AeroCom - an overview

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Special acknowledgments

To Christiane Textor, Sarah Guibert, Stefan Kinne

To numerous observation data « provider »

To enthousiastic « model colleagues »

ACKNOWLEDGMENTS
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EU projects PHOENICS and CREATE

Laboratoire des Sciences
du Climat et de l'environnement

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

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AeroCom – Methodology

- *Multicomponent global aerosol models follow AEROCOM protocol*

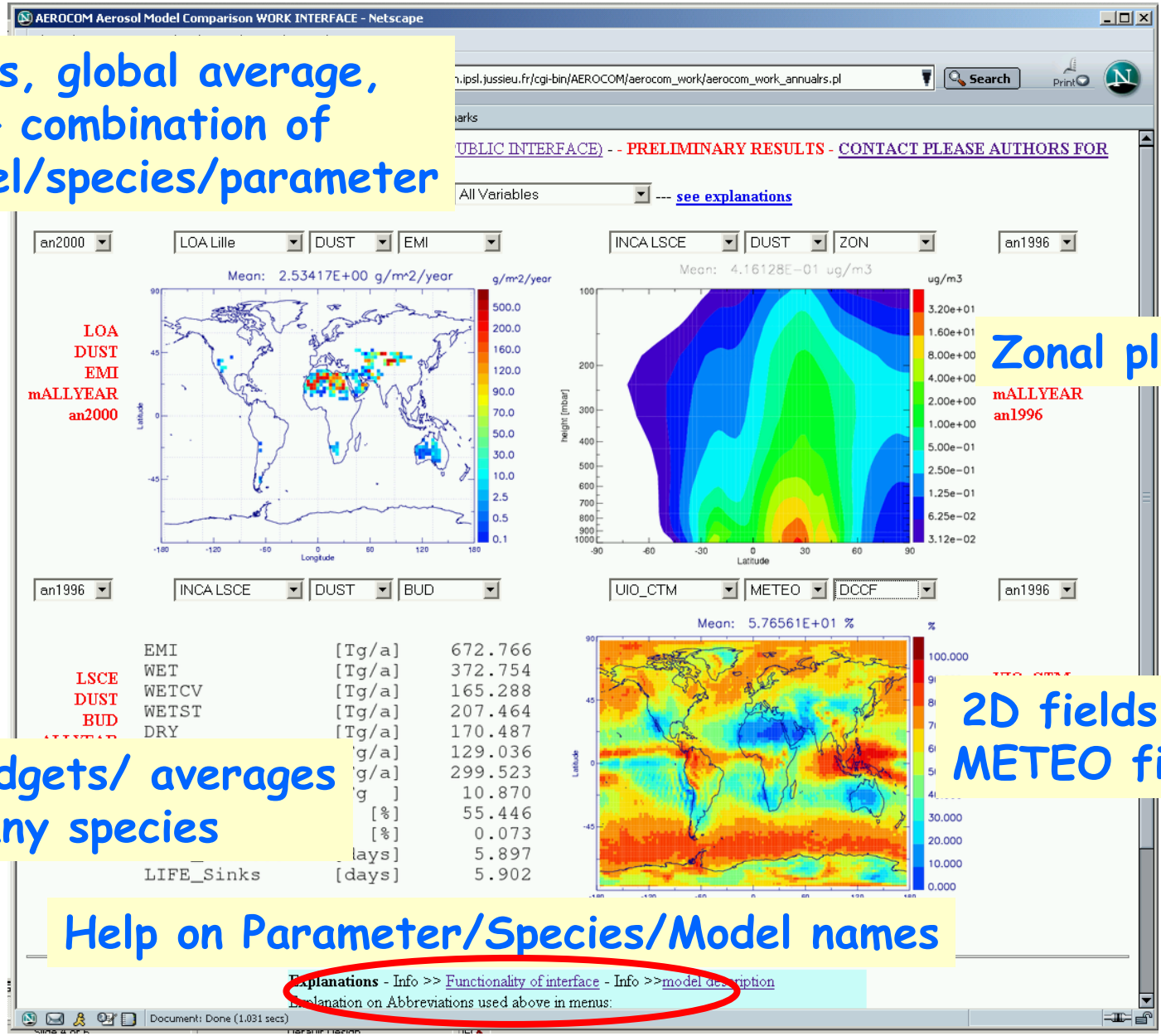
- *Simulation years 1996+1997+2000+2001 (AGCMs admitted)*

- *Experiment A – models as they are – (12 models reported so far)*
- *Definition of AEROCOM year 2000 prescribed source scenario*
- *Experiment B – using these sources (2 models reported so far)*

- *netCDF-nco-IDL image processing at LSCE (with MPIM)*
- *Combination with new data (MODIS, MISR, POLDER, AERONET, etc)*
- *Process analysis to understand differences*
- *Transparency of work-up through web interface to image database*
- *Work-shops (such as 10-12 March in Ispra)*

AEROCOM internal working web interface

2D fields, global average, «any» combination of year/model/species/parameter



Zonal plots

2D fields of METEO fields

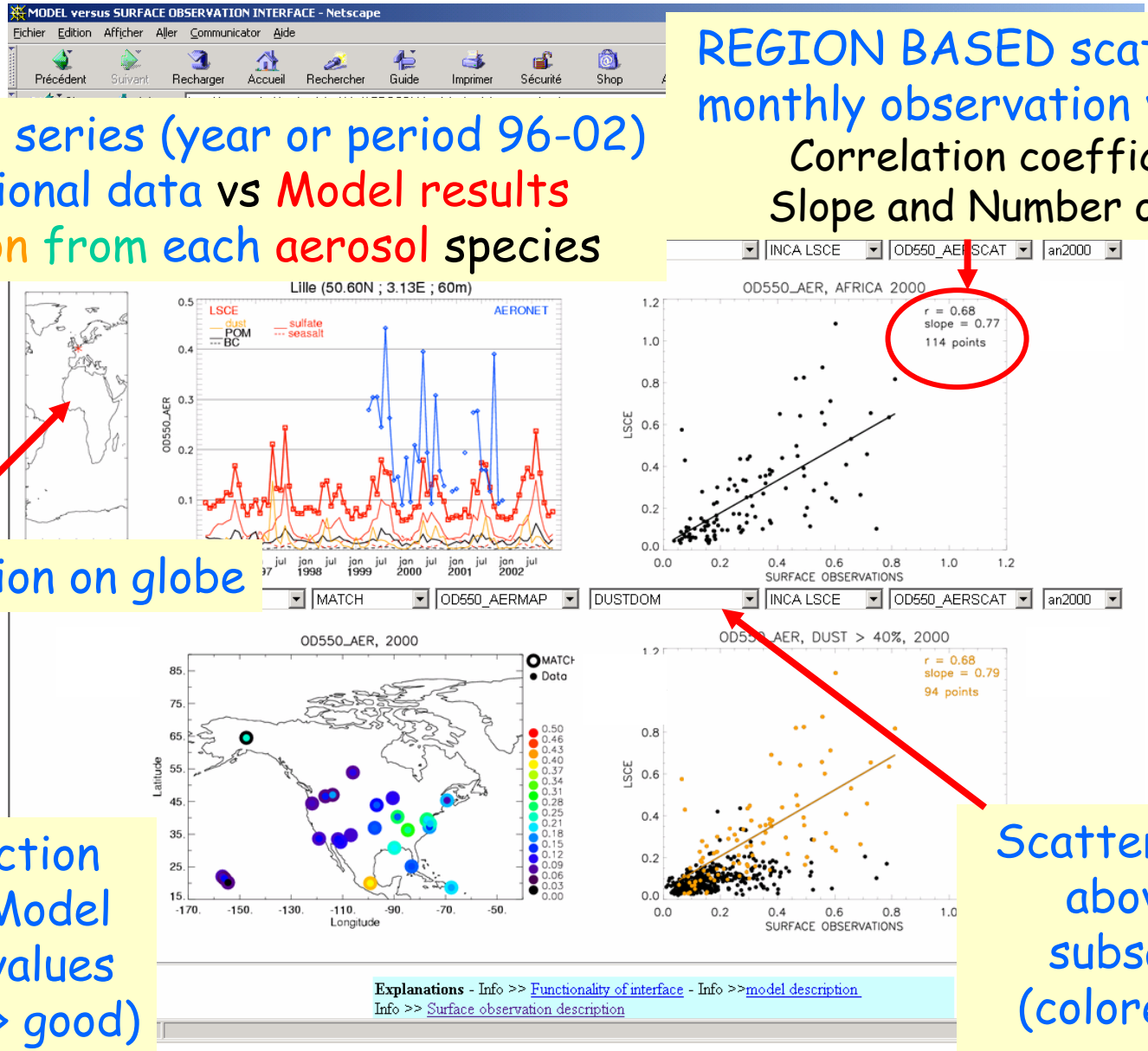
Global budgets/ averages of any species

Help on Parameter/Species/Model names

Surface observations web interface

Monthly time series (year or period 96-02)
Observational data vs Model results
Contribution from each aerosol species

REGION BASED scatter plot
monthly observation vs model
Correlation coefficient
Slope and Number of obs



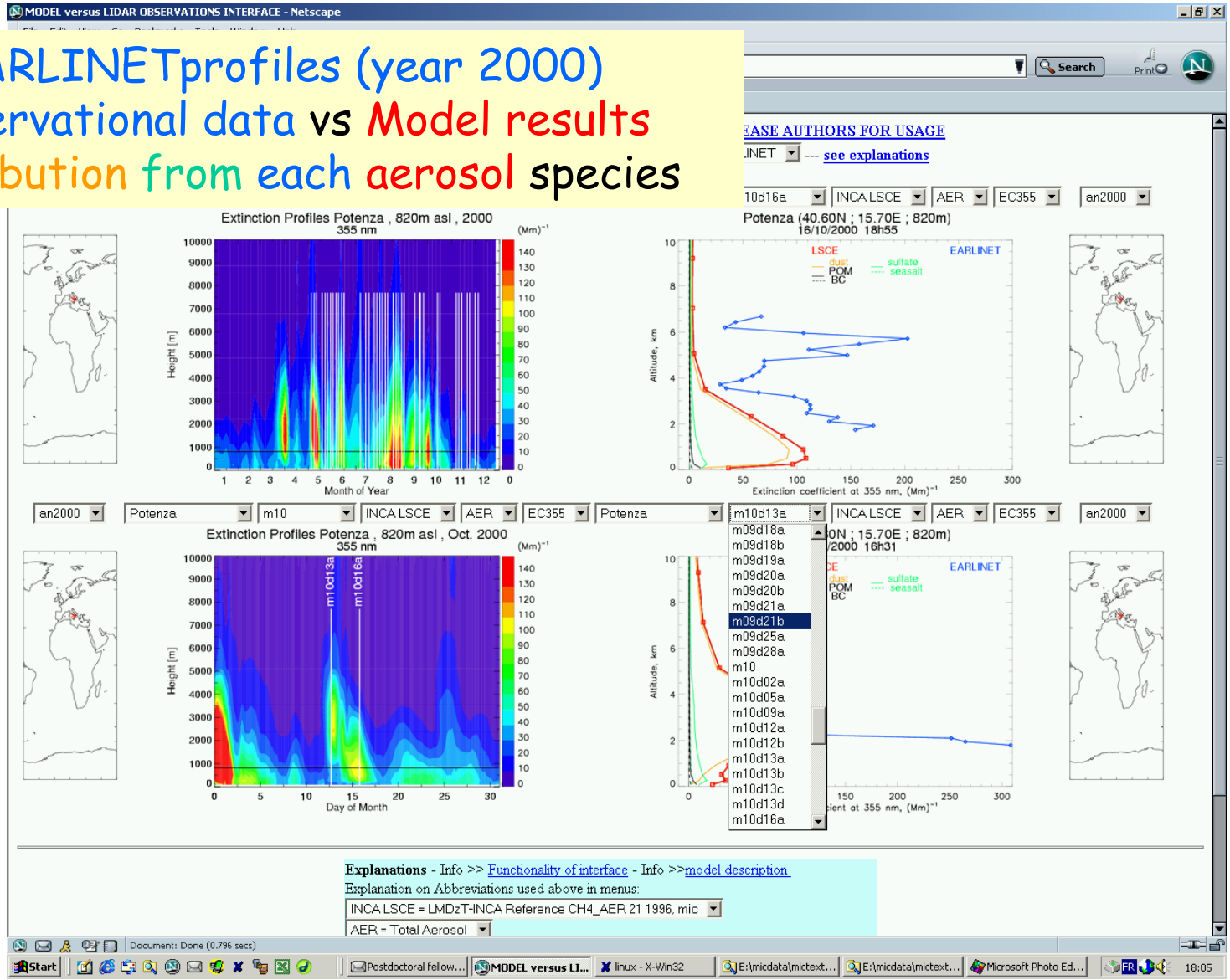
Station location on globe

Region selection
Obs versus Model
mapping of values
(same color -> good)

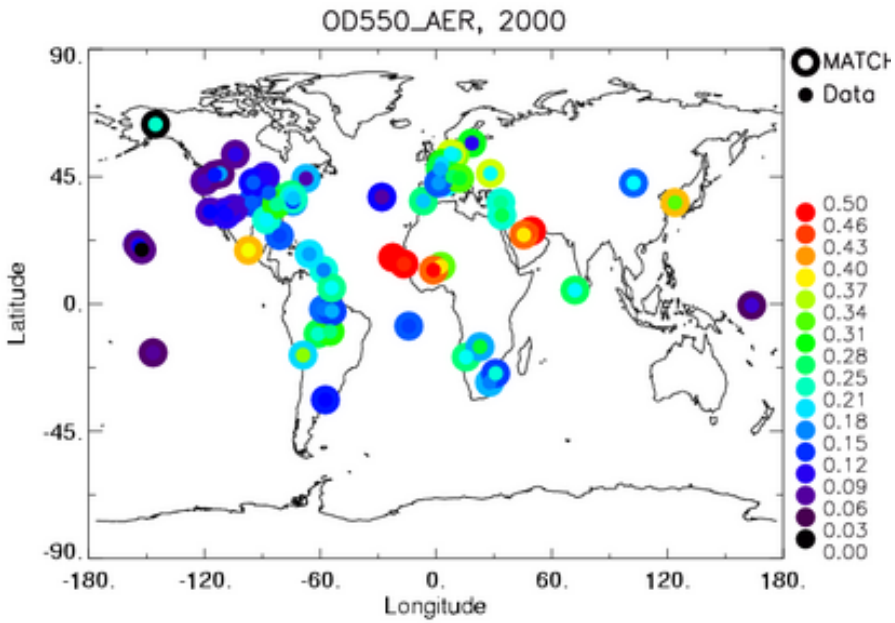
Scatter plot as above of subsample (colored) obs versus model

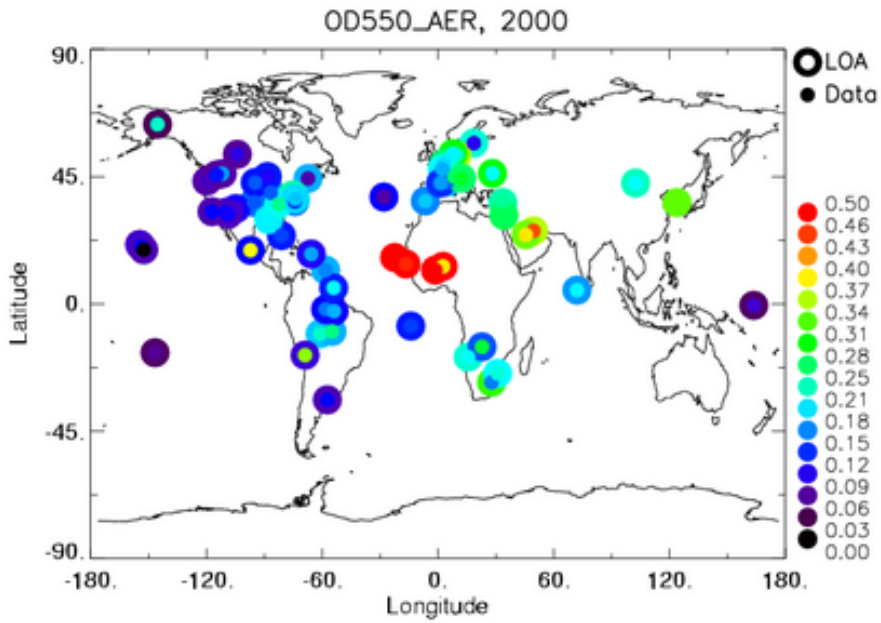
LIDAR observations vs Model web interface (not yet AEROCOM)

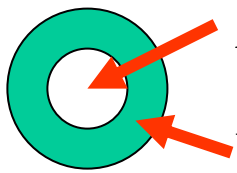
EARLINETprofiles (year 2000)
Observational data vs Model results
Contribution from each aerosol species



AEROSOL MODELS
REPRODUCE GLOBAL DISPERSION OF THE AEROSOL
(Example of two good models for year 2000)







AERONET sun photometer observation

MODEL SIMULATION at the same place

With respect to « the global aerosol »

- How much and why do models differ?
- Which specific problems for which aerosol component?
- How do they compare to measurements?
- Which is THE best model?

