



Meteorologisk
institutt



10 years AeroCom

Michael Schulz



AeroCom, Hamburg , 23 September 2013



Meteorologisk
institutt



Acknowledgment I

- ◆ Database
Christiane Textor, Sarah Guibert, Jan Griesfeller
- ◆ AeroCom papers published (*ca 1900 citations so far*)
Dorothy Koch, Nicolas Huneeus, Brigitte Koffi, Gunnar Myhre, Bjorn Samset, Philip Stier, Cynthia Randles, Frank Dentener, Joyce Penner, Stefan Kinne, Johannes Quaas, Christiane Textor
- ◆ Workshop Organisers
Frank Dentener, Didier Tanre, Dorothy Koch, Rich Ferrare, Steve Ghan/Tom Ackerman, Toshi Takemura, Jon Egill Kristjansson/Trond Iversen, Philip Stier, Paul Ginoux, Stefan Kinne
- ◆ SSC Stefan Kinne, Mian Chin, Michael Schulz



Meteorologisk
institutt



Some words on Technology

- ◆ How to facilitate multi-model analysis?
 - ◆ How to obtain and store data homogeneously?
 - ◆ Provide Documentation?
 - ◆ Check Data Quality?
-
- ◆ With limited resources....

File Upload Tool

- ◆ <http://aerocom-test.met.no/upload>
- ◆ Developed to support the second phase of the TFHTAP multimodel intercomparison activity and AEROCOM P3
- ◆ It tests netCDF files for-
 - ◆ CF compliance
 - ◆ Range check for all variables in the uploaded file i.e. if their minimum, maximum, and mean value lies within the range of previous TFHTAP model results (or met.no defined limits).

See poster from Jan



File upload facility for TFHTAP model data

Help

File and CF-Version

Select File(s) to Upload

Select CF-version to validate

Test Results



File Name	File size	Upload Status
UM-CAM-v01_SR6NA_tracerm_2001_0003.nc	741 kByte	failure

CF-Convention Test

- ✘ global Conventions attribute should be set to "CF-1.1", not "CF-1.0" (2.6.1)
- ✘ lev: missing formula variable in file: p0 (4.3.2)
- ✘ lon: a coordinate variable must have values that are strictly monotonic (5)
- ✘ lat: bounds variable "lat_bnds" not found in file (7.1)
- ✘ lon: bounds variable "lon_bnds" not found in file (7.1)
- ✘ lev: bounds variable "lev_bnds" not found in file (7.1)
- ✘ time: bounds variable "time_bnds" not found in file (7.1)
- ℹ running CFchecker version 1.5.11 (INIT)

[click here](#) to list all errors!



Meteorologisk
institutt



The latest ultimate upload procedure

<http://iek8wikis.iek.fz-juelich.de/HTAPWiki/HTAP-2-data-submission>

The obligatory Filename for using the cf checker and the submission of data is

"htap2_<ModelName>_<ExperimentName>_<VariableName>_<VerticalCoordinateType>_<Period>_<Frequency>.nc"

<ModelName> => can be chosen such that Model Name, Model version and possibly the institution can be identified. No underscores () are allowed in <ModelName>, use (-) instead. Restrict <ModelName> to max 20 characters.

<ExperimentName> => will be provided with htap-2 experiment description, see excel htap protocol file

<VariableName> => see htap variable names in excel sheet

<VerticalCoordinateType> => "Surface", "Column", "ModelLevel", "SurfaceAtStations", "ModelLevelAtStations"

<Period> => "2008", "2010"

<Frequency> => "timeinvariant", "hourly", "daily", "monthly", "sat1000", "sat1330", "sat2200", "sat0130"



Suggestion for new experiments

- ◆ ONE CONTROL experiment for all new model versions participating in any experiment
 - ◆ Allows check of improvement over time
 - ◆ Basic diagnostics of emissions, loads, surface concentrations, optical properties give quick feedback on model quality
- ◆ Variable participation for experiments - clearly identify EXPERIMENTS!



Meteorologisk
institutt

Four lessons



- ◆ Black Carbon
- ◆ Trends
- ◆ Forcing diversity
- ◆ Aerosol-climate interactions



Meteorologisk institutt

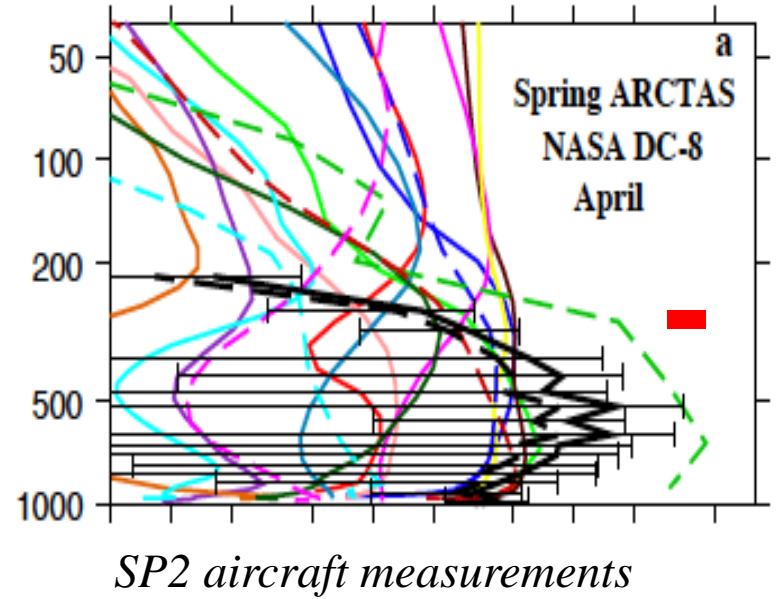
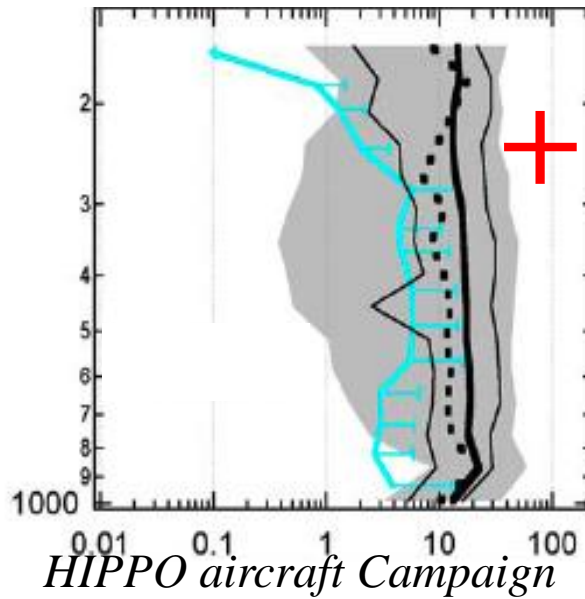
Inconsistent evaluation of black carbon in AeroCom model intercomparison



Column



upper Troposphere



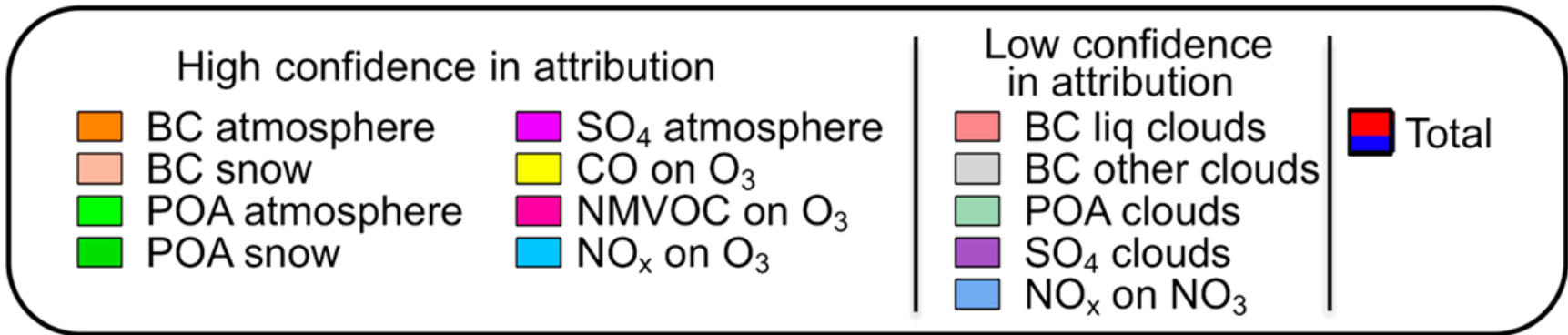
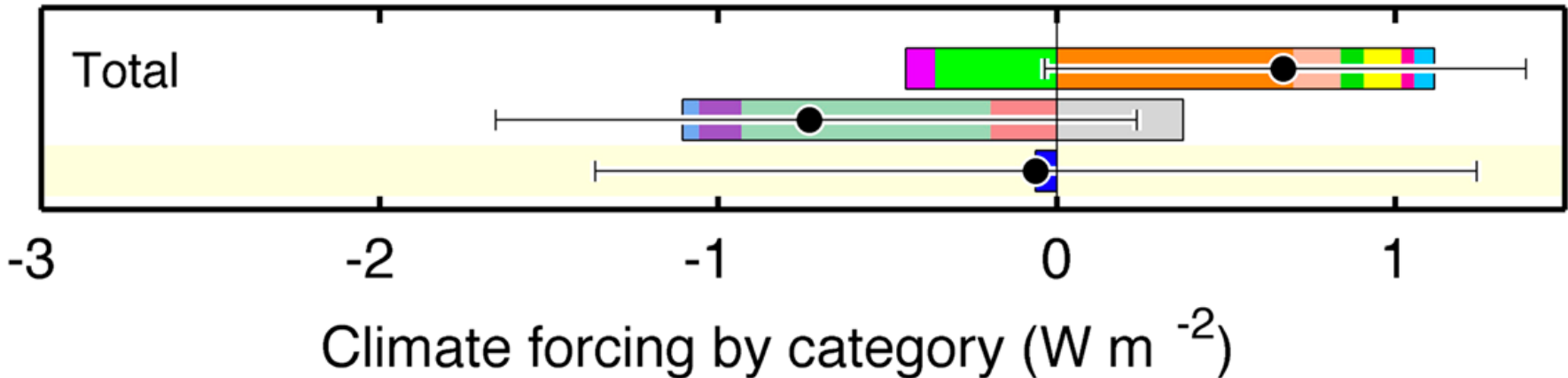
surface

