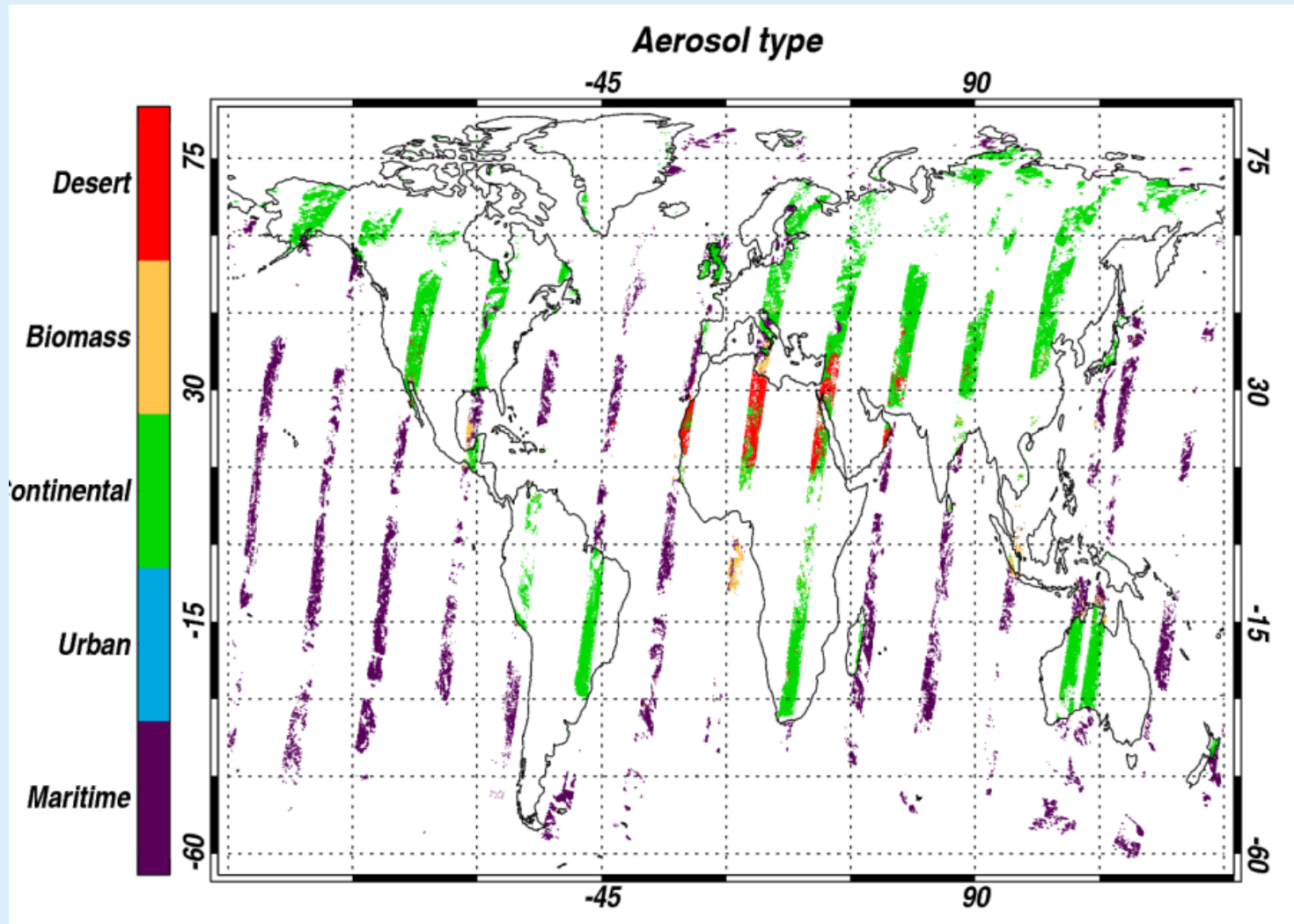
GlobAEROSOL aerosol properties



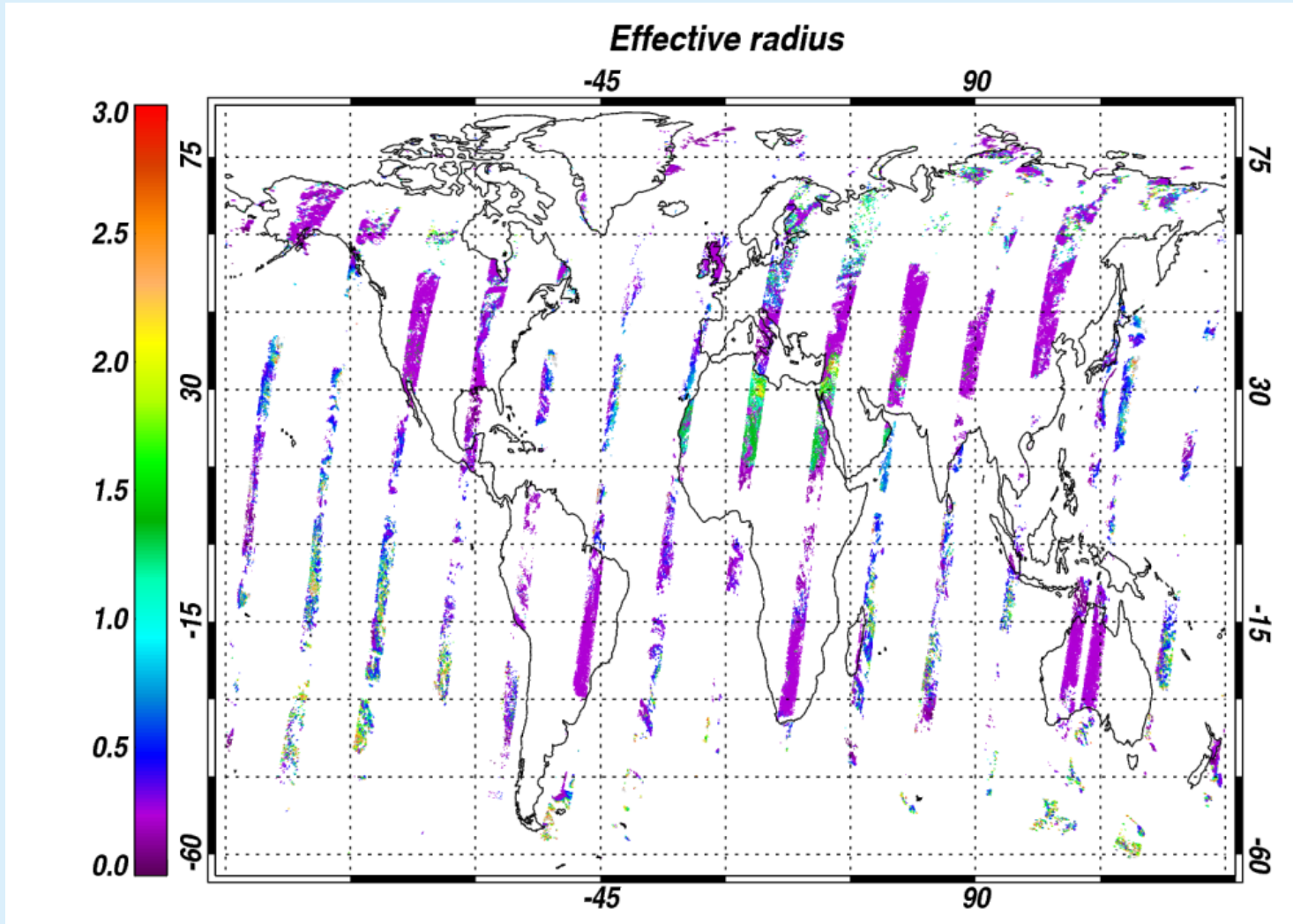
GlobAEROSOL aerosol properties



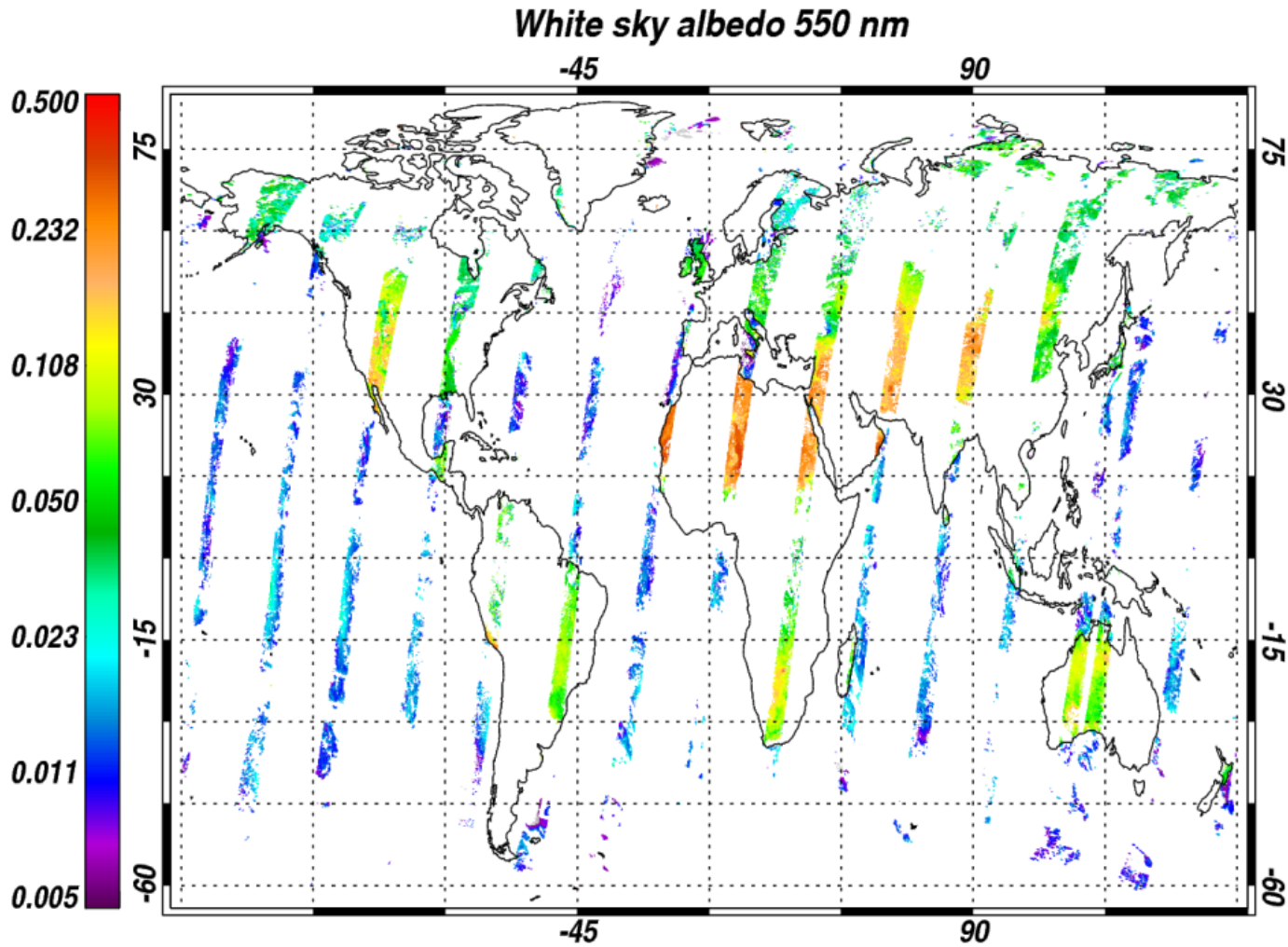
GlobAEROSOL aerosol properties



GlobAEROSOL aerosol properties



GlobAEROSOL aerosol properties



- MERIS product is the standard ESA level 2 aerosol retrieval

See Santer *et al.*, *Int. J. Remote Sens.*, 1819–1840, 1999.

Antoine and Morel, *Int. J. Remote Sens.*, 1875-1916, 1999.

- ATSR-2, AATSR and SEVIRI products are produced using the Oxford-RAL Aerosol and Cloud (ORAC) retrieval scheme:
 - Optimal estimation retrieval scheme
 - Retrieves 550 nm optical depth, effective radius and surface albedo for a set of predefined aerosol components. Other GlobAEROSOL parameters derived from these.

