Global Aerosol Model Tested Against Surface Observations : Revisit of model validations

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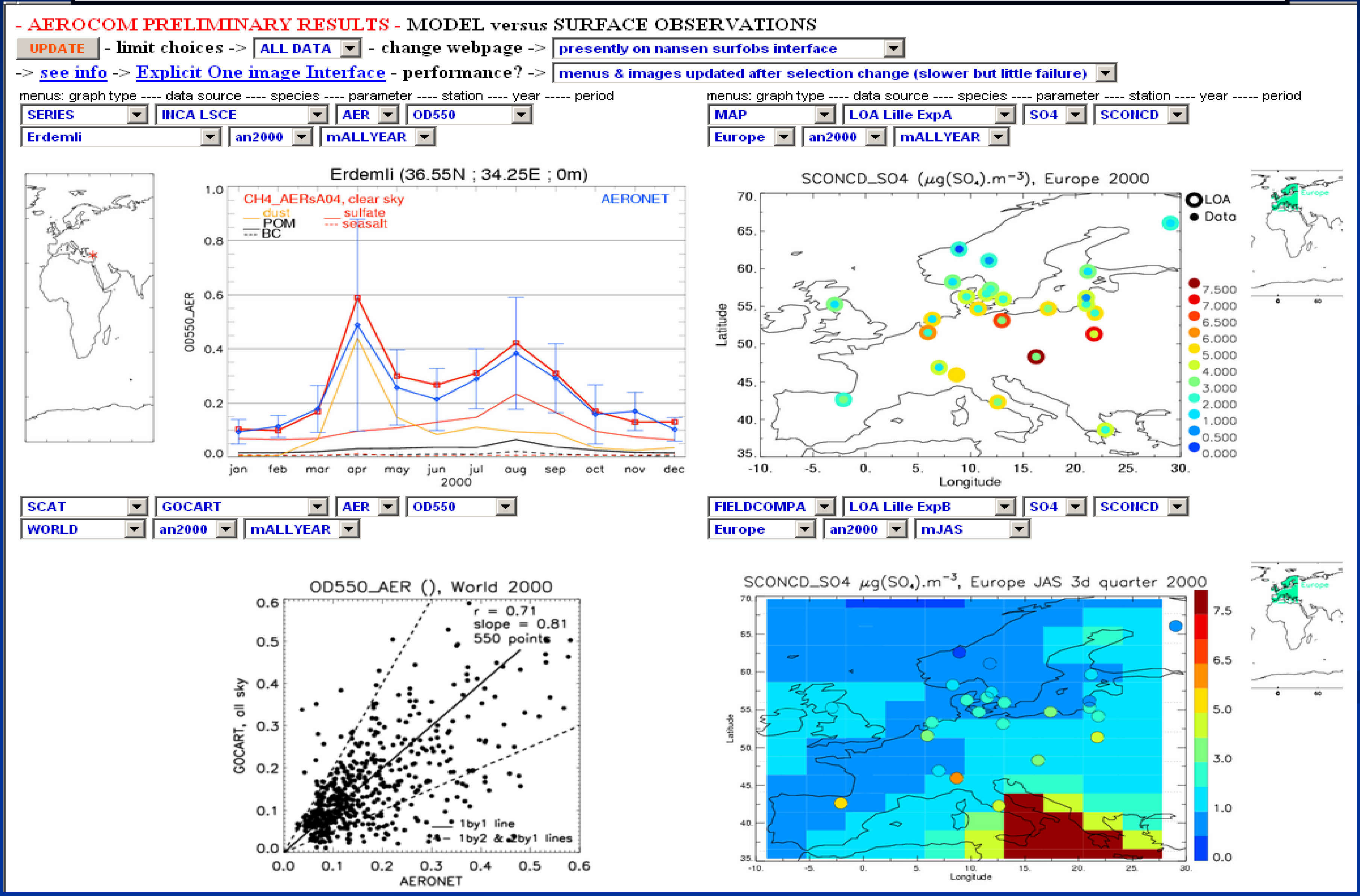
SURFOBS web interface

http://nansen.ipsl.jussieu.fr/AEROCOM/DATA/surfobs.html



Types of graph producted

Species - Parameter

AER
SO4
BC
OC
DUST

Monthly or daily data → OD550 (D), ANGSTROM (D)

OD550LT1D
EC550

Use of 3D or surface conc → SCONCD, CONC3D

Year/Month/Season

Station / Region

Type

SERIES
MAP
SCAT (scatterplot)
FIELDCOMPA

Post-processing of model output

Horizontal interpolation :
Model output interpolated to stations locations

Daily filtration :
Daily data => Model data filtering according to observations

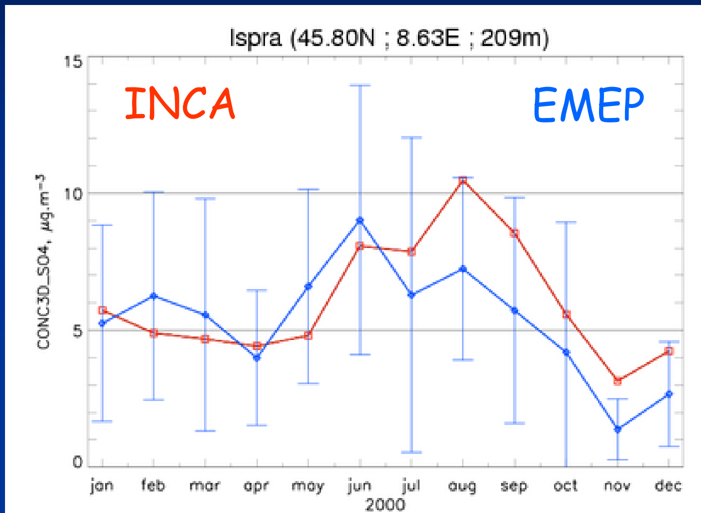
If at least 8 days in a month with data
=> Monthly mean (use for timeseries and scatterplots)

