

the **AeroCom** project

an international collaboration

*diagnostics of aerosol modules
in global models*

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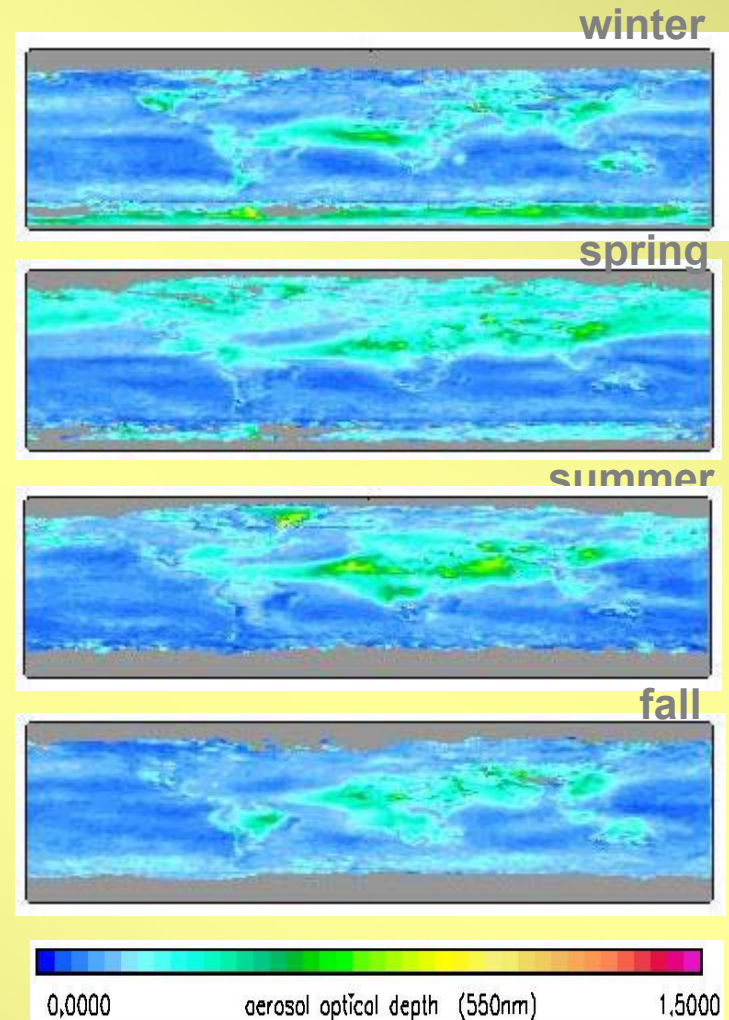
Outline

- **aerosol in global modeling**
- **AeroCom - Goals**
- **AeroCom - Participation**
- **AeroCom - First Results**
- **AeroCom - Activities**
- **AeroCom - Web-Support**

Aerosol – Climate - Modeling

- the Earth's **climate is a global issue**
- 'global' aerosol is **complex** (*variable by region, season, year*)
 - concentration (aot \Rightarrow)
 - absorption
 - size

MODIS/ MISR 2001 composite \Rightarrow
for seasonal aerosol optical depth



anthropogenic climatic impacts

- our understanding is based on **Models**
- aerosol introduces one of the largest uncertainties \Rightarrow
- ‘low understanding’ reflects deficiencies in modeling: let us look a closer look at aerosol modules in global models