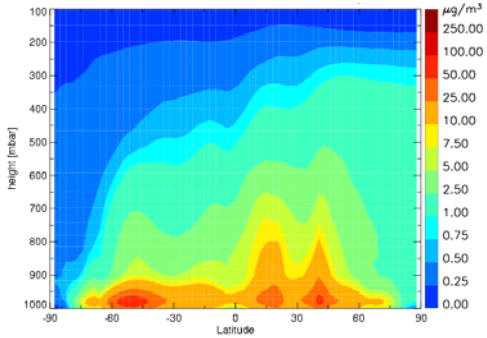
- On the scale of continents: Do we understand regions equally well?
- Why do models and observations differ?

- Which uncertainty on globally averaged aerosol optical properties?
- Can we extrapolate observations with the help of models?

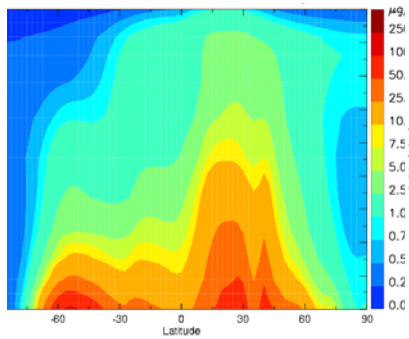
- Whats needed to improve our understanding?

Annual zonal mean, vertical cut, Aerosol Concentration

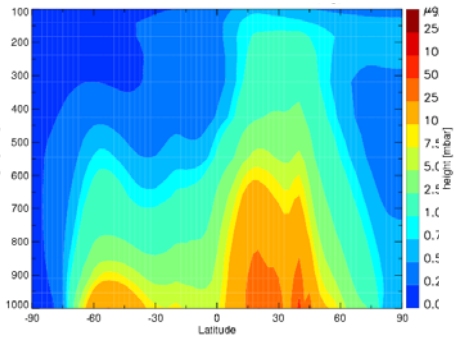
ARQM 1.06



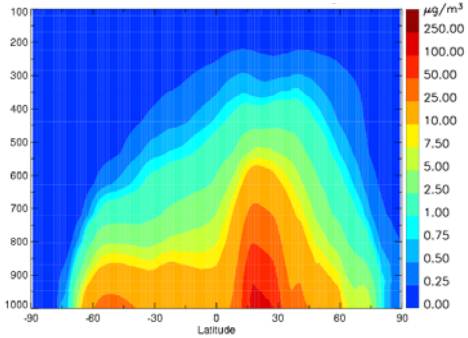
LSCE 1.66



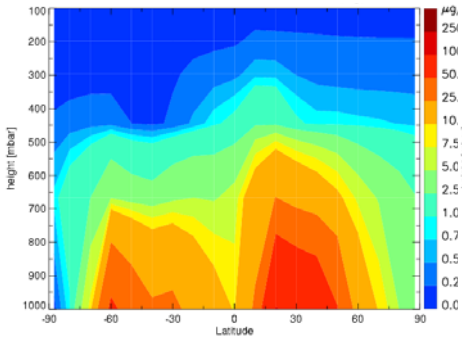
LOA 0.87



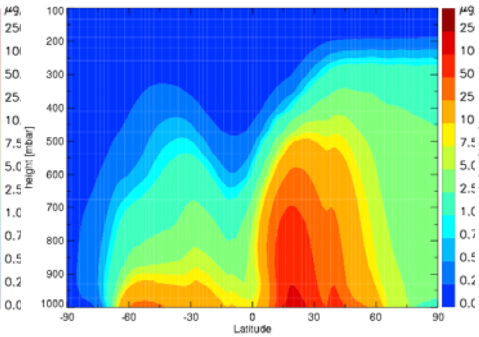
KYU 1.2



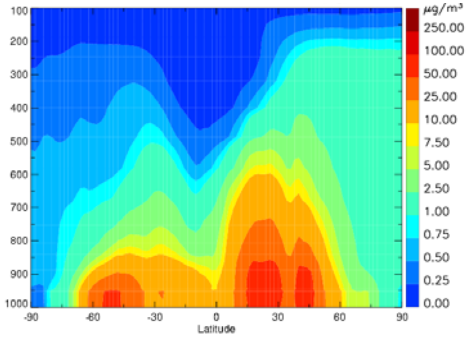
ULAQ 2.69



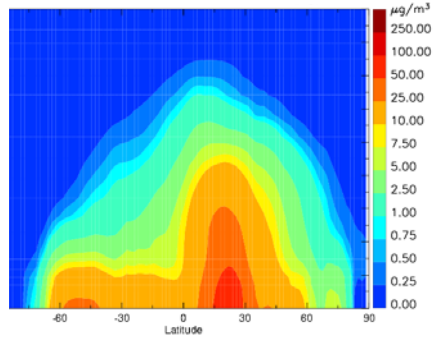
UMI 1.72



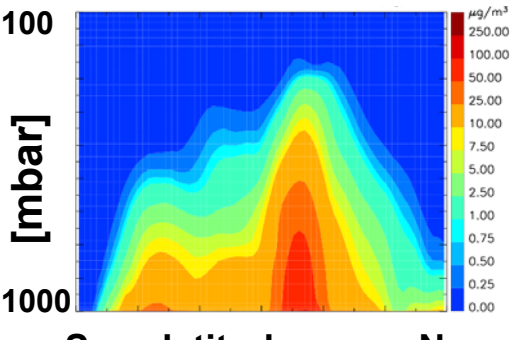
PNNL 3.04



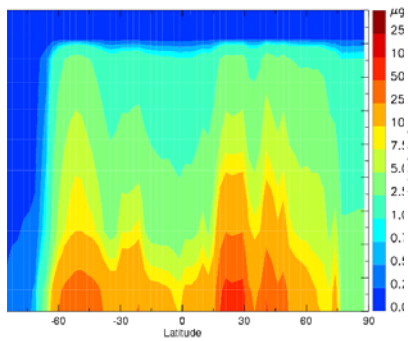
MATCH 0.96



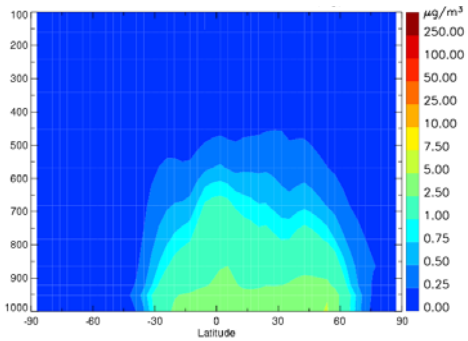
UIO_CTM 1.91



UIO_GCM 1.63

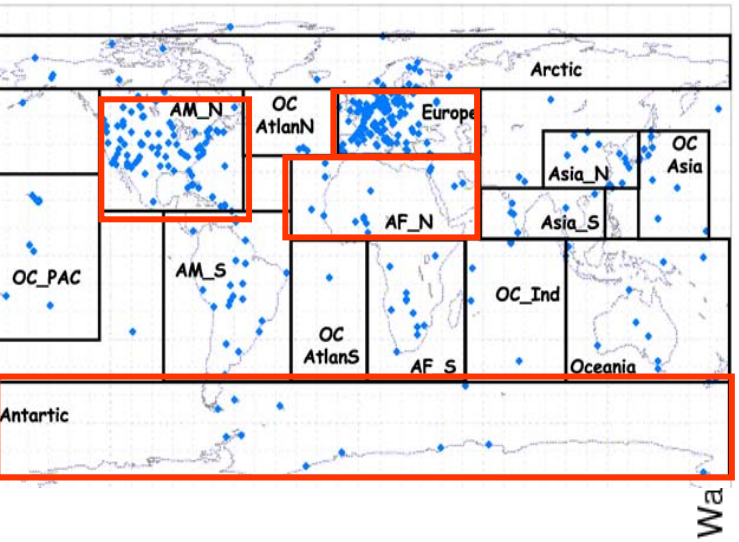


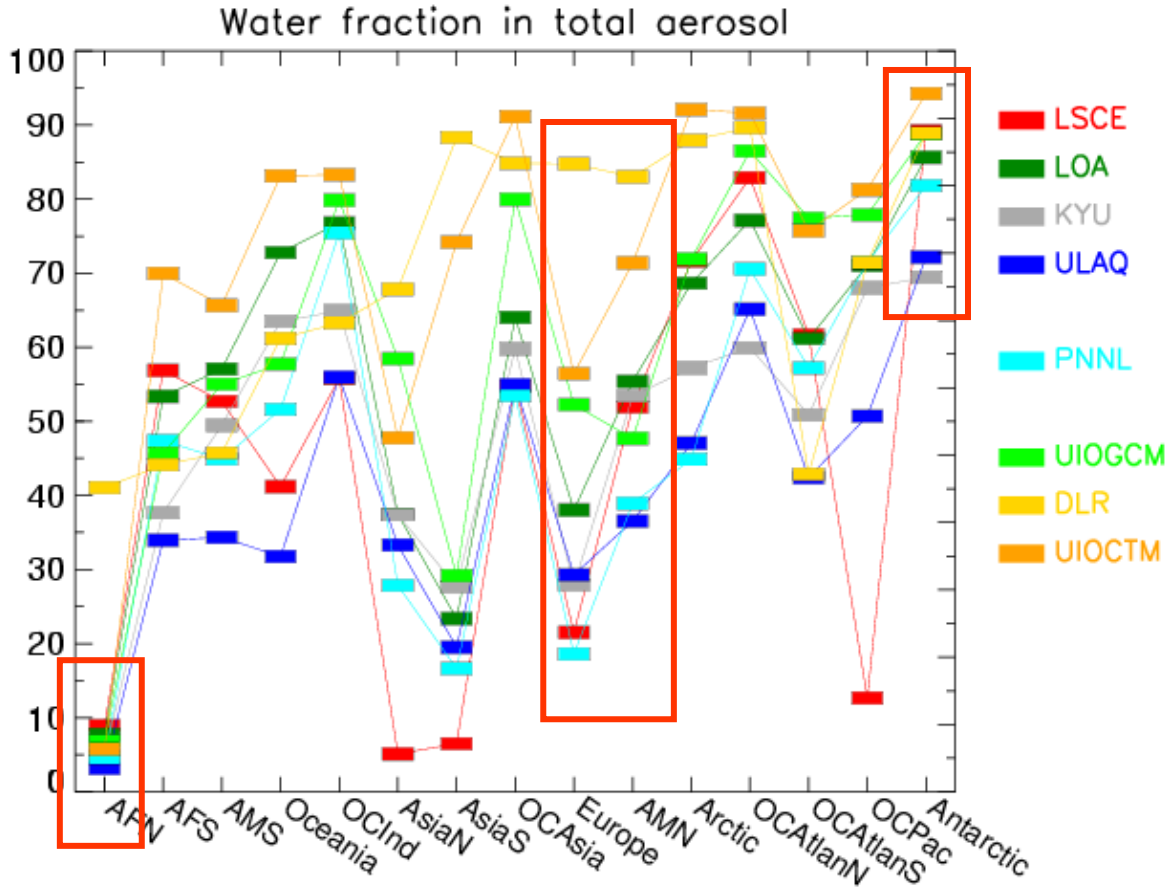
DLR 0.08 (no du ss)



Model name
Mean conc. [ug/m³]

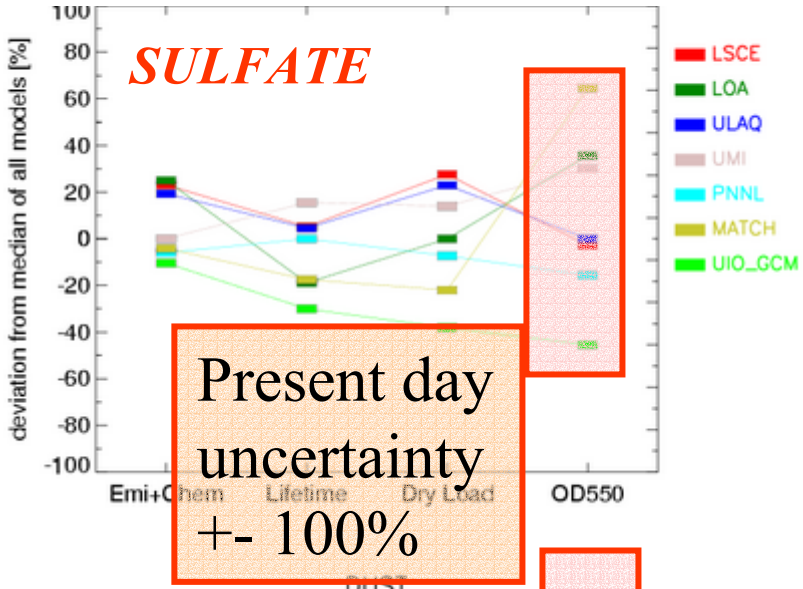
Parameterisation of hygroscopic particle growth

