Nick Schutgens[1], Ed Gryspeerdt[2], Andreas Veira[3], Natalie Weigum[1], Dan Partridge[1], Philip Stier[1]

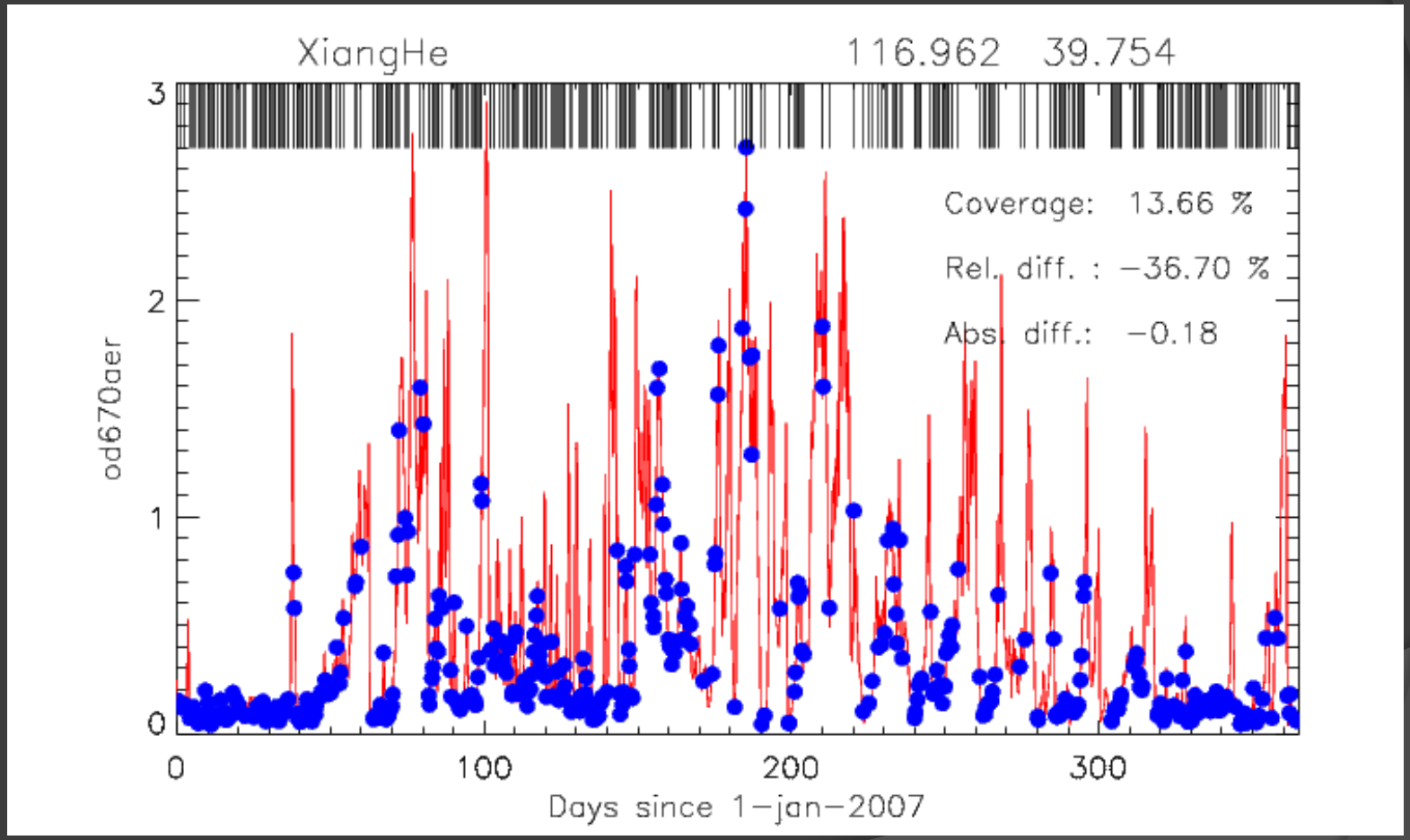
1) University of Oxford; 2) University of Leipzig; 3) MPI-MET, Hamburg

ON THE USE OF REMOTE SENSING OBSERVATIONS FOR AEROCOM

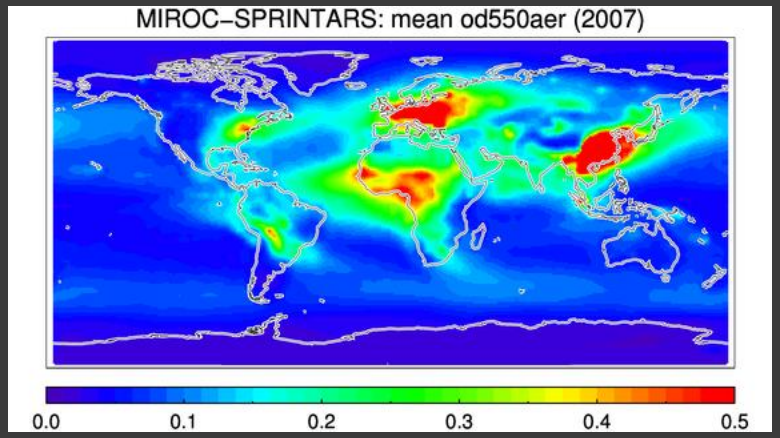
Using remote sensing observations

- Retrieval errors
- Observation operator
- Temporal sampling
  - Collocation
- Spatial aggregation
  - Noise