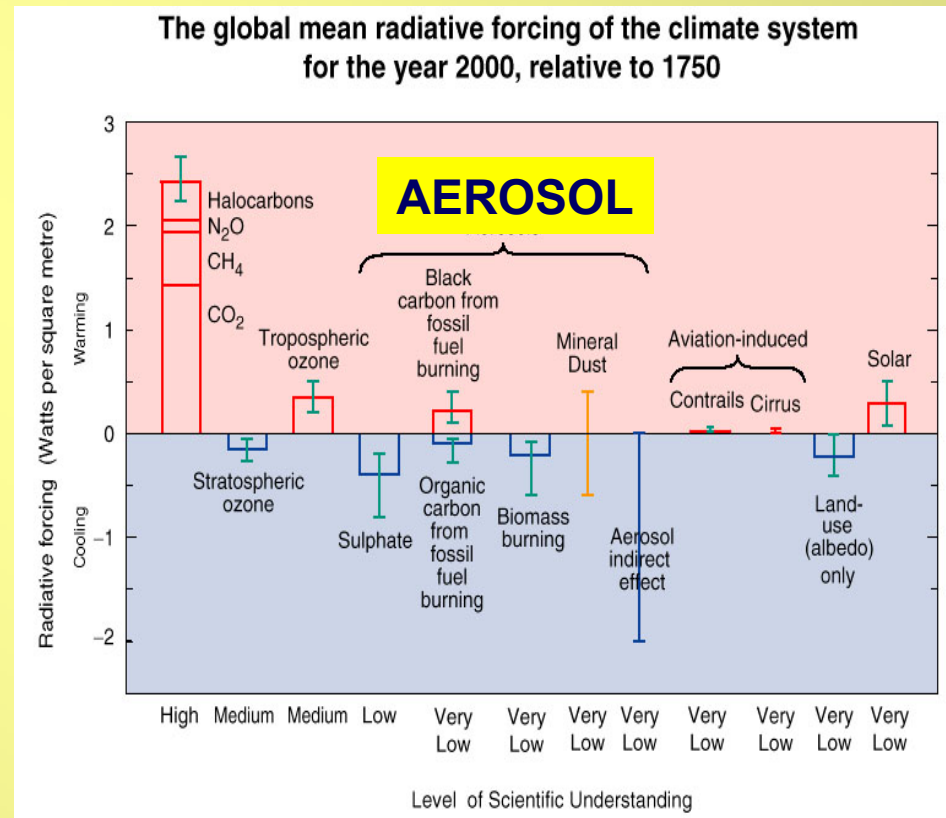
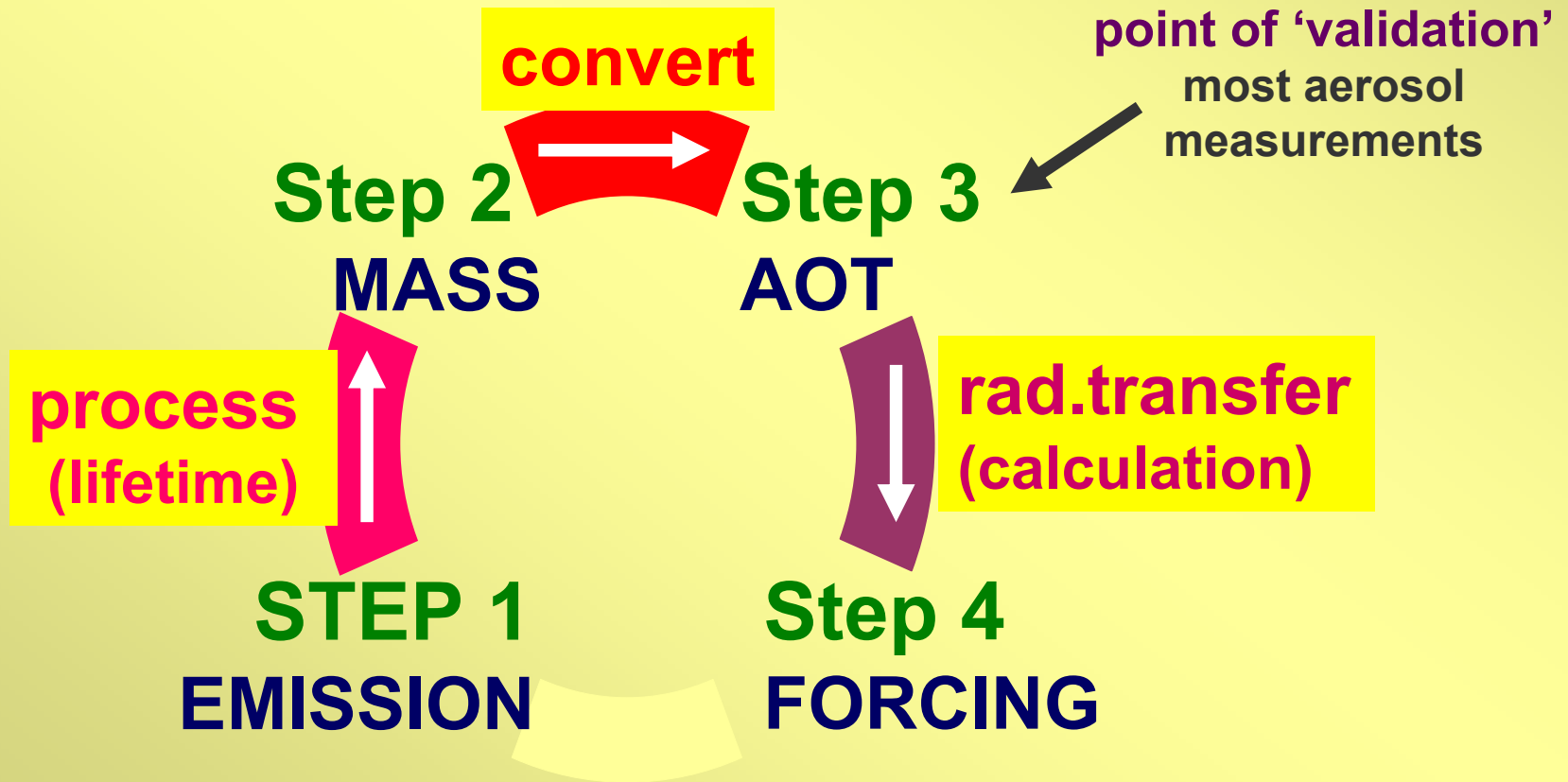


illustration of ‘forced’ changes to the radiative energy budget at the top of the atmosphere

Modeling – a 4 STEP process



Modeling: OLD vs. NEW

OLD

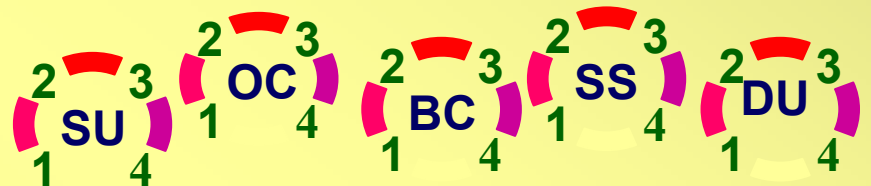
- aerosol = sulfate



- low absorption
- focus on industry
- globally incomplete

NEW

- aerosol = many types



- better characterization
 - more processes
- ⇒ more errors ?!

despite better representation in new aerosol modules
... the associated climate uncertainties remain large !

AeroCom - Goals

- **diagnose aerosol modules *of global models***
 - **assemble useful data-sets *for evaluations***
- ⇒ **identify (and eliminate) weak components
*in aerosol modules of global modeling***
- ⇒ **reduce uncertainty in simulated forcing**

'home' website

<http://nansen.ipsl.jussieu.fr/Aerocom>

(contacts: schulz@lsce cea.fr or kinne@dkrz.de)

AeroCom - Participation

- **Modeling**
 - **15 groups indicated their participation**
 - ... and more groups are expected to join
 - **8 groups contributed to PHASE A ('best effort')**
 - from US, Germany, France, Italy, Norway and Japan
- **Measurements**
 - **in-situ and remote sensing data from many sources**
 - many (quality) data-needs remain and scale differences must be understood
 - we are still looking for quality (global) aerosol data-sets !

