WHY

Aerosol **introduces one of the largest uncertainties in climate assessments *and climate* predictions. The complex nature of aerosol properties and interactions with chemistry and the hydrological cycle render measurement based approaches usually as too inaccurate. Thus, our understanding on the role of aerosol is largely based on simulations with global models and uncertainty is usually derived by comparing final (forcing) predictions, without bothering too much with the details (e.g. assumptions, included processes and feedbacks). Initial comparisons of aerosol modules (in global models) at more detail, reveal significant differences at intermediate processing steps. This suggests that actual uncertainties in aerosol modeling are much larger than currently thought. An international aerosol community effort called *AEROCOM* seeks to diagnose modeling with available quality data for more confidence in simulated assessments.**

AEROCOM

diagnostics of component aerosol modules in global modeling

Stefan Kinne (1), **Michael Schulz** (2) and the **AEROCOM** modeling and data **communities**

(1) MPI for Meteorology, Hamburg, Germany

(2) LSCE, Saclay (near Paris), France

model-name	location	authors
LOA	Lille, Fra	Reddy / Boucher
LSCE	Saclay, Fra	Schulz / Balkanski
ULAQ	L'Aquila, Ita	Pitari / Montenaro
SPRINTARS	Kyushu, Jan	Takemura
ARQM	Toronto, Can	Gong
MIRAGE	Richland, WA	Ghan / Easter
ECHAM5-hh	Hamburg, Ger	Stier / Feichter
ECHAM4	Dalhousie, Can	Lohmann / Lesins
NCAR-Match	Boulder, CO	Fillmore / Collins
NCAR-Mozart	Boulder, CO	Tie / Brasseur
OSLO CTM	Oslo, Nor	Myhre / Isaksen
OSLO GCM	Oslo, Nor	Iversen et al.
IMPACT	Ann Arbor, MI	Liu / Penner
GRANTOUR	Ann Arbor, MI	Herzog / Penner
GOCART	Greenbelt, MD	Chin / Diehl
GISS	New York, NY	Koch / Bauer
ECHAM5-dlr	Oberpfaff., Ger	Lauer / Hendricks
TM5	Uetrecht, Ned	Krol / Dentener
GFDL	Princeton, NJ	Ginoux / Horrowitz

about AeroCom

PROJECT

- *initiated by state-of-the art aerosol modelling groups*
- *open to any aerosol (-component) modelling groups*
- *foster contacts to data groups in regular meetings*

GOALS

- *seeks to document differences of aerosol modules*
- *assemble useful data-sets for the model evaluation*
- *identify and assist in removal of model weaknesses*
- *reduce uncertainties of aerosol impact on climate*

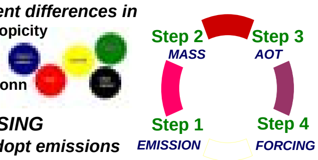
ACTIVITIES

- *data protocols (requests for detailed model output)*
- *web-based evaluation* [http://nansen.ispl.jussieu.fr/AEROCOM]
- *organization of scientific meetings*
- *prescribed model input for sensitivity studies*

about component modeling

DISTINGUISH

- *aerosol properties vary (not only in amount)*
- *treatment by component (SU, OC, BC, DU, SS) to represent differences in*
  - hygroscopicity
  - size
  - shape
  - absorptionn

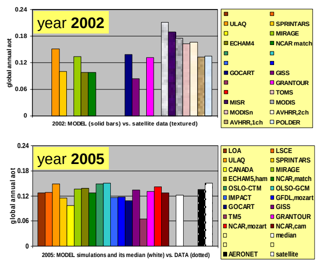


PROCESSING

- *Srep1: adopt emissions*
- *Step2: process to yield dry mass*
- *Step3: convert mass to aerosol opt.depth (aot)*
- *Step4: calcul. impacts on rad. energy balance*
  - direct effect (from the aerosol presence)
  - indirect effects (from aerosol modified atm. prop.)

current status

aot - global annual mean



within recent years:

- *more component models appear*
- *better agreement among models*
- *fair agreement to 'data-sets'*

Are we making progress?

not really …

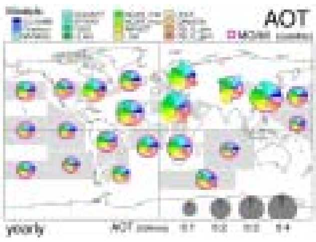
… and here are the problems:

- ***annual global averages hide spatial differences***
  see 'aot regional differences' and 'uncertainy maps'
- ***component integrated data hide comp. mix differences***
  uncertainty maps to the far right show that model-differences for component combined totals [1.column] deviate much less than for individual components (in particular for dust)

in reality there are large model differences!