If at least 3 months in a year with data
=> Yearly mean (use for Map anf Fieldcompa)

Rejection of « mountain » sites for surface comparison
-> some mountains remain in the comparison if models put ground level at the correct altitude
exemple :

Features (1)

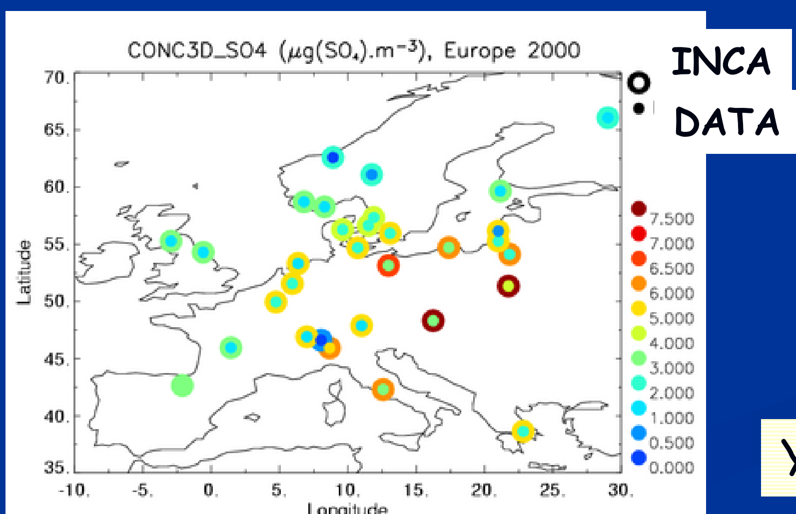
SERIES : time series at each station

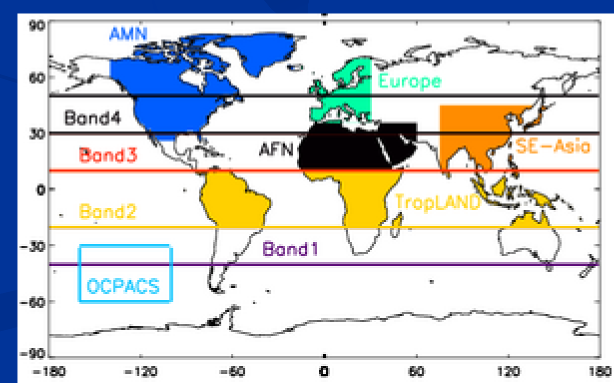


SCONCD : use of surface daily concentration => Daily filtration + no mountain sites

CONC3D : use of 3D monthly concentration => interpolation of modeled data to the grid box containing the altitude of the station