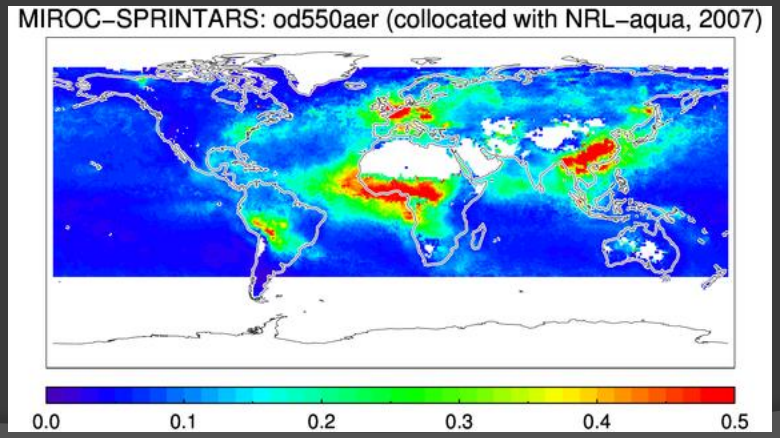
The issue of temporal sampling

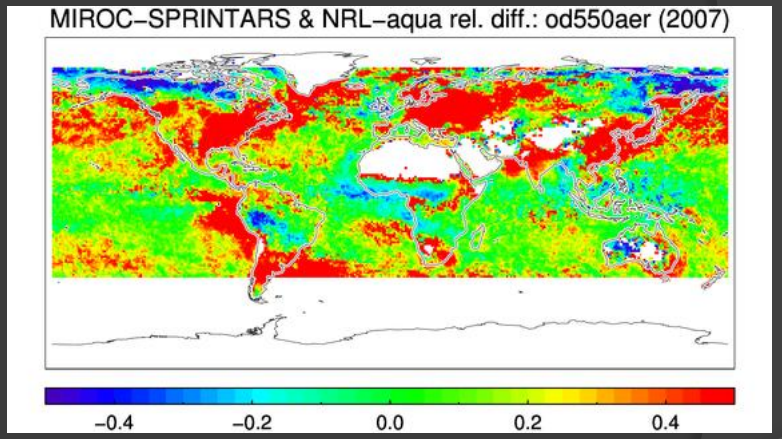


Temporal sampling i.c. MODIS Aqua



Sampled to NRL-Aqua observations





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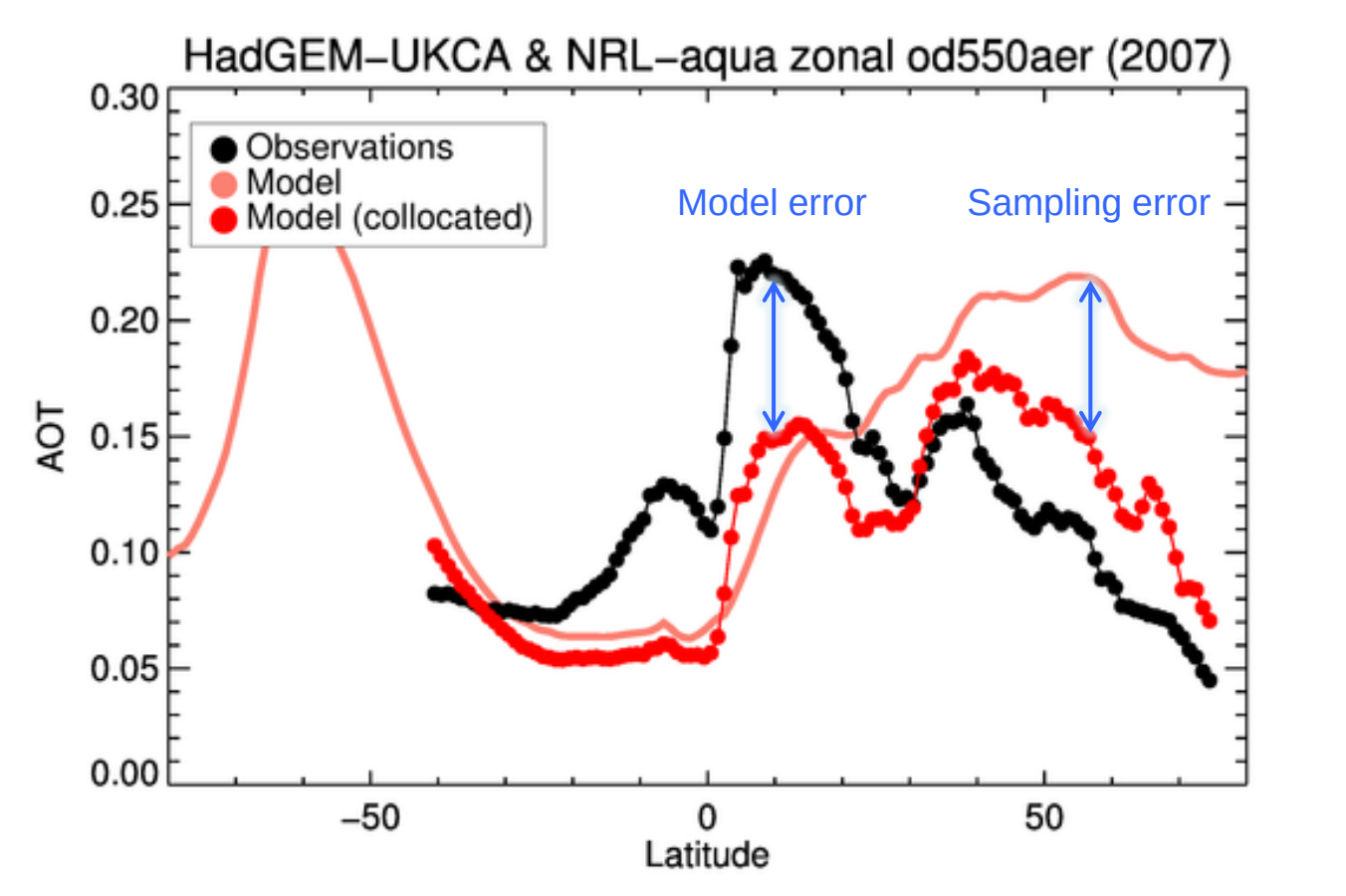
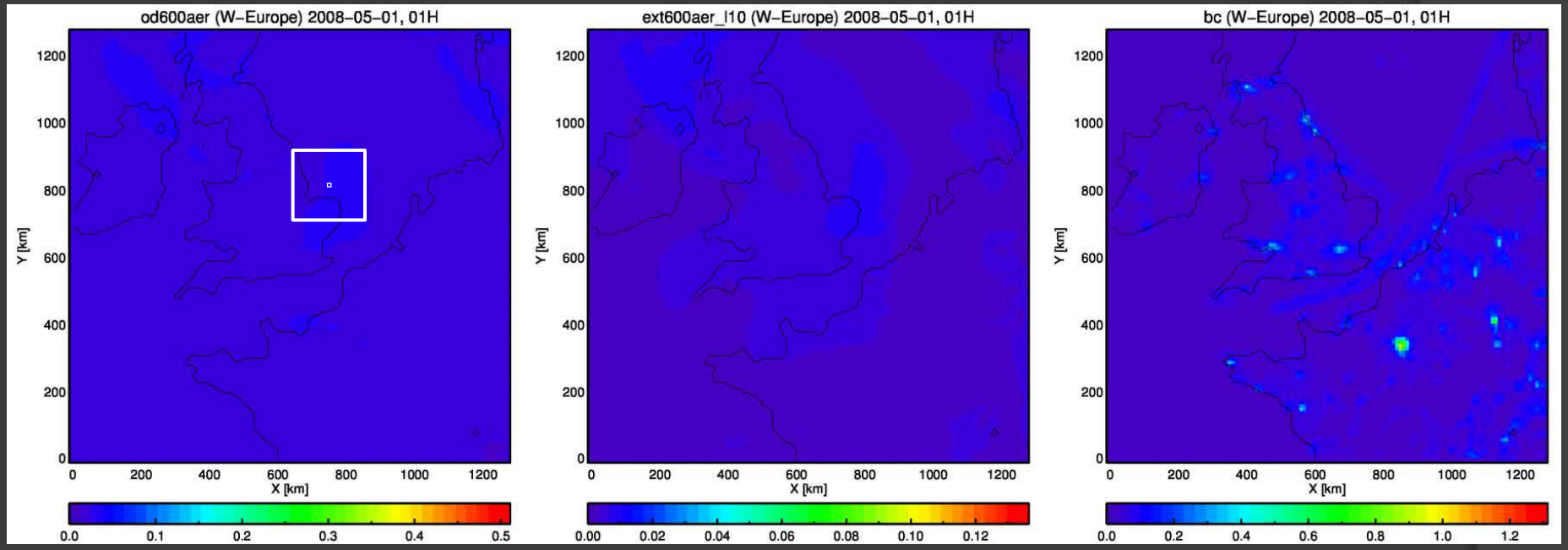
Sampling error vs model error



The issue of spatial aggregation

~2,000 m alt.



GCM gridboxes tend to be at least 10x larger than the footprint of observations:

- Model T63: 210km at equator
- MODIS L2: 10km
- AERONET: 0-5km

WRF-Chem simulations

Use high-resolution WRF-Chem simulations to study impact of spatial aggregation on model evaluation

- GCM gridbox: 200km
- Observation: 10km

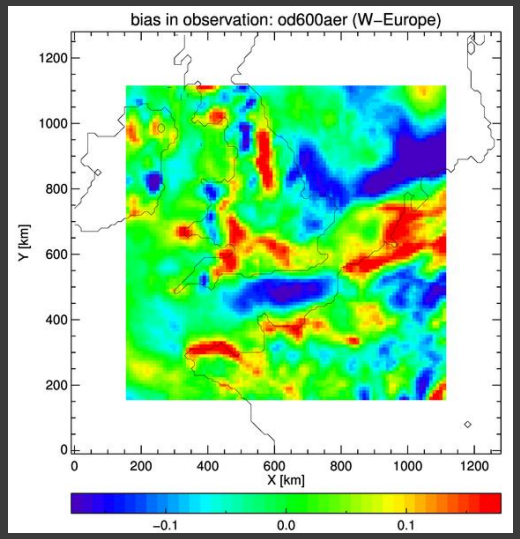
Model runs by Ed Gryspeerdt & Natalie Weigum

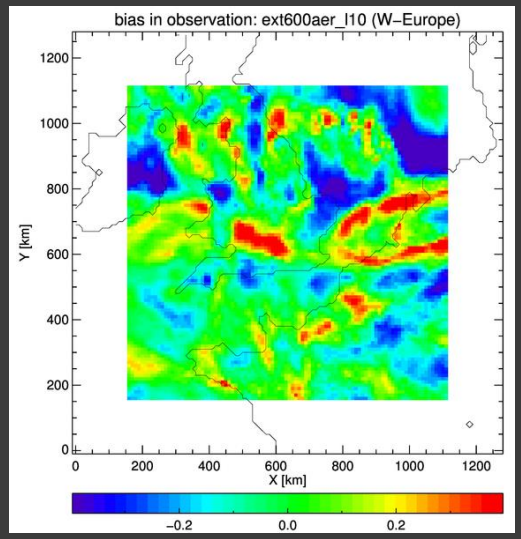
Region	Resolution	Domain	Emissions
W-Europe	10^{km}, 1^{hr}	1280^{km} , 1^{mth}	TNO (1^{hr})
Oklahoma	10^{km}, 1^{hr}	1190^{km} , 1^{mth}	EPA/NEI (1^{hr})
Congo	10^{km}, 1^{hr}	2090^{km} , 1^{mth}	EDGAR (1^{yr}) + MODIS (1^{d})
Ocean	10^{km}, 1^{hr}	1280^{km} , 1^{mth}	parametrisation

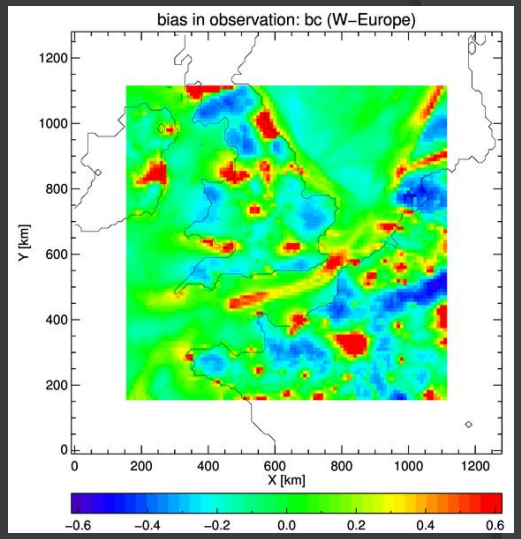
Observables: AOT, AE, SSA but also surface properties like PM2.5 and individual species concentrations.