[Model bias]





Climate forcing by Black Carbon

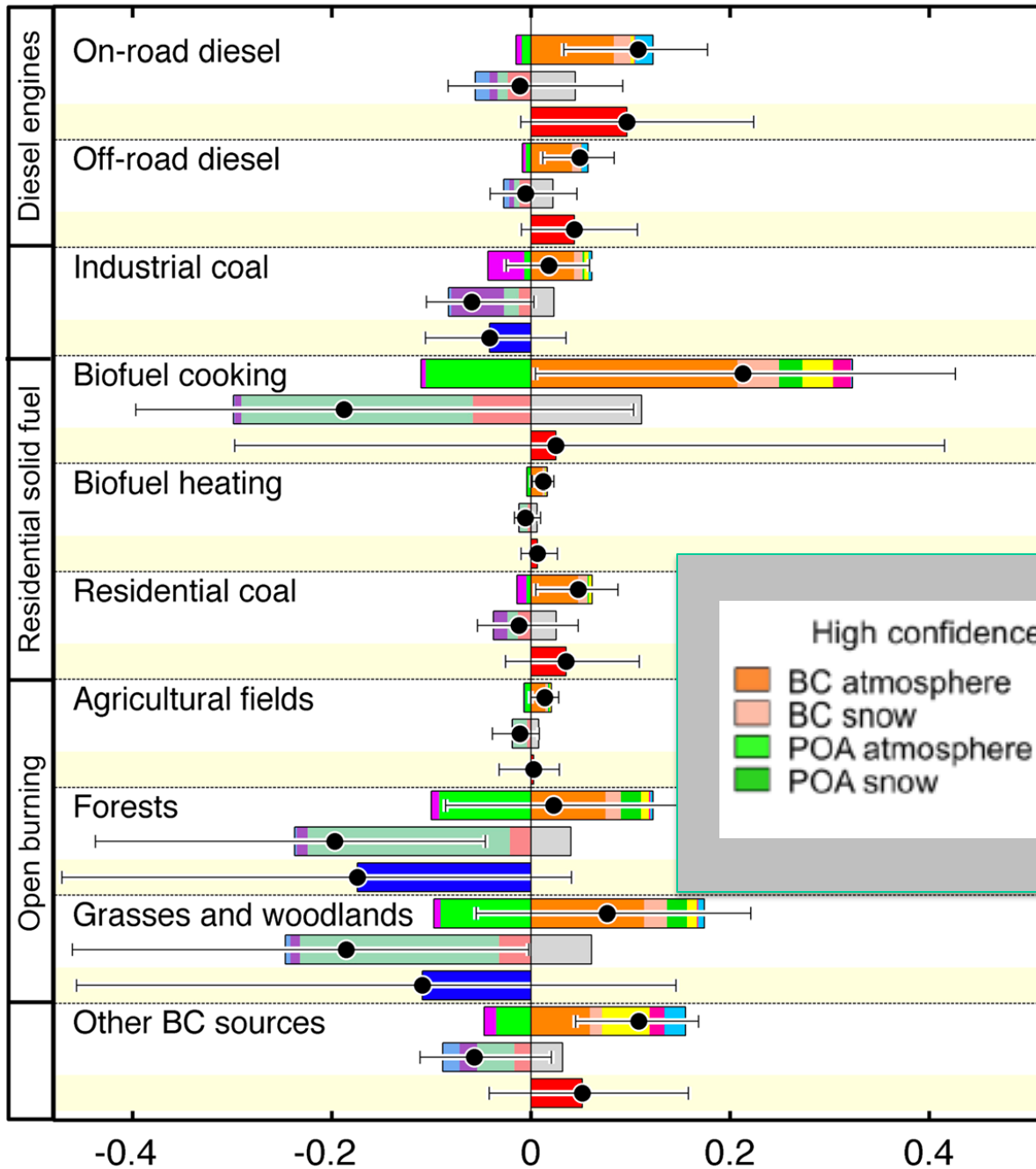


Bond et al, 2013

Climate forcing by BC-rich source categories in year 2005



Where to act
on Black Carbon?



High confidence in attribution		Low confidence in attribution
BC atmosphere	SO ₄ atmosphere	BC liq clouds
BC snow	CO on O ₃	BC other cloud
POA atmosphere	NMVOC on O ₃	POA clouds
POA snow	NO _x on O ₃	SO ₄ clouds
		NO _x on NO ₃

Bond et al, 2013

Scientific work needed to clarify BC mitigation potential

- ◆ Contribute to continued joint, international scientific assessments of BC effects; *Quantify BC climate forcing, health effects, the role of co-emitted species*
- ◆ Clarify uncertainties and misunderstandings, answer to frequently asked questions on climate and air quality benefits
- ◆ Monitor over time BC-related atmospheric parameter in the atmosphere through measurements and modelling
Measurement strategy, method harmonization, supersites development
- ◆ Provide emission-to-impact modelling
for sectors/scenarios/countries/regions



Meteorologisk
institutt

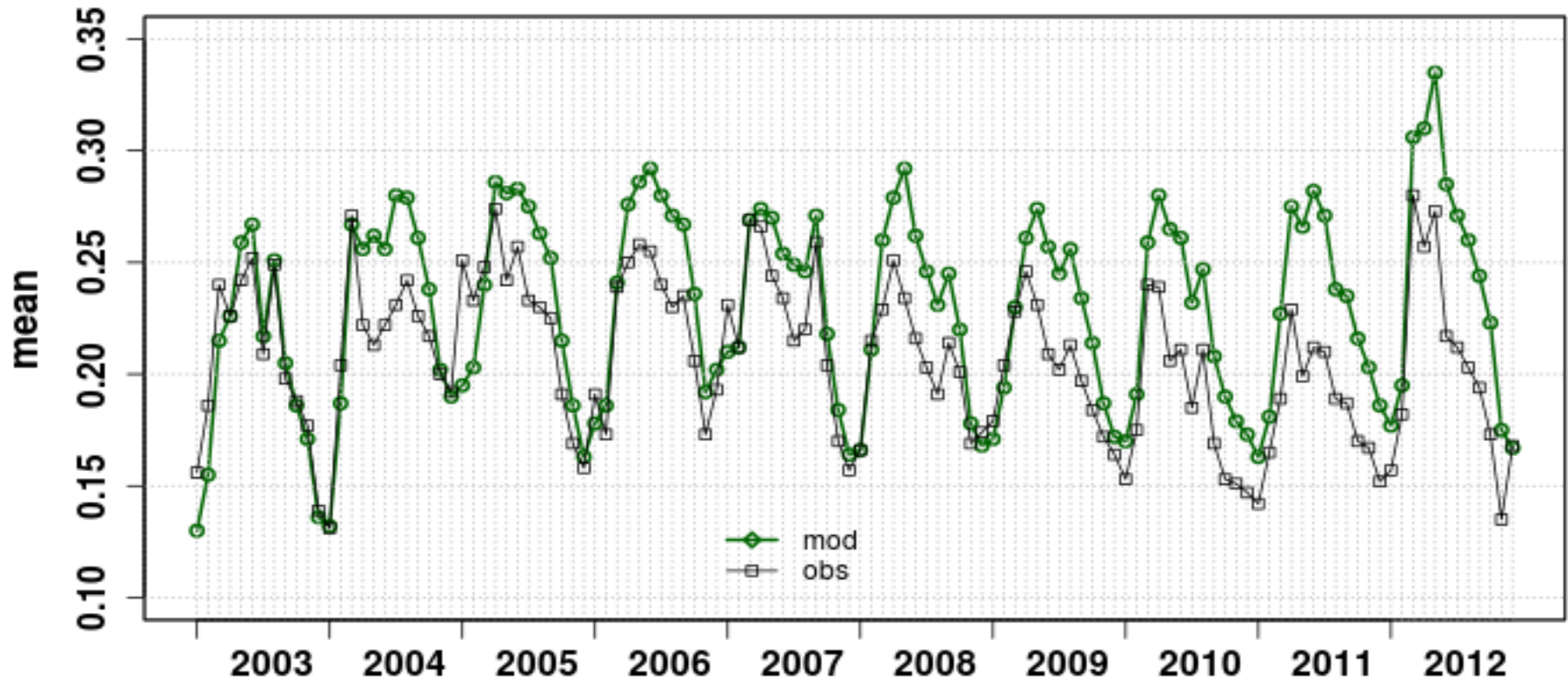


More work on aerosol trends ??