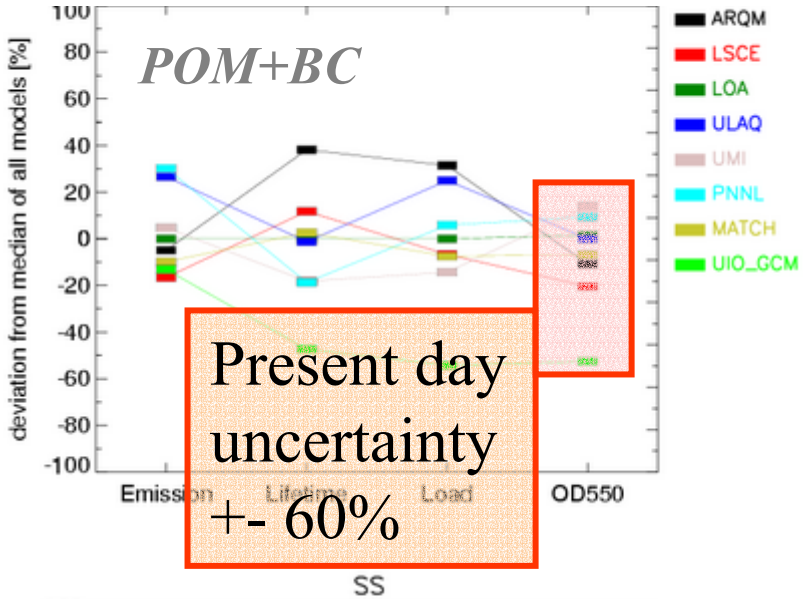


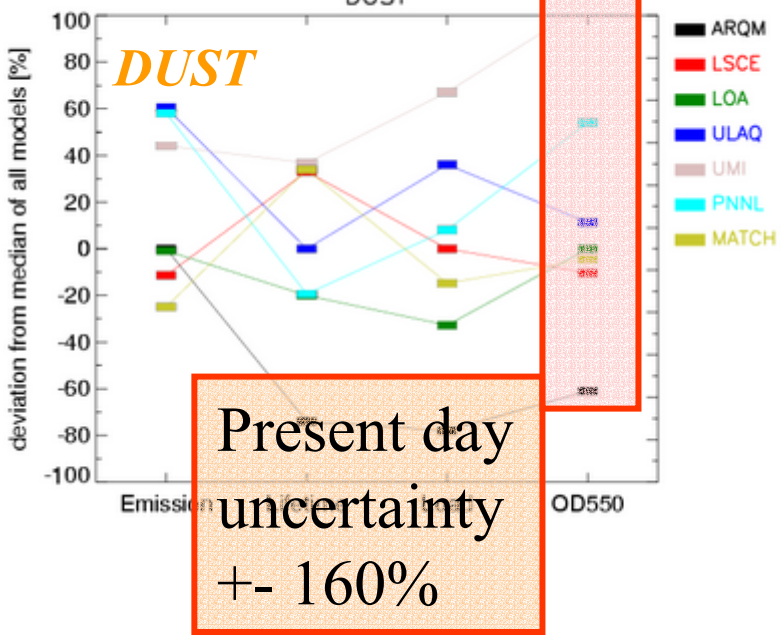


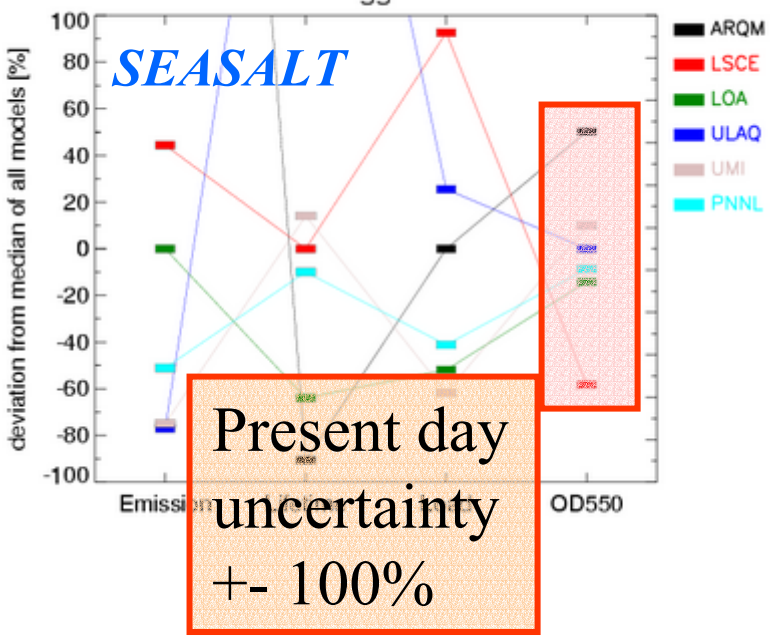
How much do models differ?

EMISSION and LIFETIME -> LOAD -> OPTICAL PROPERTIES



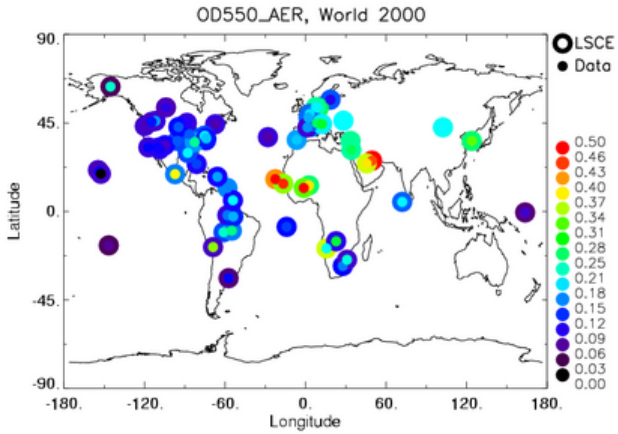




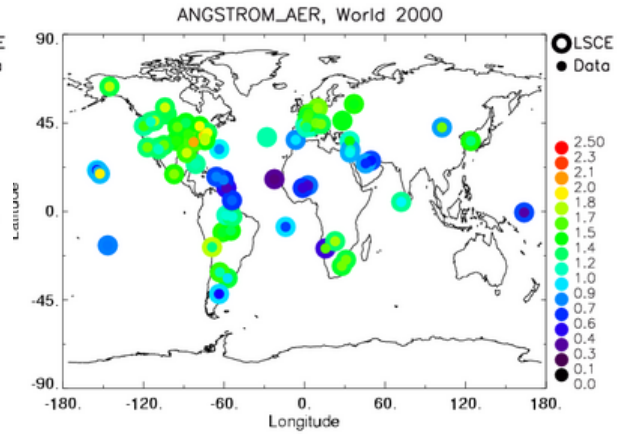


ONE MODEL – DIFFERENT DATA SETS

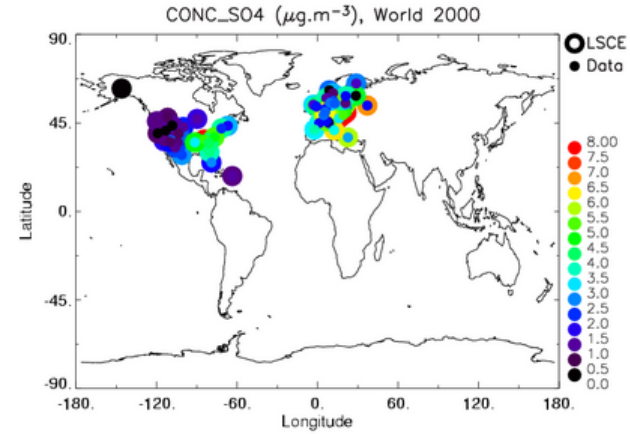
AOD@550nm



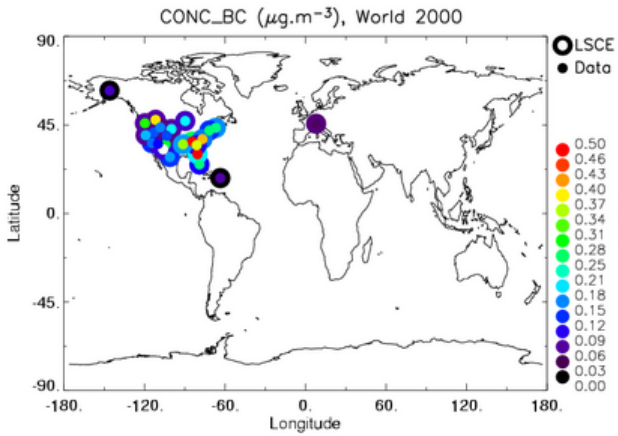
Angstroem Comp.



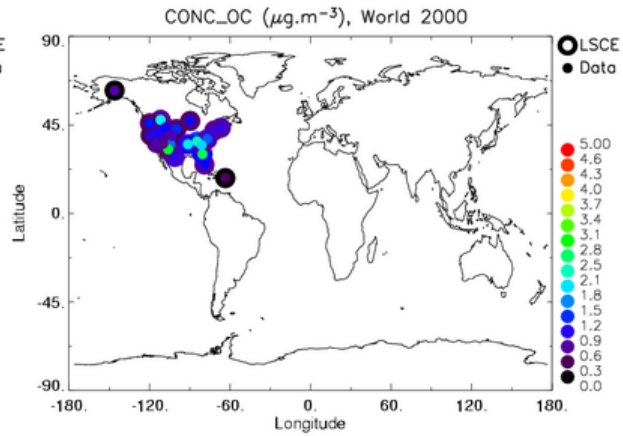
Sulphate Conc



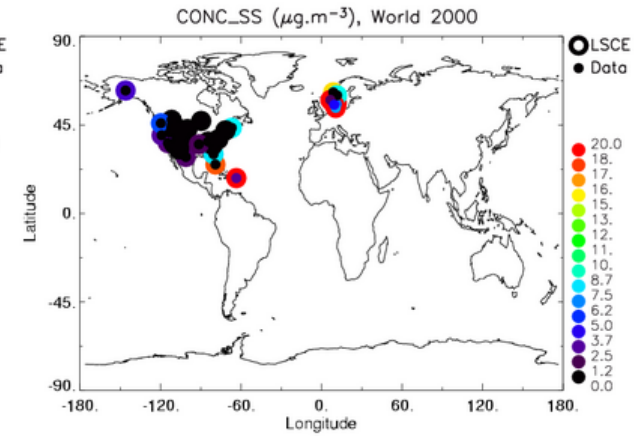
Black Carbon Conc.



Organic Carbon Conc.

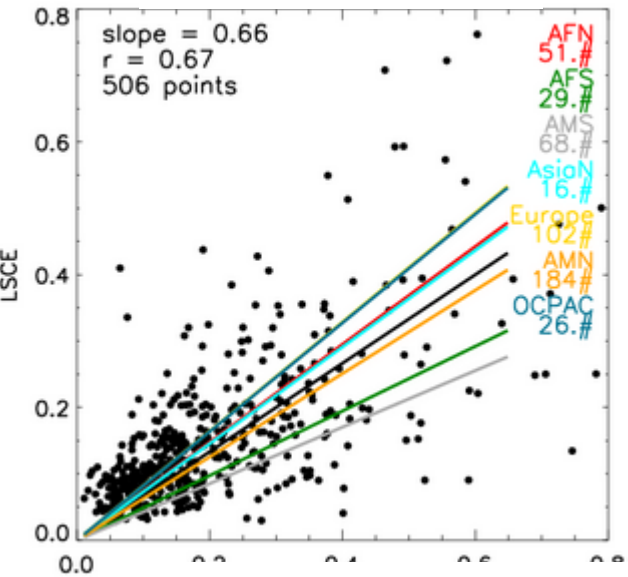


Sea Salt Conc.

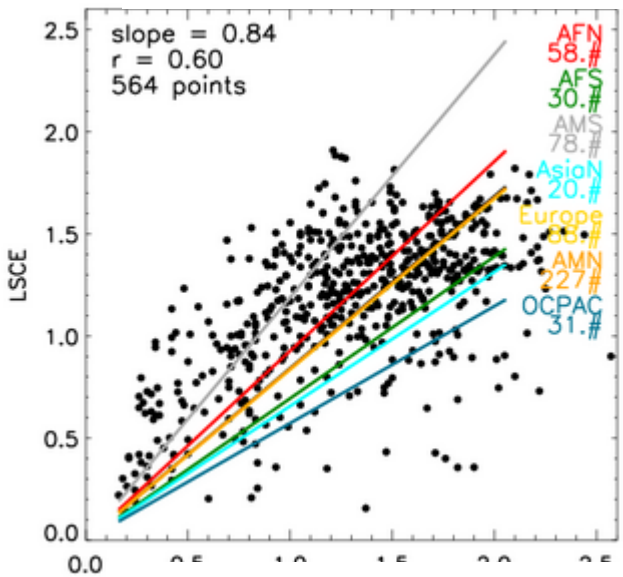


ONE MODEL against DIFFERENT DATA SETS (year 2000)

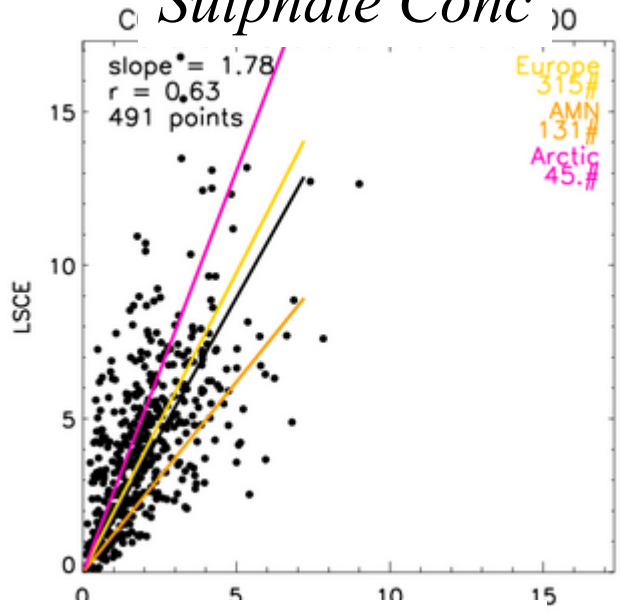
AOD@550nm



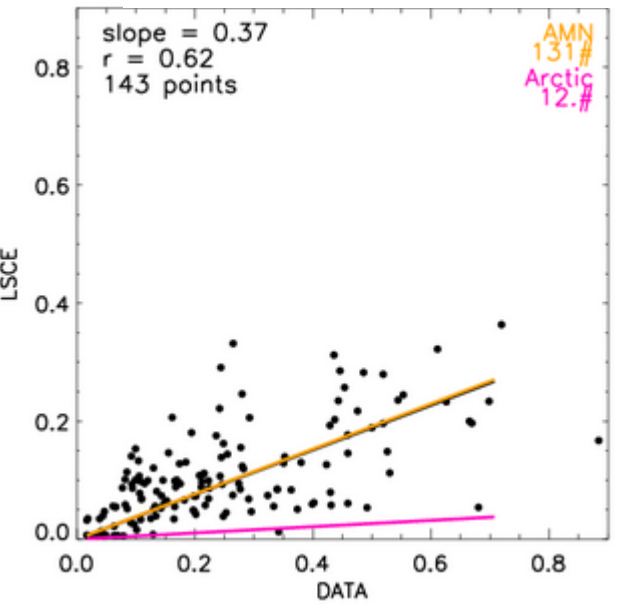
Angstroem Comp.