See Thomas *et al.* in Kokhanovsky and de Leeuw (eds), “*Satellite Aerosol Remote Sensing Over Land*”, Springer, Berlin, 2009.

- ORAC is run for 5 separate aerosol classes:
 - Maritime Clean[†]
 - Continental Clean[†]
 - Biomass Burning[‡]
 - Desert Dust[†]
 - Urban[†]
- From these types the “best” type is selected, based on how well the retrieval fit the measurements and a priori constraints.

[†]From OPAC, Hess *et al.*, *Bull. Am. Met. Soc.*, 831–844, 1998.

[‡]From Dubovik *et al.*, *J. Atmos. Sci.*, 590–608, 2002.

- ORAC has undergone a major update since the production of the preliminary GlobAEROSOL test product in 2007:

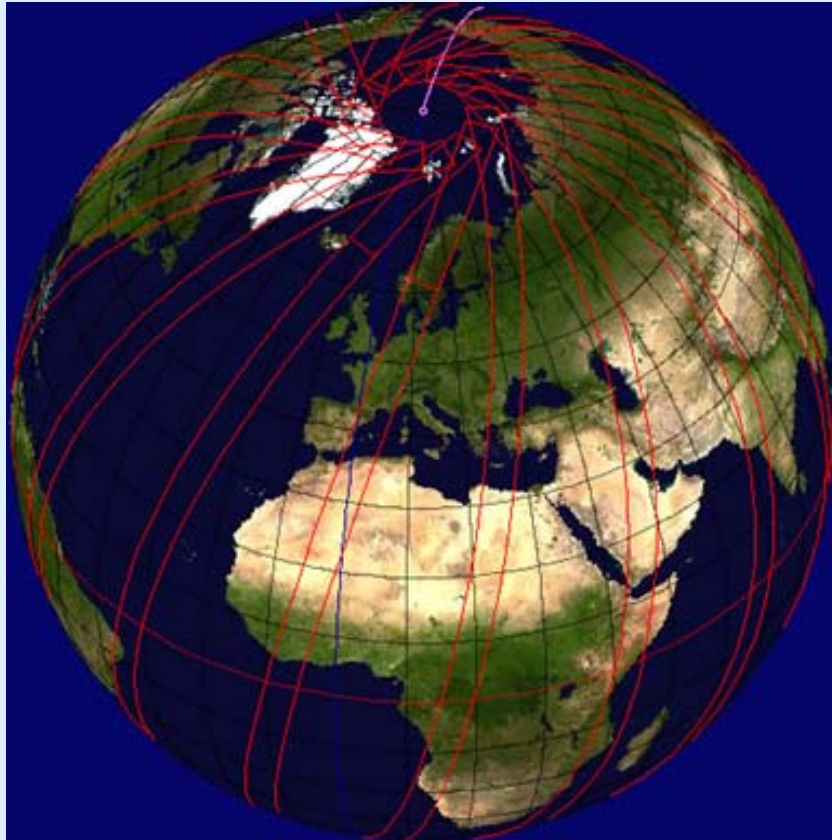
A new BRDF surface reflectance forward model has been incorporated into the retrieval

- Improved description of surface reflectance
- Both views of the ATSR instruments are used in the retrieval