- ◆ Trends and Forcing are linked
- ◆ Multi-annual analysis allows “check in another year”
- ◆ Global Emission Patterns have changed
- ◆ Meteorological Variability influences Cycles

MACC reanalysis of aerosol trends

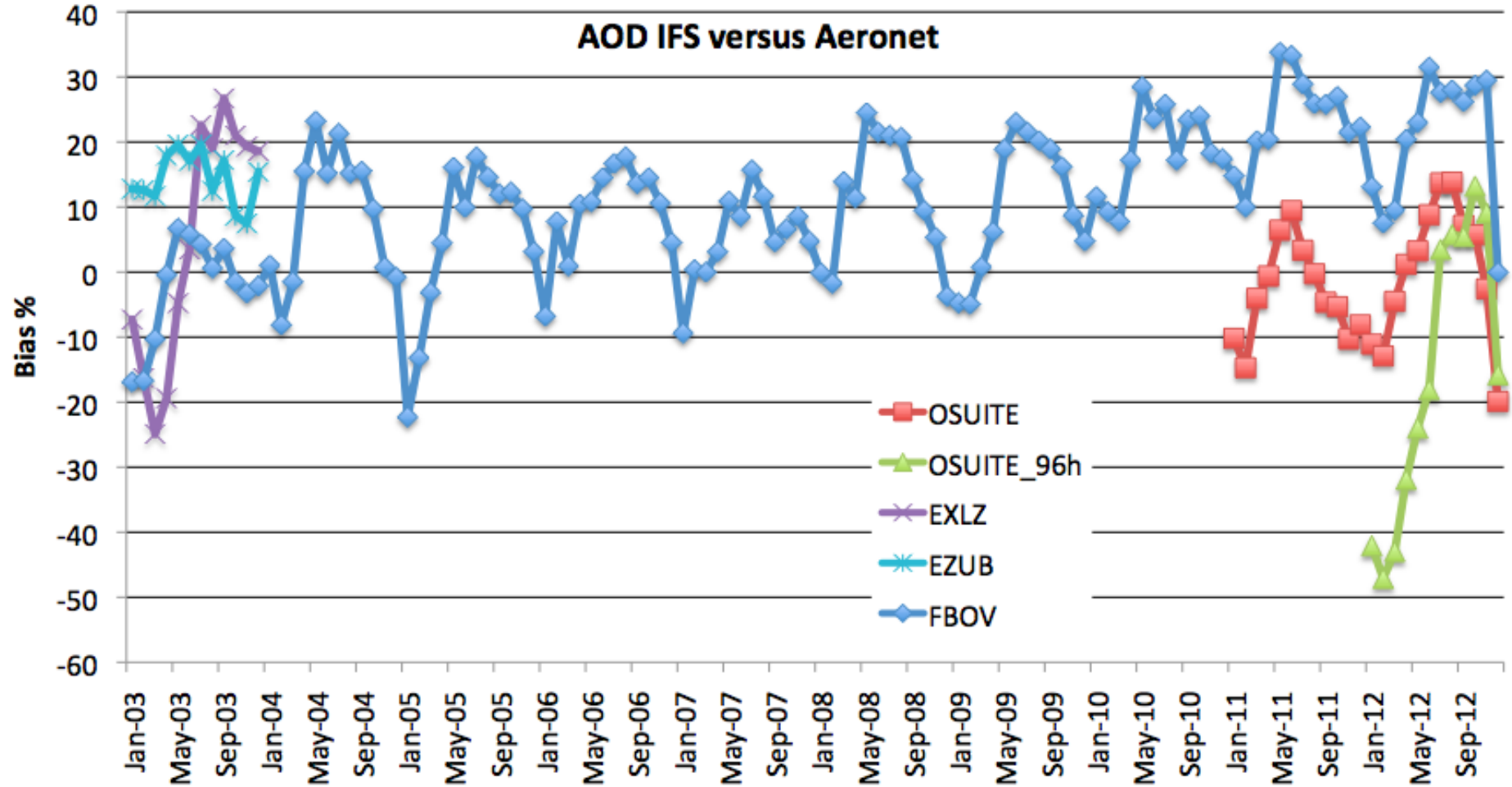
MACC reanalysis 2003-2012 against AERONETSun data AOD@550



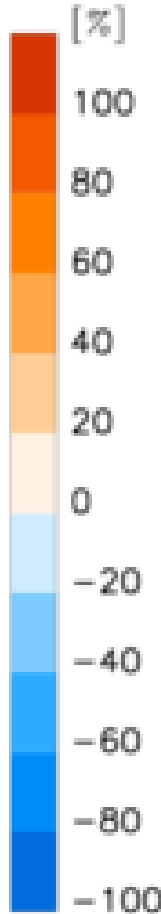
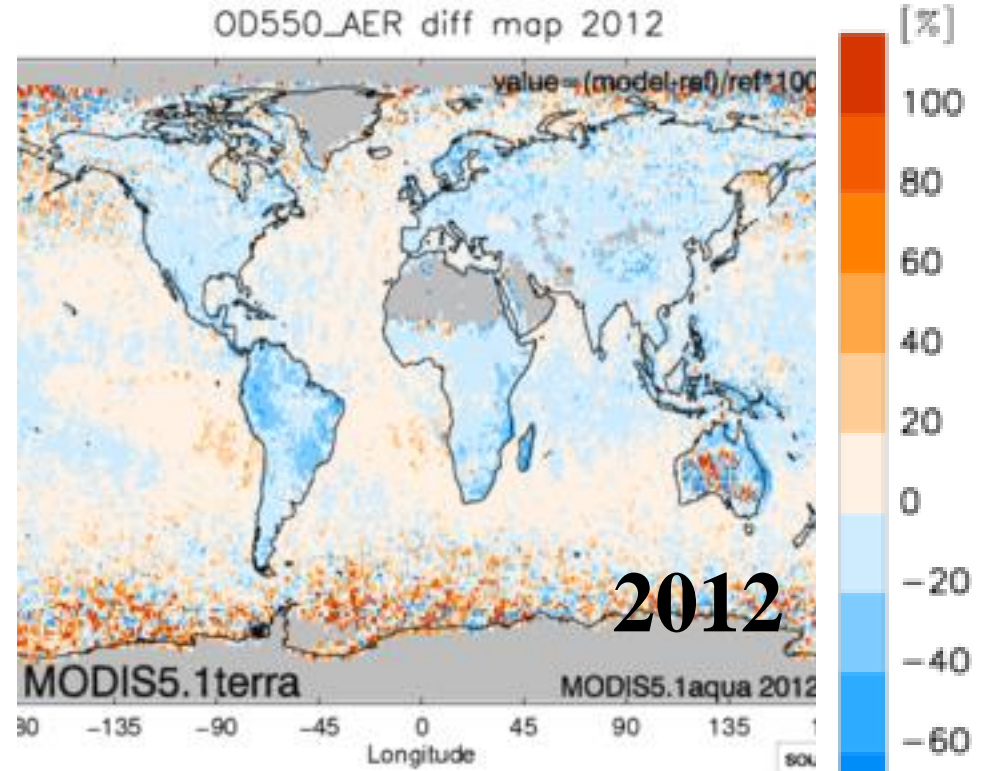
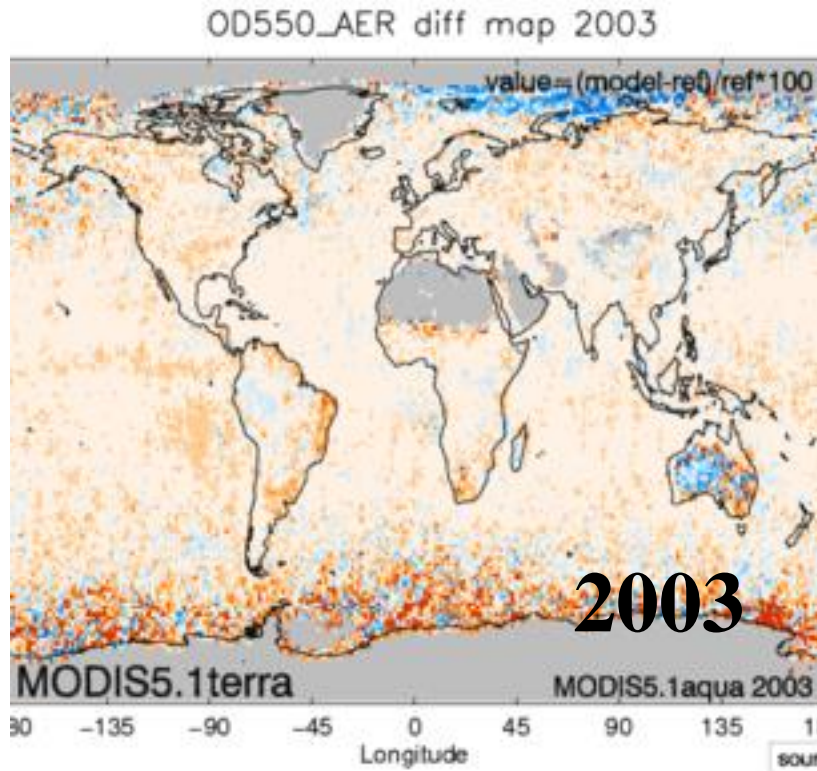
**IFS Model assimilating MODIS aqua+terra
Aeronet sun photometer ground stations**