MAP : comparison model/obs at each station

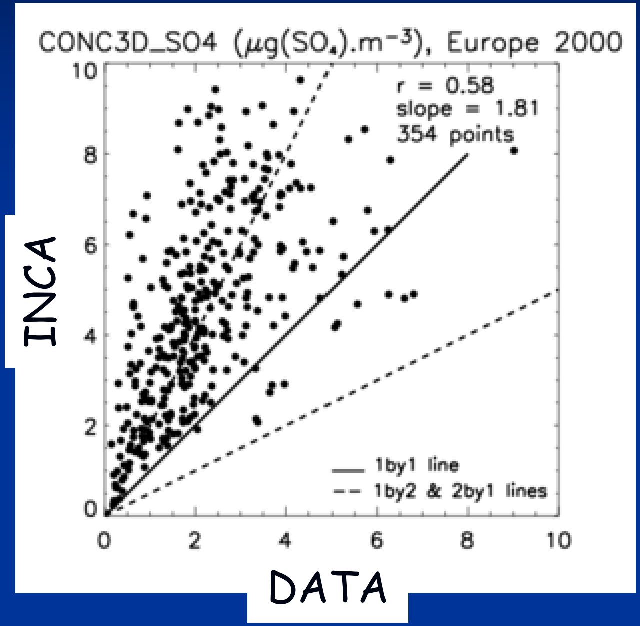




Yearly mean values

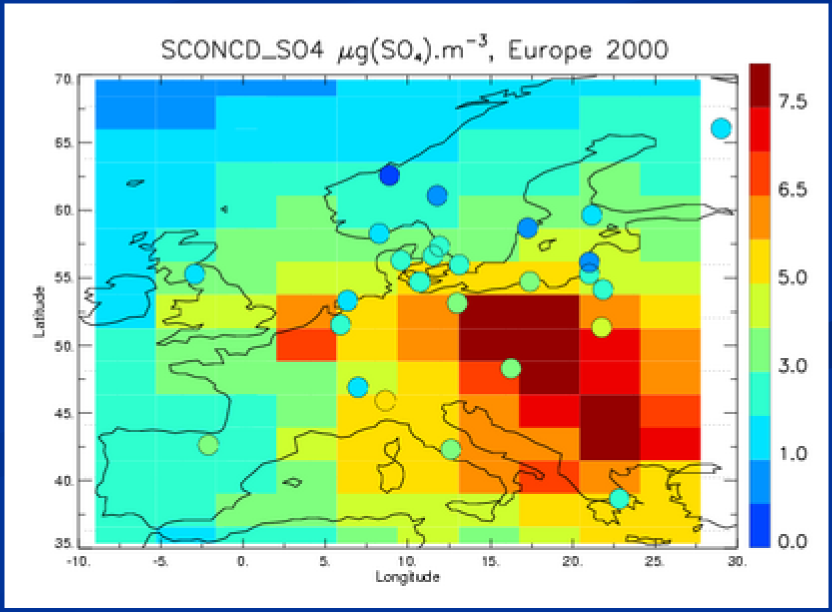
Features (2)

SCAT : scatterplot between model and obs



Use of the monthly mean values at each station

FIELDCOMPA: FIELD + superposition of obs value at each station



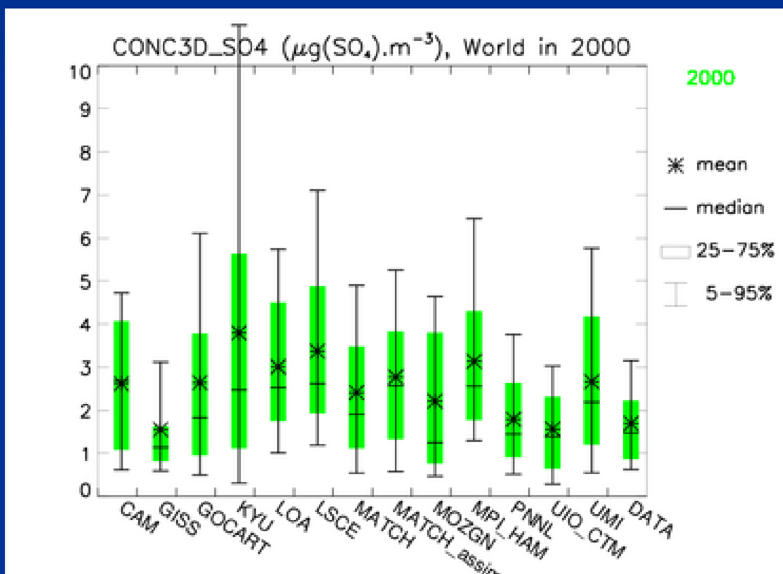
Yearly mean value

Model output + data at surface

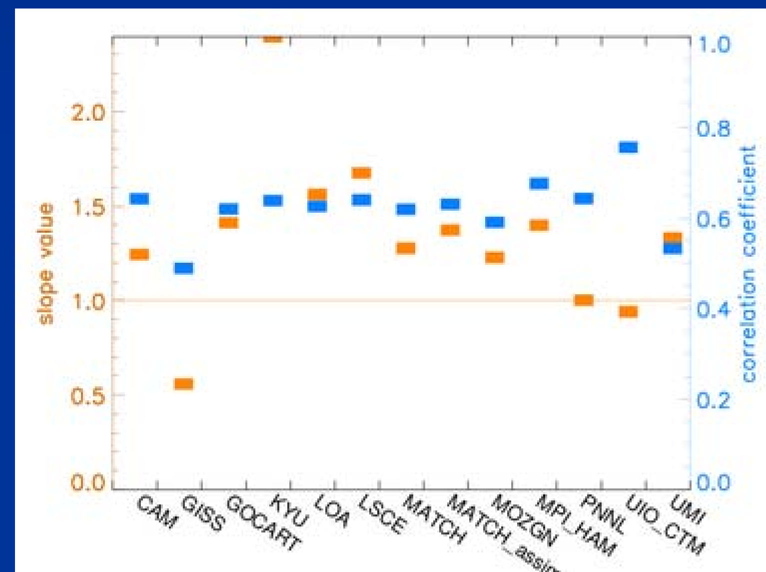
Exists for each month + seasonal average

Features (3)