AeroCom – First Results

- **Comparison**

- Models vs Data (remote sensing)
- Models vs other Models
- Models by aerosol component

- **Conclusions**

(in case it gets too boring)

- Explanations needed for model differences
 - in mass (\Rightarrow aot) conversion (mass ext eff) for each type !
 - in aerosol lifetime (mass / emission) for each type
- Prescription of common input will be first step

Aerosol Optical Depth (STEP 3)

global yearly average

- AERONET**

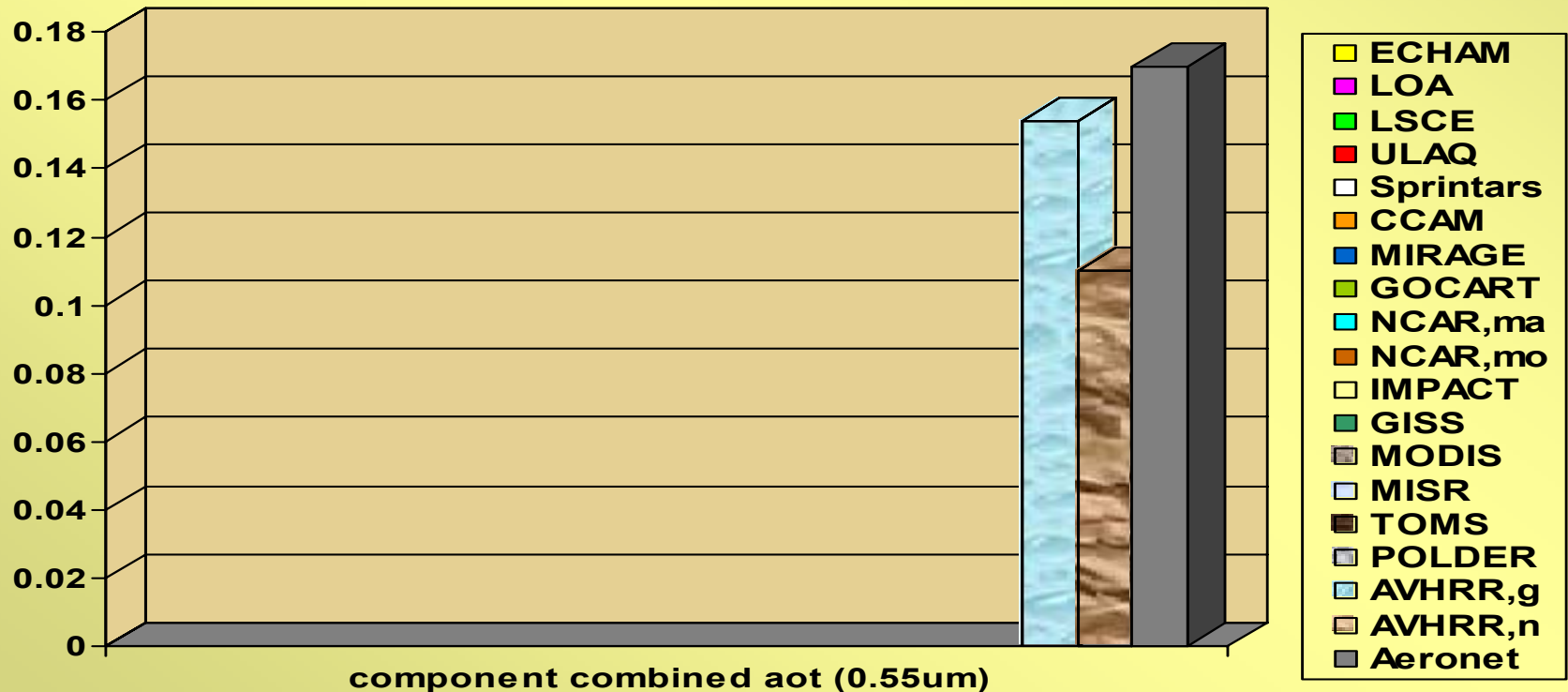
- ground statistics from 100 sites (1998-2001)



Aerosol Optical Depth (STEP 3)

global yearly average

- **Satellite (ocean coverage only \Rightarrow 'low' bias)**
 - AVHRR retrievals (n: NOAA 1ch 81-91, g: GISS 2ch 93-01)