Bias evolution of different IFS versions 2003-2012

AOD IFS versus Aeronet



Explanation of drift of bias? $(MODIS_{terra} - MODIS_{aqua}) / MODIS_{aqua}$

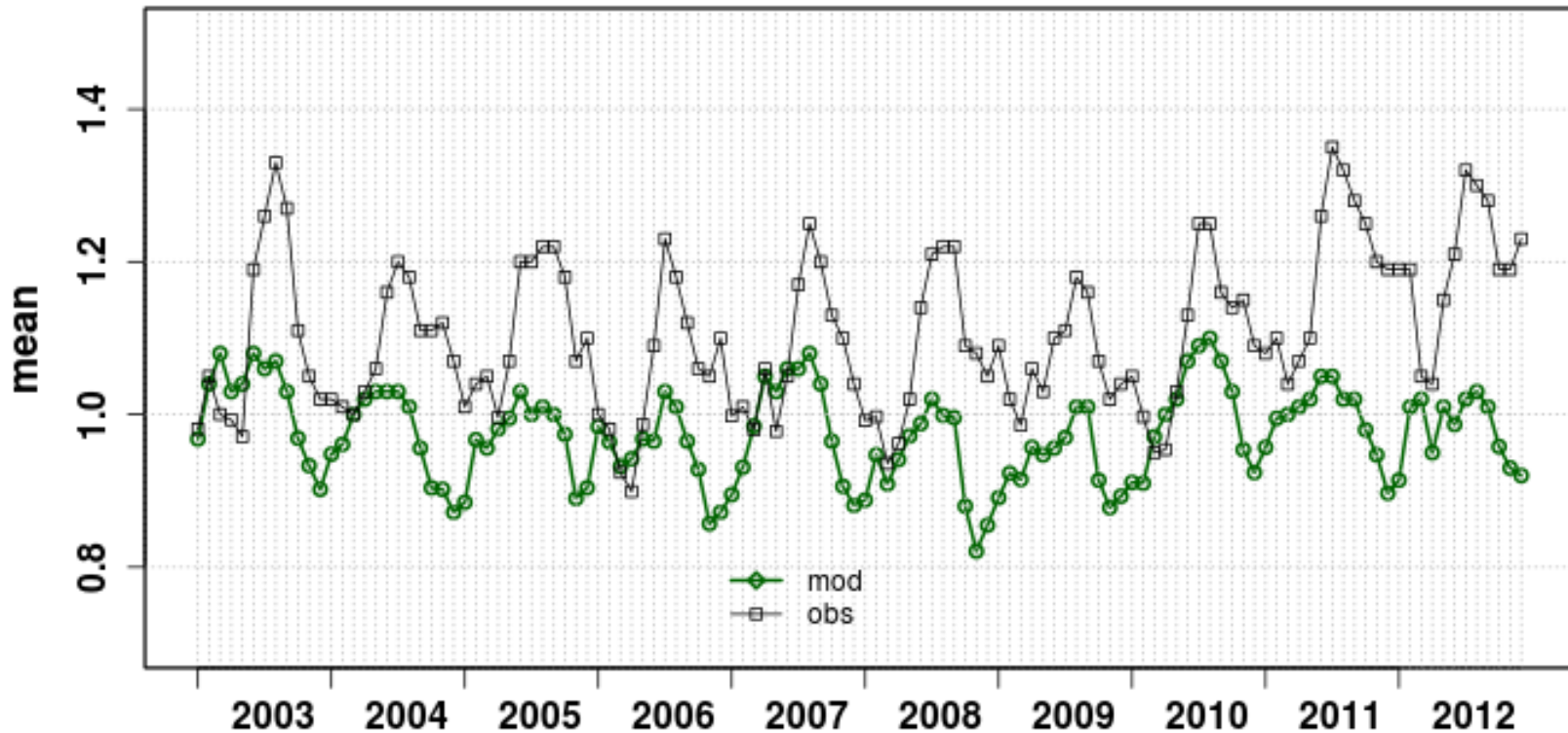




MACC reanalysis Angstroem exponent mean obs/IFS

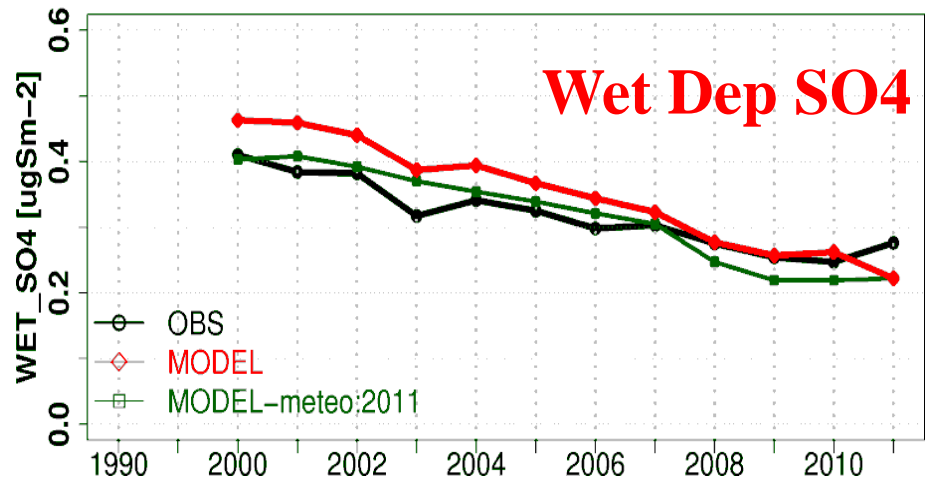
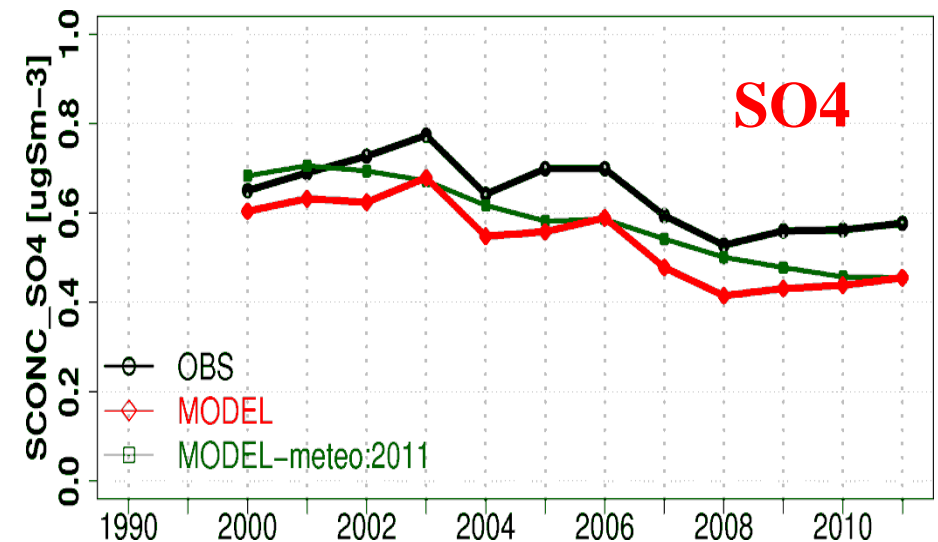
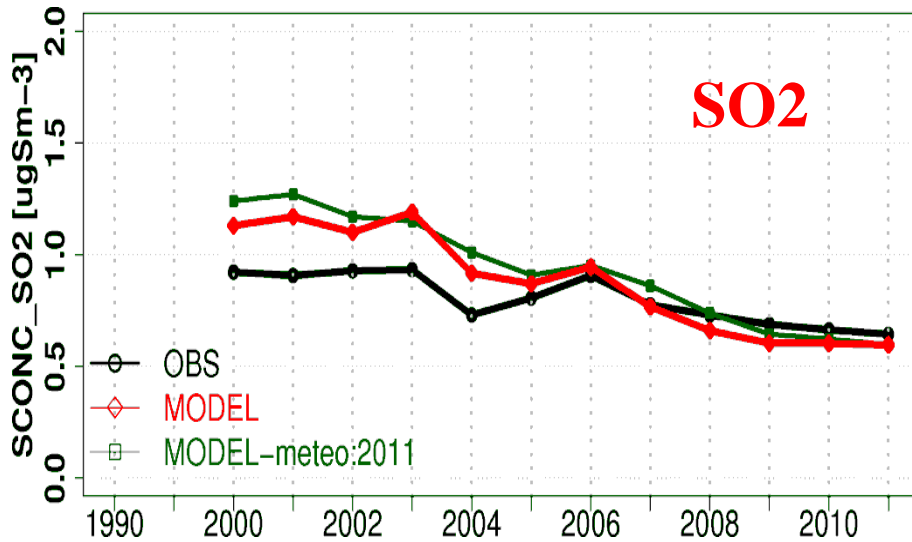