The algorithm now also copes with one or more channels of missing data

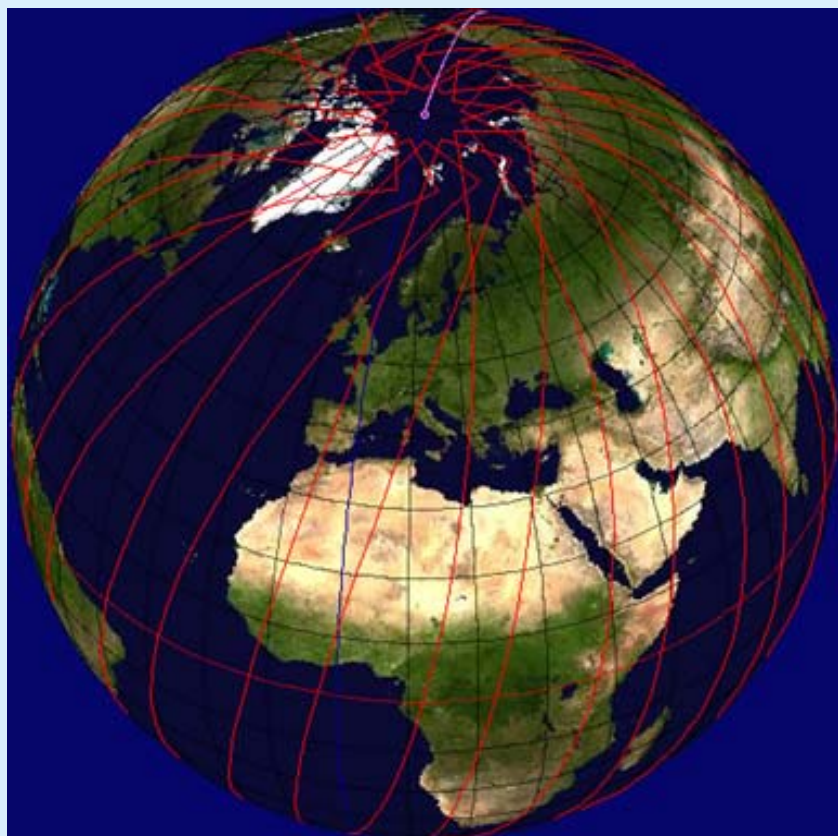
- The narrow-swath mode of ATSR-2 over the oceans no longer results in missing retrievals.
- Sun glint does not effect the (A)ATSR retrieval

ATSR-2 and AATSR



(A) ATSR daily coverage

- Dual-view optimal estimation retrieval
- Global coverage from 1995 – ...
- Poorest spatial coverage
- Some problems with cloud flagging over land

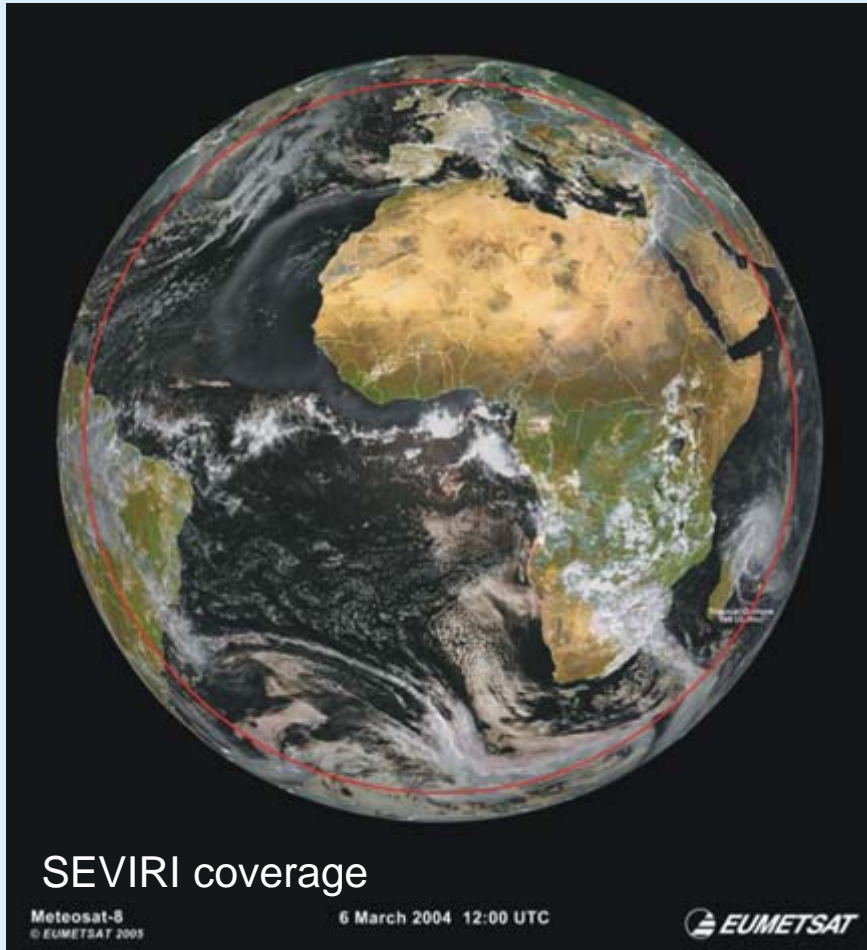


MERIS daily coverage

MERIS

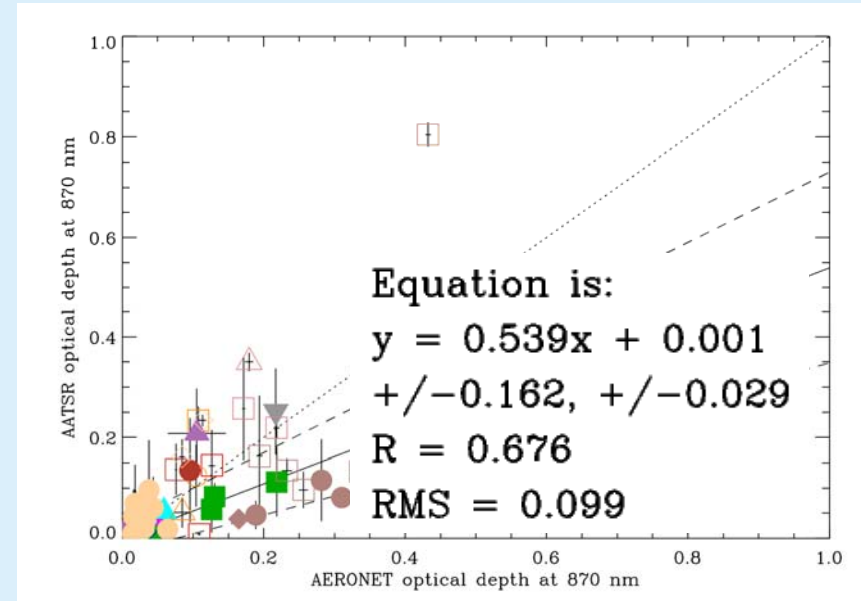
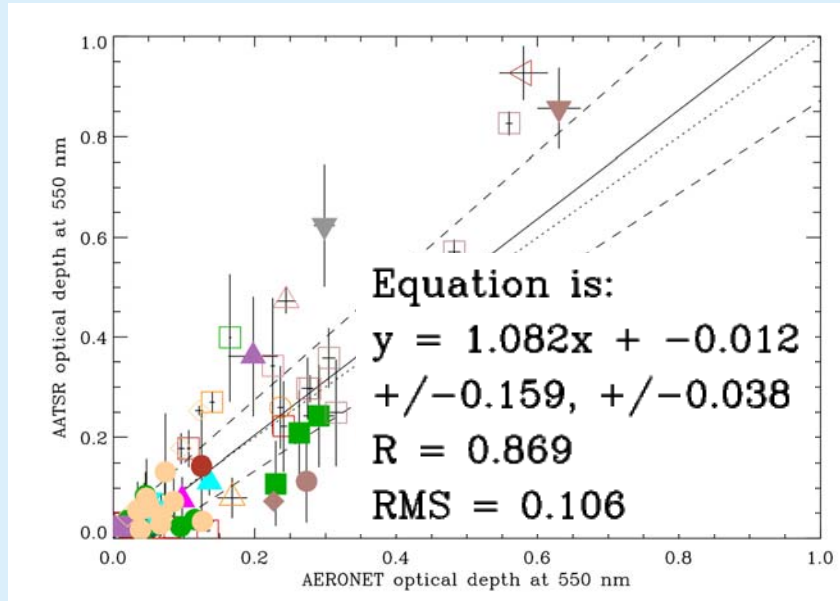
- Global coverage from 2002 – ...
- Much better spatial coverage than AATSR
- Weakest retrieval:
 - Operational atmospheric correction product
 - No aerosol type information
 - Optical depth limited to <0.5 over the ocean
 - Cloud flagging also an issue