Synthesis graphs
on http://nansen.ipsl.jussieu.fr/AEROCOM/DATA/synthesis.html



SURFOBS : comparison of mean model/data values

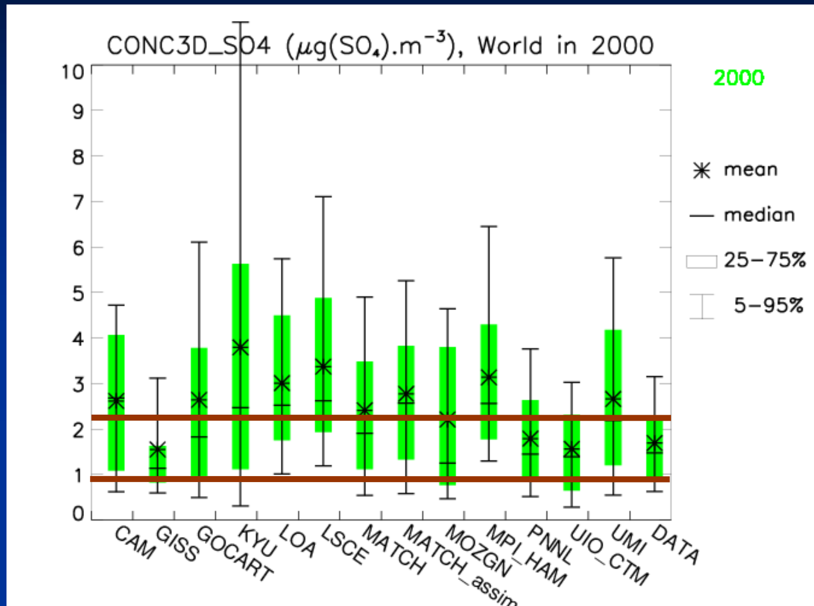


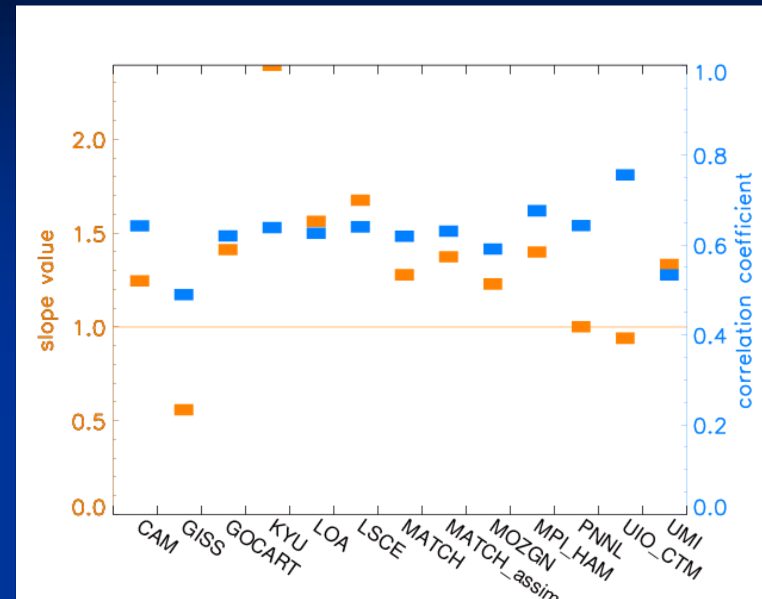
SCATCOEF : comparison of slope and regression coef

SO_4 concentration (1)

Experiment A

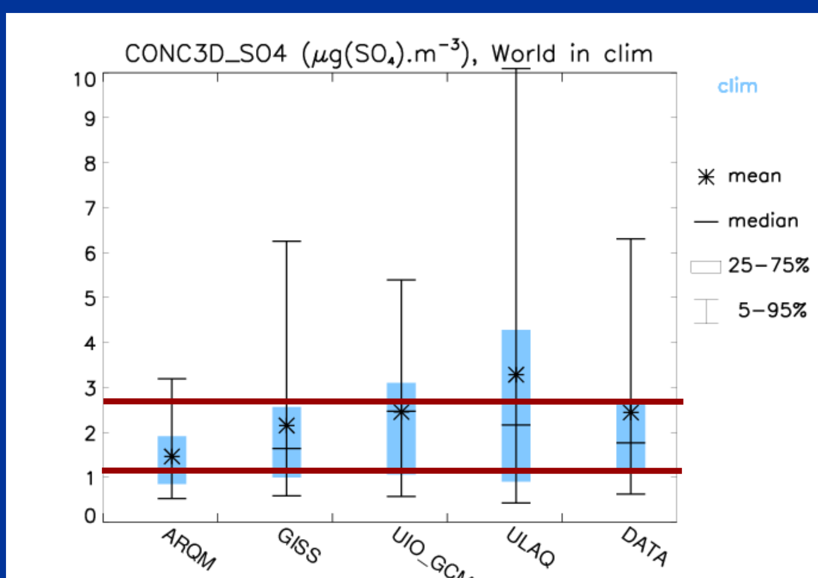
Nudged, year 2000

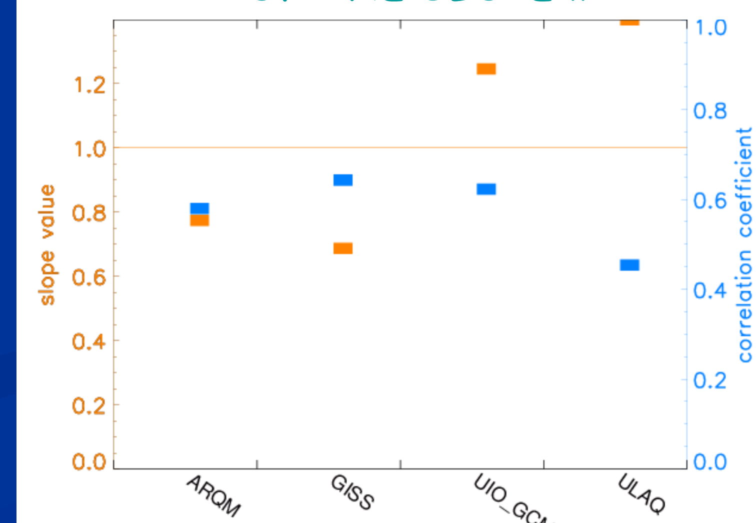




BE CAREFUL WITH THE VALUE OF THE SLOPE !!