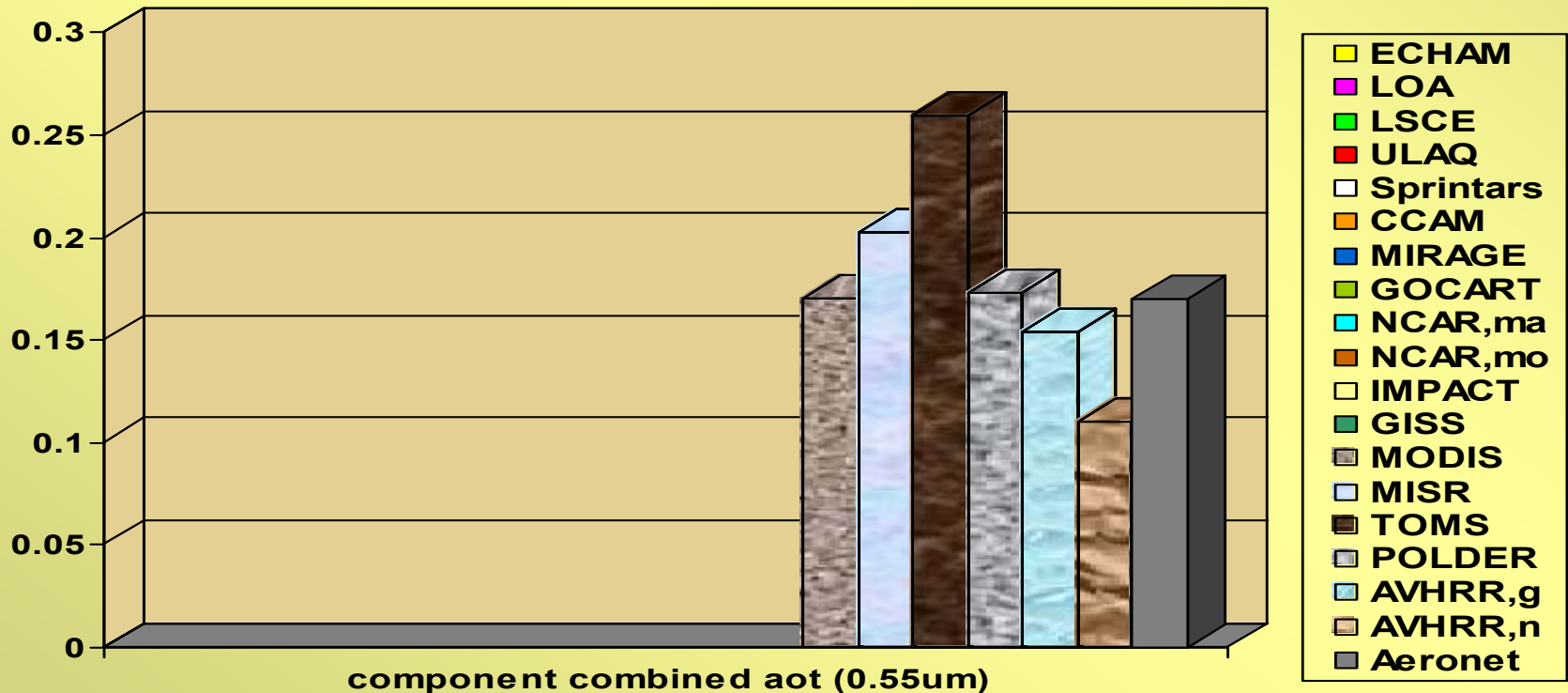


Aerosol Optical Depth (STEP 3)

global yearly average

- **Satellite (global coverage)**

- MODIS 2001, MISR 2001, TOMS (79-01), POLDER (96/97)

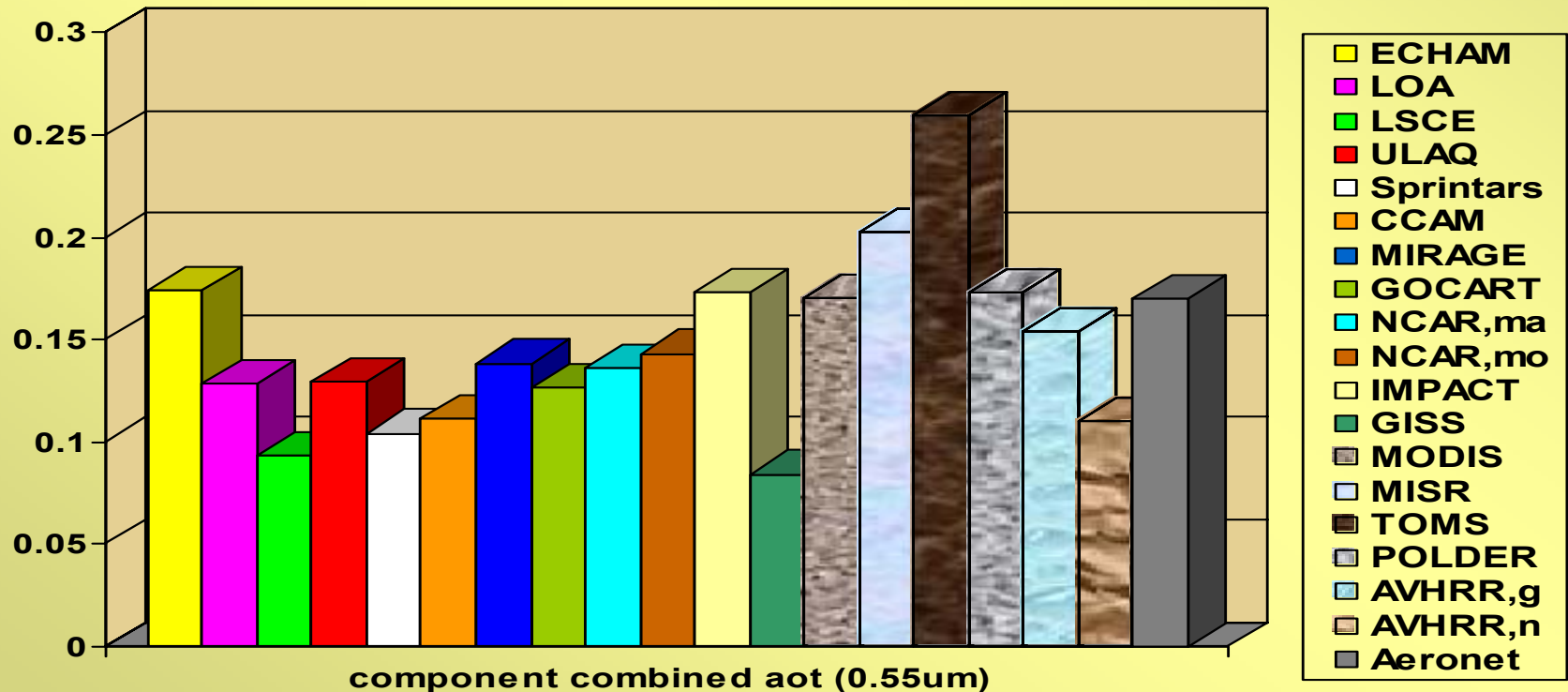


Aerosol Optical Depth (STEP 3)

global yearly average

- model simulations

- 12 models (if possible for the year 2000)



Aerosol Optical Depth (STEP 3)