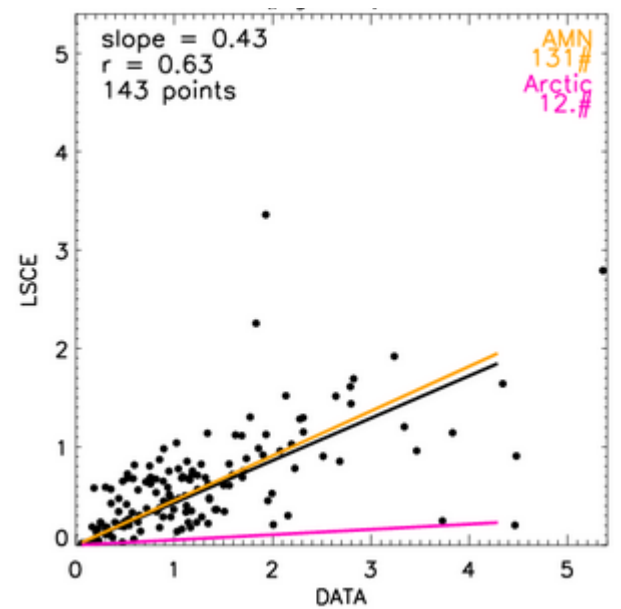
Sulphate Conc



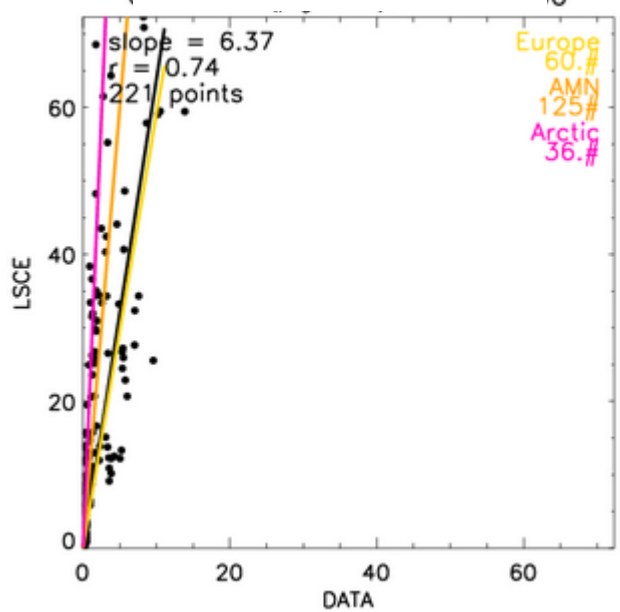
Black Carbon Conc.



Organic Carbon Conc.

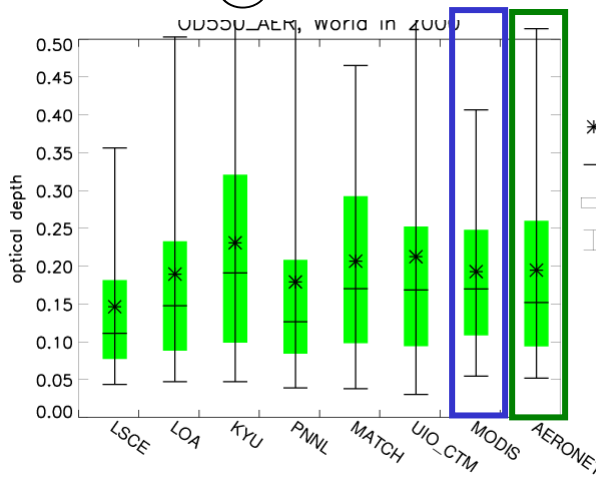


Sea Salt Conc.

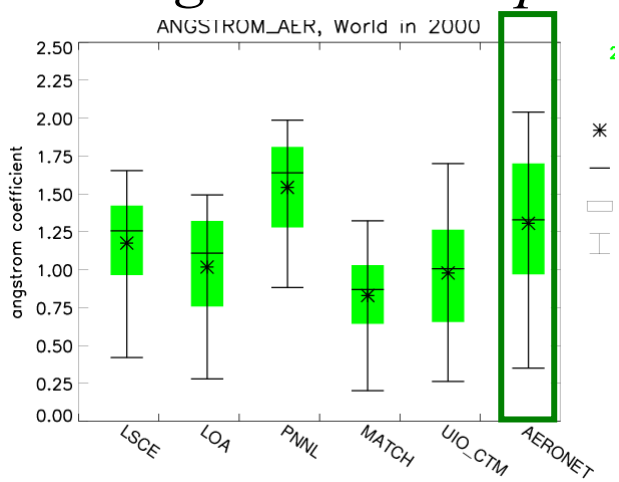


NUDGDED MODELS YEAR 2000 – DIFFERENT DATA SETS

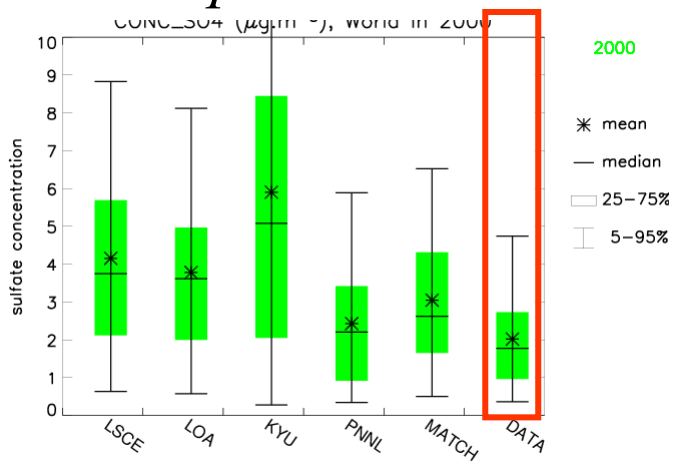
AOD@550nm



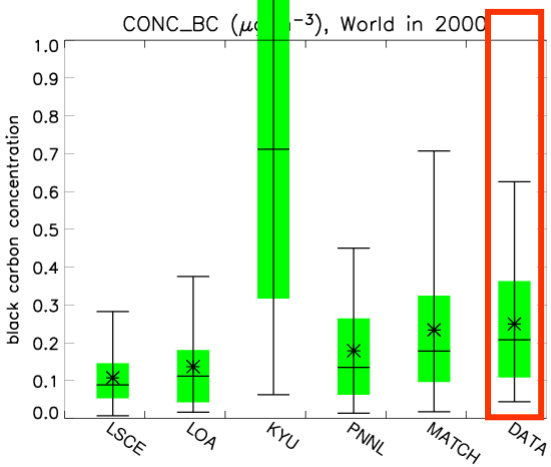
Angstroem Comp.



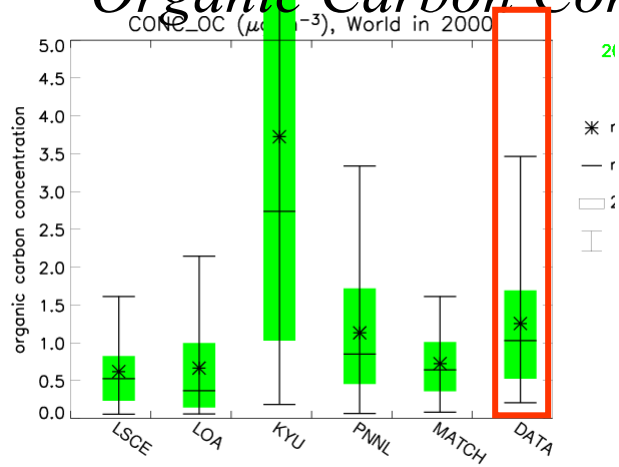
Sulphate Conc



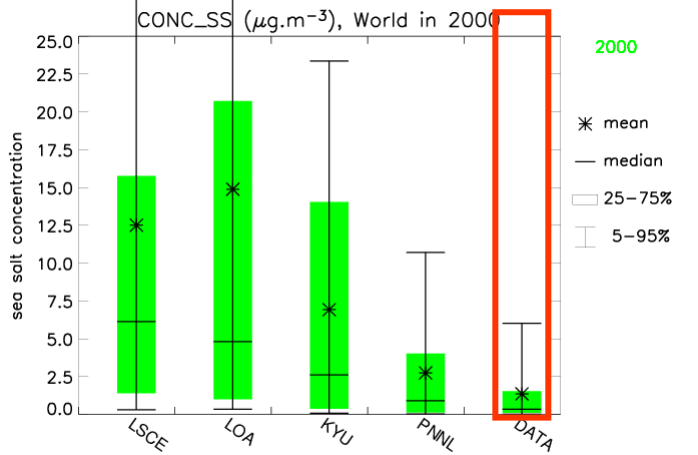
Black Carbon Conc.



Organic Carbon Conc.



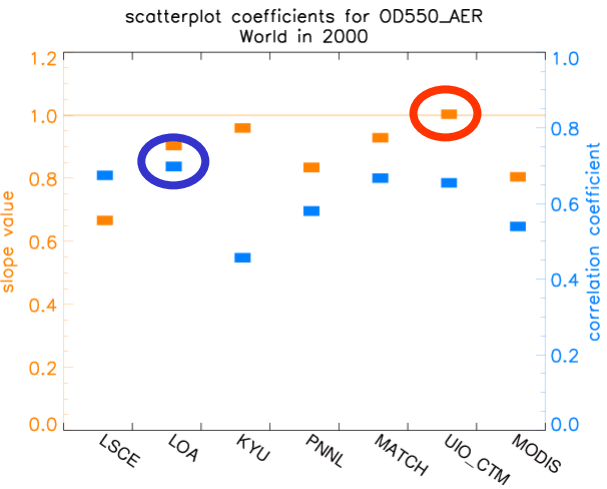
Sea Salt Conc.



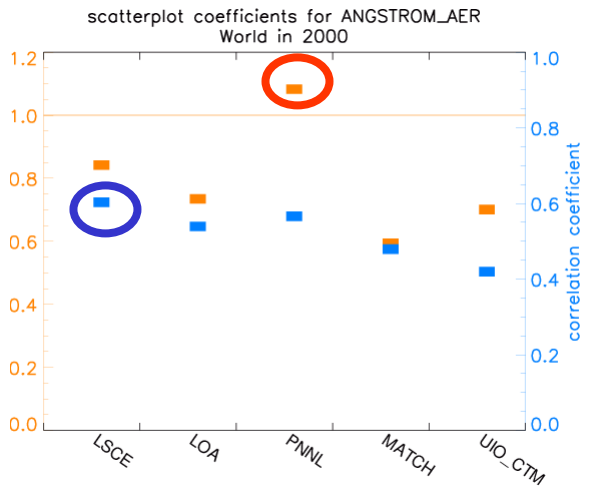
MODIS **AERONET** **GAW,EMEP,IMPROVE**

CORRELATION AND SLOPE MODELS vs DIFFERENT DATA SETS

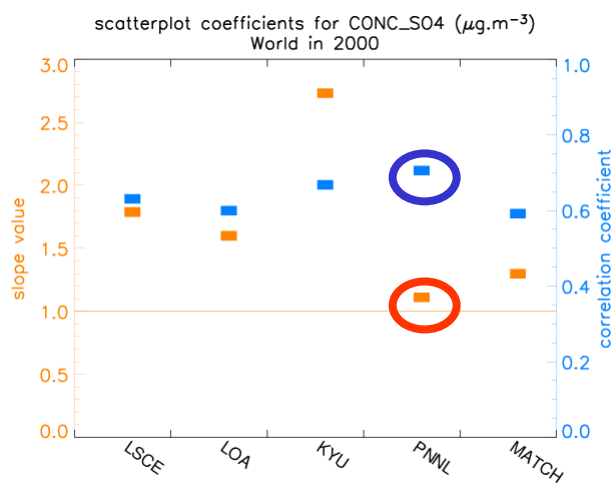
AOD@550nm



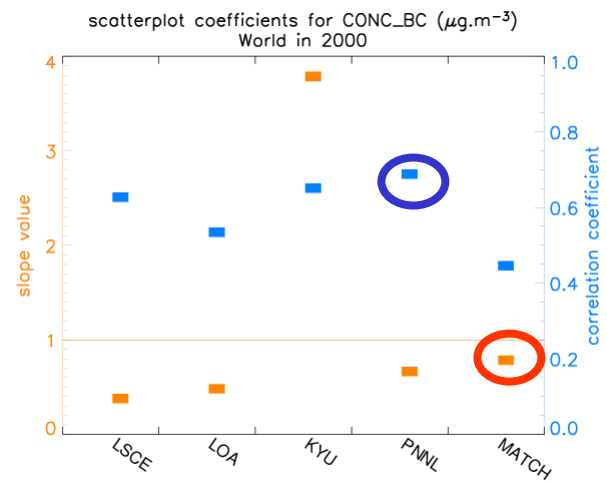
Angstroem Comp.



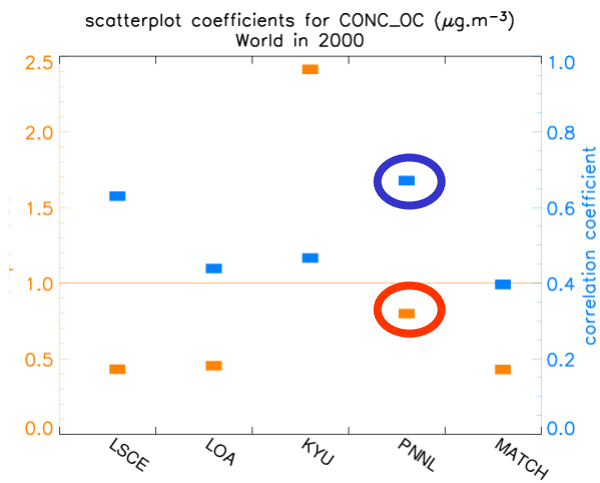
Sulphate Conc



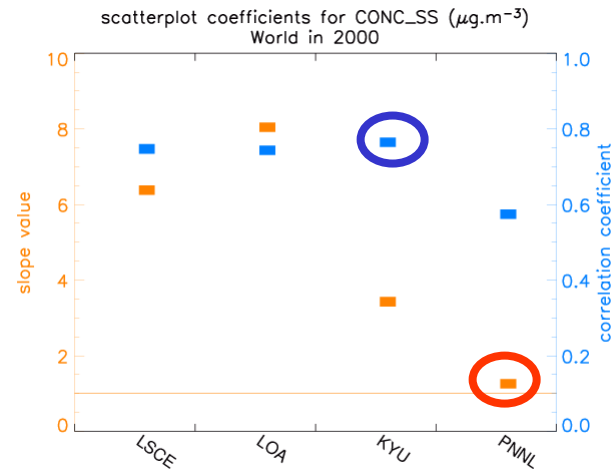
Black Carbon Conc.