Clim, year 9999

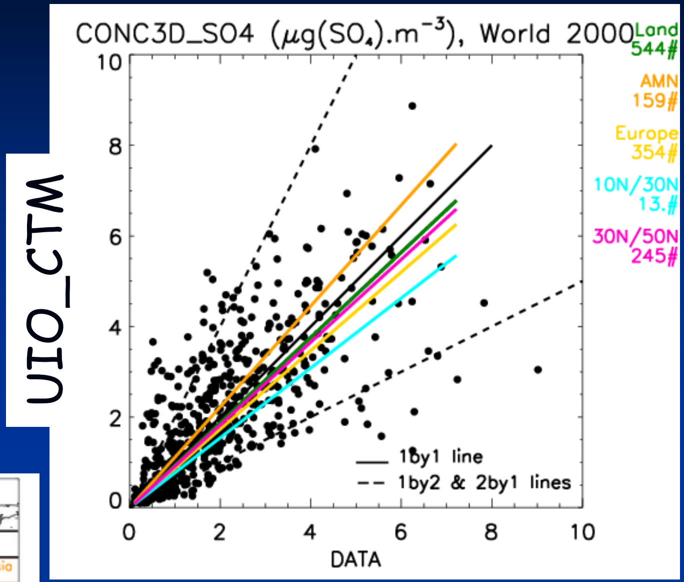


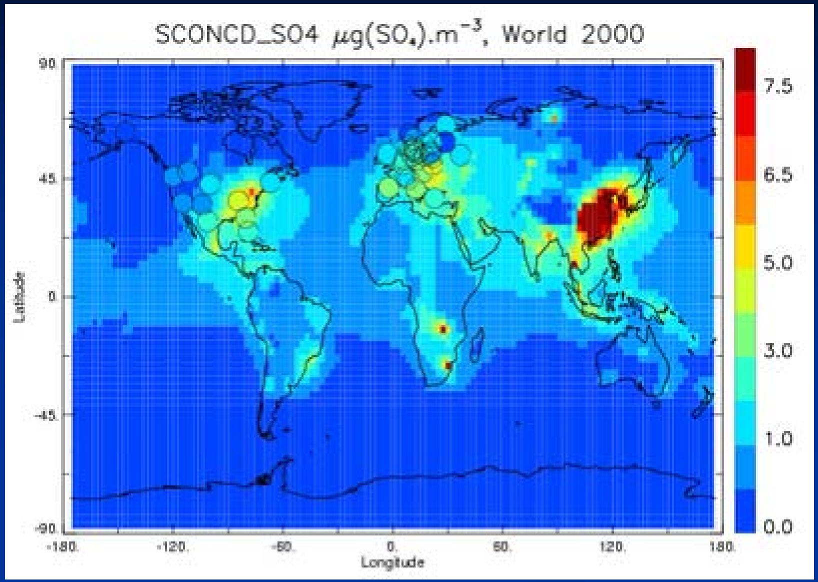


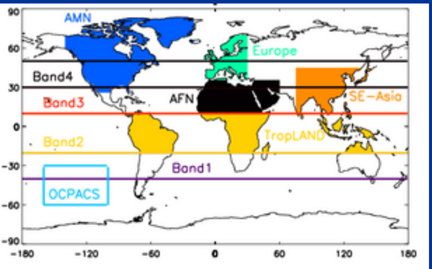
SO_4 concentration (2)