global yearly average

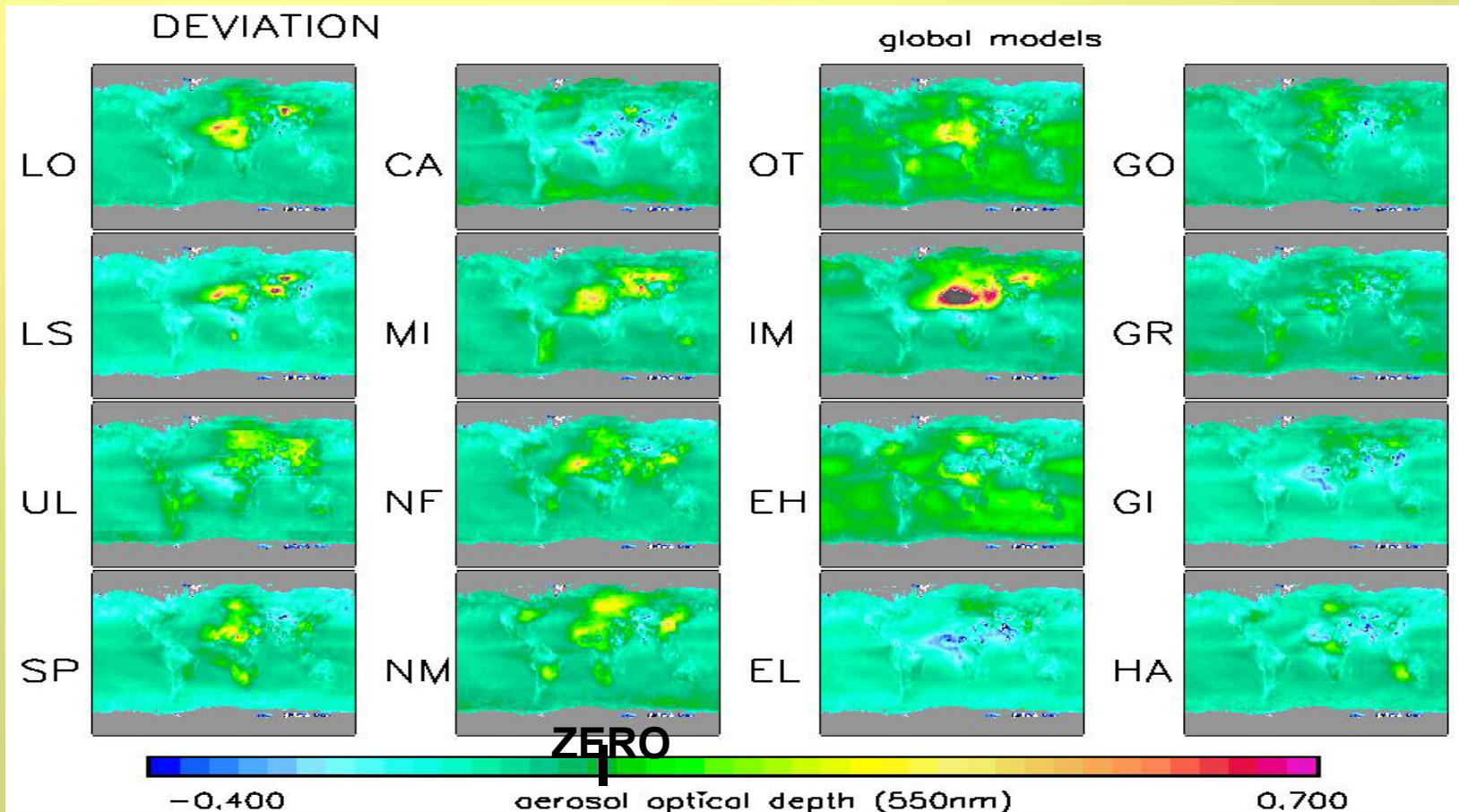
SUMMARY

- **simulations tend to underestimate aot**
 - **newer models underestimate less than older models**
- ... **but global yearly totals average out deviation detail**
 - **beware of regional deviations on subscales**
 - **comparison of global yearly average aot-fields**
 - **beware of deviations on a component basis**
 - **Investigation of component contribution and modeling**

aot regional differences (STEP 3)

yearly average

- type (SU,OC,BC,SS,DU) combined deviations of 18 models to MODIS/MISR 2001



Model is ...

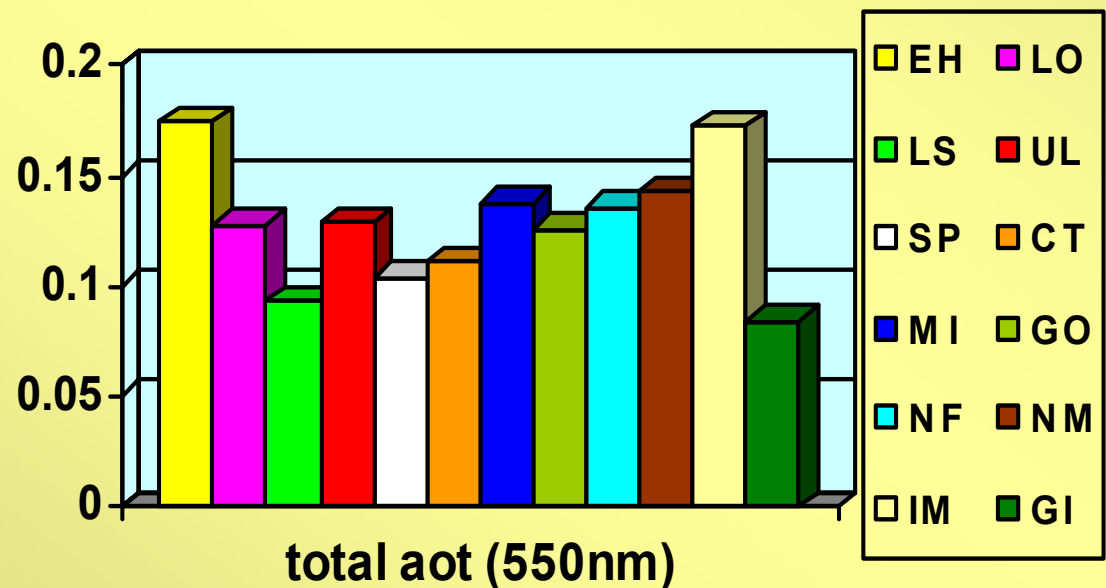
too large

too small

aerosol optical depth (STEP 3)

- let us return to global yearly averages
- let us explore the details behind differences in simulated aerosol optical depths