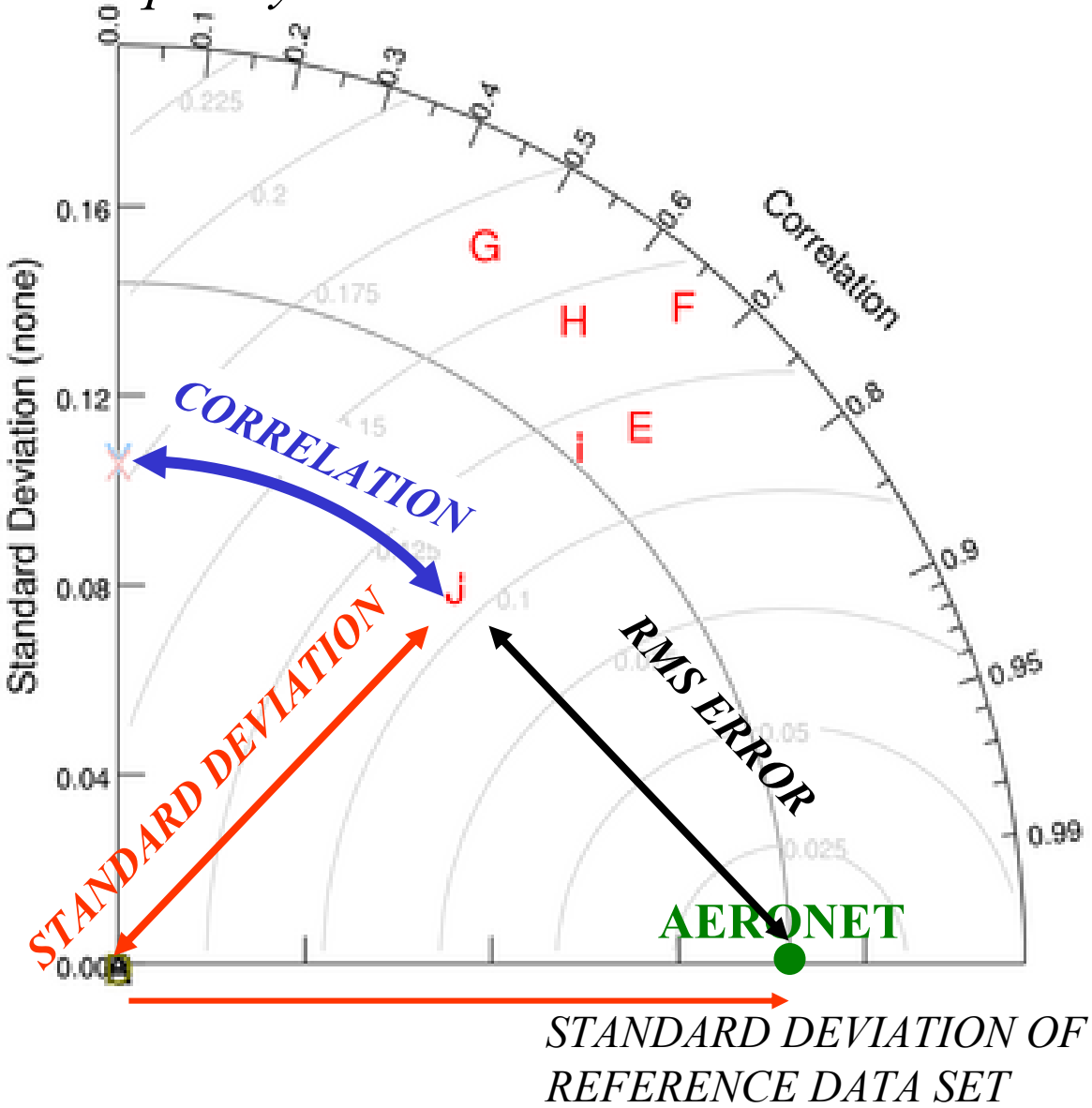
Organic Carbon Conc.

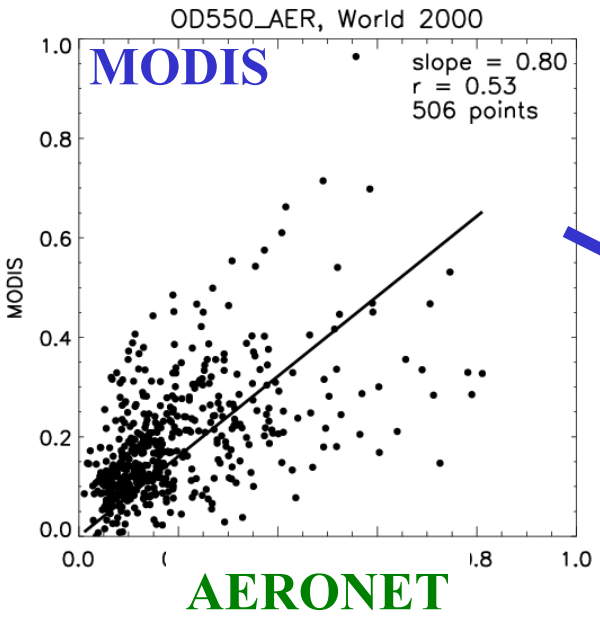


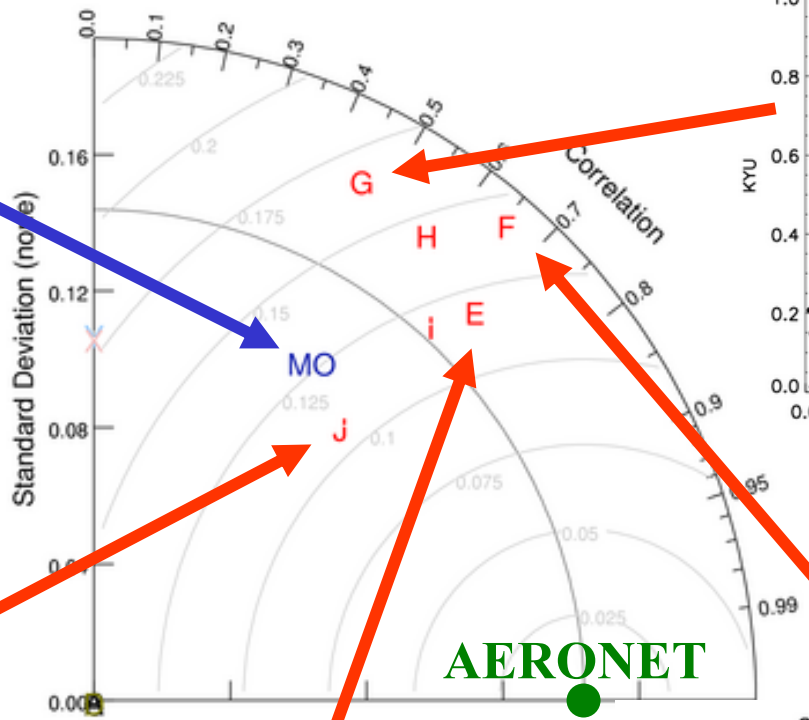
Sea Salt Conc.

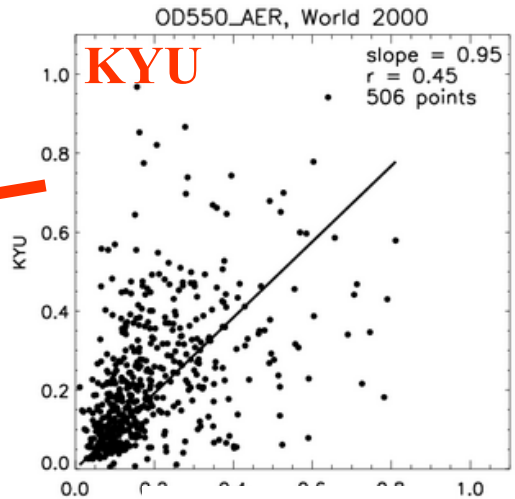


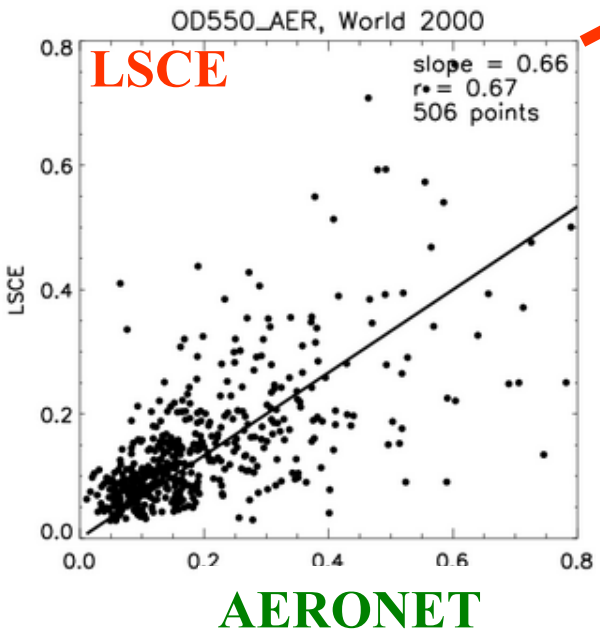
Taylor Diagrammes - condense info of spatio-temporal varying fields
Use geometric relation between RMS – STDDEV - CORRELATION to judge model quality

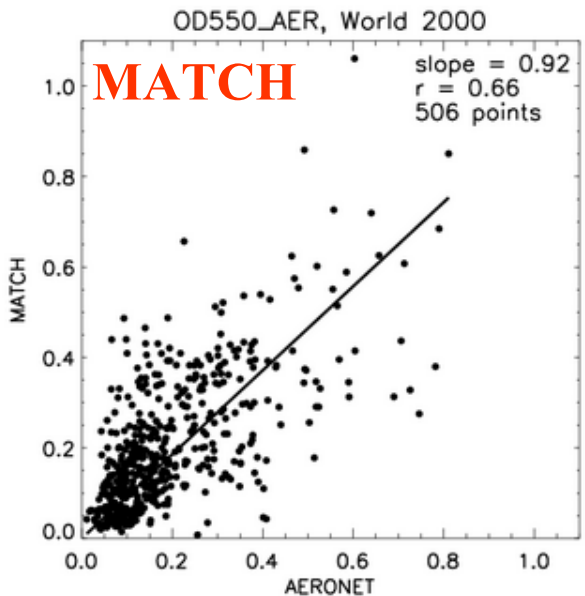


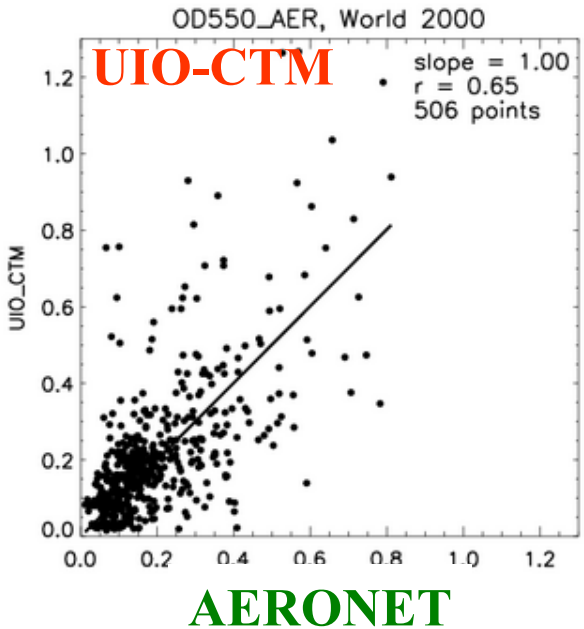

OD550_AER, World 2000
MODIS
slope = 0.80
r = 0.53
506 points
MODIS
AERONET


Standard Deviation (norm)
Correlation
G
H
F
E
MO
J
AERONET

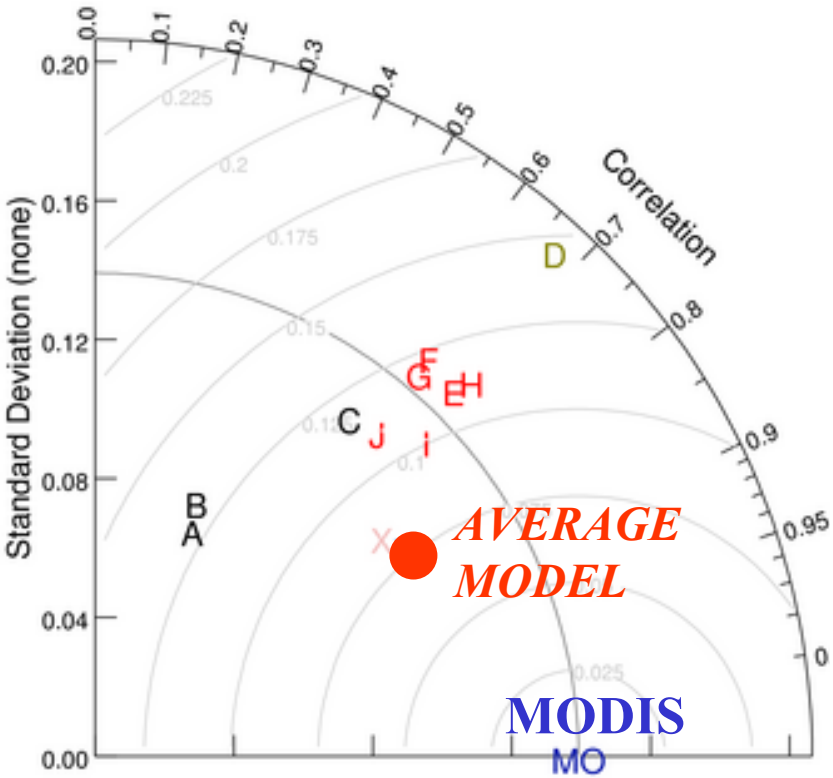

OD550_AER, World 2000
KYU
slope = 0.95
r = 0.45
506 points
KYU
AERONET

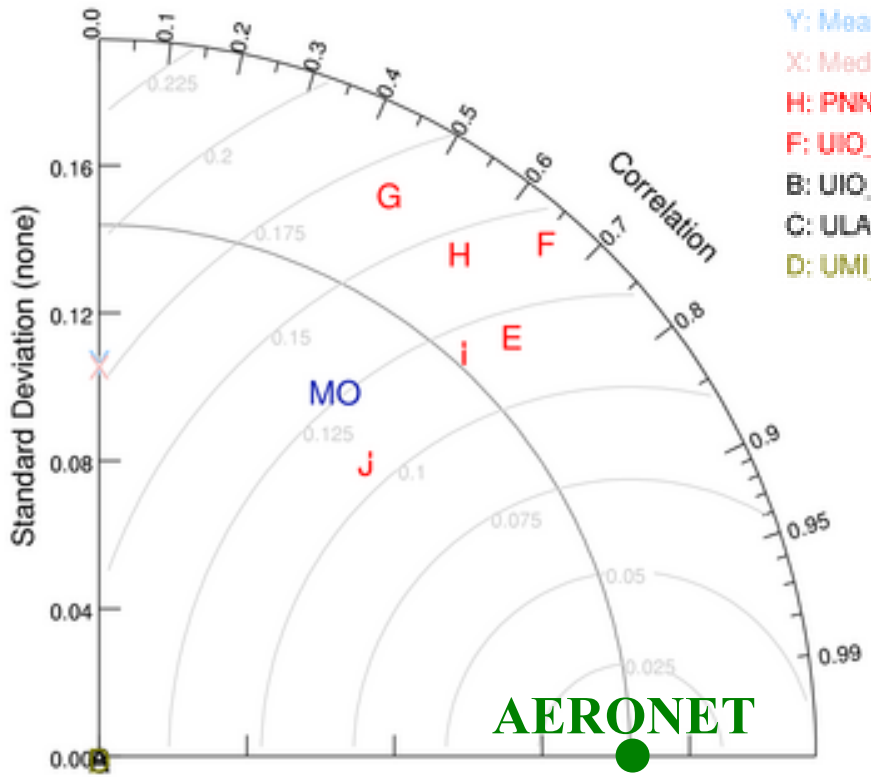

OD550_AER, World 2000
LSCE
slope = 0.66
r = 0.67
506 points
LSCE
AERONET


OD550_AER, World 2000
MATCH
slope = 0.92
r = 0.66
506 points
MATCH
AERONET


OD550_AER, World 2000
UIO-CTM
slope = 1.00
r = 0.65
506 points
UIO_CTM
AERONET

Global comparison Aerosol Optical Depth
MODELS vs DATA
Monthly values for year 2000