MACC reanalysis 2003-2012 against AERONETSun data ANG4487_AER

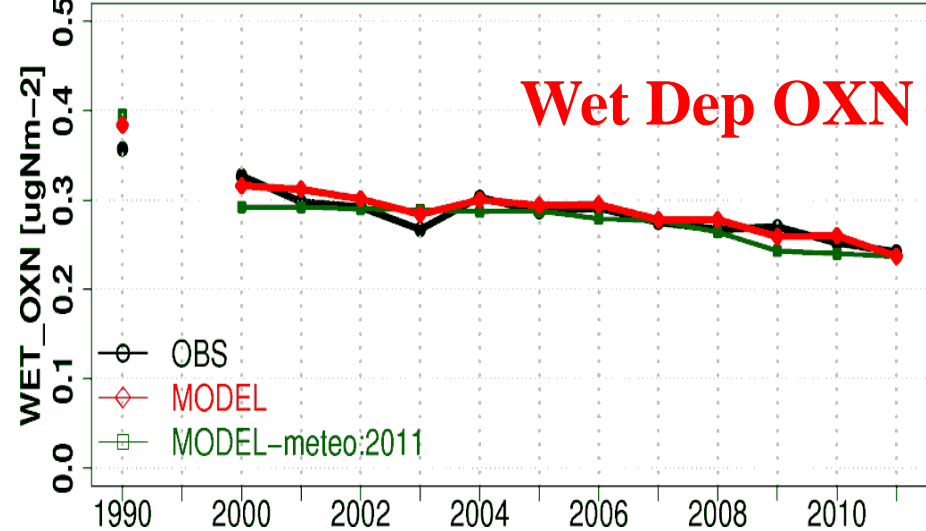
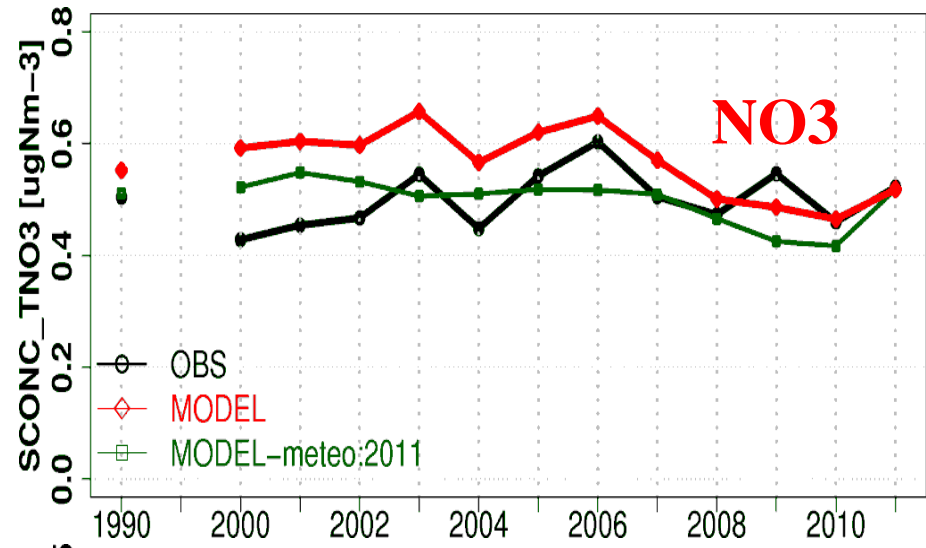
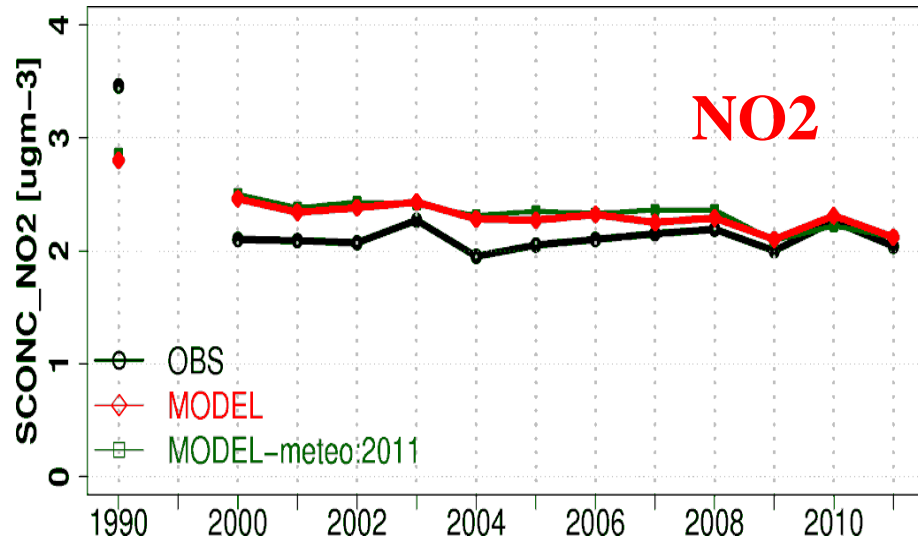


**IFS Model assimilating MODIS aqua+terra
Aeronet sun photometer ground stations**

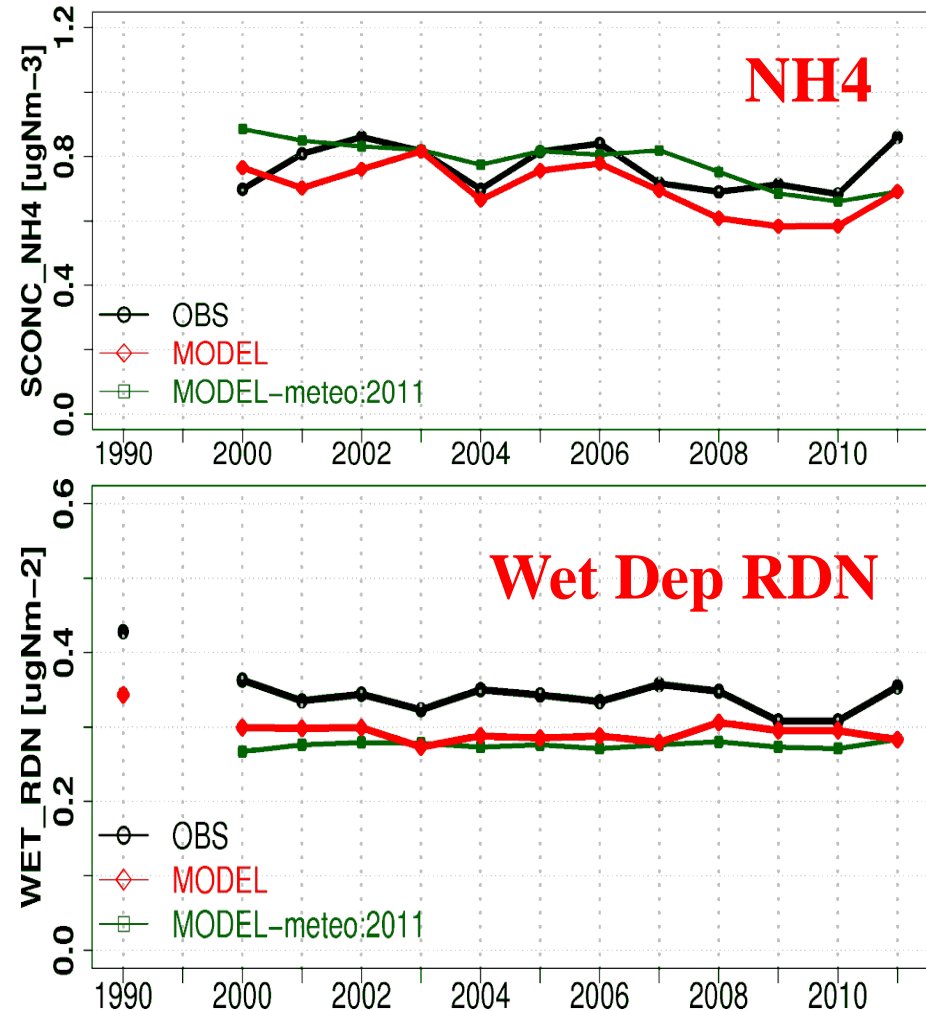
Sulphur trends in Europe EMEP model and EBAS data



Nitrogen trends in Europe EMEP model and EBAS data



Reduced Nitrogen trends in Europe EMEP model and EBAS data





Data Overview
 Phase II interface
 Database Explanations
Benchmark data
 Acknowledgement

Finalised Benchmark data

Higher Level products for the climate & air-pollution modelling community

AEROCE/SEAREX deposition data The dataset refers to the oceanic sites operated by J. Prospero and colleagues. Beginning in the early 1980s and into the late 1990s, the University of Miami Aerosol Group established and operated a global network of aerosol sampling stations. During these two decades, the UM group occupied over 50 stations for varying periods of time. During most of this period, 20 to 25 stations were constantly in concurrent operation. A few stations were in operation for much or all of the two decades.

[Link to data & Documentation](#)

Initial Black Carbon AeroCom evaluation data The data in this directory have been used for the AeroCom paper by Koch et al. 2009 and the corrigendum: Koch, D., M. Schulz, S. Kinne, et al. Evaluation of black carbon estimations in global aerosol models, Atmos. Chem. Phys., 9, 9001-9026, 2009. Both pdf files are in the directory. Please refer to the original data as cited in the paper.

[Link to data & Documentation](#)

CALIOP Aerosol Extinction Profile data The data in this directory have been used for the AeroCom paper by Koffi, B., M. Schulz, F.-M. Bréon. et al. Application of the CALIOP layer product to evaluate the vertical distribution of aerosols estimated by global models: AeroCom phase I results, J. Geophys. Res., 117, D10201, doi:10.1029/2011JD016858.