SEVIRI product



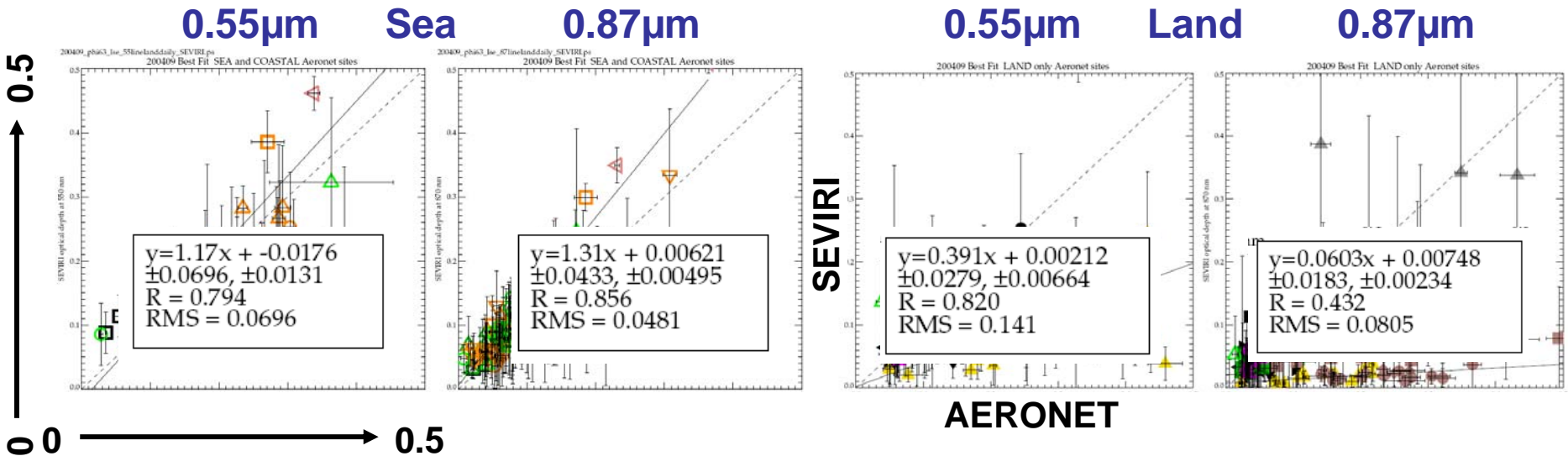
- Optimal estimation retrieval
- Gives three views of Atlantic/Africa/Europe every day (no coverage beyond this though)
- Only available since 2004
- Some problems with cloud contamination

AATSR vs AERONET



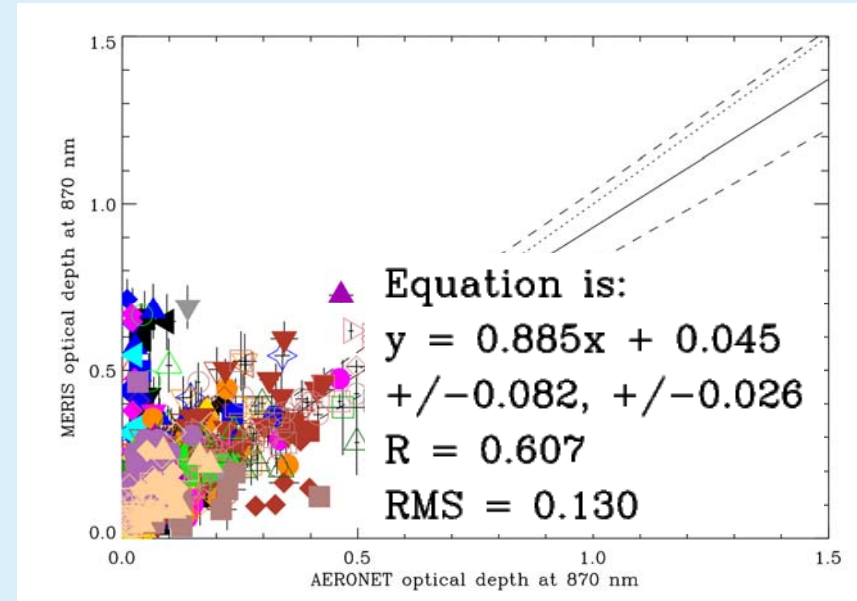
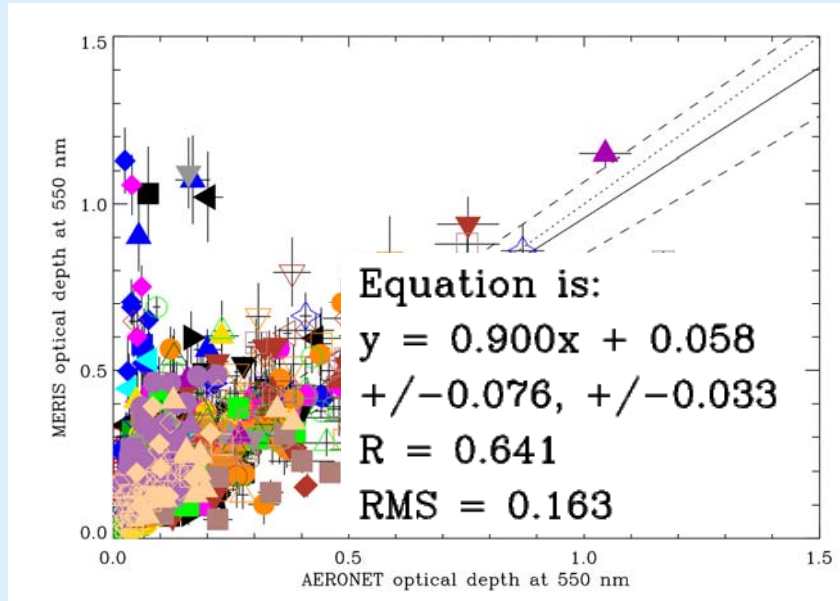
- AATSR results show good agreement with AERONET optical depth at 550 nm.
- 870 nm optical depth is not directly retrieved and depends on the assumed aerosol optical properties and retrieved effective radius.

SEVIRI vs AERONET



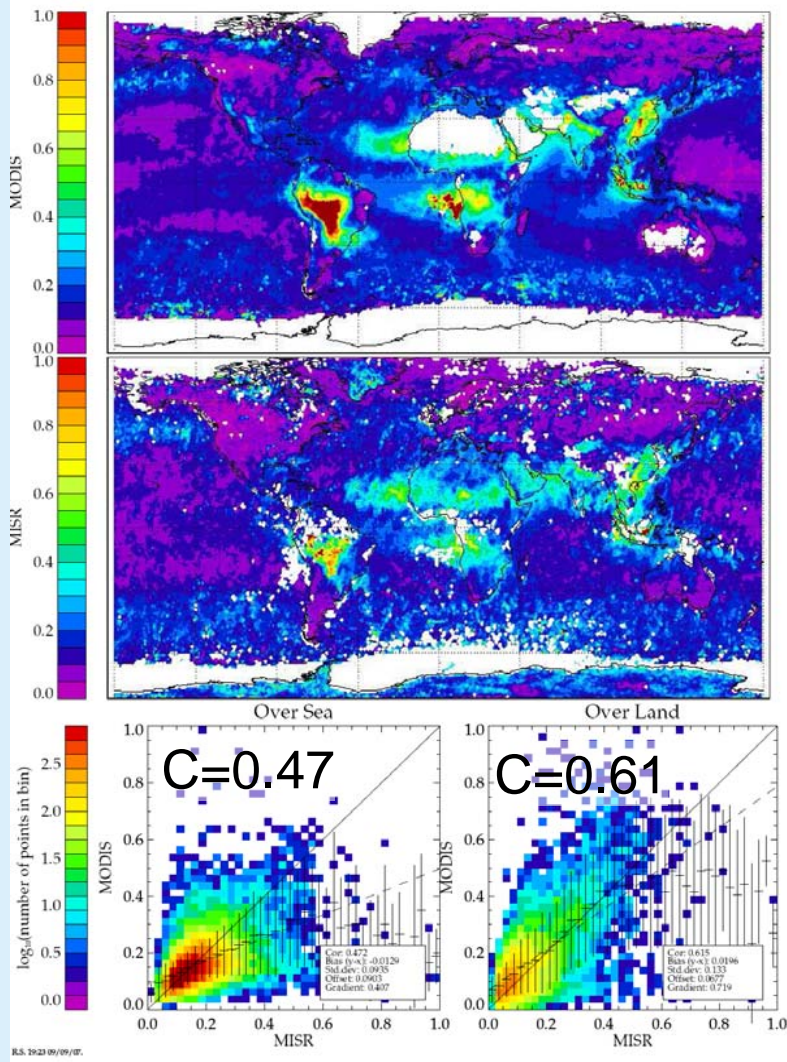
- SEVIRI results show excellent agreement at both wavelengths over the ocean, but less good over the land (especially at 870 nm).
 - Low optical depths over land are generally caused by high surface reflectances
- These results taken from preliminary validation of August 2004 data carried out in 2007.