Experiment A

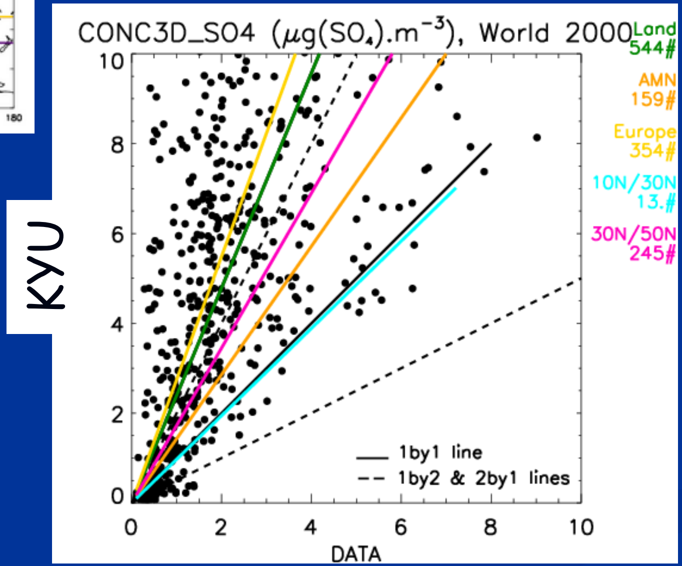
UIO_CTM

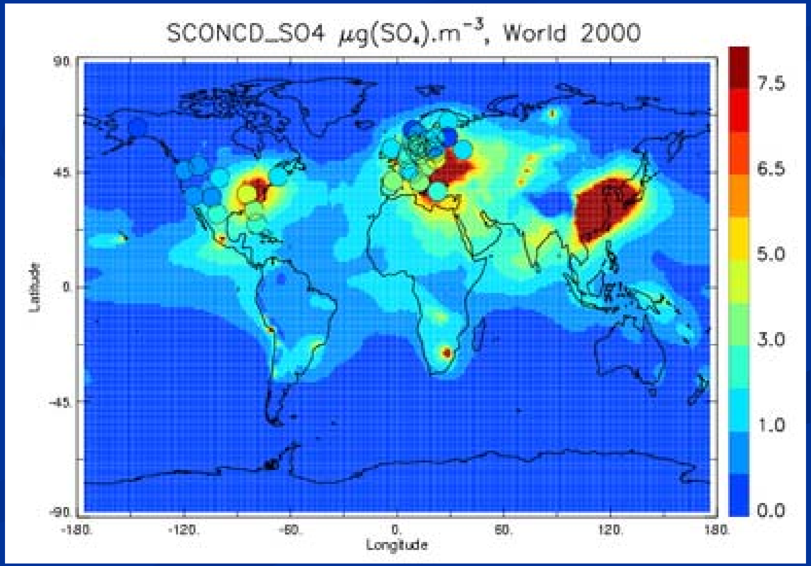






KYU

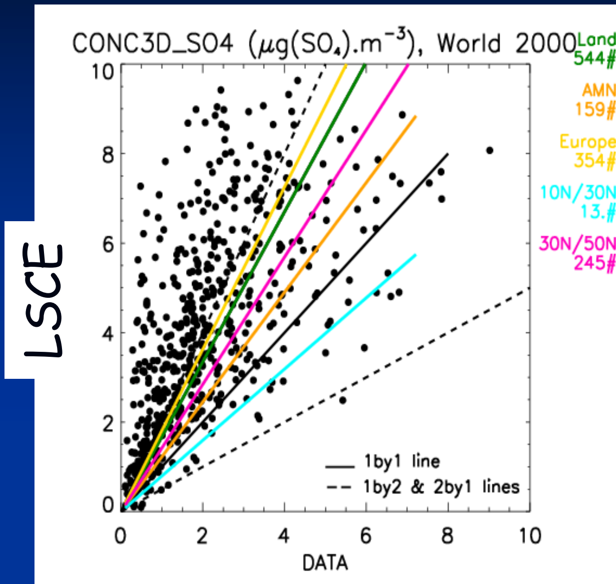




Overestimation over Europe and North America

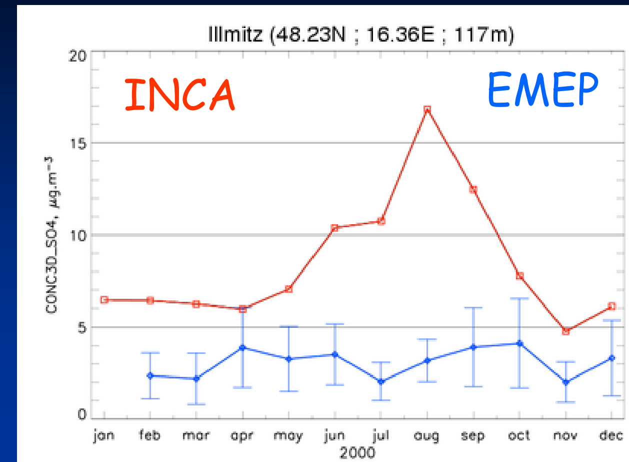
SO_4 concentration (3)