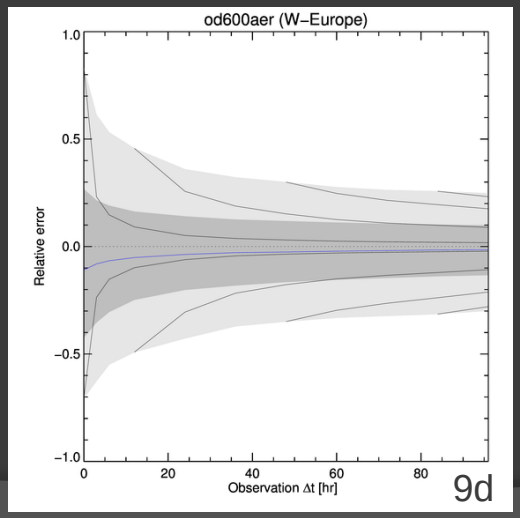
Errors due to aggregation

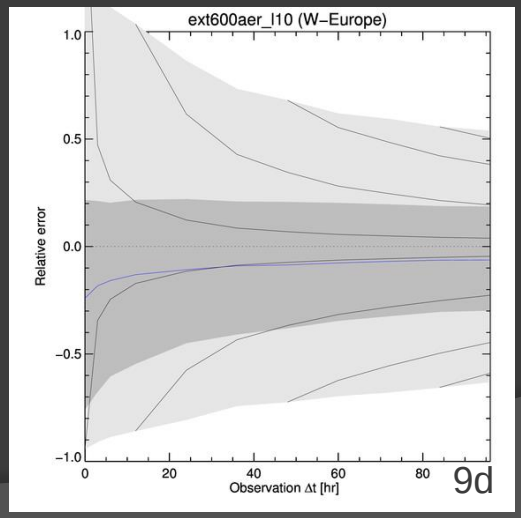
~2,000 m alt.

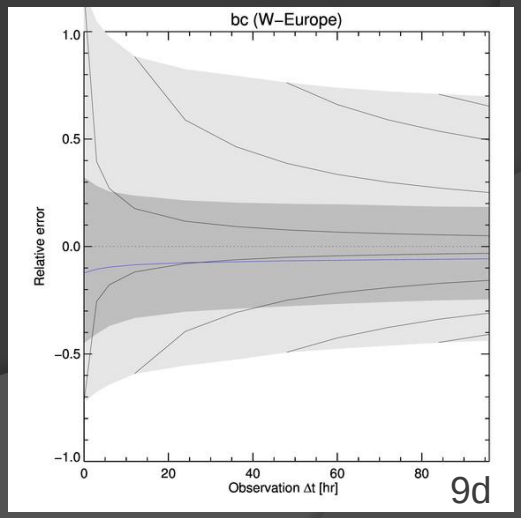




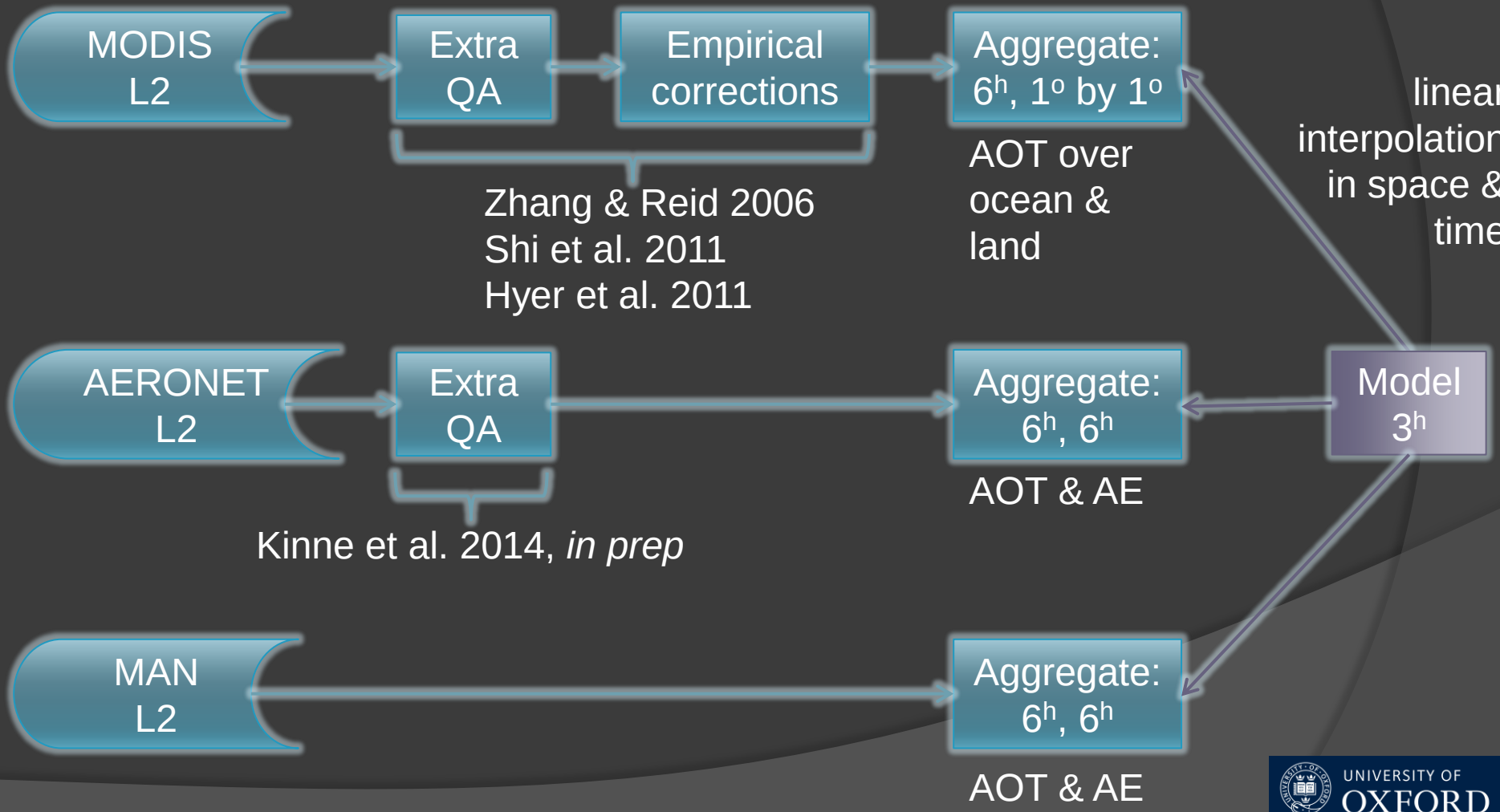








Evaluation strategy



Available experiments

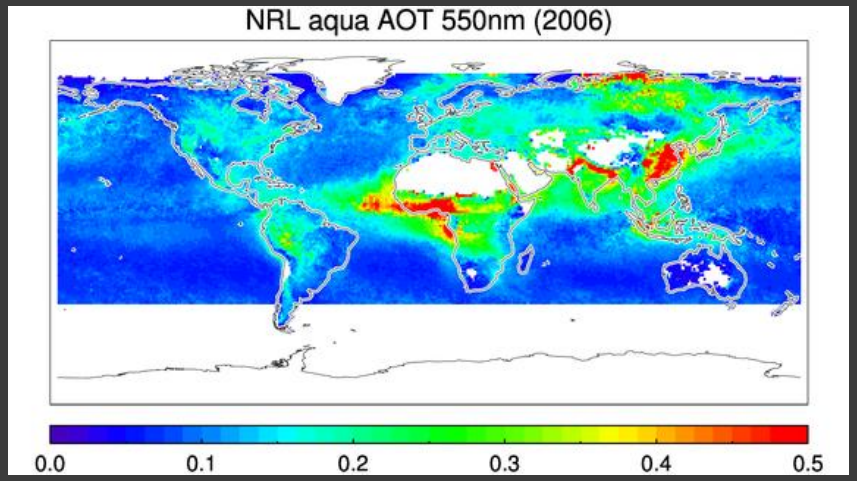
Model output: 3-hourly

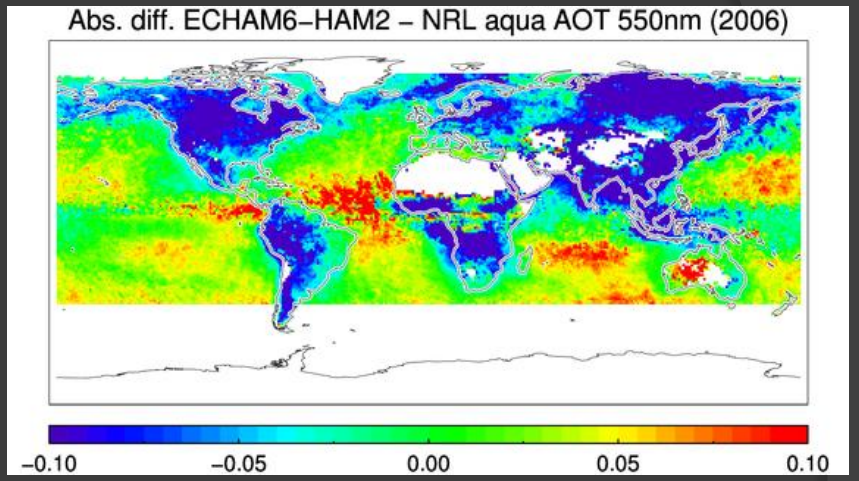
Model	Experiment	Comments
ECHAM6.1-HAM2.2	Wildfire emissions/heights	by Andreas Veira
ECHAM6.1-HAM2.2	AEROCOM/INDIRECT3	
GEOS5	AEROCOM/INDIRECT3	Not considered yet
GFDL-AM3	AEROCOM/INDIRECT3	
HadGEM3-A-GLOMAP	AEROCOM/INDIRECT3	
ModelE-TOMAS	AEROCOM/INDIRECT3	Not considered yet
SPRINTARS	AEROCOM/INDIRECT3	
UM_IMPACT	AEROCOM/INDIRECT3	Not considered yet