MERIS vs AERONET



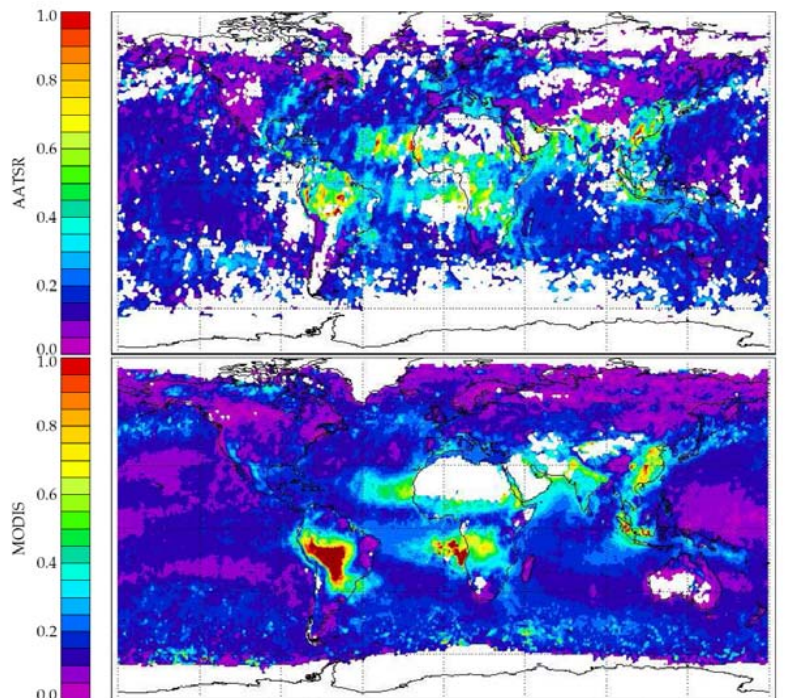
- Good agreement at both wavelengths but with a good deal of scatter.
- Evidence of some cloud contamination
- Many more points that the AATSR product

MODIS compared to MISR



- Validation also carried out against NASA's MODIS and MISR aerosol products
- Results presented here are for the preliminary validation of August 2004 data carried out in 2007
- Uses Collection 4 MODIS data

AATSR compared to MODIS and MISR

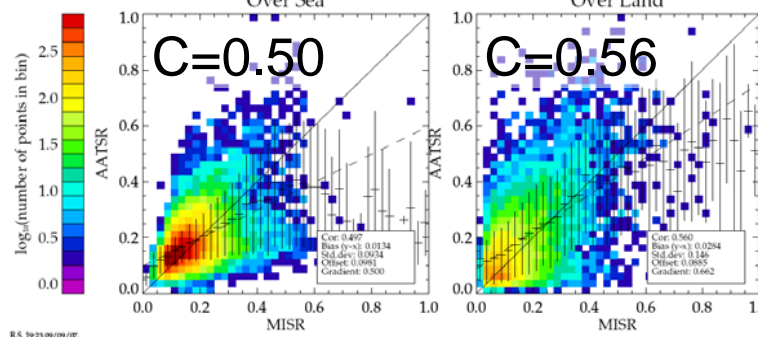
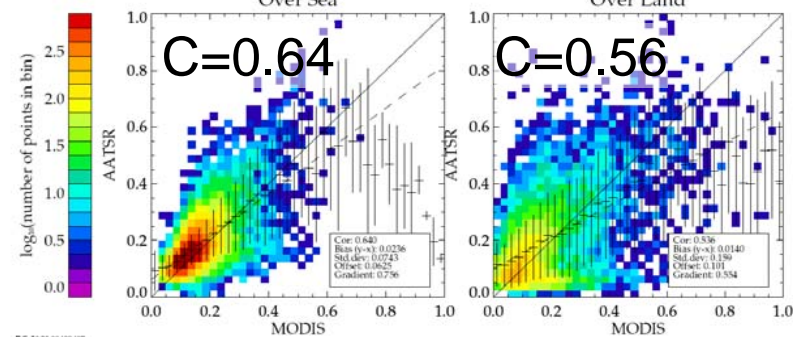
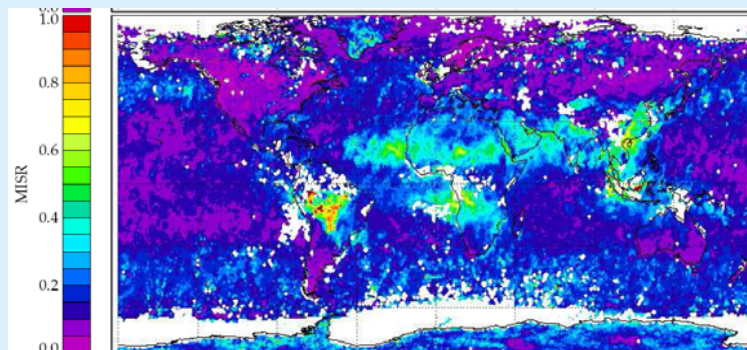