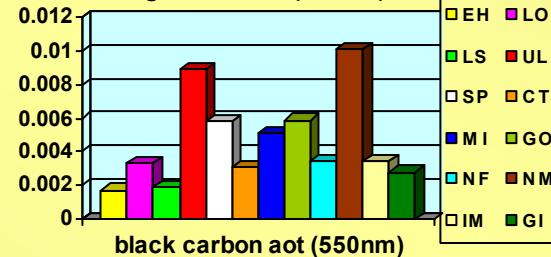
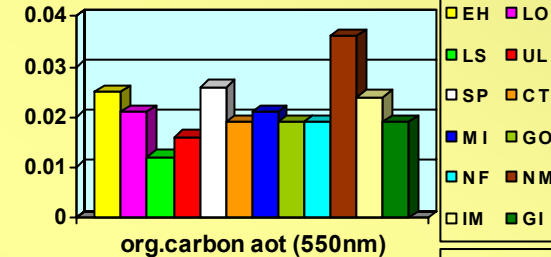
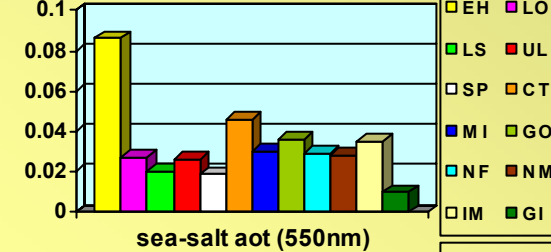
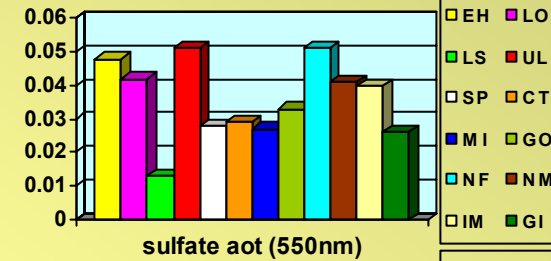
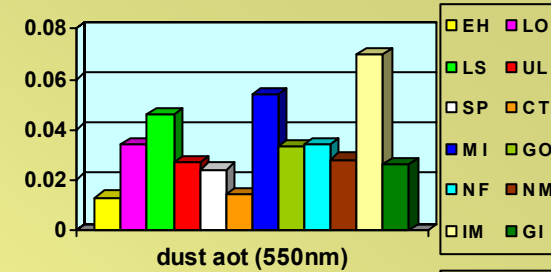
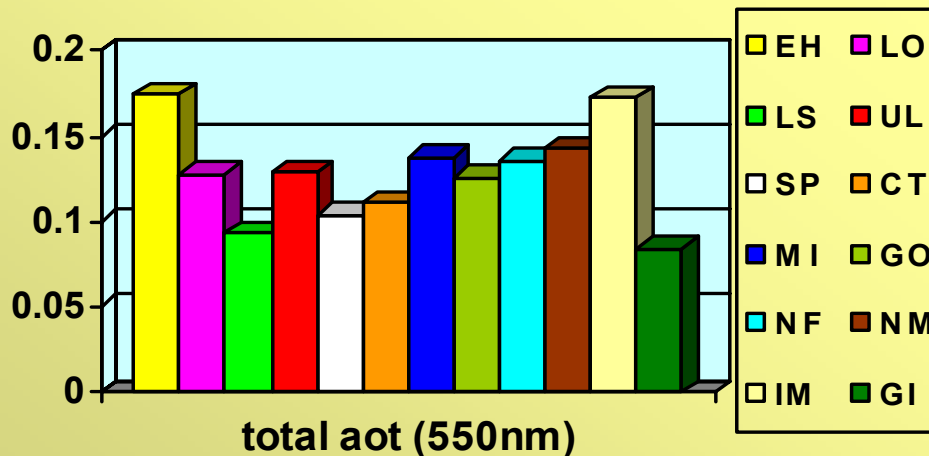
12 models:
simulated global
yearly averages
for visible aerosol
optical depth



opt. depth (STEP 3)

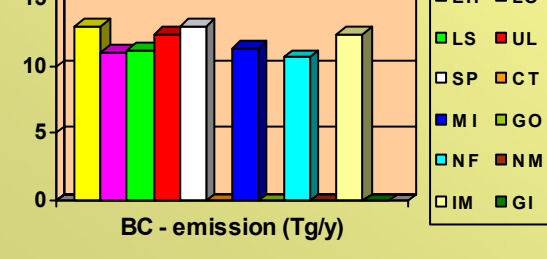
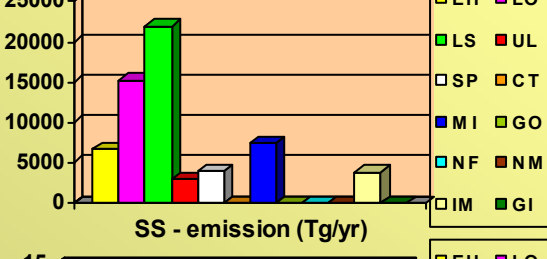
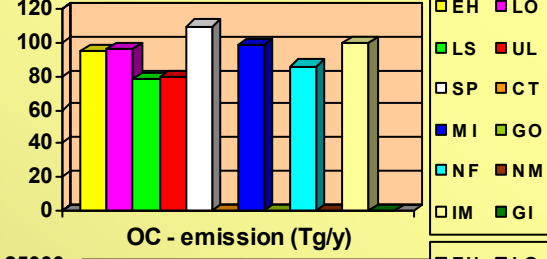
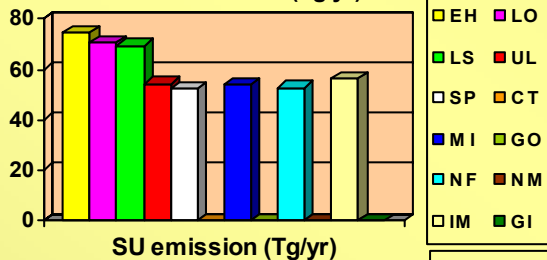
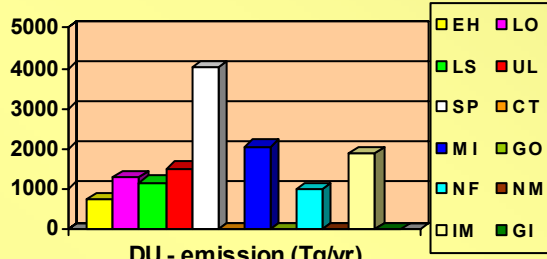
by type ⇒

- notice the different 'make-up'
 - different aerosol properties mean
 - differences in size (e.g. water uptake)
 - differences in absorption
- ⇒ differences in aerosol forcing !