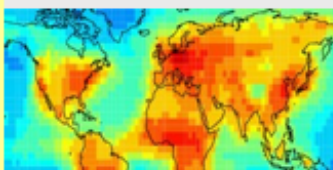
[Link to data & Documentation](#)

Dust benchmark data The data in this directory have been used for the AeroCom paper by Huneus N., M. Schulz, Y. Balkanski et al., Global dust model intercomparison in AeroCom phase I, Atmos. Chem. Phys., 11, 7781-77816, 2011.

[Link to data & Documentation](#)

Number size distribution climatology for Europe The data refer to a summarizing climatology paper by Asmi et al., Atmos. Chem. Phys., 11, 5505-5538, 2011, [\[ACP paper\]](#) of measurements made in the EUSAAR project (ACTRIS predecessor).

[Link to data & Documentation /www.atm.helsinki.fi/eusaar/](http://www.atm.helsinki.fi/eusaar/)



AEROCOM
 is an international
 science initiative
 on aerosols and climate

supported by
[EU Commission](#)
[ACTRIS](#)
[MACC-II](#)
[IS-ENES](#)
[EUCAARI](#)
[PHOENICS](#)

[Met.No](#)
[ESA-cci](#)
[Max-Planck Ges.](#)
[NASA](#)
[French CNES](#)

The preparation of this compilation was supported by the EU project.





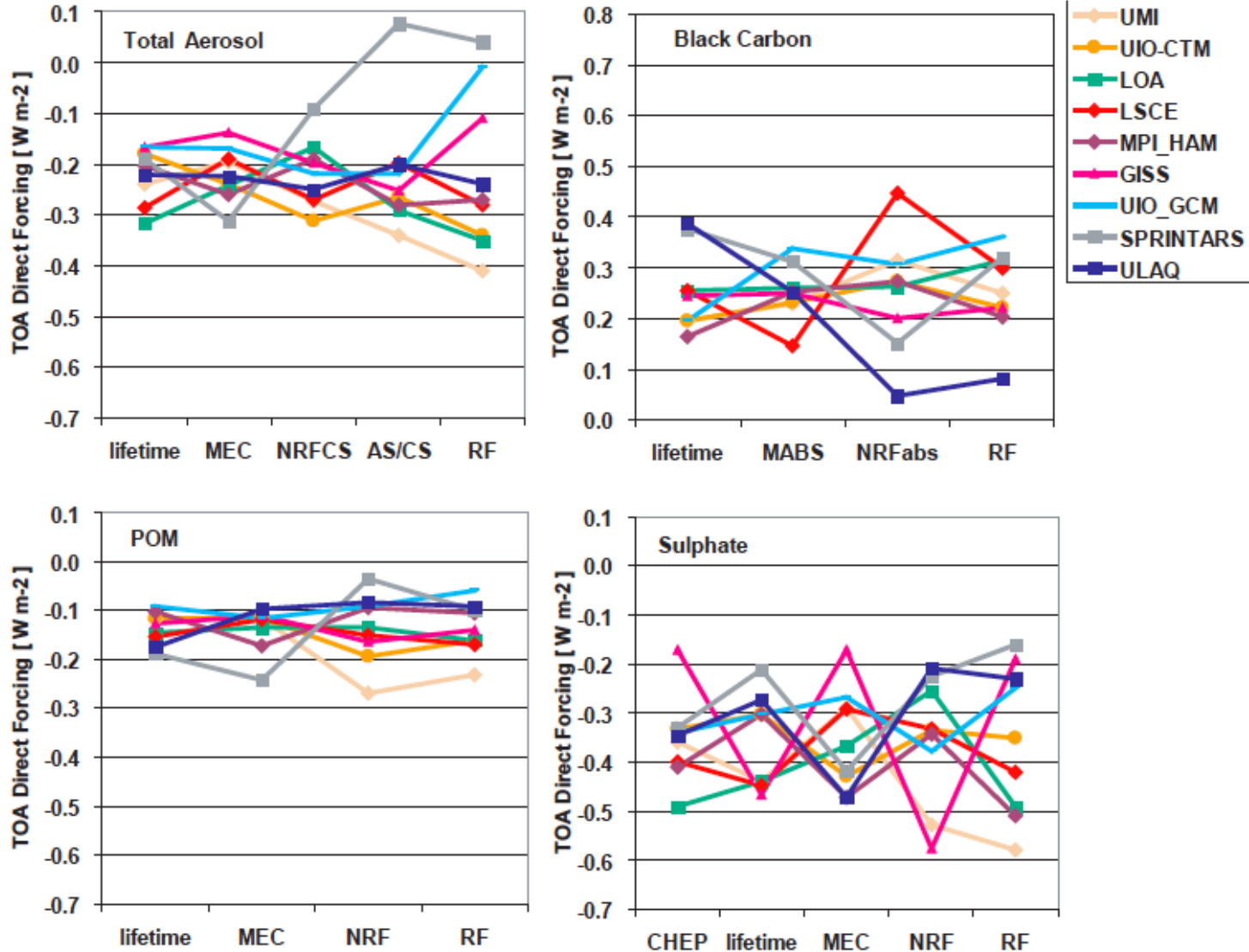
Meteorologisk
institutt

Have we constrained forcing estimates?





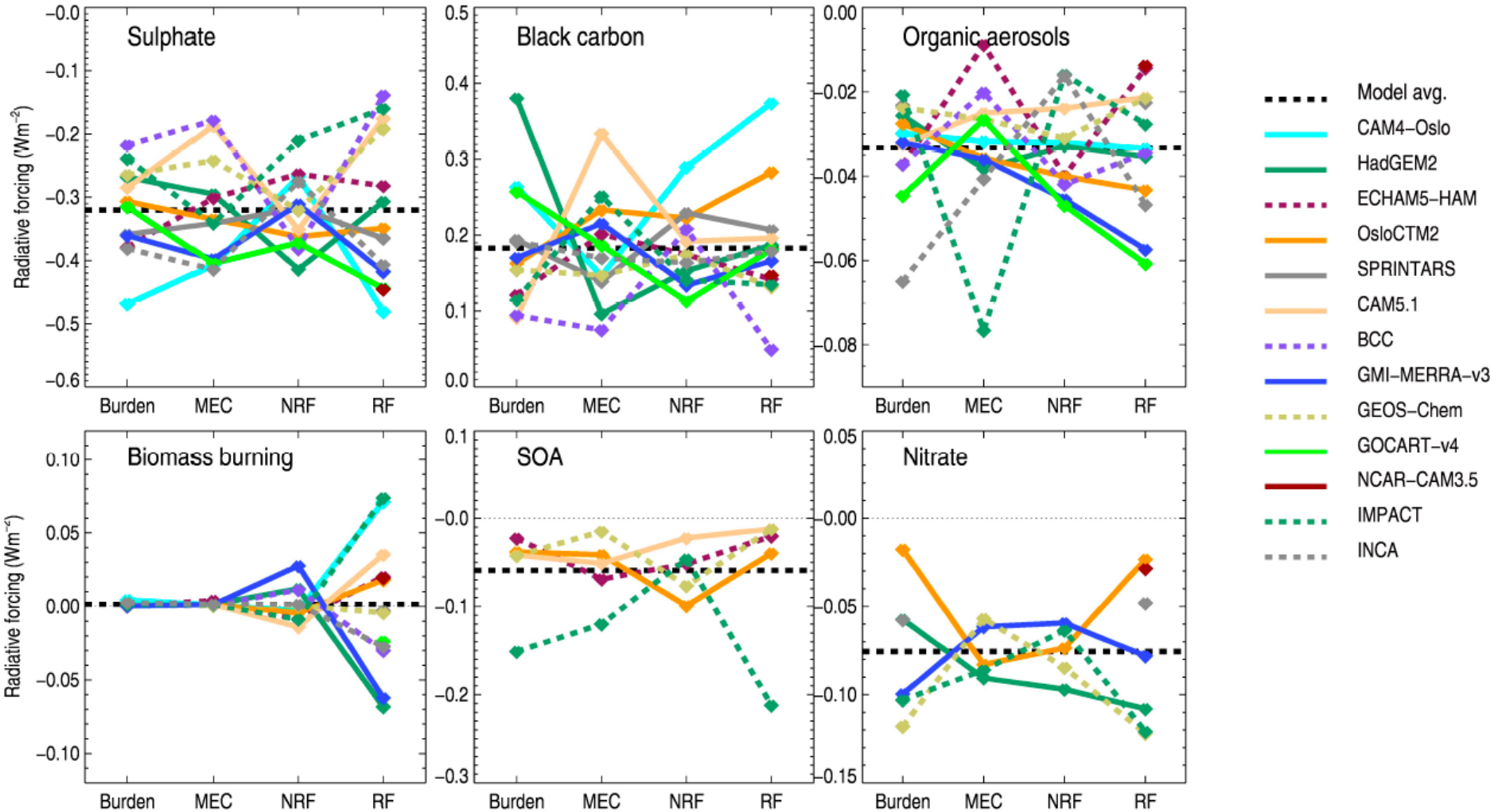
AeroCom I (Schulz et al. 2006)