← AATSR

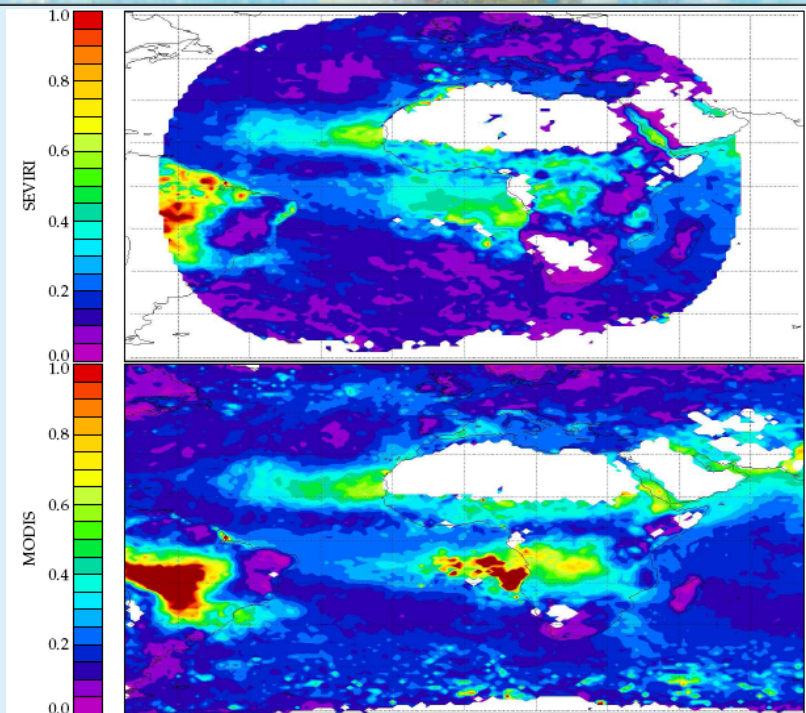
MODIS

MISR

NB. These results are from the preliminary one month validation

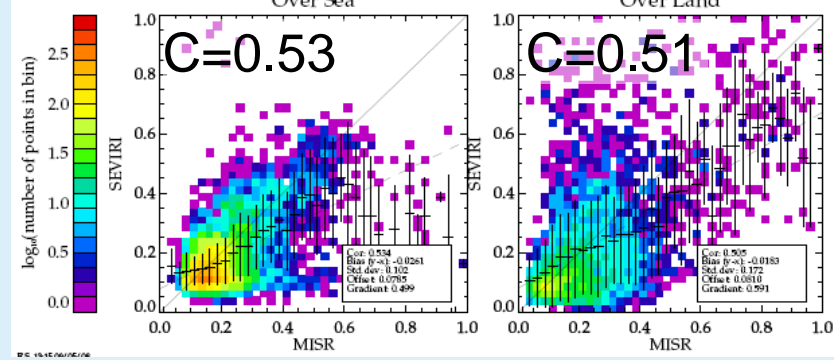
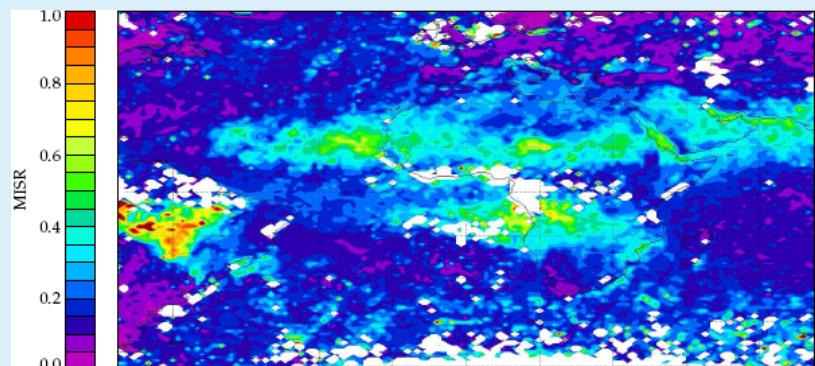


SEVIRI compared to MODIS and MISR

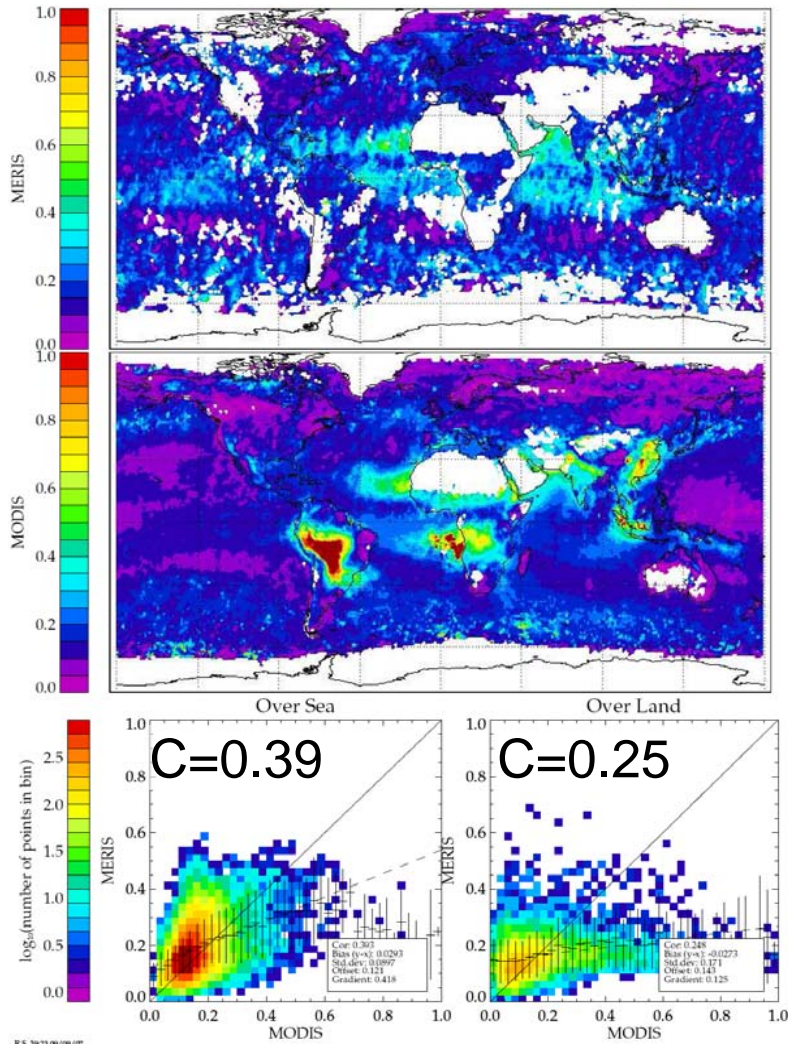


← SEVIRI
 MODIS
 MISR

NB. These results are from the preliminary one month validation



MERIS compared to MODIS and MISR

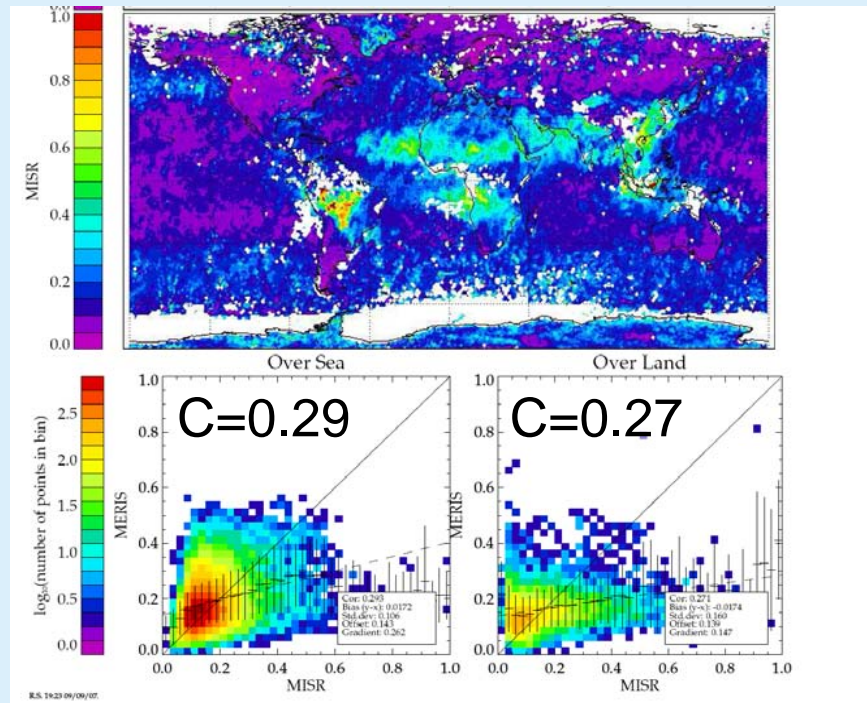


← MERIS

MODIS

MISR

NB. These results are from the preliminary one month validation



Data quality overview



- AATSR 550 nm AOD shows the best agreement with AERONET and NASA products
 - 870 nm shows poorer agreement, but still has a high correlation
 - Data coverage is also relatively poor
- SEVIRI follows similar trends to AATSR, but suffers slightly from the lack of the dual view.
 - There is a low bias over the land vs AERONET, but this can be attributed to high surface reflectances
- MERIS shows good agreement with AERONET, but ocean optical depths appear elevated in general and miss events with optical depth >0.5 .

What is left to be done?



- The first year's data will be validated and post-retrieval processing settings finalised:
 - Quality control settings for each individual product
 - Speciation of each individual product
 - Merging parameters
- These settings will be retrospectively applied to all data produced in the mean time
- A report detailing the validation of the results will be produced and data will be made available to “beta testers”
- Once the full GlobAEROSOL dataset has been produced it will be validated
- All data releases, validation reports and information can be found at <http://www.globaerosol.info>

Timeline



November 2008 – Validation of 1st year and definition of quality control and merging settings completed. Data available for beta testers.

December 2008 – Validation report on 1st year of data completed.

Mid 2009 – Full 12 year dataset available for download.

Preliminary results...