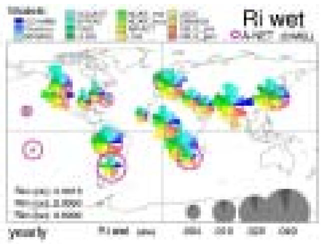
- ***aot agreement does not mean agreement for forcing***
  aerosol (direct) forcing depends (aside from external factors as avialble sun-light, surface albedo or clouds) not only on aerosol optical depth (aot) but also aerosol absorption. Model differences for absorption generally exceed those for aot!
- ***model 'validation' at Step3 (aot) is not sufficient***
  efforts are necessary to assure validations at Step2 and in particular to understand how emissions are translated into global mass-fields (Step1 to Step2 transition) – on a component basis!

aot – regional comparisons



large aot difference among models and to the satellite best *(MODIS/MISR)* ***on a regional basis***

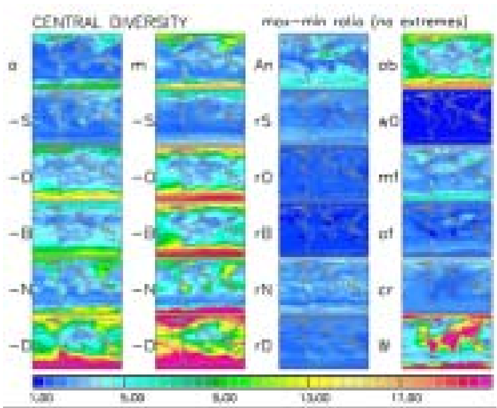
absorption – local comp.



refractive index imaginary parts as a measure of absorption were calculated based on the aerosol compositional mix and aerosol water of ECHAM5
assumed Rim for non-abs. components du, oc,bc are given

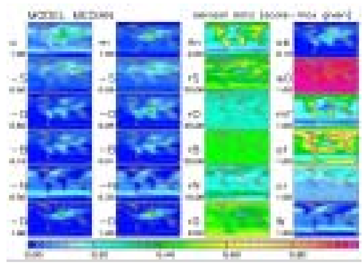
large absorption strength differences among models and to retrievals at selected AERONET sites

central diversity (83%PDF / 17%PDF of in modeling)



a	aot (total)	-S	sulfate	ab	absorption aot
m	dry mass [g/m2]	-O	org. carbon	w0	ss-albedo
r	mee (=a/m)	-B	black carbon	cr	bc/oc ratio
An	Angstrom value	-N	seasalt	-f	accumulation
W	aerosol water mass	-D	dust		mode fraction

KEY

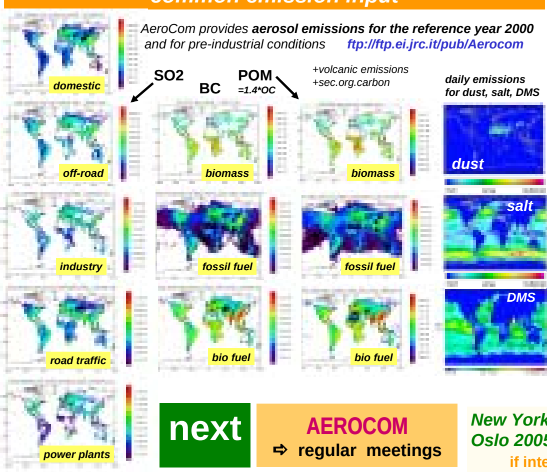


for reference

values of the model median

what is next

common emission input

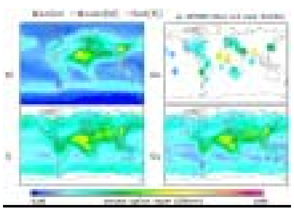


AeroCom provides ***aerosol emissions*** *for the reference year 2000 and for pre-industrial conditions* *ftp://ftp.ei.jrc.it/pub/Aerocom*

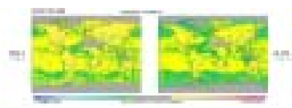
+volcanic emissions
+sec.org.carbon

daily emissions for dust, salt, DMS

evaluations to data

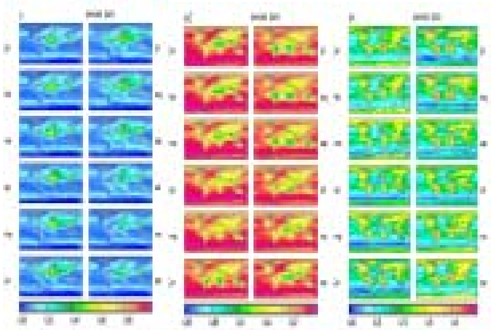


aot comparisons: median model and satellite versus AERONET and best satellite data



processing: do models reproduce observed correlations between aerosol and cloud data?

aerosol climatology – by the median model



aot (550nm)	ss-albedo (550nm)	Angstrom (550/870nm)
amount	composition	size

next

AEROCOM
⇨ **regular meetings**

New York 2004 focus on uncertainties as they relate to forcing. **provide forcing per mass for IPCC**

Oslo 2005 focus on aerosol processing (e.g. aerosol water) and modeling of the **aerosol indirect effect**

if interested in more detail please contact S.Kinne [kinne@dkrz.de] or M.Schulz [Michael.Schulz@cea.fr]