A: AROM_clim
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F: UIO_CTM_2000
B: UIO_GCM_clim
C: ULAQ_T_clim
D: UMI_D_1997

data points:
12*360*180
*cloud free area

data points:
506

With respect to « the global aerosol »

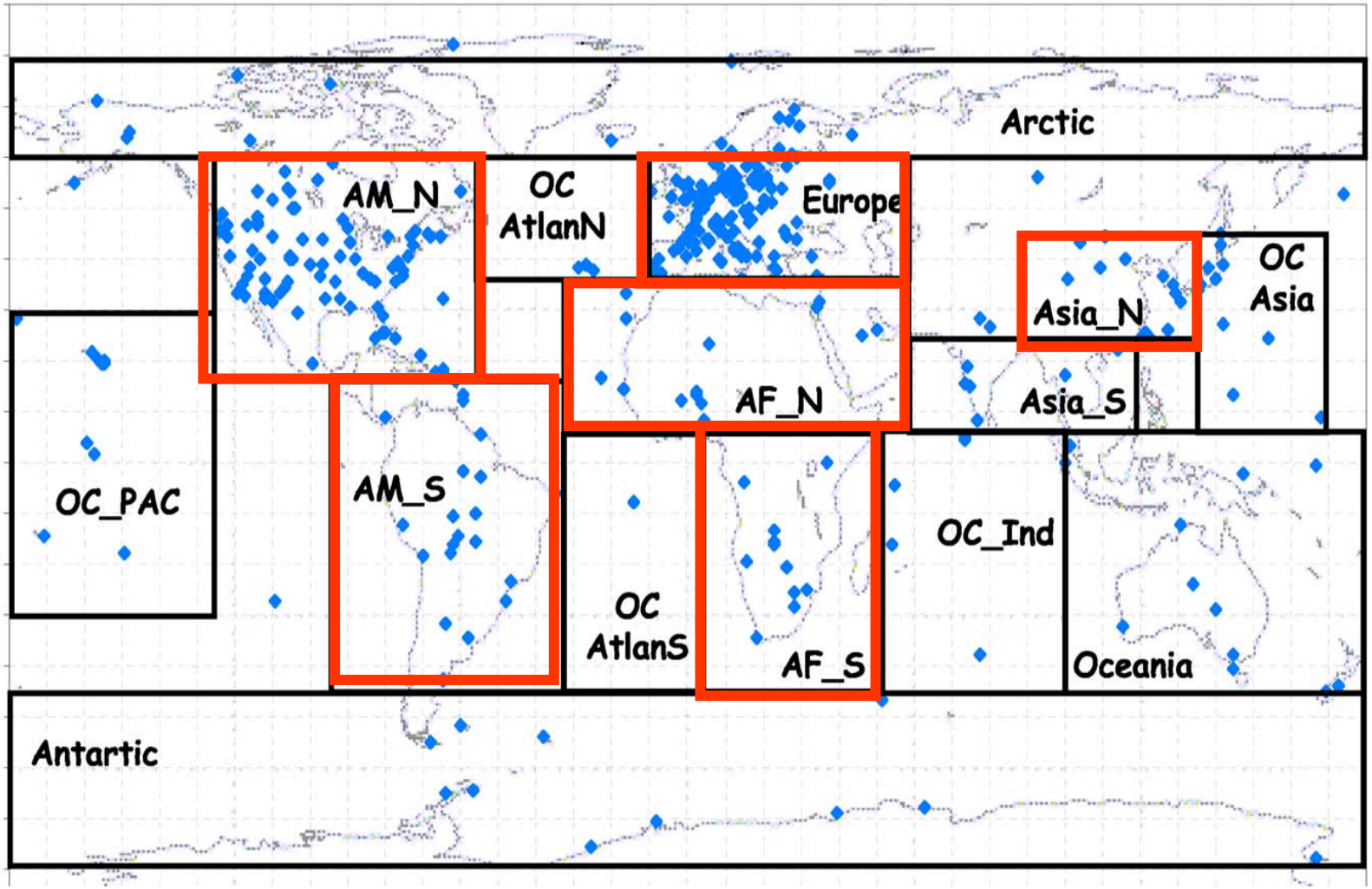
- How much and why do models differ?
- Which specific problems for which aerosol component?
- How do they compare to measurements?
- Which is THE best model?

- On the scale of continents: Do we understand regions equally well?
- Why do models and observations differ?

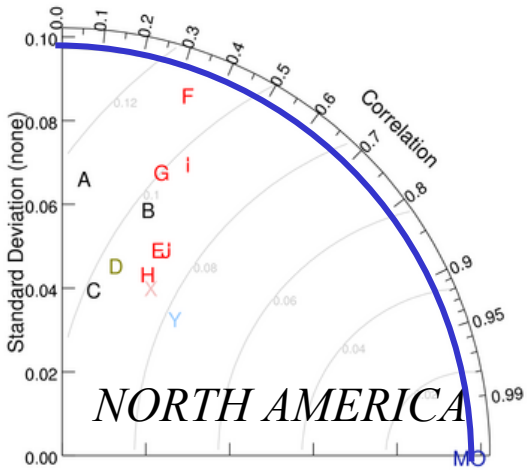
- Which uncertainty on globally averaged aerosol optical properties?
- Can we extrapolate observations with the help of models?

- Whats needed to improve our understanding?

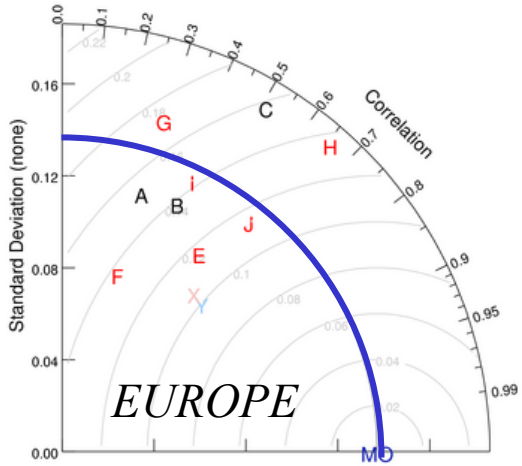
Taylor diagrammes for continental regions / MODELS VS MODIS 2000



*Taylors continental regions / MODELS VS **MODIS** 2000*



MODIS



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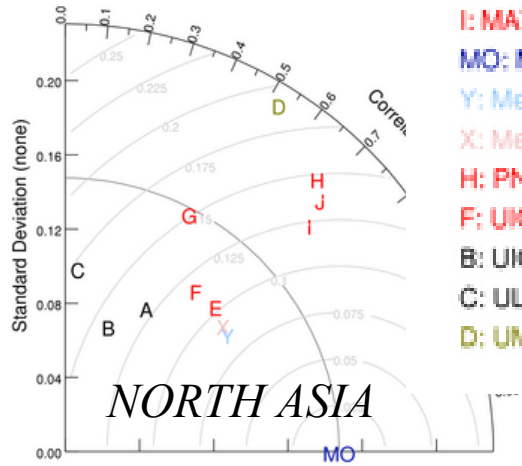

MODIS

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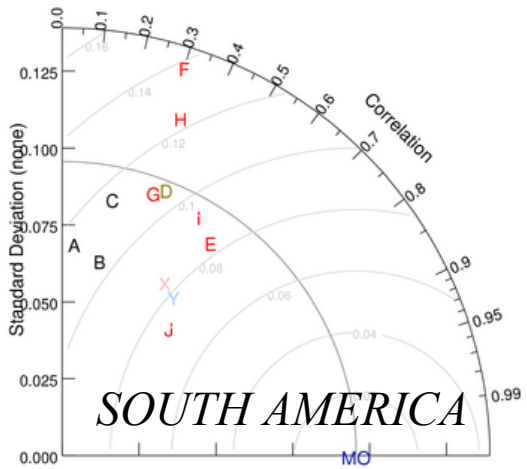
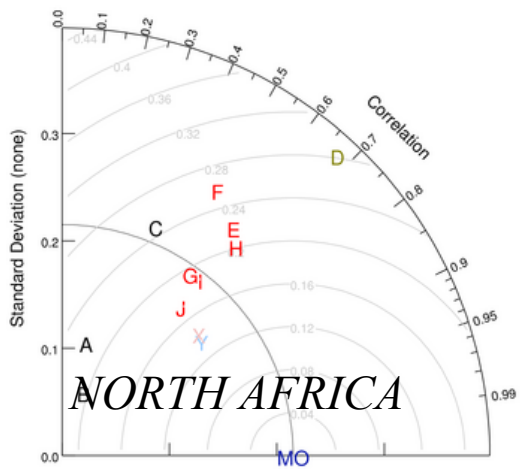
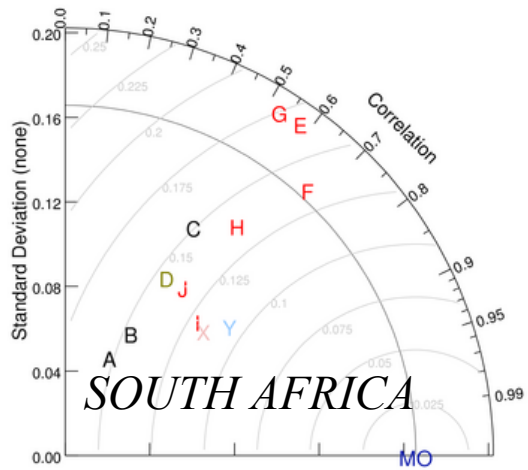


MODIS

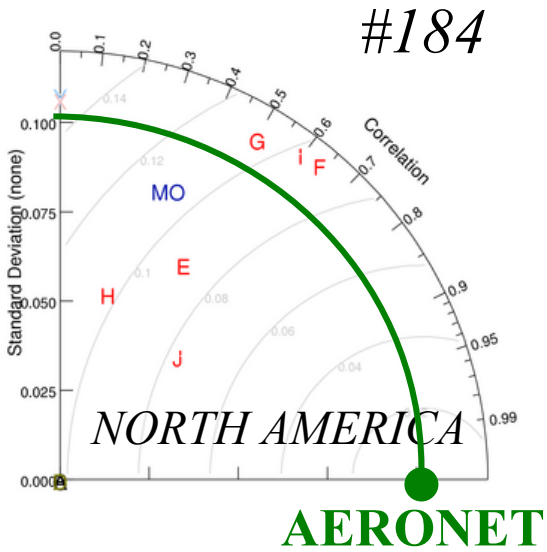


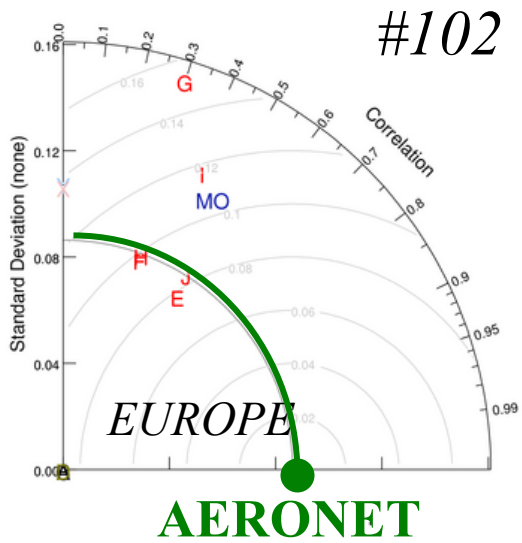
MODIS

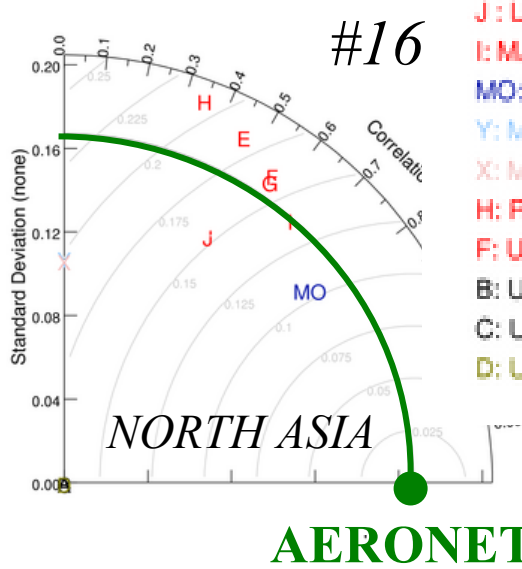


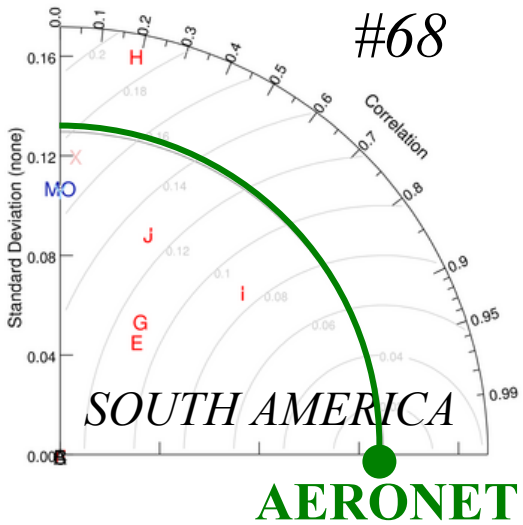
MODIS

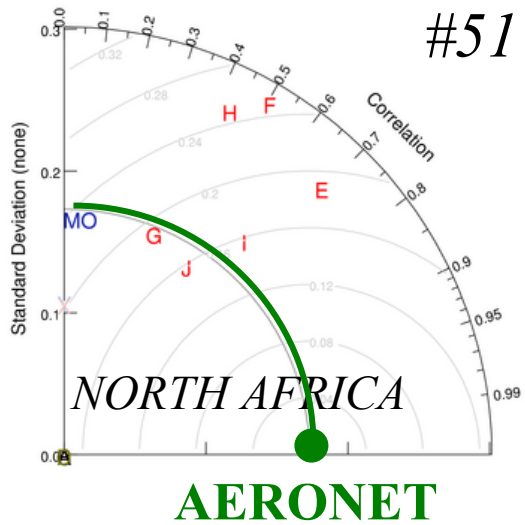
*Taylors for continental regions / MODELS VS **AERONET** 200*