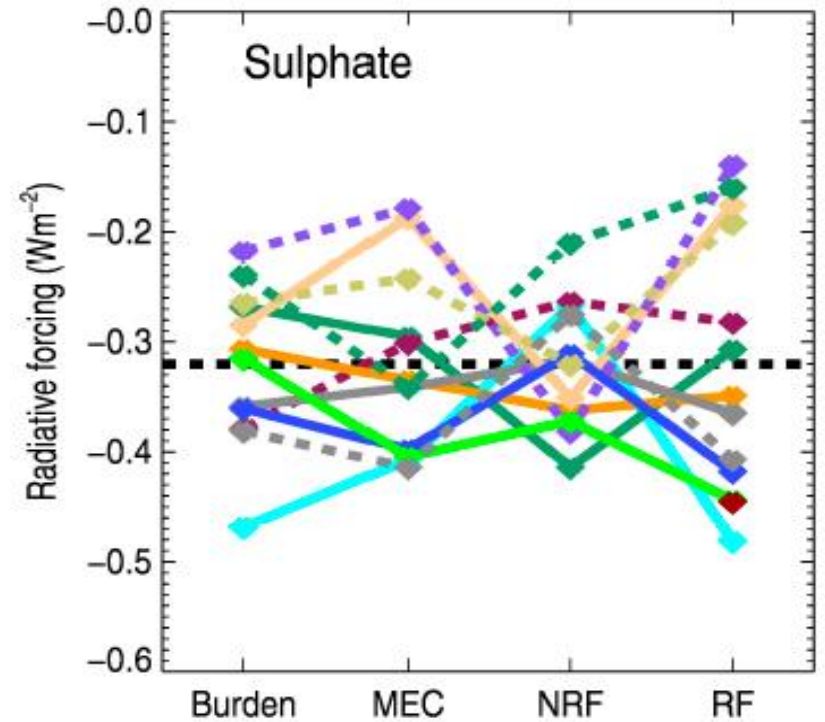
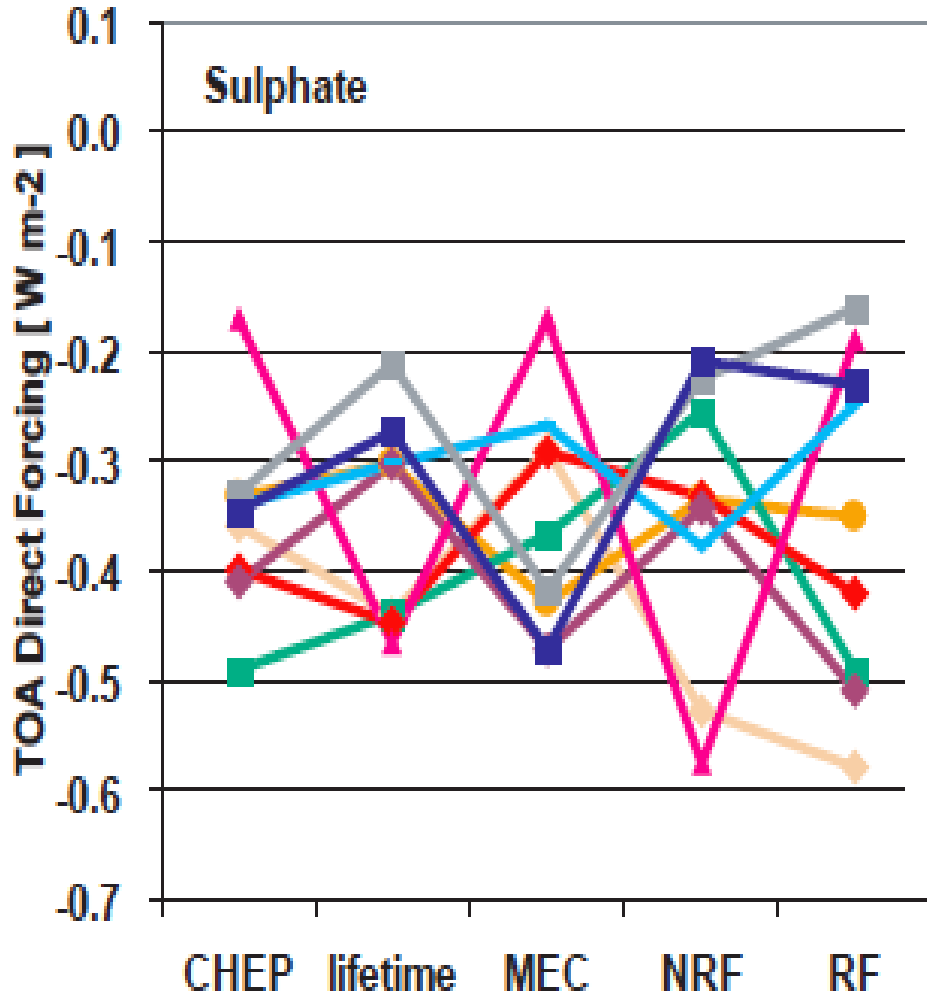


Meteorologisk

AeroCom II (Myhre et al. 2013)



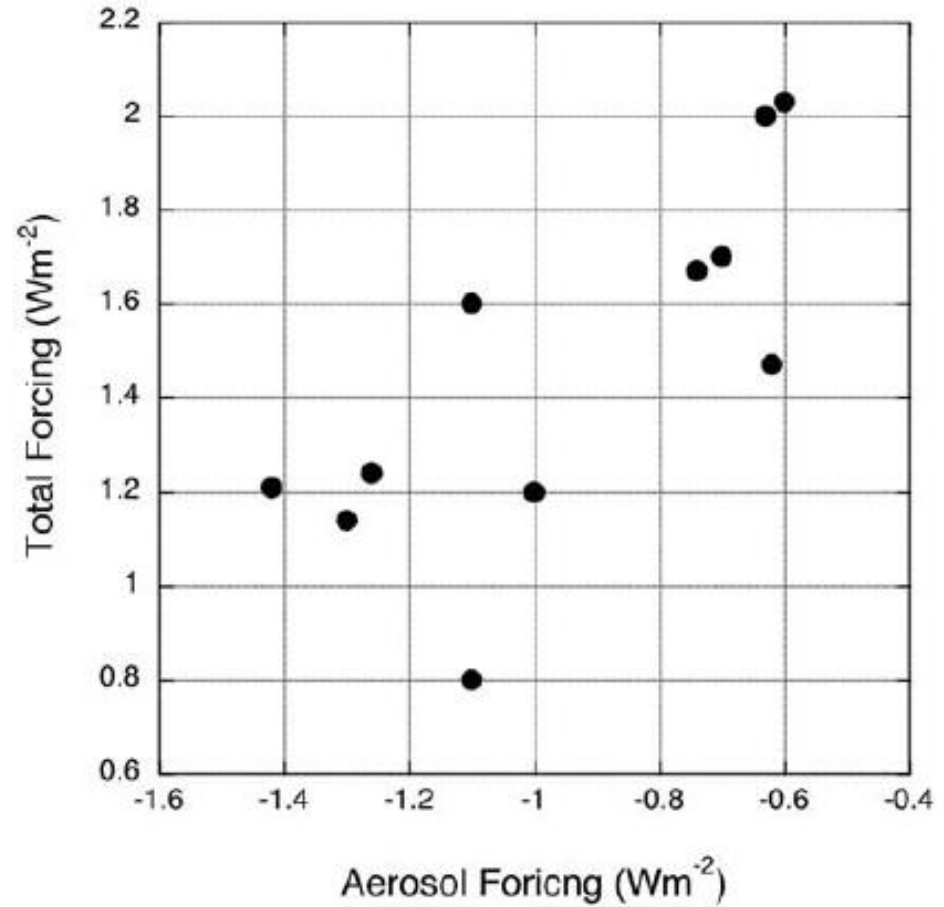
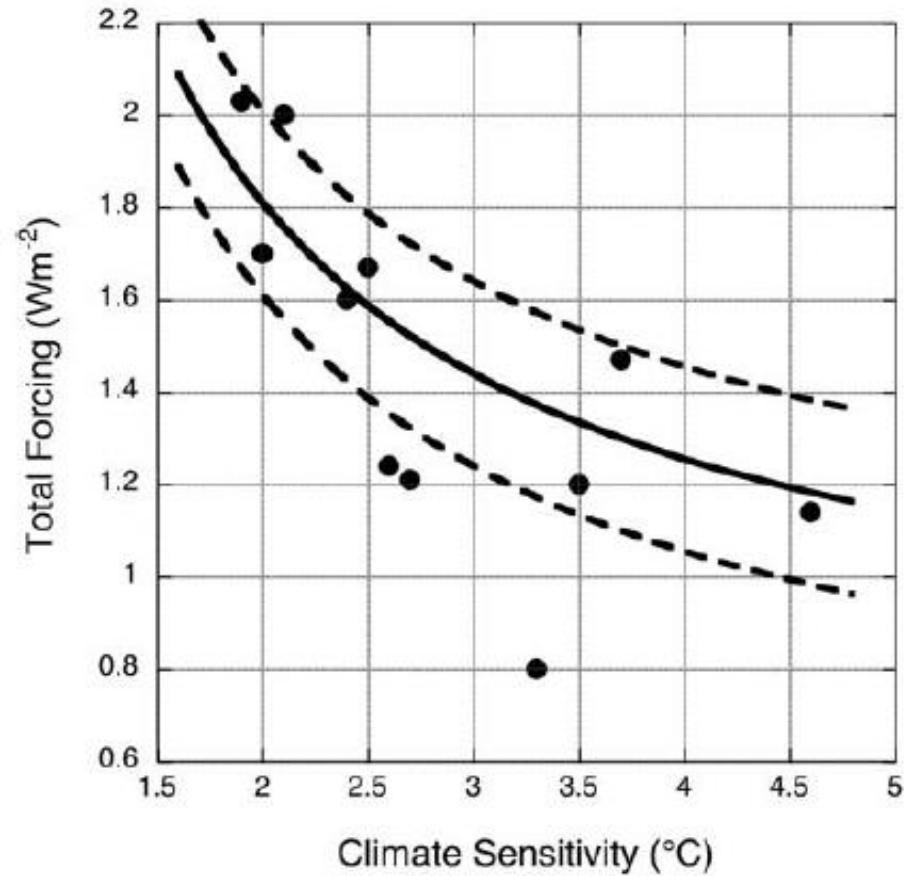
Sulphate life cycle AeroCom I and II