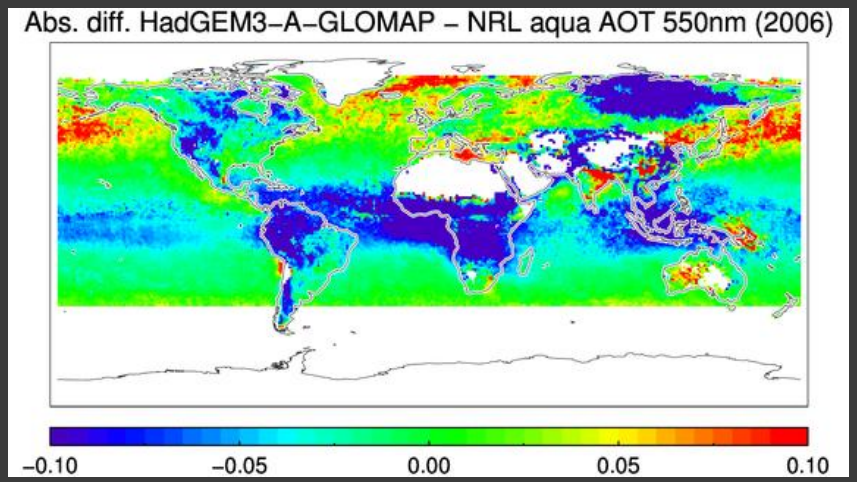
INIDRECT3: model output for 2006 (2006-2010 available)

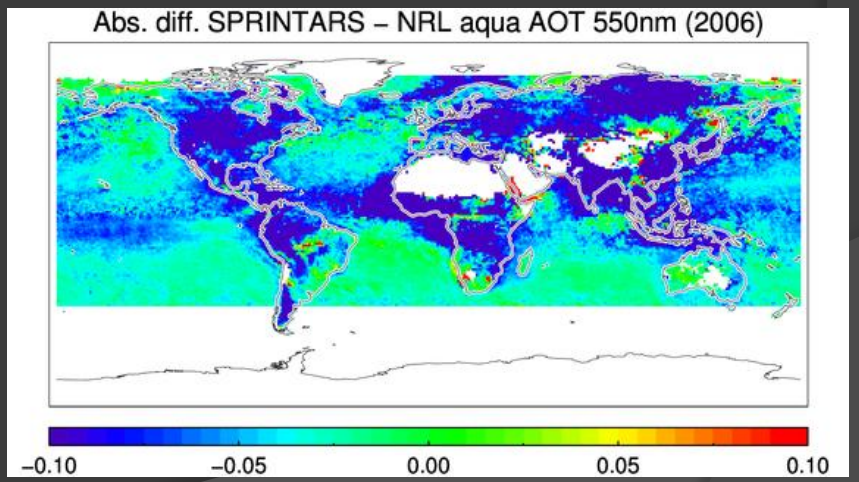
Proposed experiment: AOT (@550nm), AE (@870/440nm) and SSA (@550nm) at 3-hourly resolution