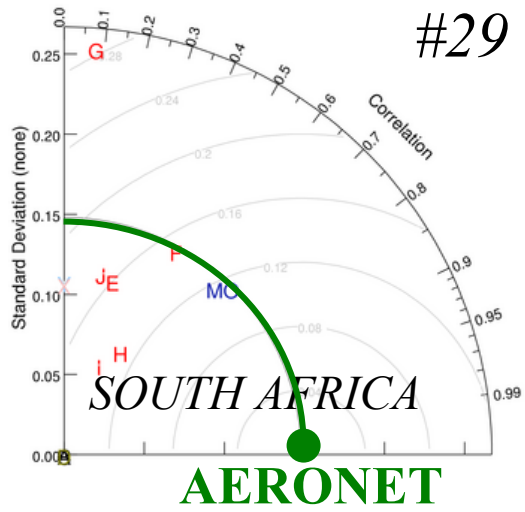












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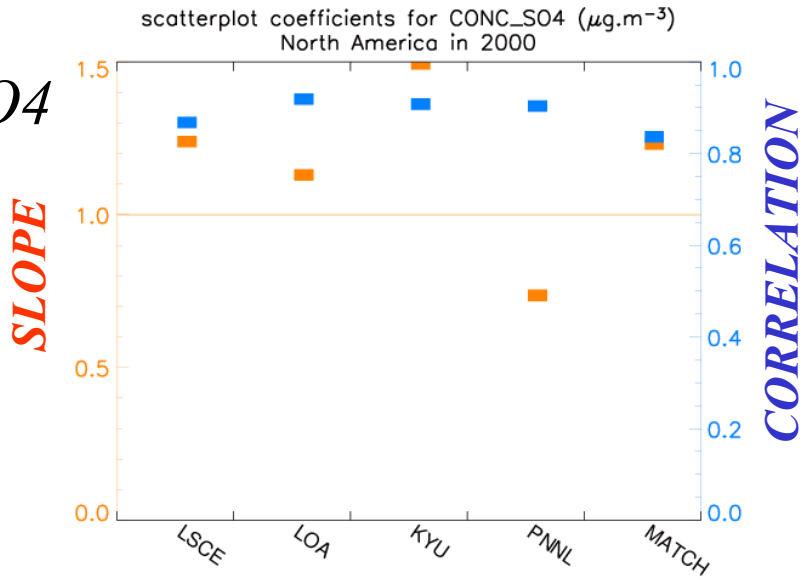
D: UMI_D_1997

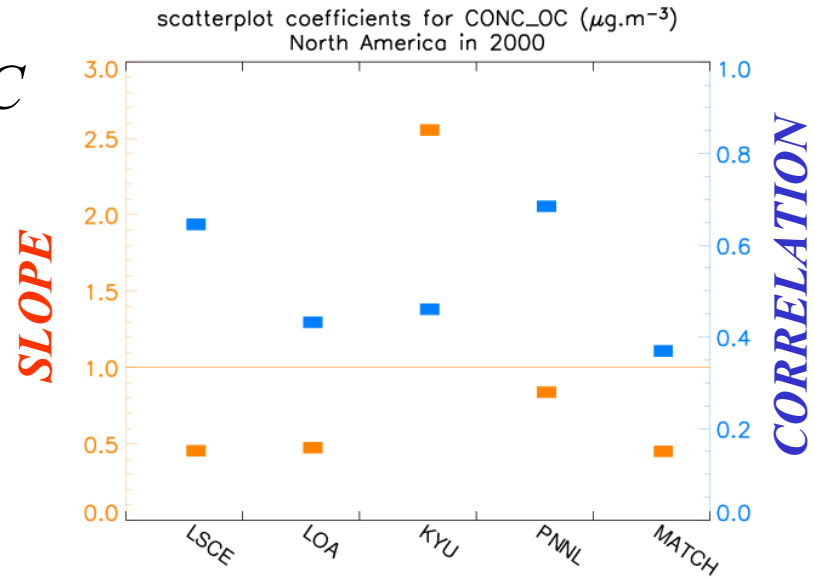
CORRELATION AND SLOPE - MODELS vs SO4 + OC

NORTH AMERICA

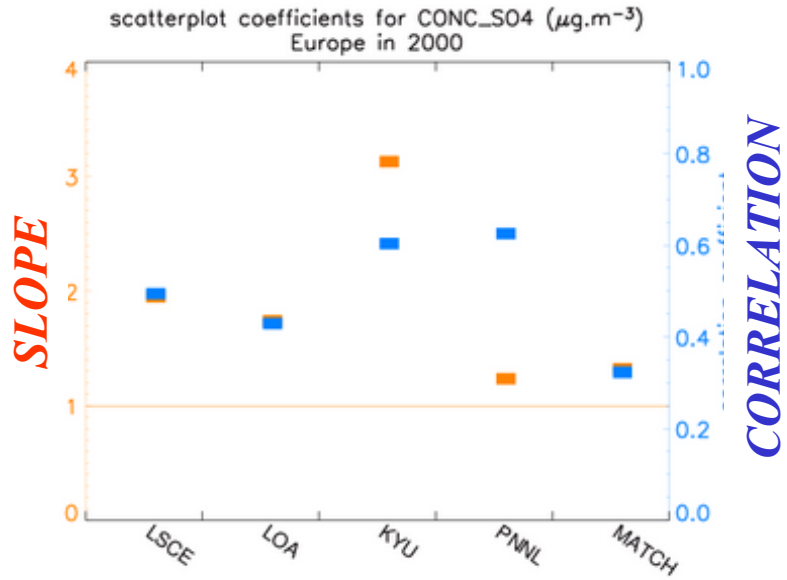
SO4



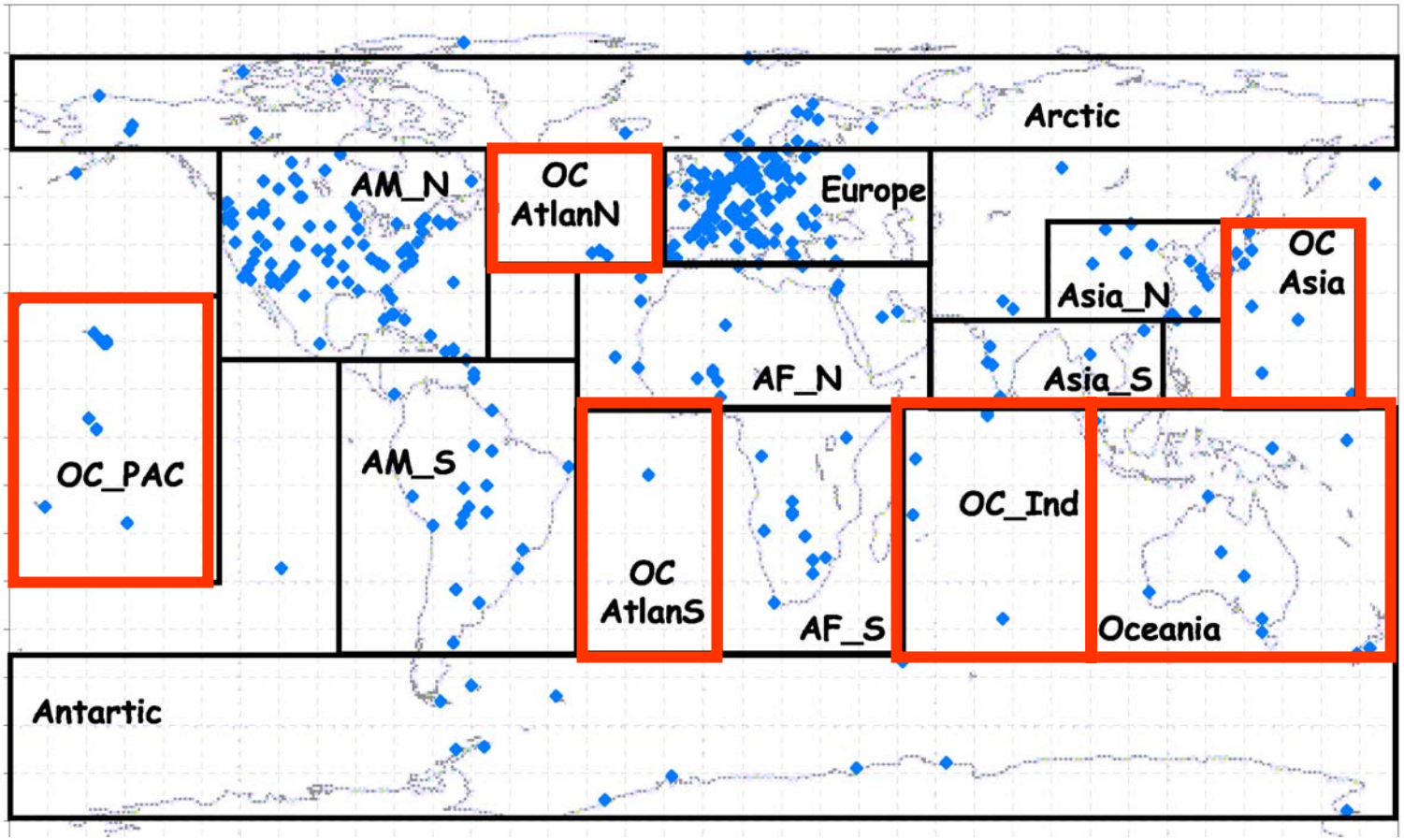
OC



EUROPE



Taylor diagrammes for oceanic regions / MODELS VS MODIS 2000



Taylor diagrammes « oceanic » regions / MODELS VS MODIS

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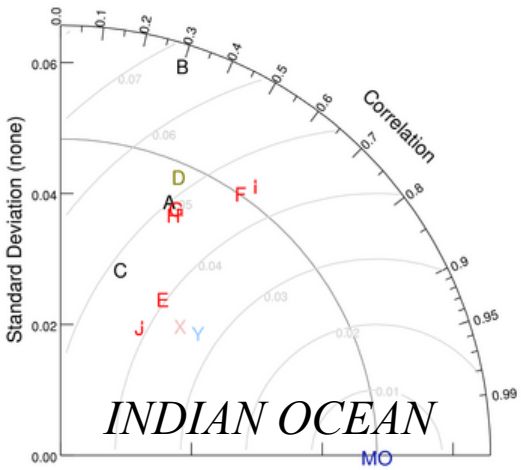
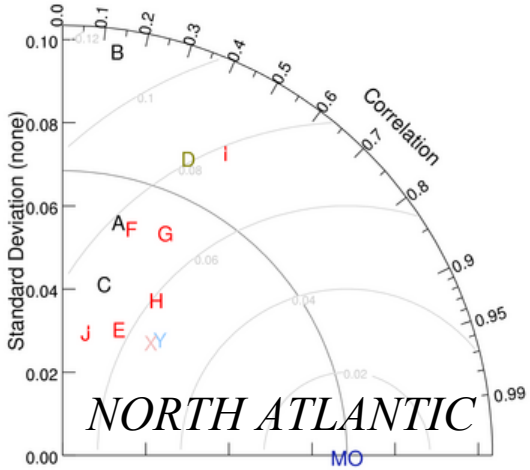