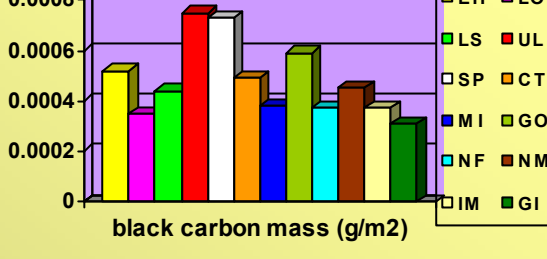
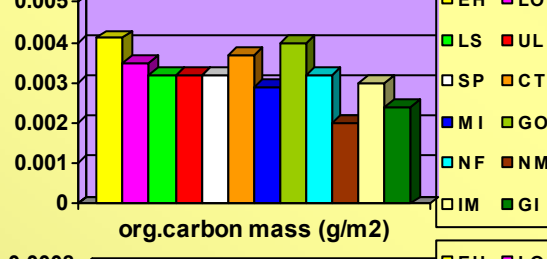
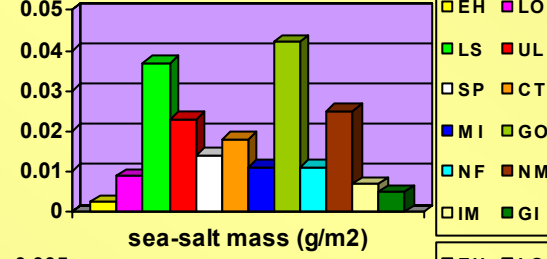
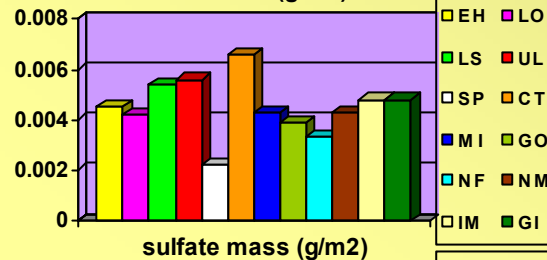
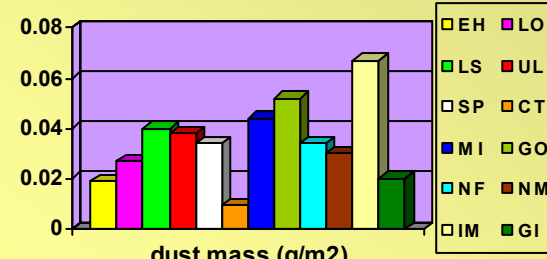


simulated aerosol - by type

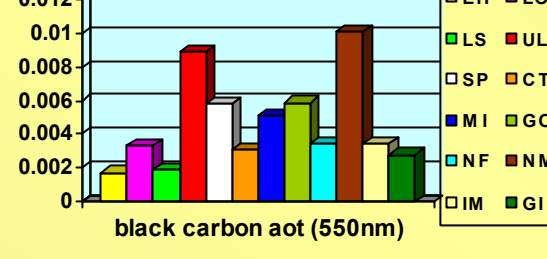
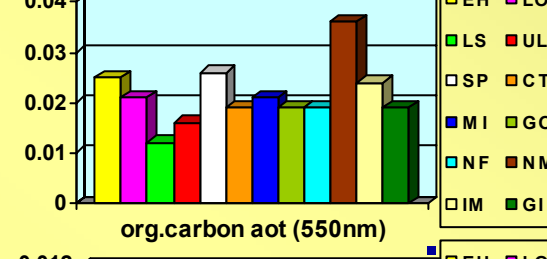
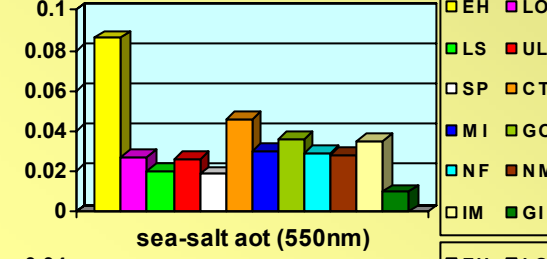
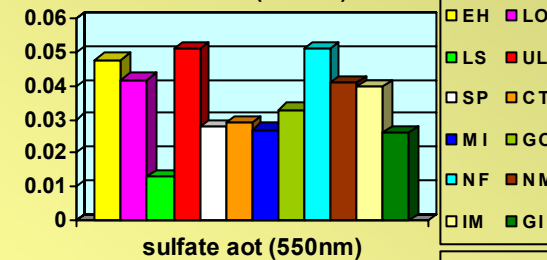
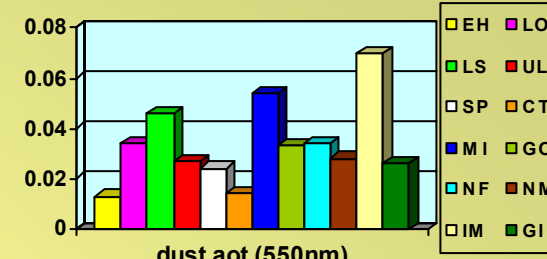
emission



mass



opt. depth



Aerosol by type

Trans-
formations:

lifetime

STEP 1 \Rightarrow STEP 2
emission \Rightarrow mass

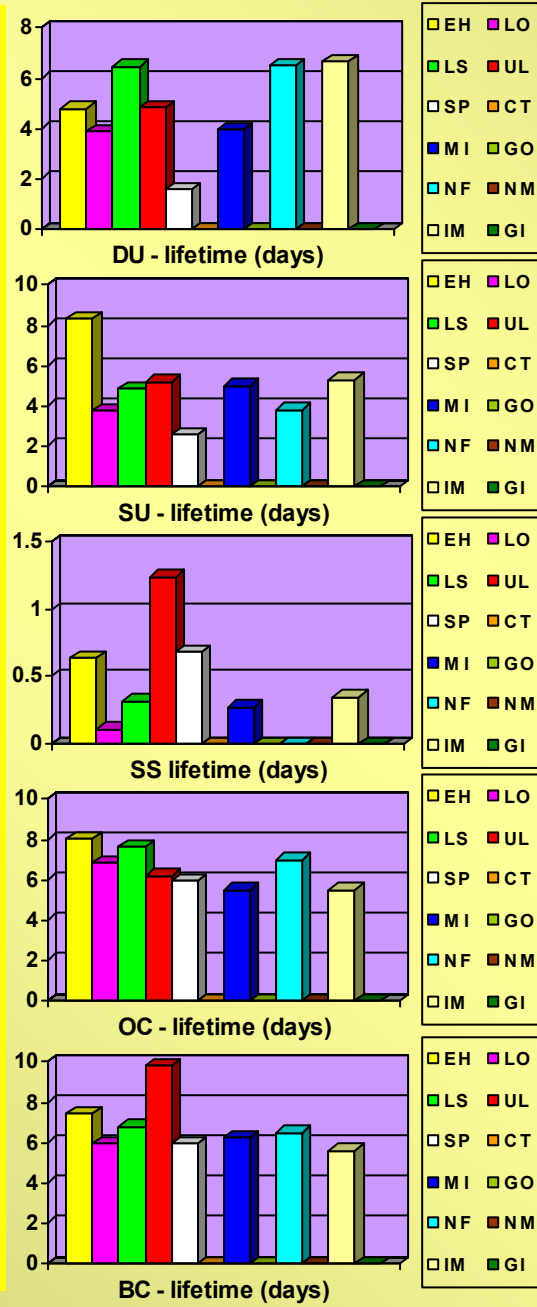
mass ext. eff.

STEP 2 \Rightarrow STEP 3
mass \Rightarrow opt.depth

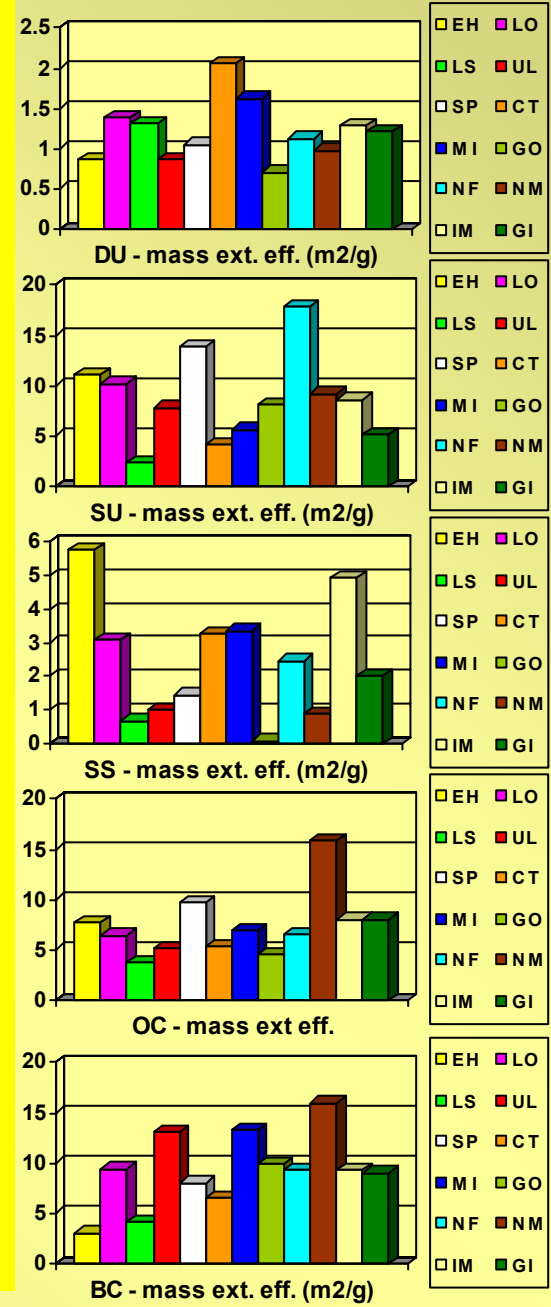
... control
experiments
to understand
differences ...

STEP 1
EMISSION

lifetime



mass ext. eff.



STEP 2
MASS

STEP 3
AOT

AeroCom – First Results

- **comparisons of aerosol optical depth are NOT 'validations' of models**
 - **one bad parameterization can kill an overall good effort**
 - **offsetting errors (and/or tuning) can elevate poor efforts**
- ⇒ **only a look at detail can provide answers !**
- ⇒ **identical input will help understanding model assumptions and deficiencies**

AeroCom - Activities

- **organize workshops**
 - present evaluations / highlight problems
 - discuss future strategies
 - forum to connect model and data communities
 - **next meeting at ISRPA, Italy, Mar 10-12, 2004**
 - ISPRA has security issues as well ... please let us
 - know in advance, if you plan to join the meeting
 - **in conjunction with major aerosol meetings**
 - *NOTE: there will be dinner workshop after today's session*
- JOIN US !*
- **provide support via the web**

AeroCom facilities (*websites*)

- <http://nansen.ipsl.jussieu.fr/Aerocom>
 - data request (*volume and format*)
 - performance feedback
 - (help) evaluate your model to other model and to data !
 - results (*workshop summaries /publications*)
- <ftp://ei.jrc.it> ... cd pub/Aerocom
 - prescribed emission sources (+sizes +heights) for nudged simulations of year 2000
(overview in an 'aerocom...ppt' [powerpoint] file)

AOT – regional differences

seasonal average

- type (SU,OC,BC,SS,DU) combined deviations of 18 models to MODIS/MISR 2001

Model is ...

too large

too small