Yearly averaged MODIS Aqua AOT

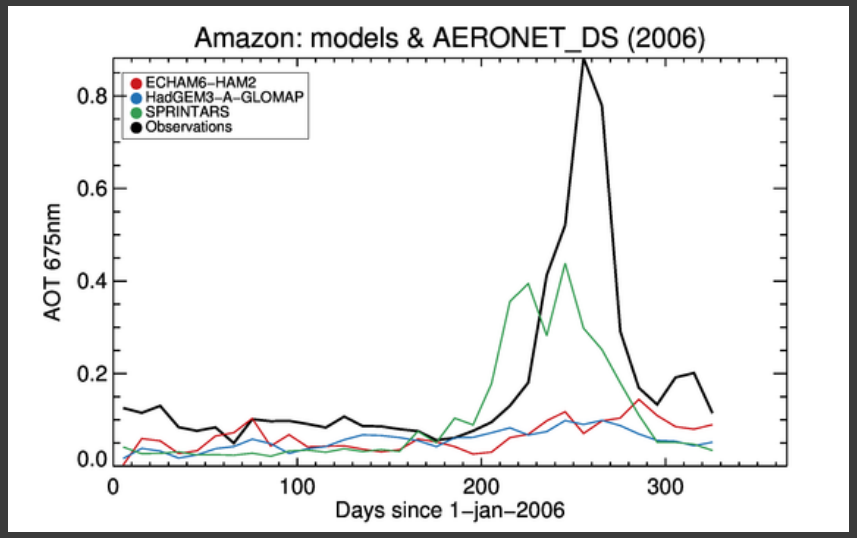


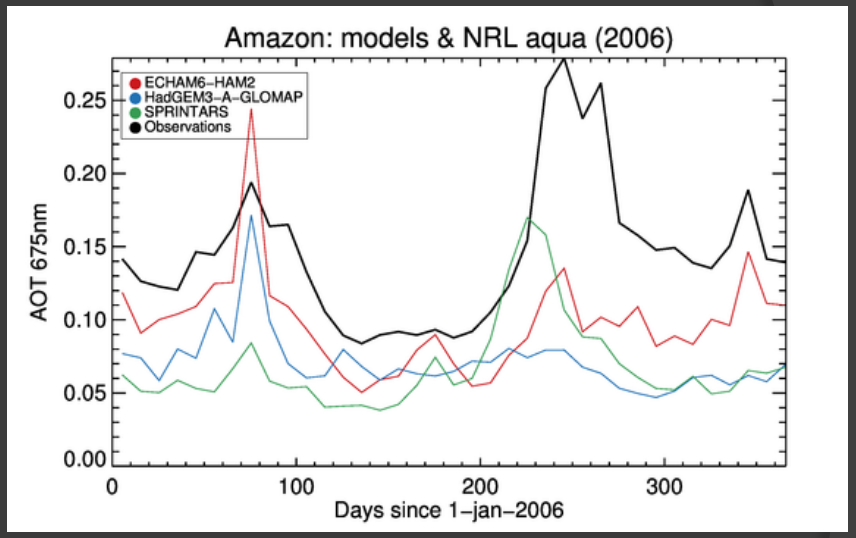






Area-averaged, weekly AOT

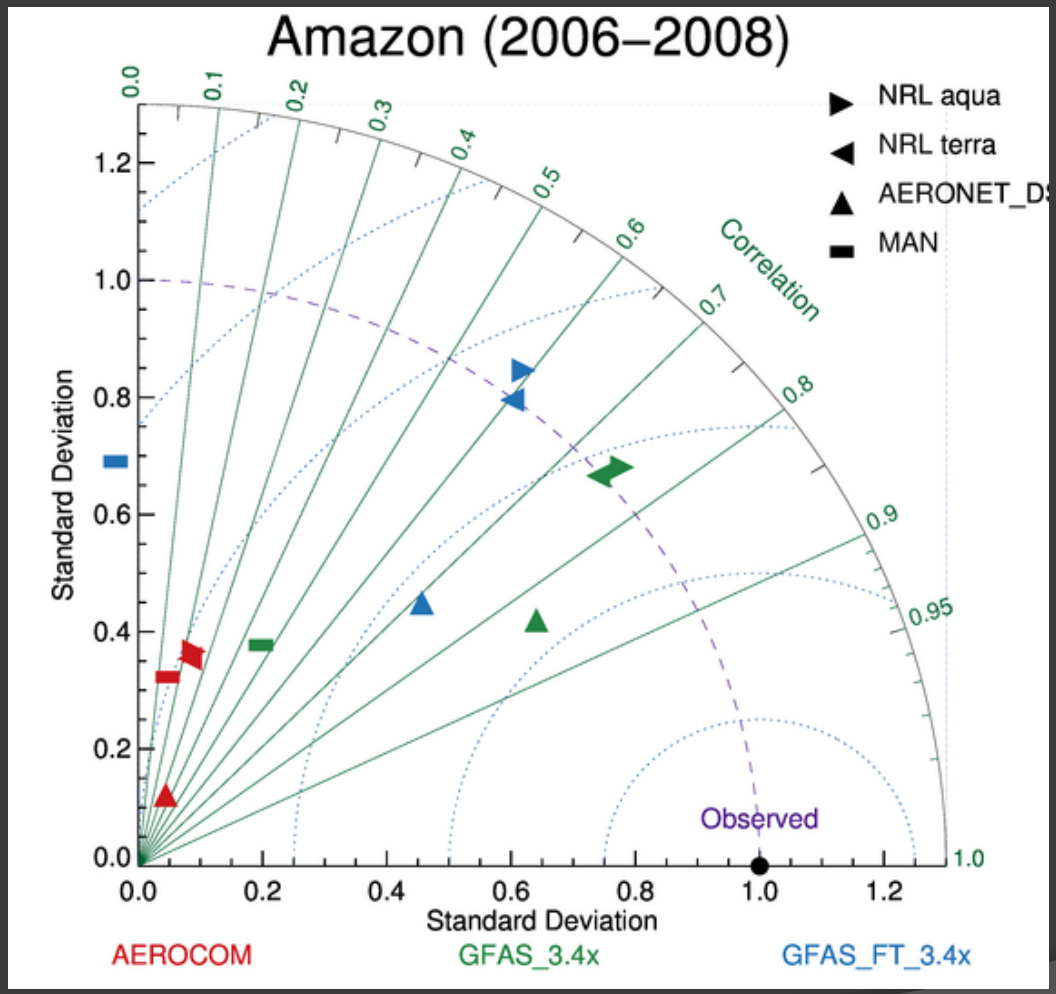


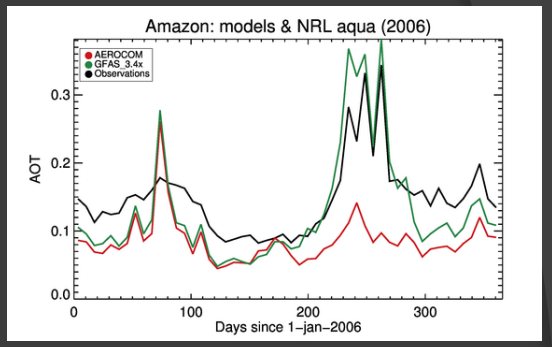


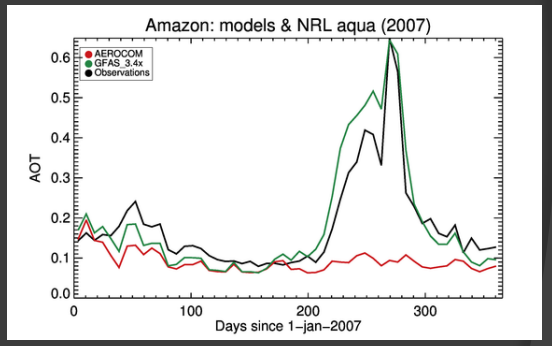
It appears models significantly underestimate AOT in the wildfire region/season. This is true not only for the Amazon, but also Boreal America, Tropical Savanna and Siberia.

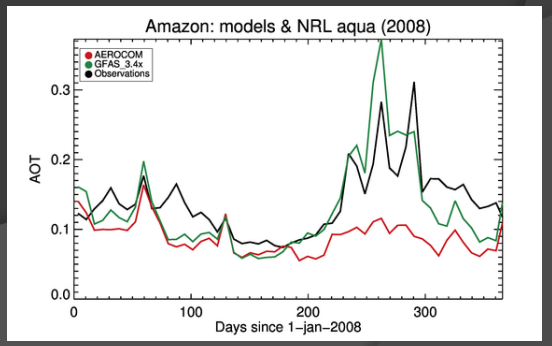
Note: both ECHAM-HAM & HadGEM use AEROCOM wildfire emissions

Impact of emission datasets







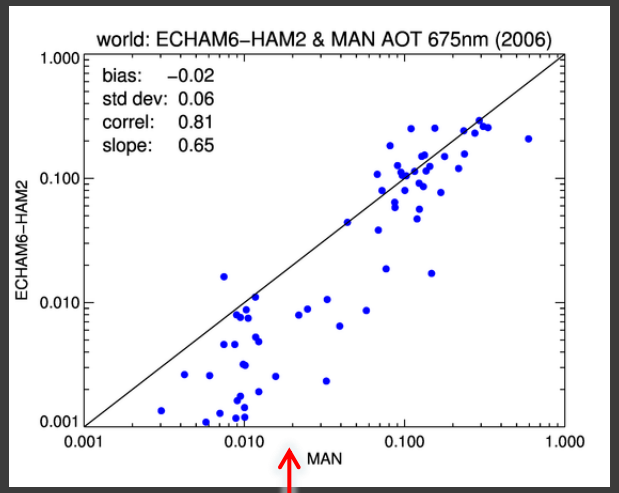


Model runs by Andreas Veira

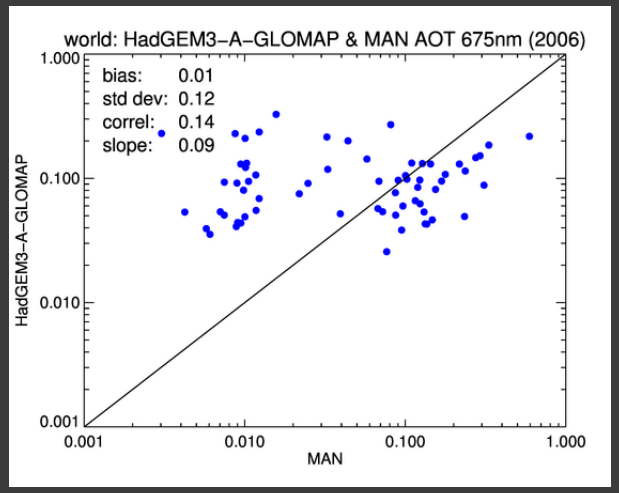
Maritime Aerosol Network AOT

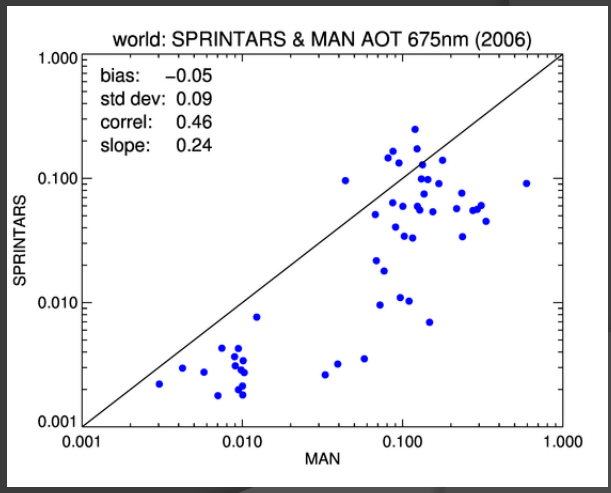
As MAN data is so sparse (both spatially and temporally), we can expect:

- Temporal collocation to be very important for model evaluation
- Spatial aggregation to cause a significant amount of scatter