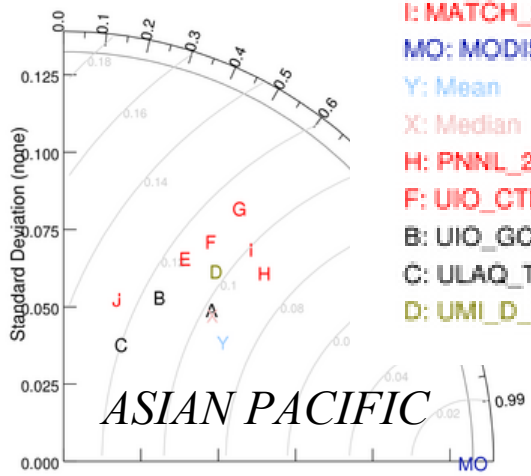
INDIAN OCEAN

MODIS



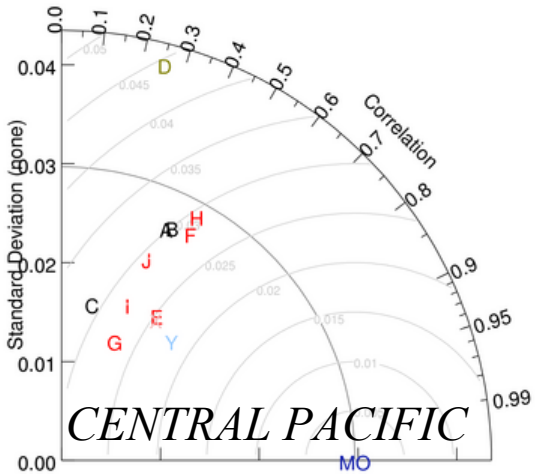
NORTH ATLANTIC

MODIS



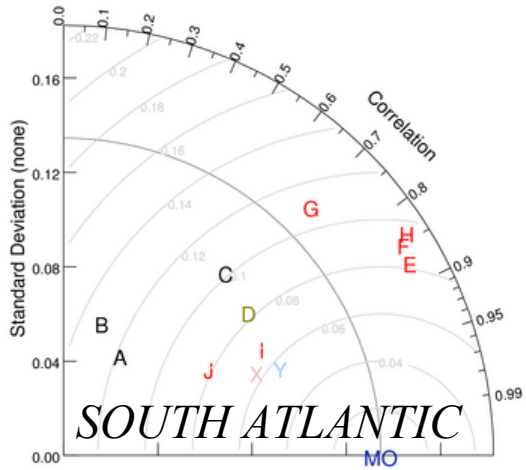
ASIAN PACIFIC

MODIS



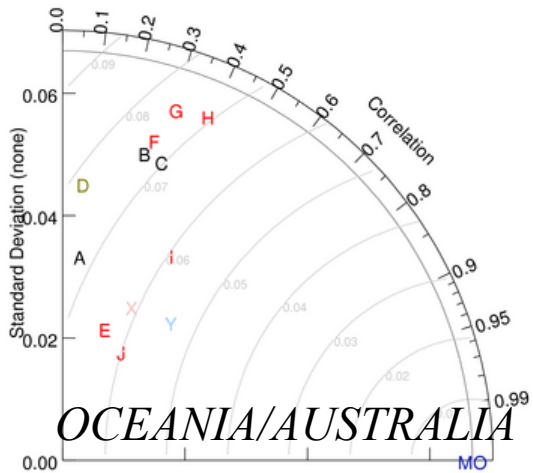
CENTRAL PACIFIC

MODIS



SOUTH ATLANTIC

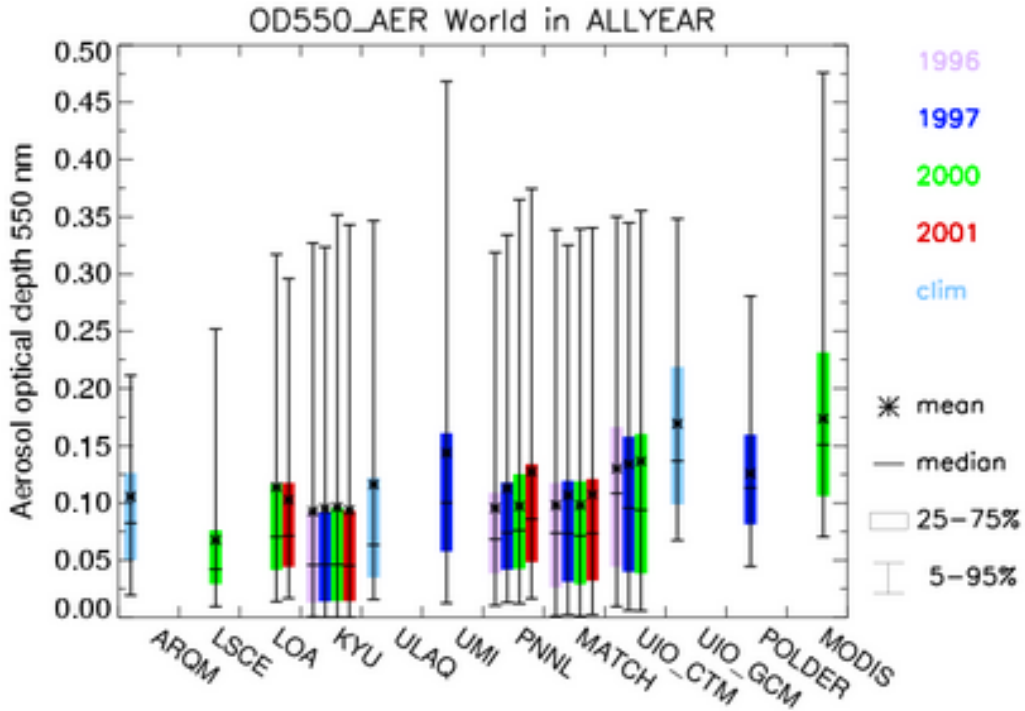
MODIS

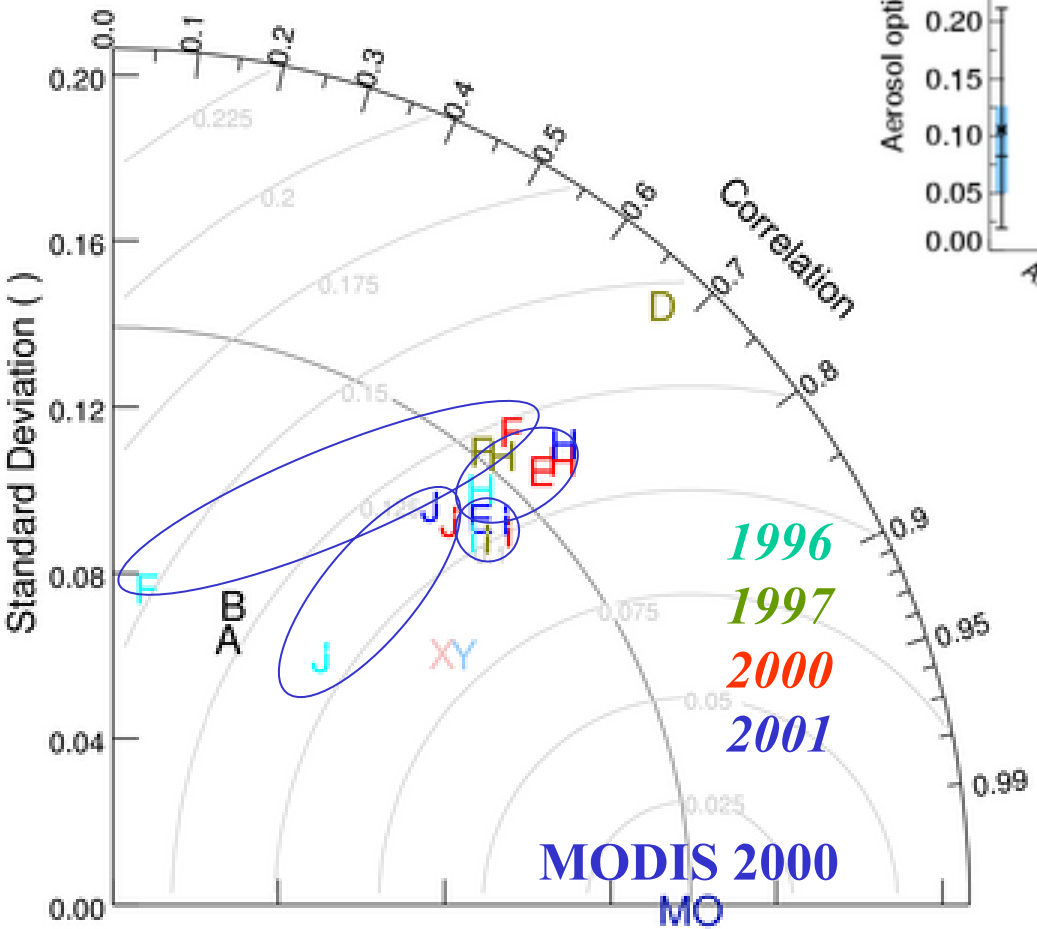


OCEANIA/AUSTRALIA

MODIS

INTERANNUAL VARIABILITY VERSUS MODEL DIFFERENCES





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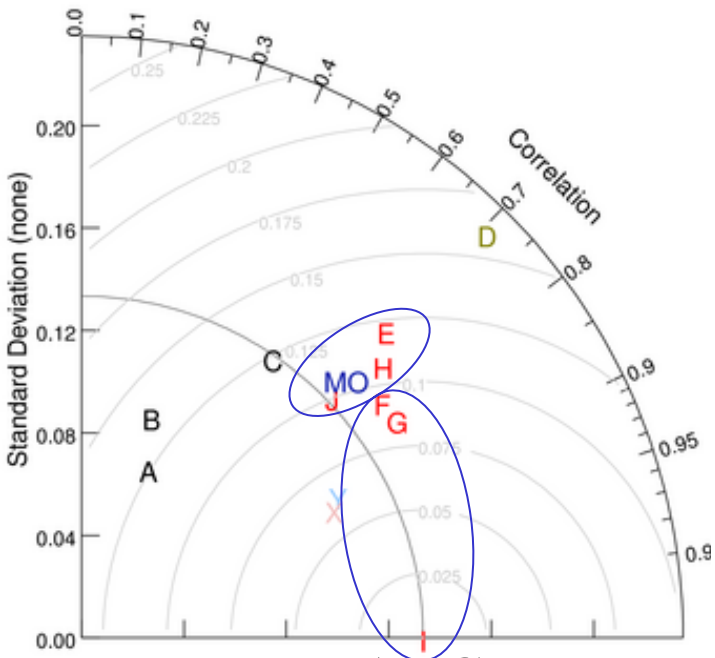
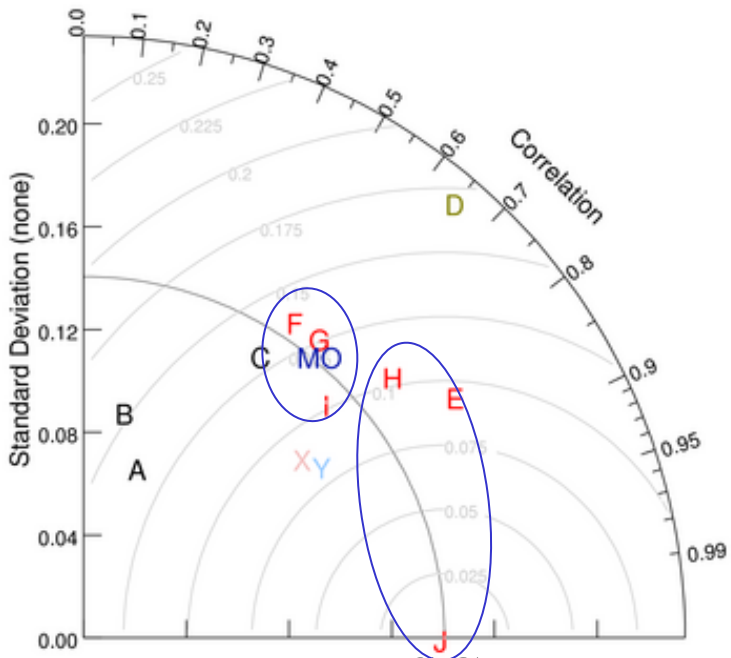
D: UMI_D_1997

Do models resemble each other more than
models resemble observations?



MATCH



LSCE

A: AROM_clim
G: KYU_D_2000
E: LOA_D_2000
J : LSCE_2000
I: MATCH_2000
MO: MODIS_2000
Y: Mean
X: Median
H: PNNL_2000
F: UIO_CTM_2000
B: UIO_GCM_clim
C: ULAQ_T_clim
D: UMI_D_1997

Model fields taken as reference data set

With respect to « the global aerosol »

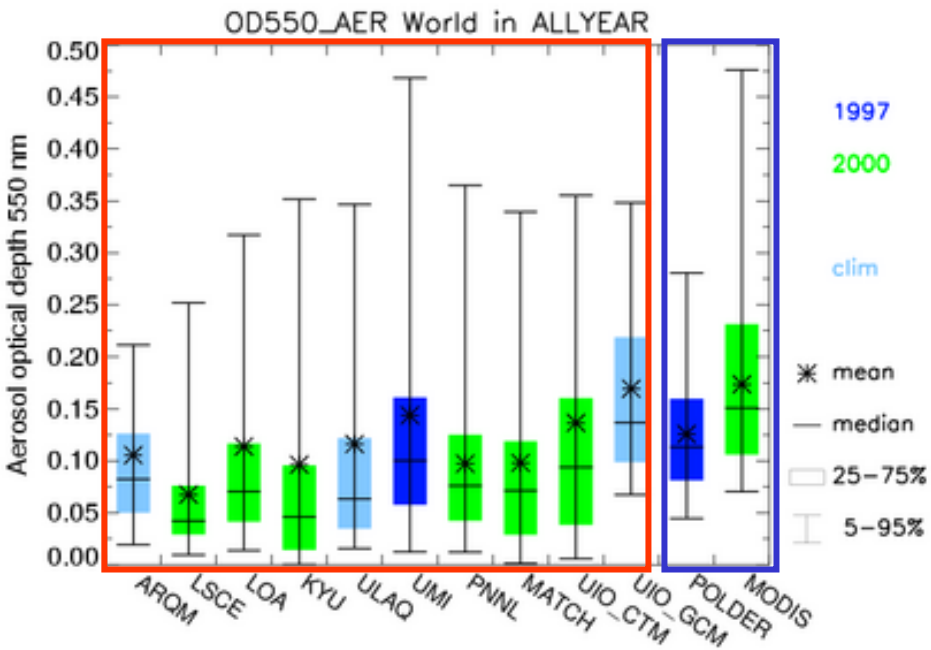
- How much and why do models differ?
- Which specific problems for which aerosol component?
- How do they compare to measurements?
- Which is THE best model?

- On the scale of continents: Do we understand regions equally well?
- Why do models and observations differ?

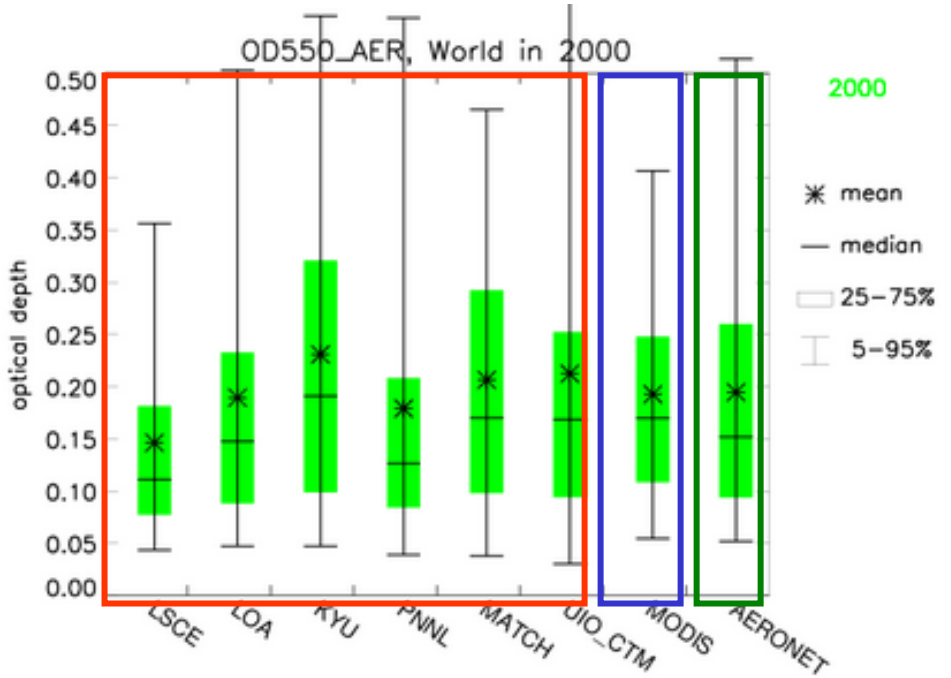
- Which uncertainty on globally averaged aerosol optical properties?
- Can we extrapolate observations with the help of models?

- Whats needed to improve our understanding?

*EXTRAPOLATING **OBSERVATIONS** WITH THE HELP OF **SATELLITES**/**MODELS**??*



GLOBAL AREA MEAN
FROM MONTHLY VALUES



GLOBAL MEAN
@ AERONET STATIONS
FROM MONTHLY VALUES

*MODIS / MODIS@AERONET ~ **0.7** * MODIS@AERONET / AERONET ~ **1.0*** = ***0.7***
*LSCE / LSCE@AERONET ~ **0.5** * LSCE@AERONET / AERONET ~ **0.7*** = ***0.4***
*MATCH / MATCH@AERONET ~ **0.5** * MATCH@AERONET / AERONET ~ **1.1*** = ***0.55***
*KYU / KYU@AERONET ~ **0.4** * KYU@AERONET / AERONET ~ **1.15*** = ***0.46***

With respect to « the global aerosol »

- How much and why do models differ?
- Which specific problems for which aerosol component?
- How do they compare to measurements?
- Which is THE best model?

- On the scale of continents: Do we understand regions equally well?
- Why do models and observations differ?

- Which uncertainty on globally averaged aerosol optical properties?
- Can we extrapolate observations with the help of models?

- Whats needed to improve our understanding?

AEROCOM shall establish modelled uncertainty range for aerosol parameters relevant to impact on climate

Future goals

Add data – investigate effect of sampling errors (eg daily vs monthly)

Add further model parameter into analysis (absorption, size…)

Analyse differences between models and observations

Document model progress+quality (Harmonised evaluation tools?)

Establish an aerosol climatology data base (best model=average ?)

Harmonise work on aerosol emission scenarios
Extend towards cload-aerosol interaction?