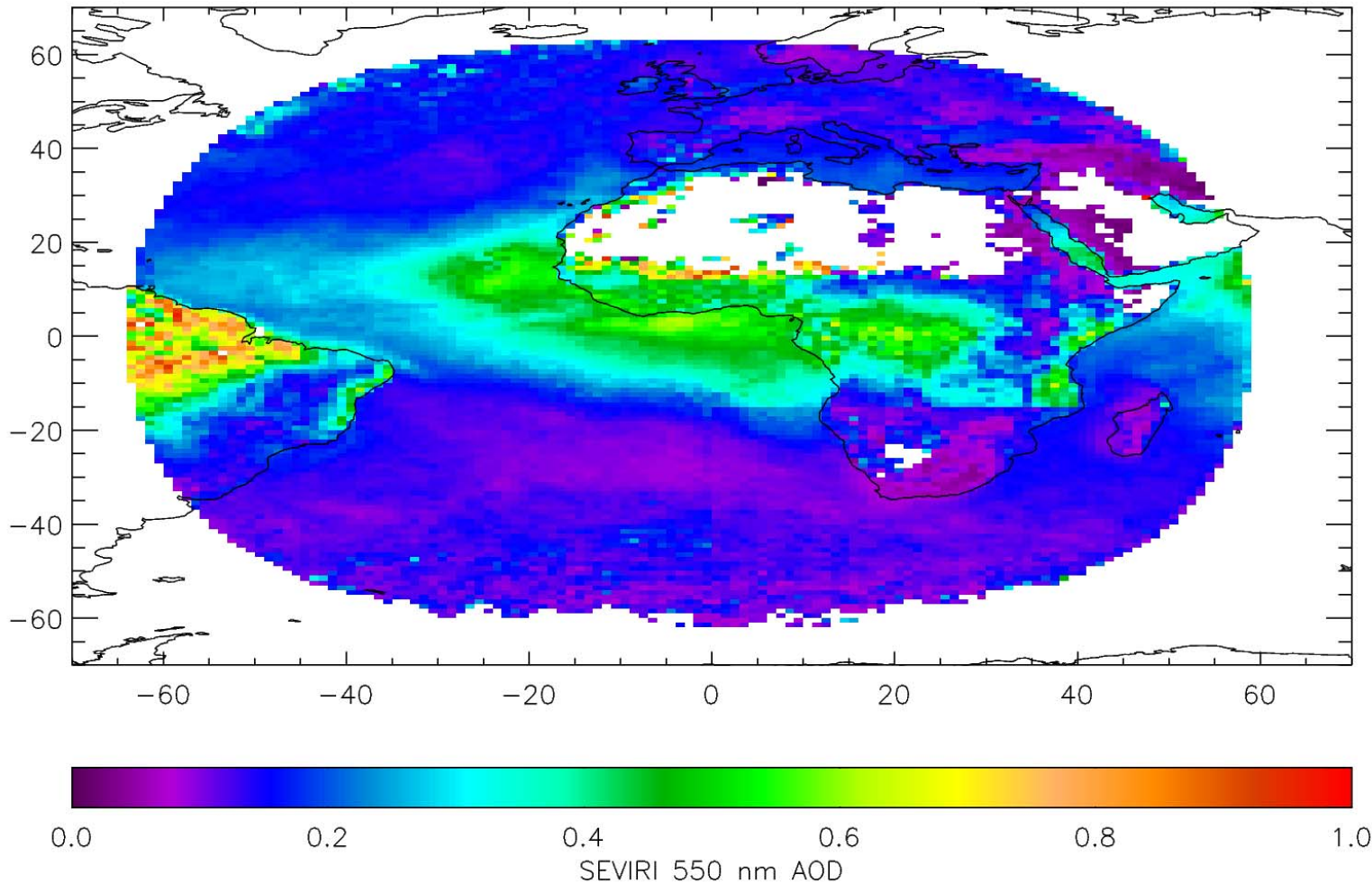


- At the time of preparations the first run through a full year's data was almost complete:
 - 4609 AATSR orbit files (1 year),
 - 991 SEVIRI images (1 year),
 - 2941 MERIS orbit files (7 months),have been produced
- Although the quality control and speciation has yet to be finalised, the products look promising...