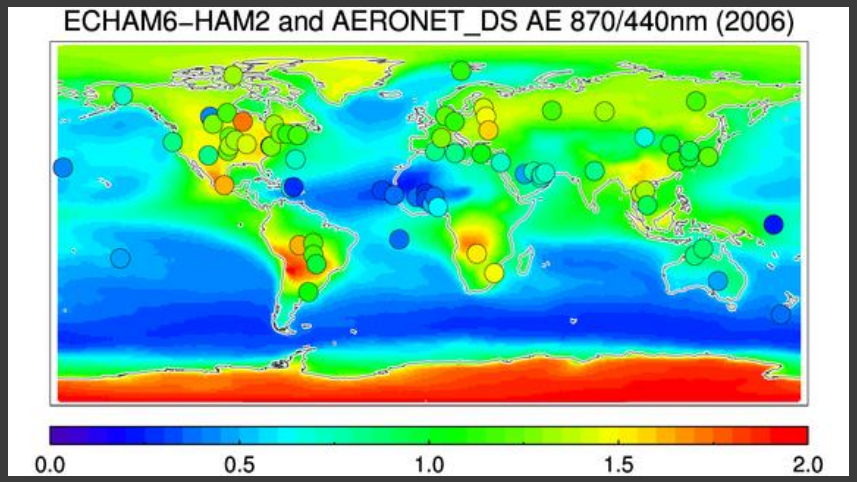
retrieval error

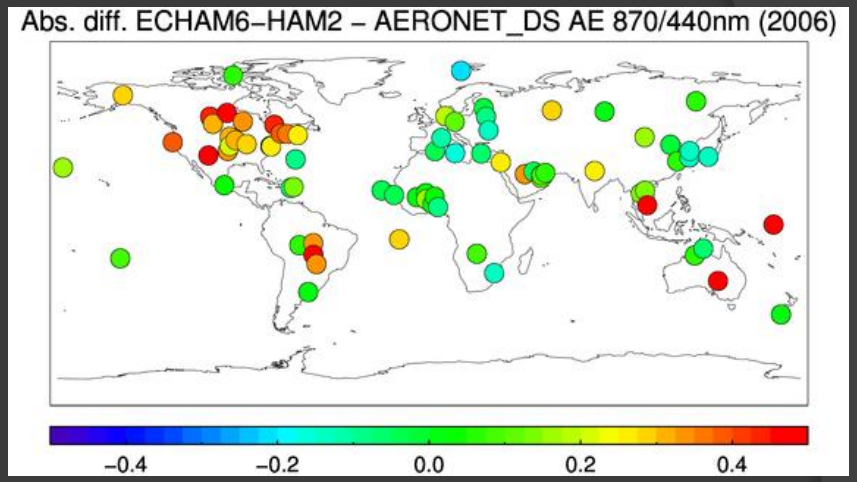


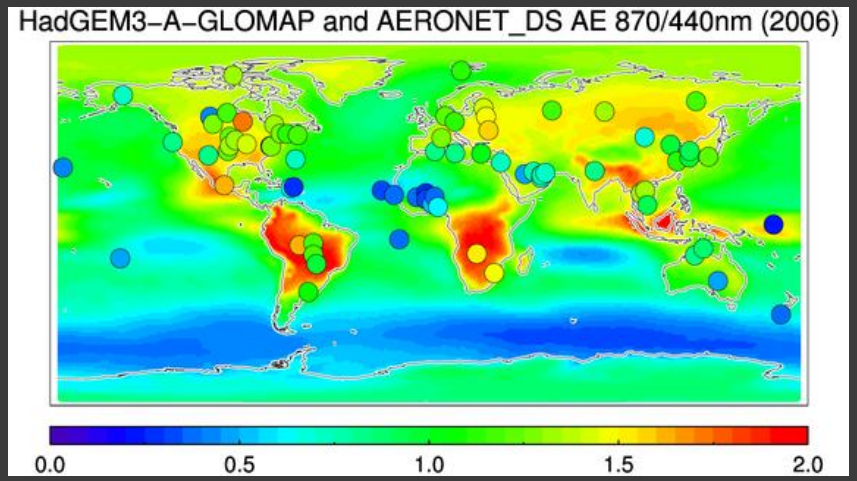


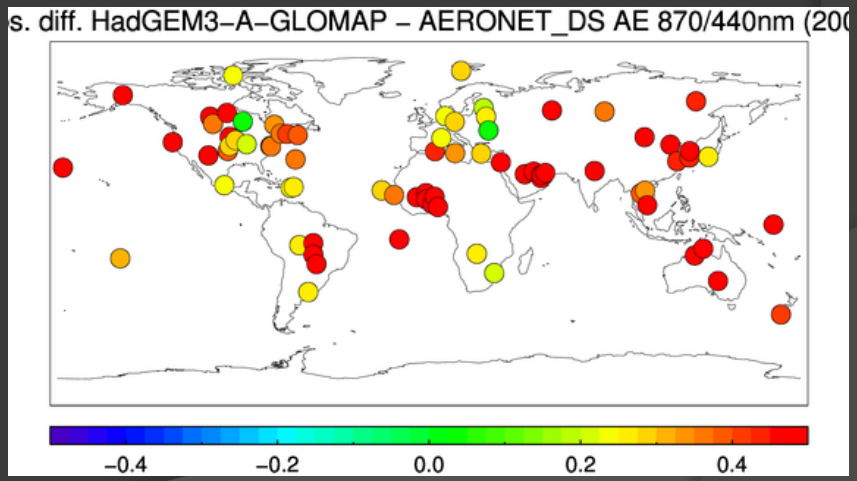
Nevertheless, the models evaluate very differently against MAN. Interestingly results are rather similar for 2007.

Yearly averaged AERONET AE



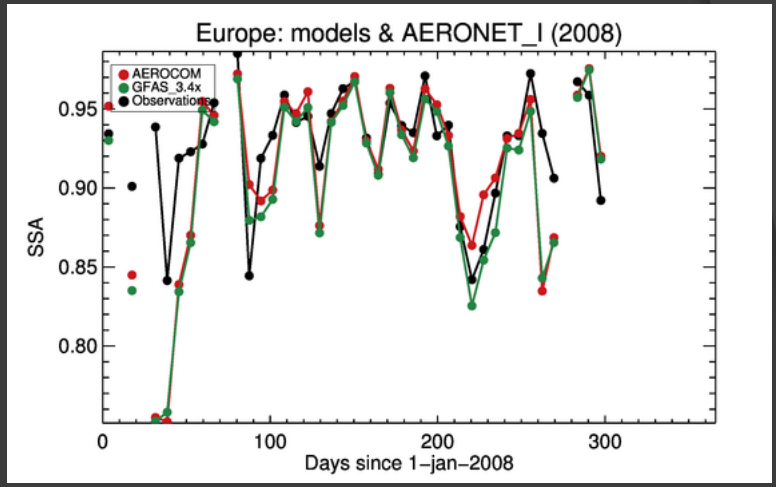


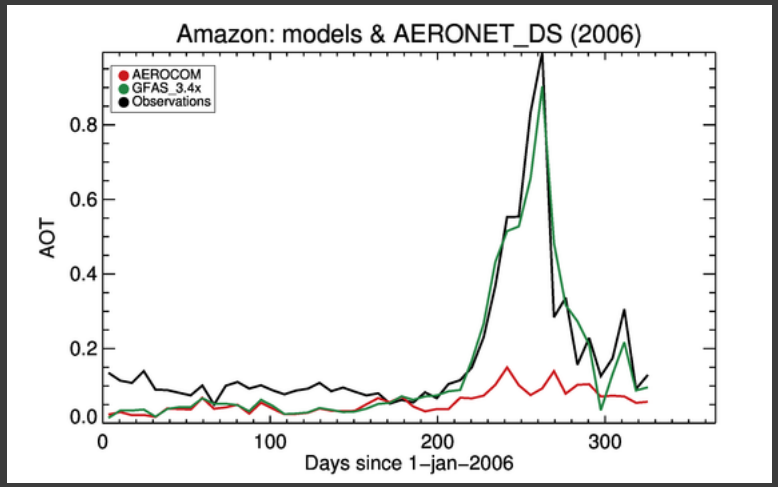


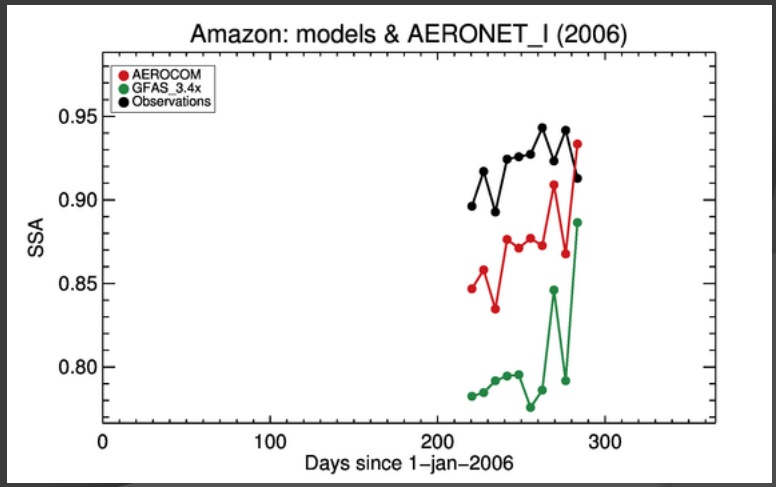


Area-averaged, weekly SSA

Note: INDIRECT3 modellers were not asked to provide SSA. Here we show ECHAM-HAM runs by Andreas Veira.



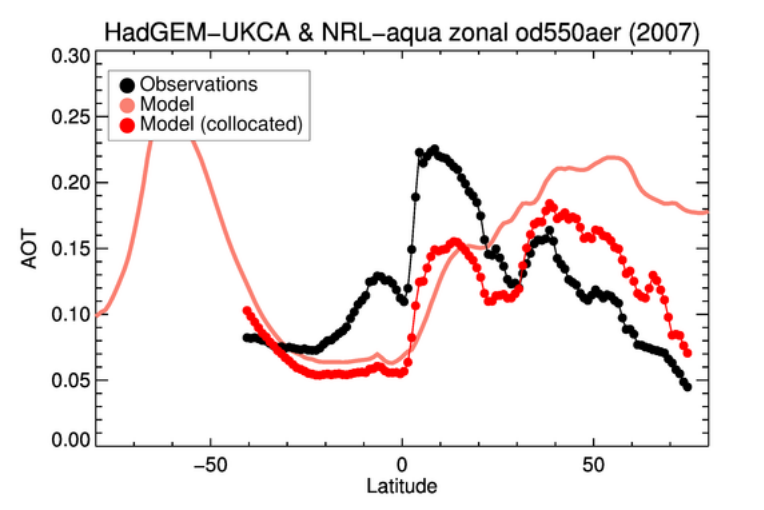




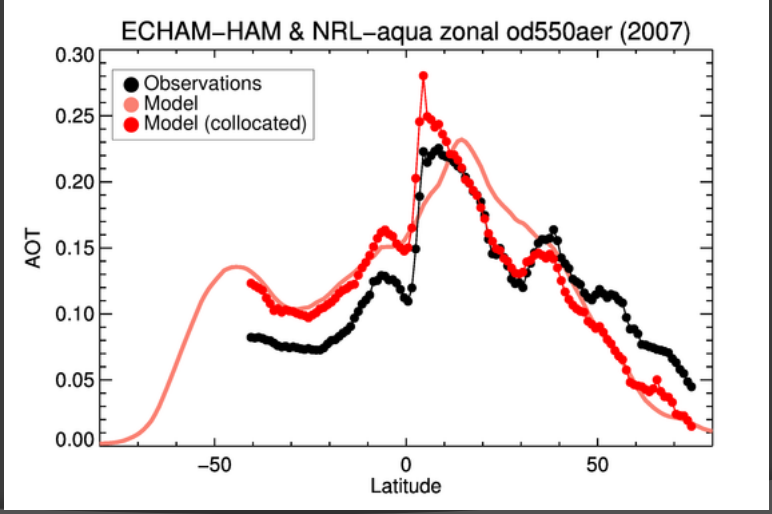
Summary

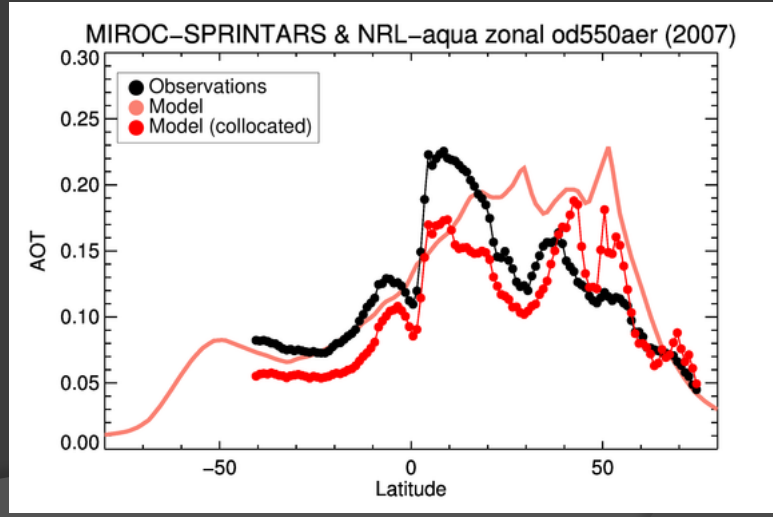
- Assessed impact of sampling issues
- Proposed strategies to deal with those issues
- Preliminary evaluation of AEROCOM models
  - AEROCOM wildfire emissions?
  - Proposed AEROCOM experiment

