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

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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 /Feichter*
NCAR-Match	Boulder, CO	*Fillmore / Collins*
NCAR-Mozart	Boulder, CO	*Tie / Brasseur*
OSLO CTM	Oslo, Nor	*Myhre /Isaksen*
OSLO GCM	Oslo, Nor	*Seland /Iversen*
IMPACT	Ann Arbor, MI	*Liu/ Penner*
GRANTOUR	Ann Arbor, MI	*Herzog / Penner*
GOCART	Greenbelt, MD	*Chin / Ginoux*
GISS	New York, NY	*Koch / Tegen*
ECHAM5-dlr	Oberpfaff., Ger	*Lauer / Sausen*
TM5	Uetrecht, Ned	*Krool / Dentener*
GFDL	Princeton, NJ	*Ginoux I Reddy*

about AeroCom

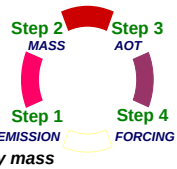
PROJECT
- *initiated by state-of-the art aerosol modelling groups*
- *open to any aerosol (-component) modelling groups*
- *foster contacts to data groups in regular meetings*

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

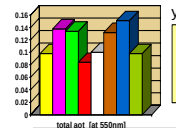
DISTINGUISH
- *aerosol properties vary (not only in amount)*
- *treatment by component (SU, OC, BC, DU, SS) to represent differences in*
  - hygroscopicity
  - size
  - shape
  - absorptionn



PROCEESSING
- *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

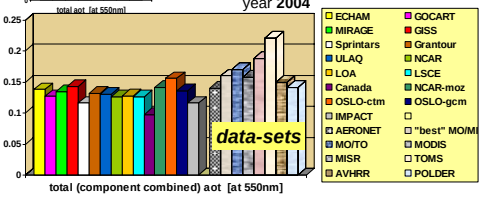
aot - global annual mean



year **2003** *within a year:*
- *more component models appear*
- *better agreement among models*
- *fair agreement to 'data-sets'*

Are we making progress?

year **2004**



not really …

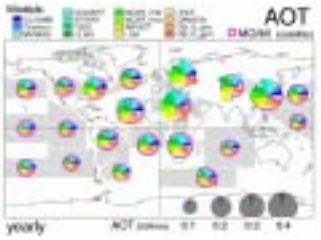
… and here are the problems:

- ***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!

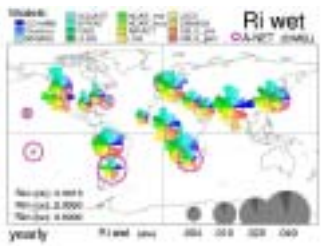
- ***aot agreement does not mean agreement for forcing***
  aerosol (direct) forcing depends (aside from external factors as avialble sun-light, surface albedo or clouds) not only on aerosol optical depth (aot) but also aerosol absorption. Model differences for absorption generally exceed those for aot!
- ***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 satellites best ***(MODIS/MISR)*** ***on a regional basis***

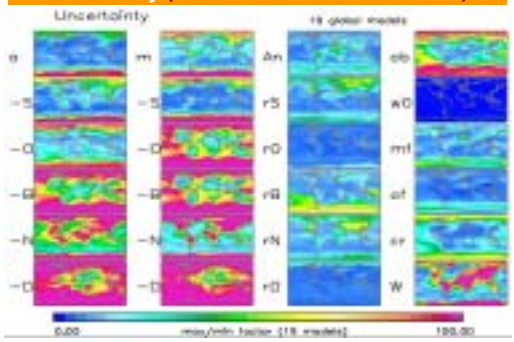
absorption – local comp.



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

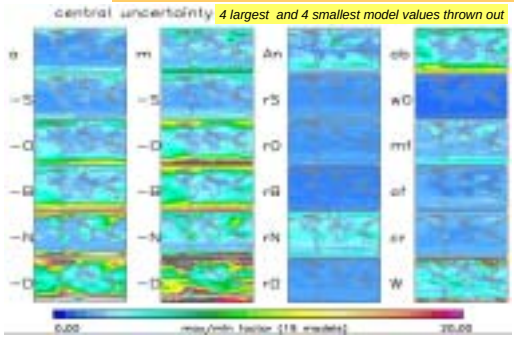
large absorption strength differences among models and to retrievals at selected ***AERONET*** ***sites***

uncertainty *(max.model value / min model value)*



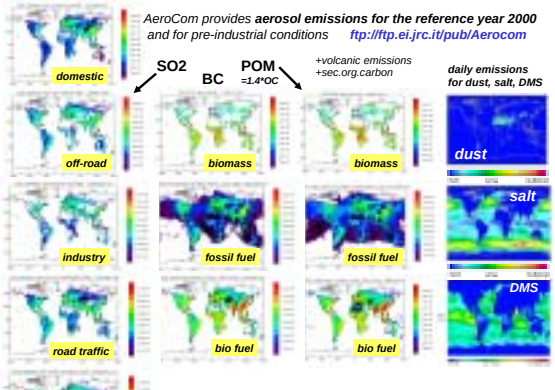
KEY

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 mode fraction*
W	*aerosol water mass*	*-D*	*dust*		

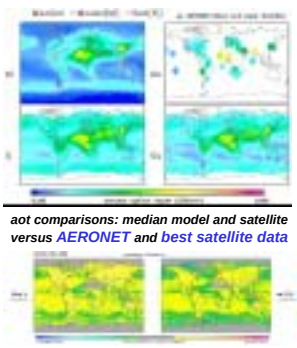


what is next

common emission input



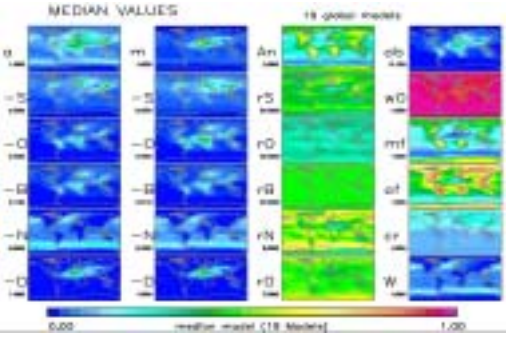
evaluations to data



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 – the median model?



- use the same key as for the uncertainties (above)
- below the labels any value other than 1.0 replaces the maximum value of the linear scale (at the bottom of the figure)

next

AEROCOM
⇨ upcoming events

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

Jun 2005 Oslo focus on aerosol processing and modeling of the **aerosol indirect effect**

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