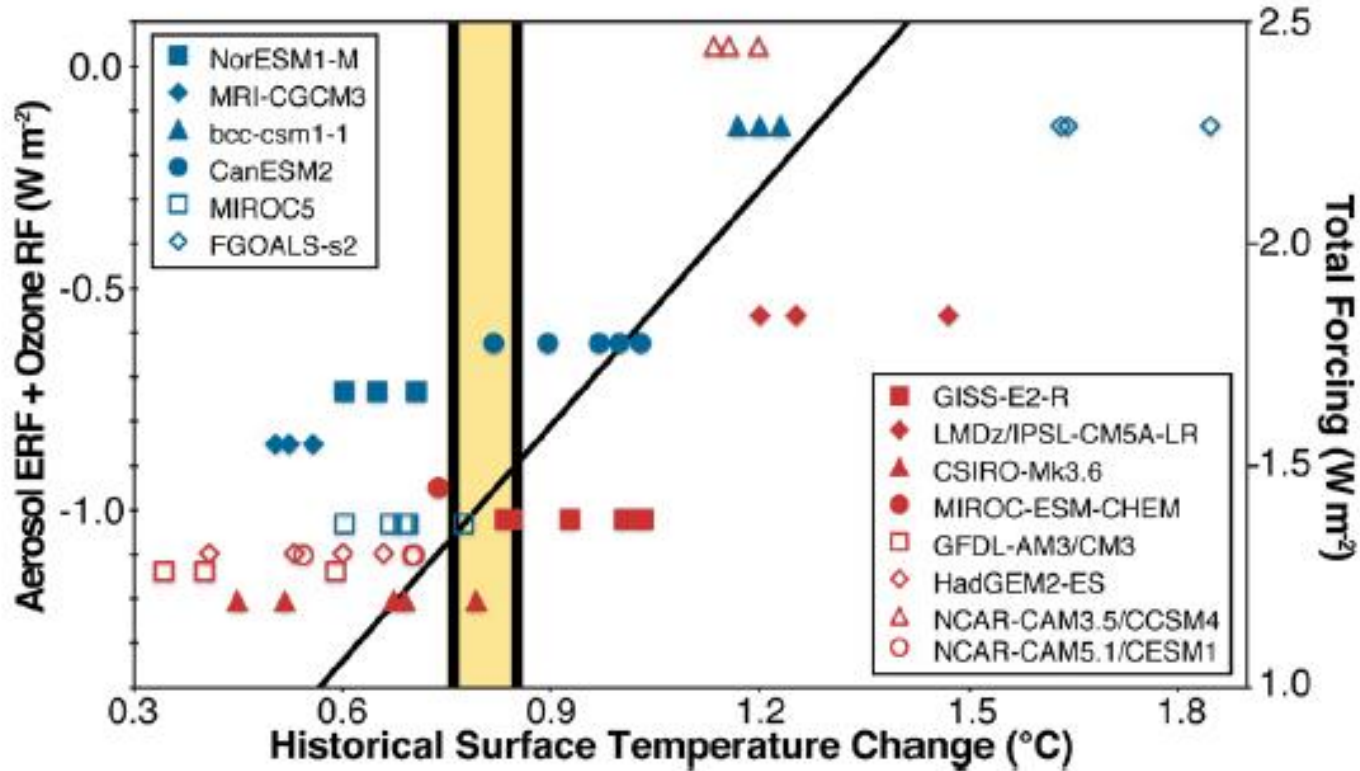
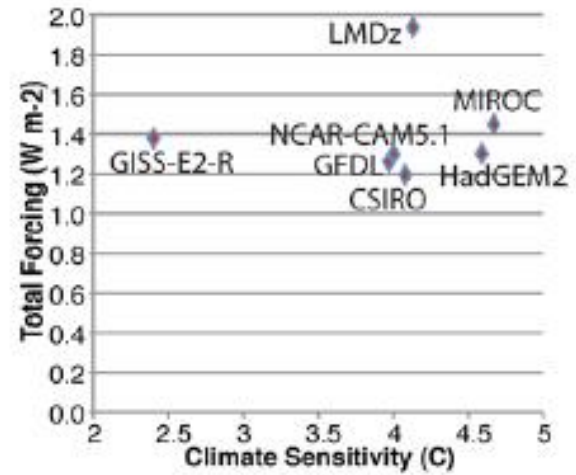
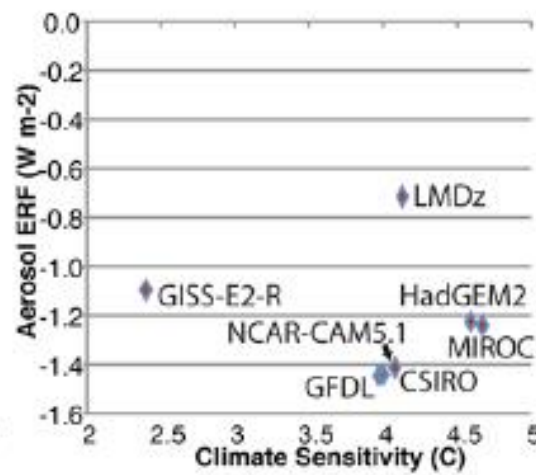
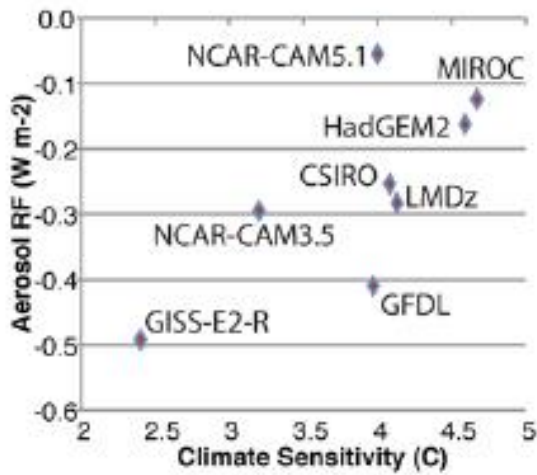


Meteorologisk
institutt

CMIP3: forcing vs sensitivity



Kiehl, GRL, 2007



Shindell et al., ACP, 2013



Lessons learned from CMIP5

- ◆ CMIP5 aerosol schemes are generally not state-of-the-art (aerosols \neq sulfate, aerosols \neq sulfate+BC)
- ◆ Less than half of CMIP5 models diagnosed aerosol forcings (ERF, only present-day)
- ◆ All CMIP5 models and simulations use the same historical aerosol emissions, hence have the same time profiles for aerosol variations => D&A, reconstructions
- ◆ Not much spread in short-lived climate forcers in RCP scenarios => issue for decadal prediction



Meteorologisk
institutt

Science questions for CMIP6



AeroCom

- ◆ What aerosol physics/chemistry is needed?
- ◆ ERF aerosol-radiation interactions (especially BC)
- ◆ ERF aerosol-cloud interactions
- ◆ Are aerosol biogeochemical feedbacks really small?
- ◆ D&A of climate response to aerosols, especially at the regional scale
- ◆ Bound uncertainties in future climate change that is due to aerosols (scenarios+RF+response)

Acknowledgment II

- ◆ AERONET, surface site operators, satellite teams
- ◆ LSCE/Paris + MetNo/Oslo + MPIM/Hamburg + NASA Goddard
- ◆ EU projects for support
PHOENICS / EUCAARI / GEOMON / ISENES / MACC I & II /
ECLIPSE / ACTRIS
- ◆ CNES, NASA, Norsk Romsenter, ESA (cci-aerosol)
- ◆ New project will be funded by Norwegian Research Council from 1.10.2013 (6.5Mio NOK)

***Support by the Norwegian Research Council
(MetNo, CICERO, NILU)***

- ◆ AEROCOM P3 project funded 1.10.2013 -> three years
- ◆ Mitigation of atmospheric particles and black carbon:
Problem or potential for future climate evolution ?
- ◆ Tasks (I):

Management of international AeroCom initiative / Outreach

Complement the observational database with size distribution and CCN data

Assemble new processed satellite data into AeroCom database

Establish a multi-model reference of a completed set of aerosol parameters

Aerosol lifetime analysis using radioactive tracers of opportunity

Assessments of regional distribution and trends in inorganic aerosols

Regional trend evaluation based on optical aerosol parameters

◆ Tasks (II):

Upper troposphere lifetime of BC and aerosol extinction

BC absorption evaluation integrating multiple measurement principles

Multi-model evaluation of particle size distribution and CCN concentration

Humidity growth model evaluation and verification at golden super sites

Impact of humidity growth vertical profile on forcing
Aerosol radiative forcing
in cloudy skies

Elaboration of a strategy to improve indirect forcing estimates

New best estimate of aerosol forcing

Assess approaches for including aerosol regulation in mitigation strategies



Meteorologisk
institutt

2nd AeroCom workshop Ispra March 2004

AeroCom



THANKS