Model prediction of sampling error

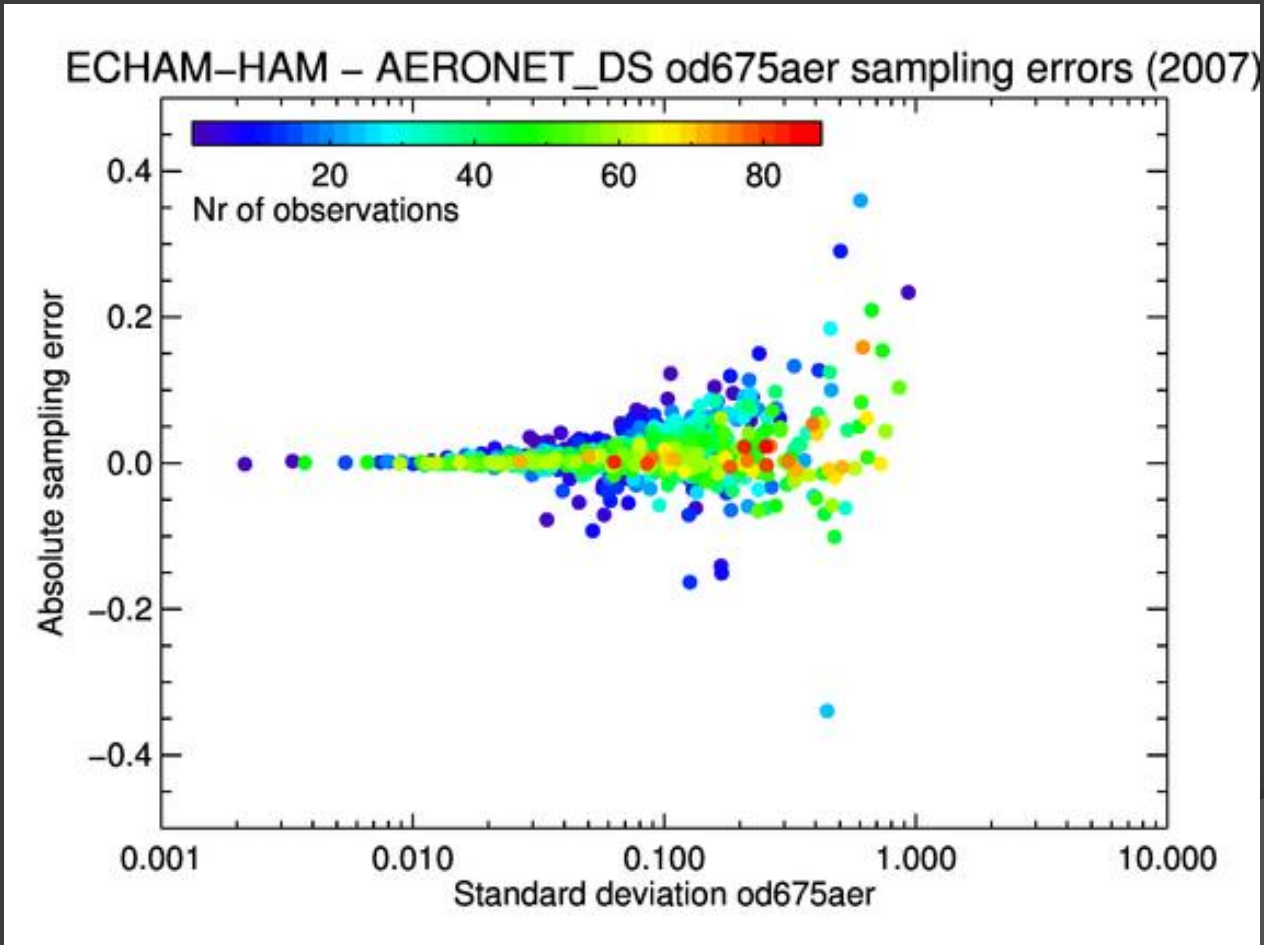


Models differ greatly in their predition of temporal sampling errors

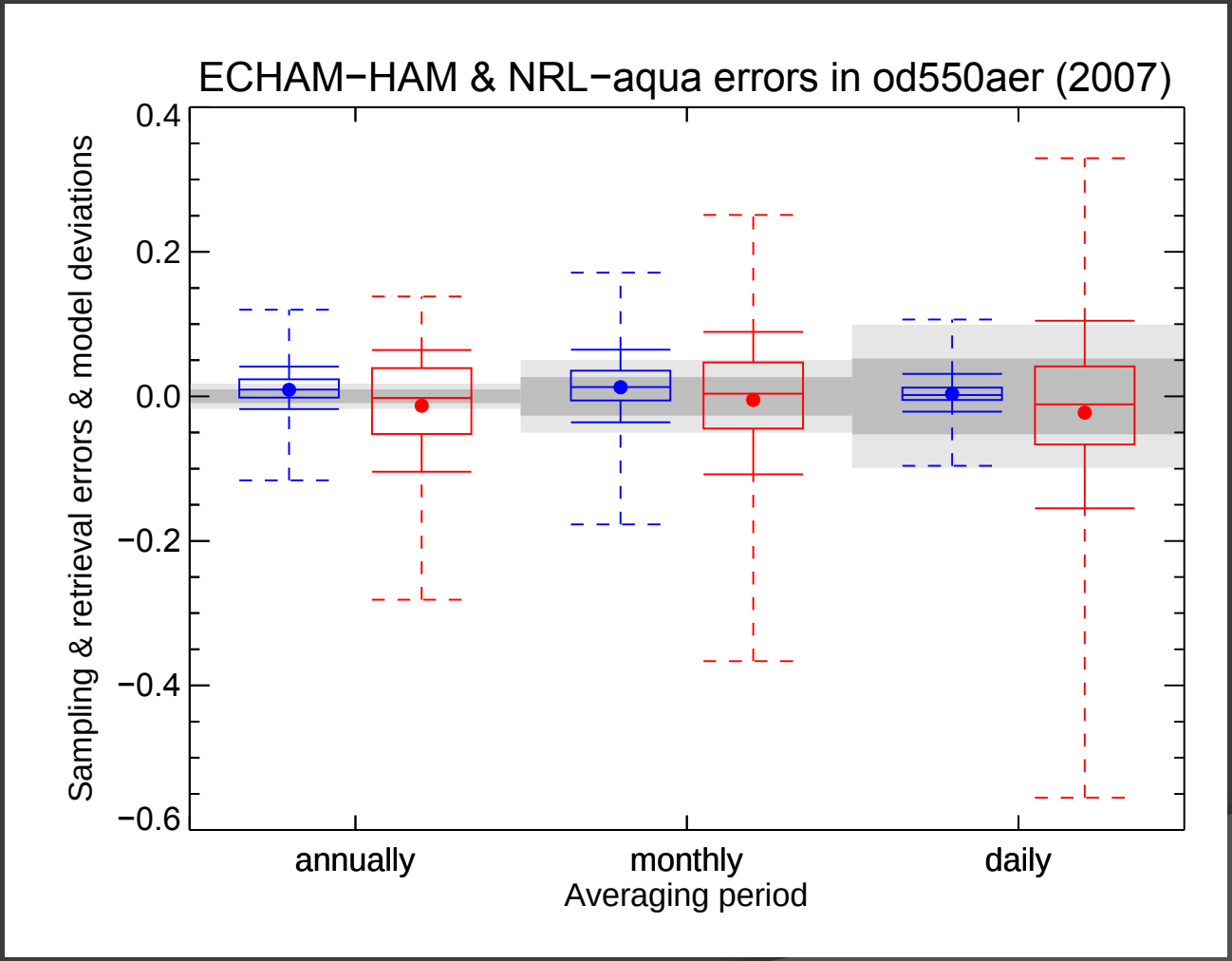




Predicting sampling error

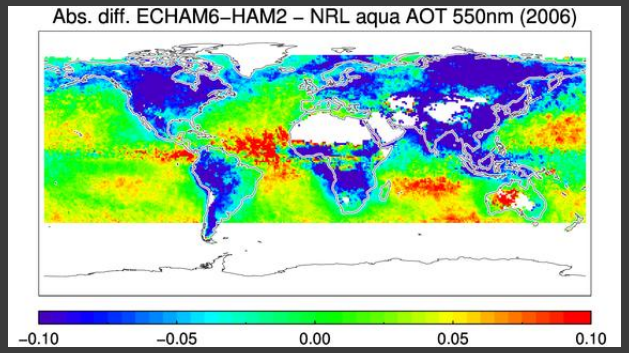


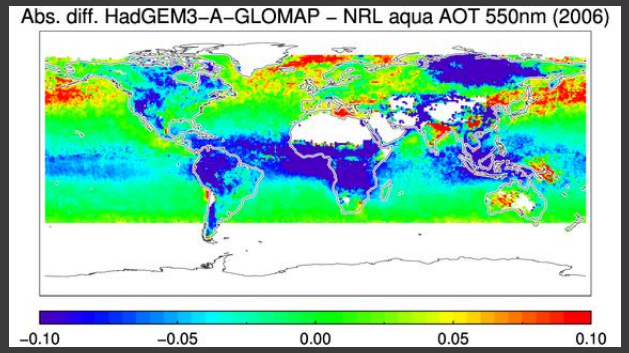
Comparison of errors

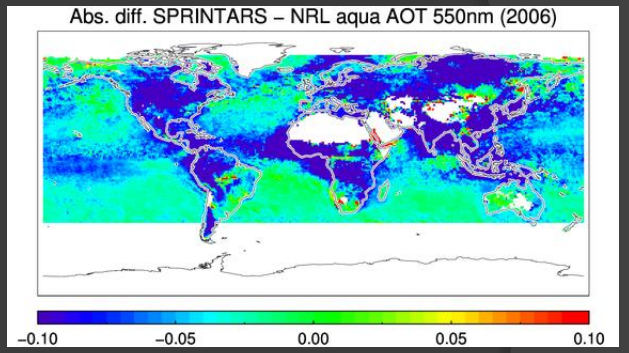