Experiment A

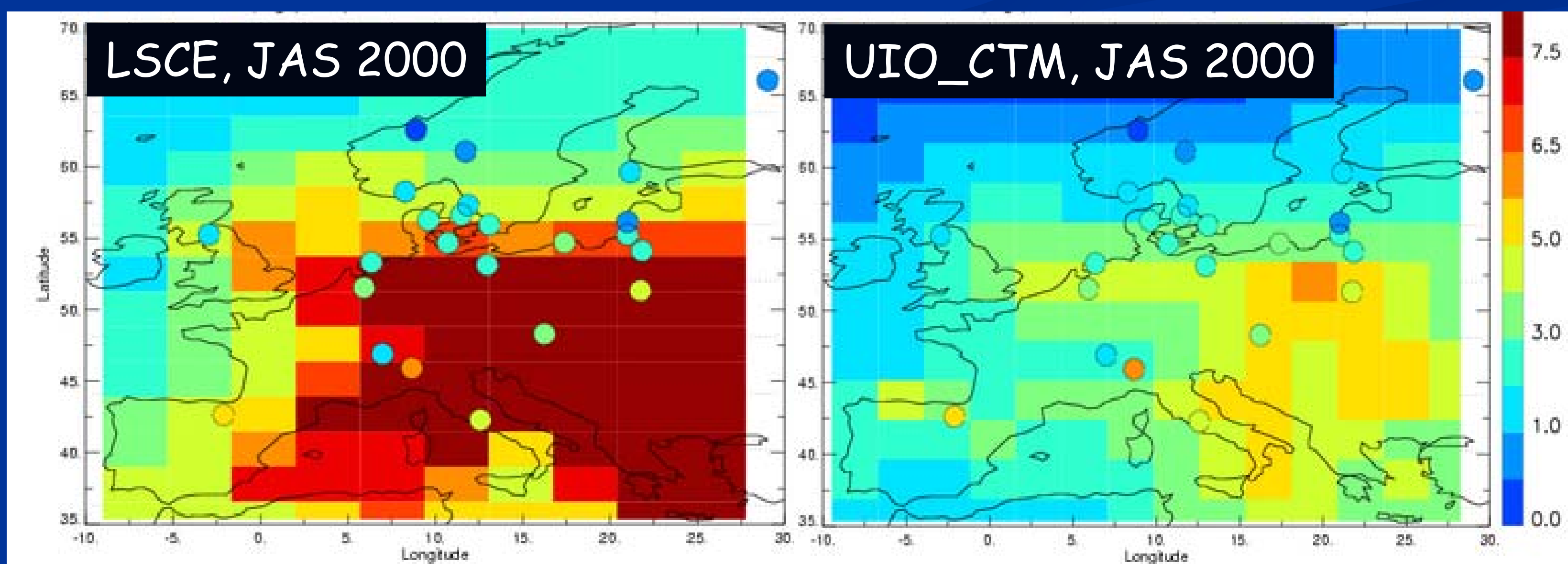


World : 544 points
r = 0.64
slope = 1.67

Europe : 354 points
r = 0.58
slope = 1.81



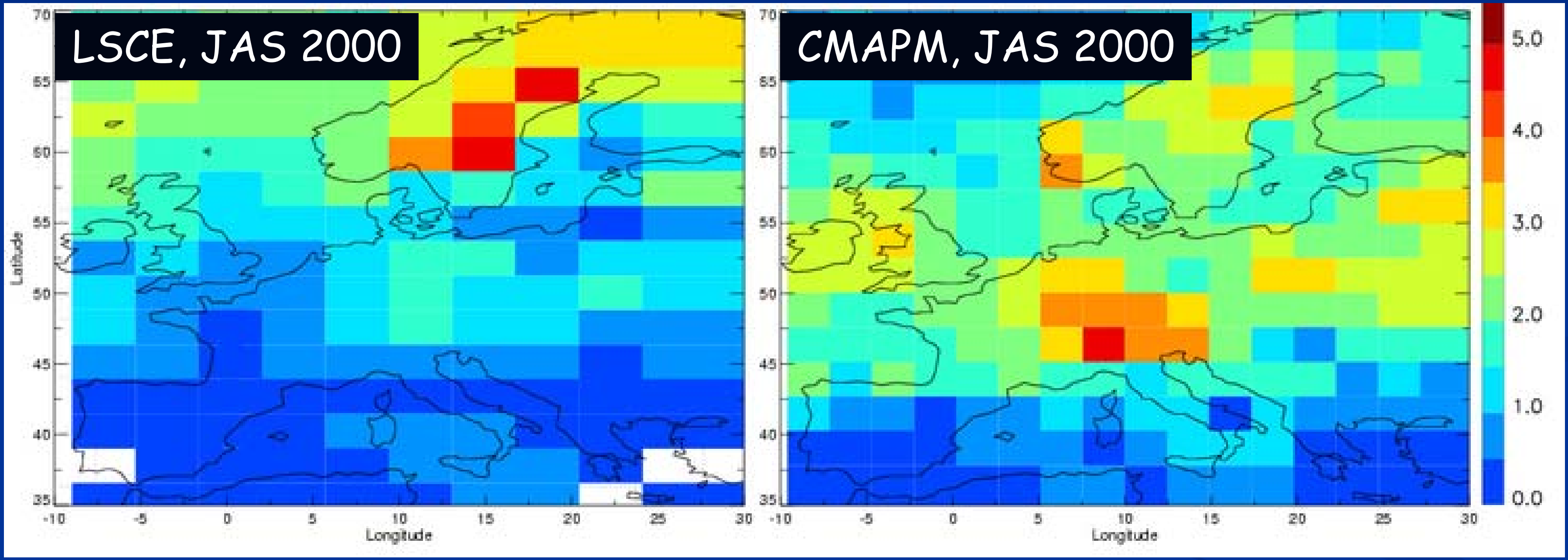
Overestimation by LSCE over Europe during the summer



SO_4 concentration (4)