First year of data: SEVIRI



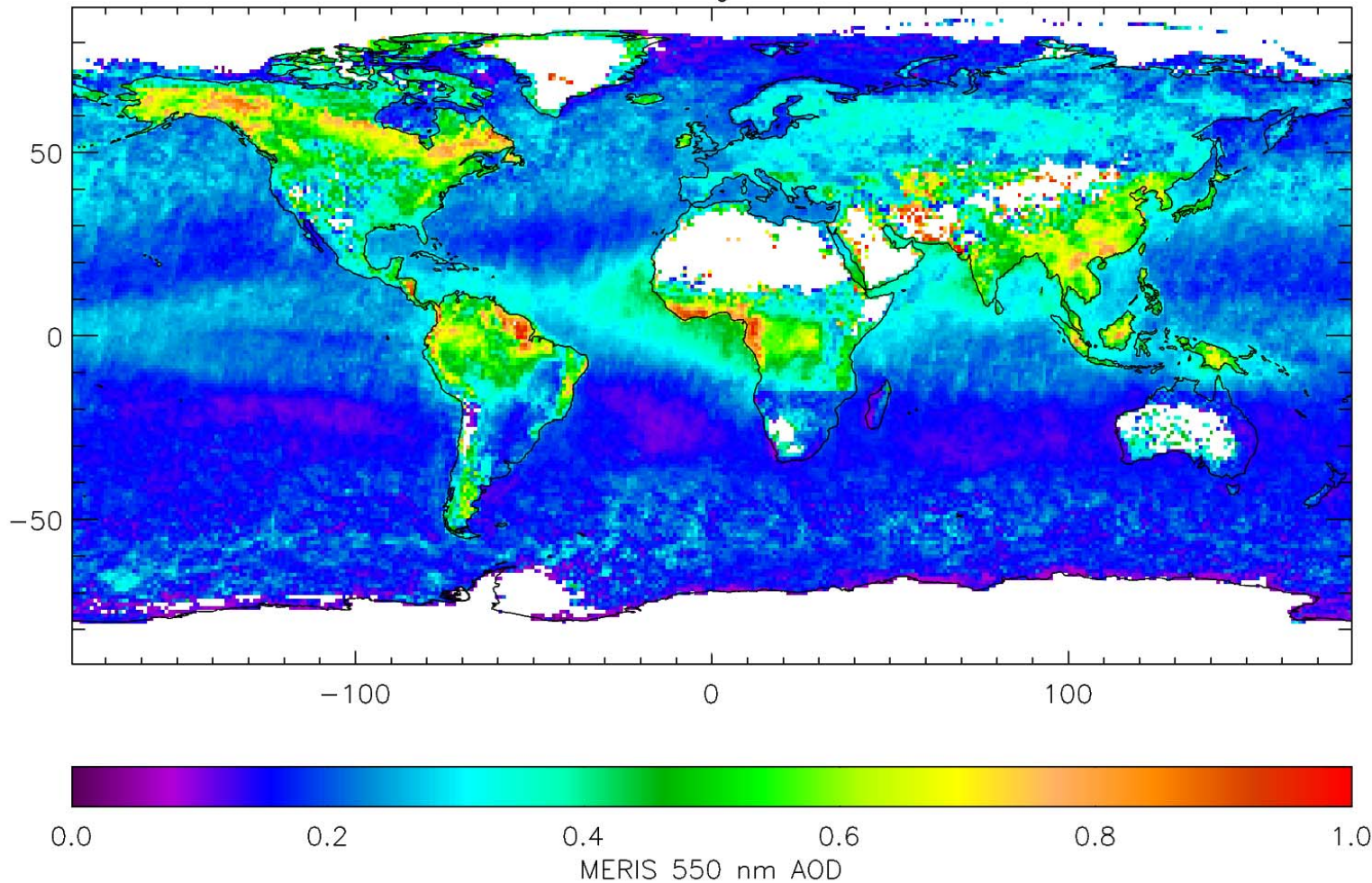
Mar-Dec 2004



First year of data: MERIS



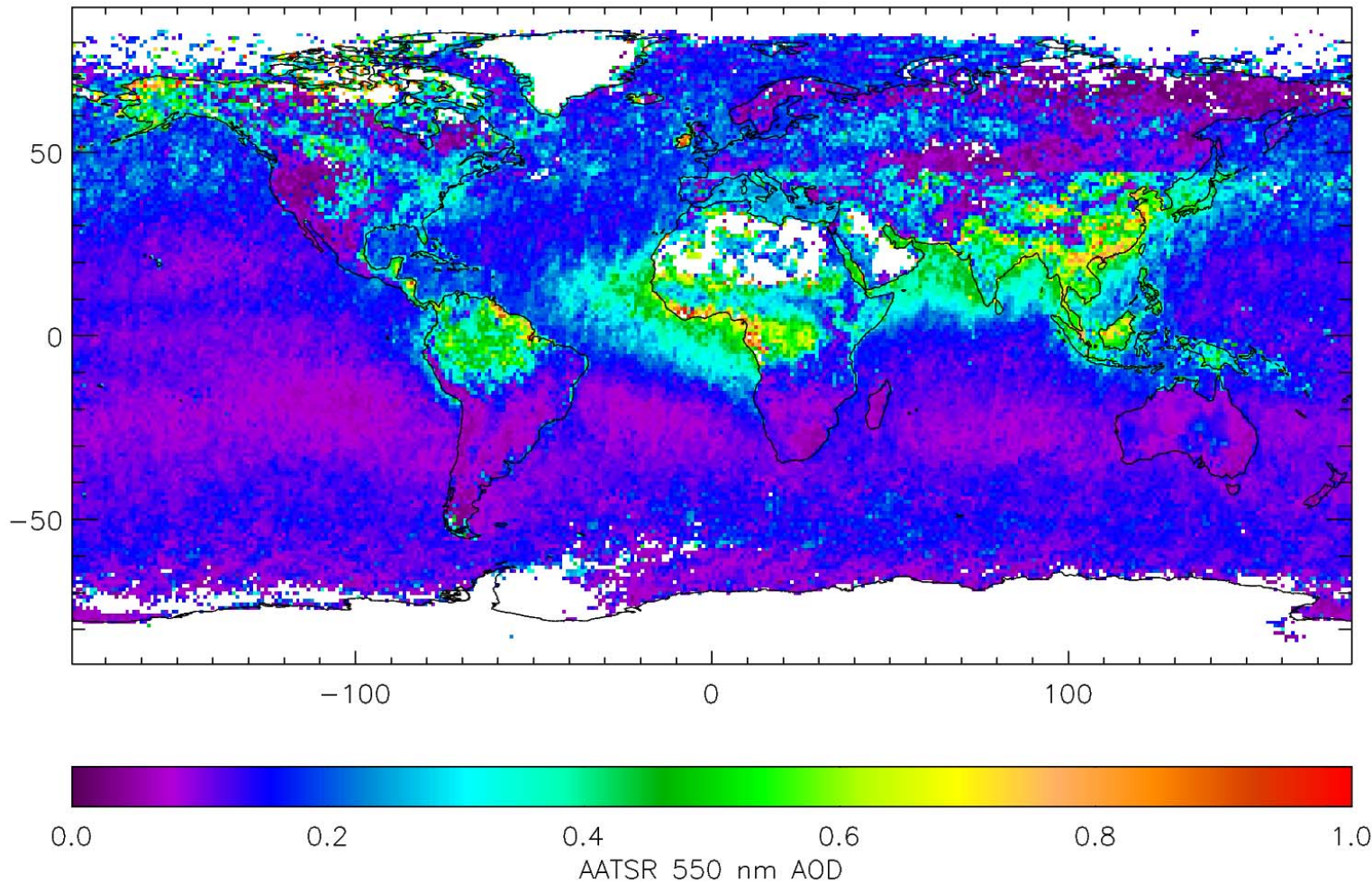
Jan–Aug 2004



First year of data: AATSR



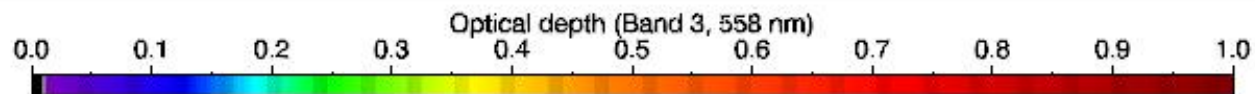
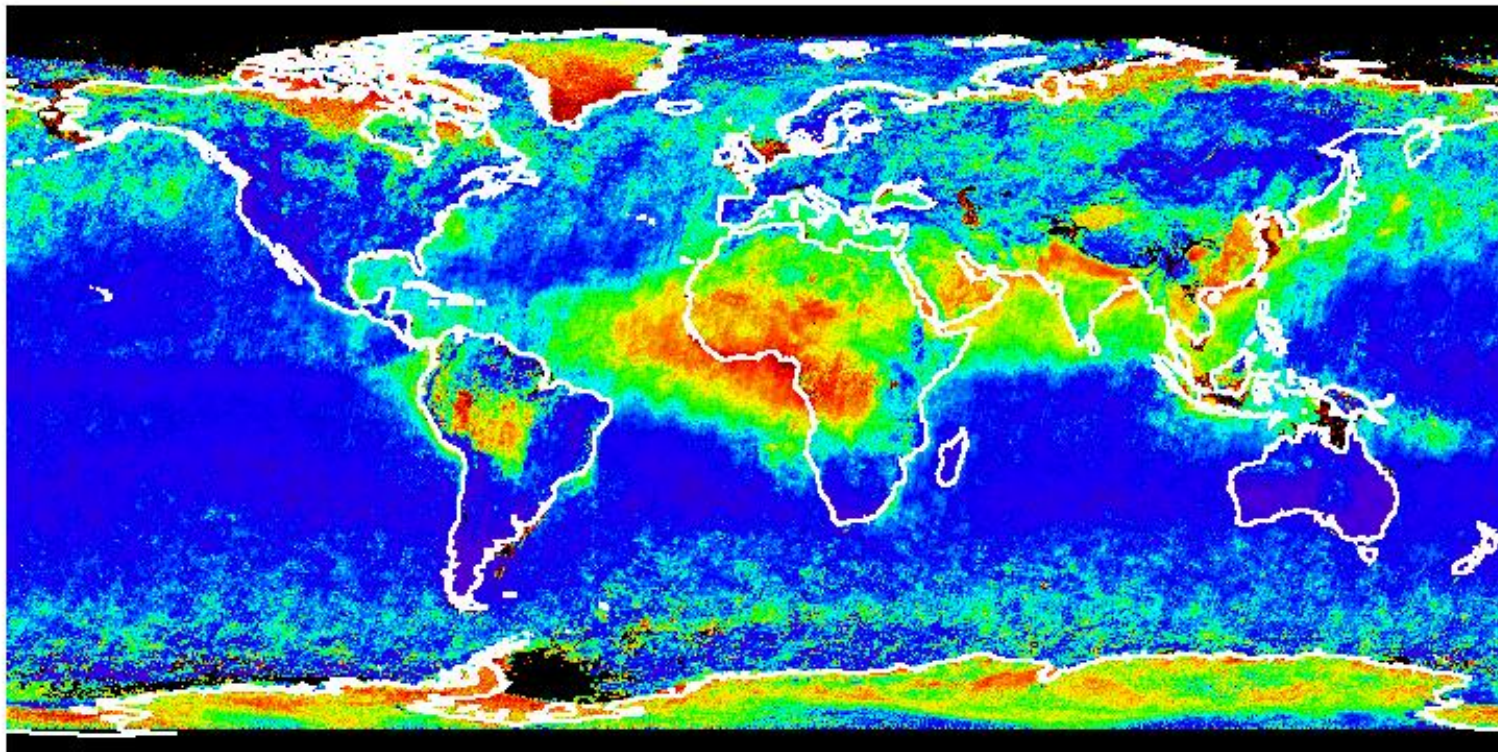
Jan–Dec 2004



MISR 2004



Optical depth Annual 2004 F02_0012
Summarizes L2 AS_AEROSOL, RegMeanSpectralOptDepth field F07_0015, 0.5 deg res



The largest task still remains...



- We are on the verge of having a 12 year aerosol dataset, now we need to exploit it.
- 12 year (A)ATSR record is an ideal tool for looking at trends.
 - The dense coverage given by SEVIRI is ideal for examining aerosol transport
 - The data will also be of use for model comparisons...

...and we'll even pay you!



- There will be a small amount of money (approx. €100,000) available for projects specifically comparing GlobAEROSOL data and model output.

Watch the GlobAEROSOL website over the next few months website for details.

- If you're interested in seeing the data early, give me your email address and I will get you added to the "beta users" list.

<http://www.globaerosol.info/>

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