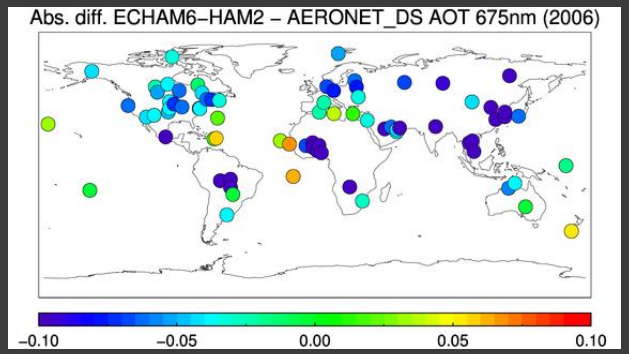
Agreement MODIS & AERONET

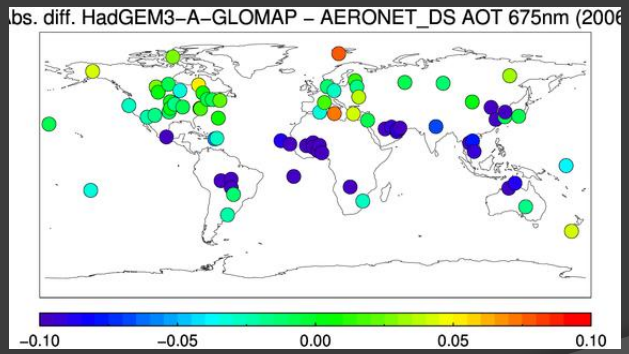
Although sampling is very different, after collocation both datasest suggest similar model errors

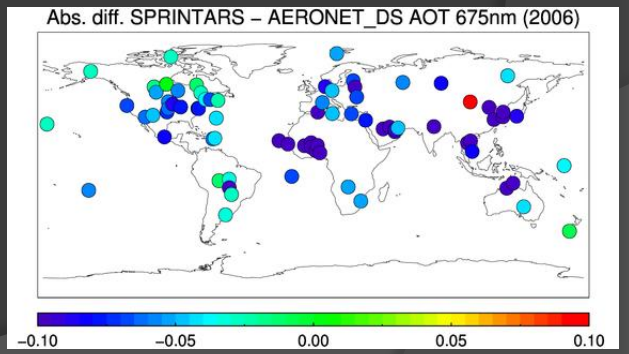




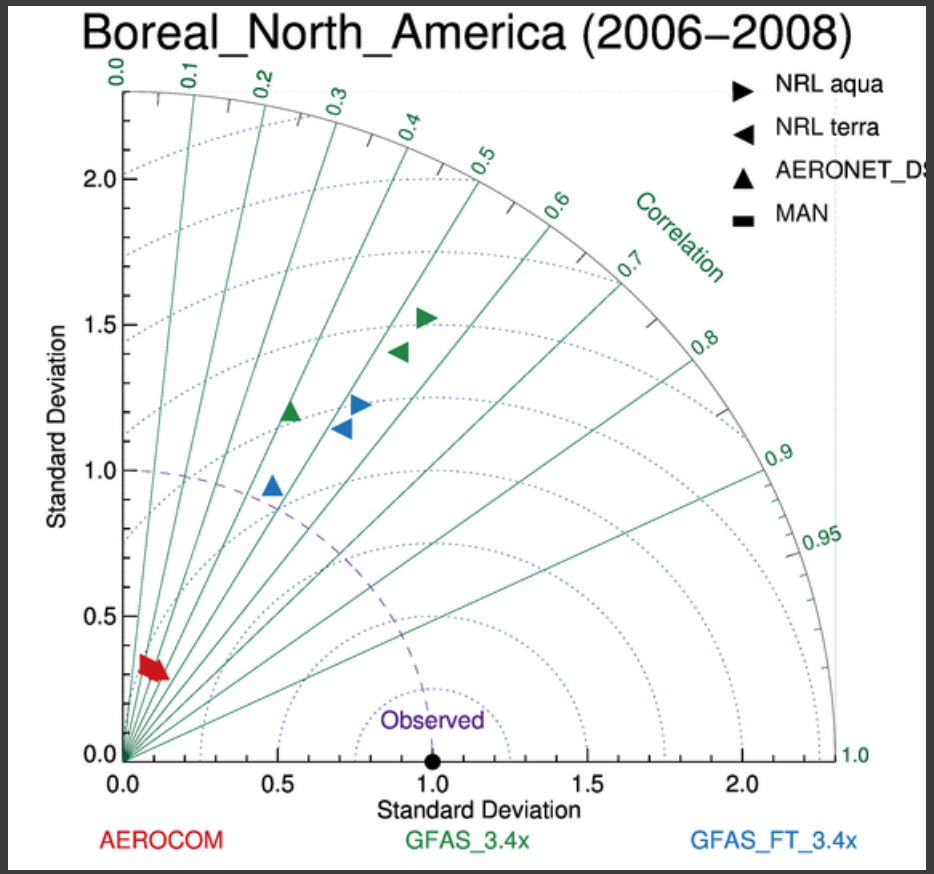


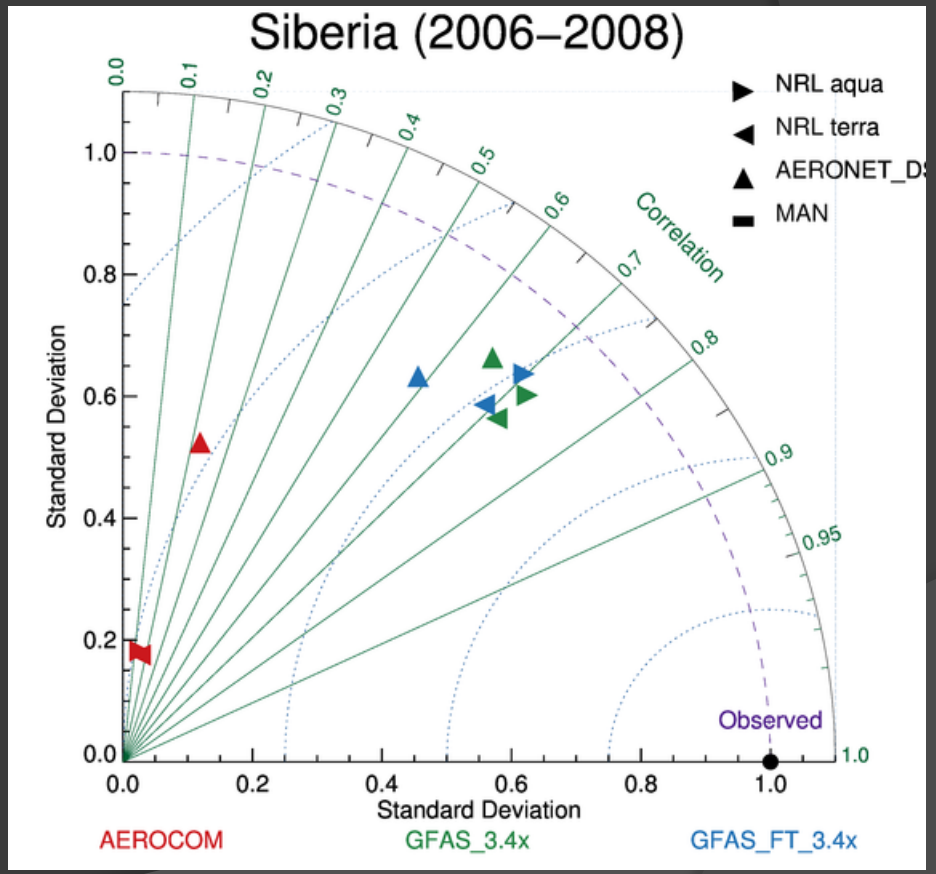






Impact of emission datasets





Maritime Aerosol Network