Experiment A

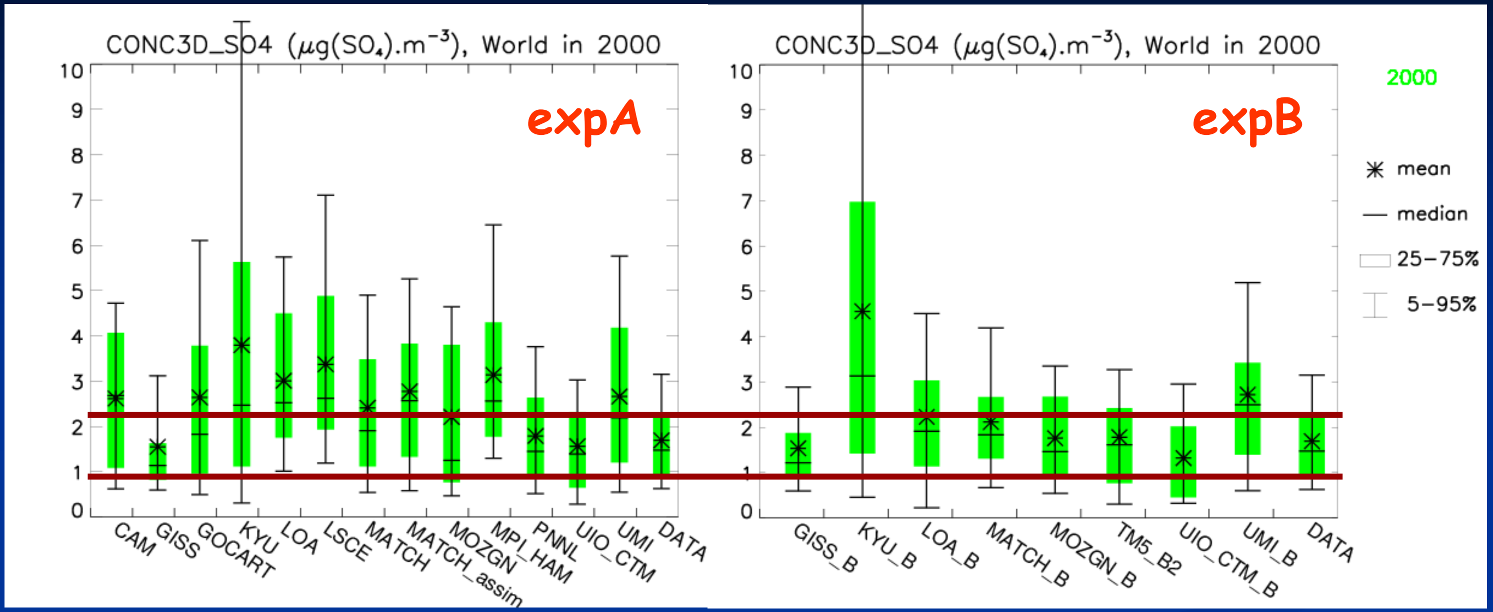
Comparison of precipitation in (mm/day)



Lack of precipitation => too much sulfate concentration

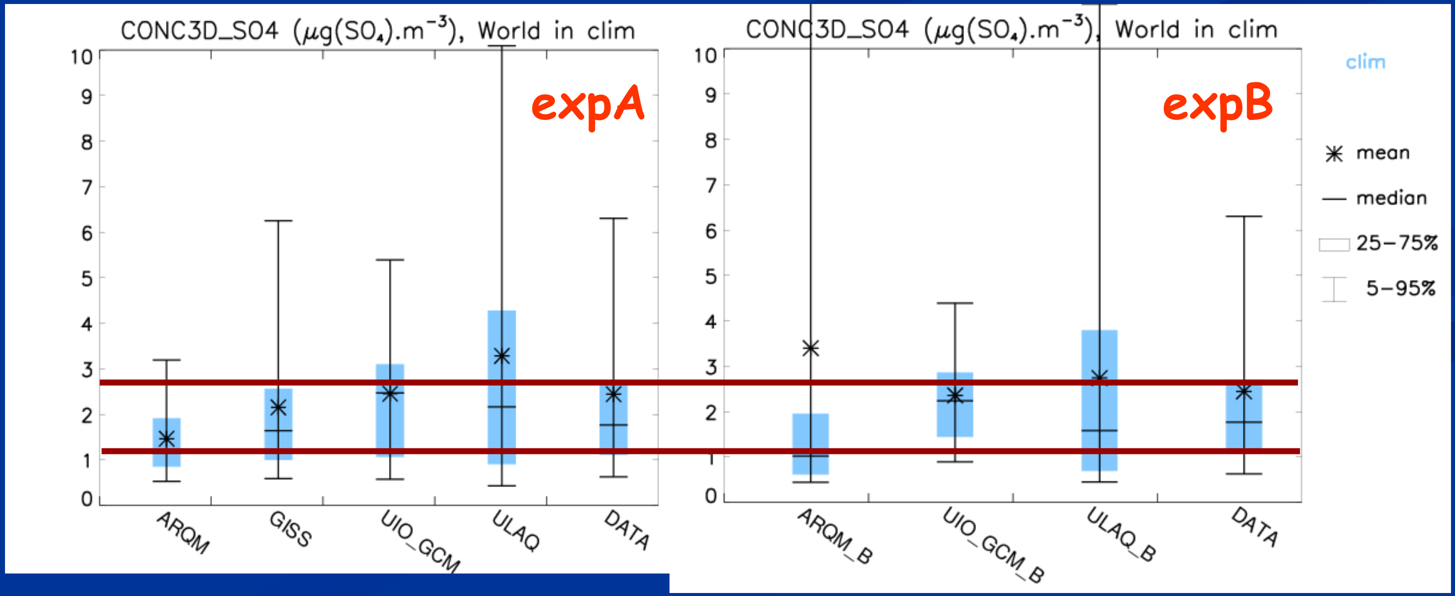
SO_4 concentration (5)

Nudged, year 2000



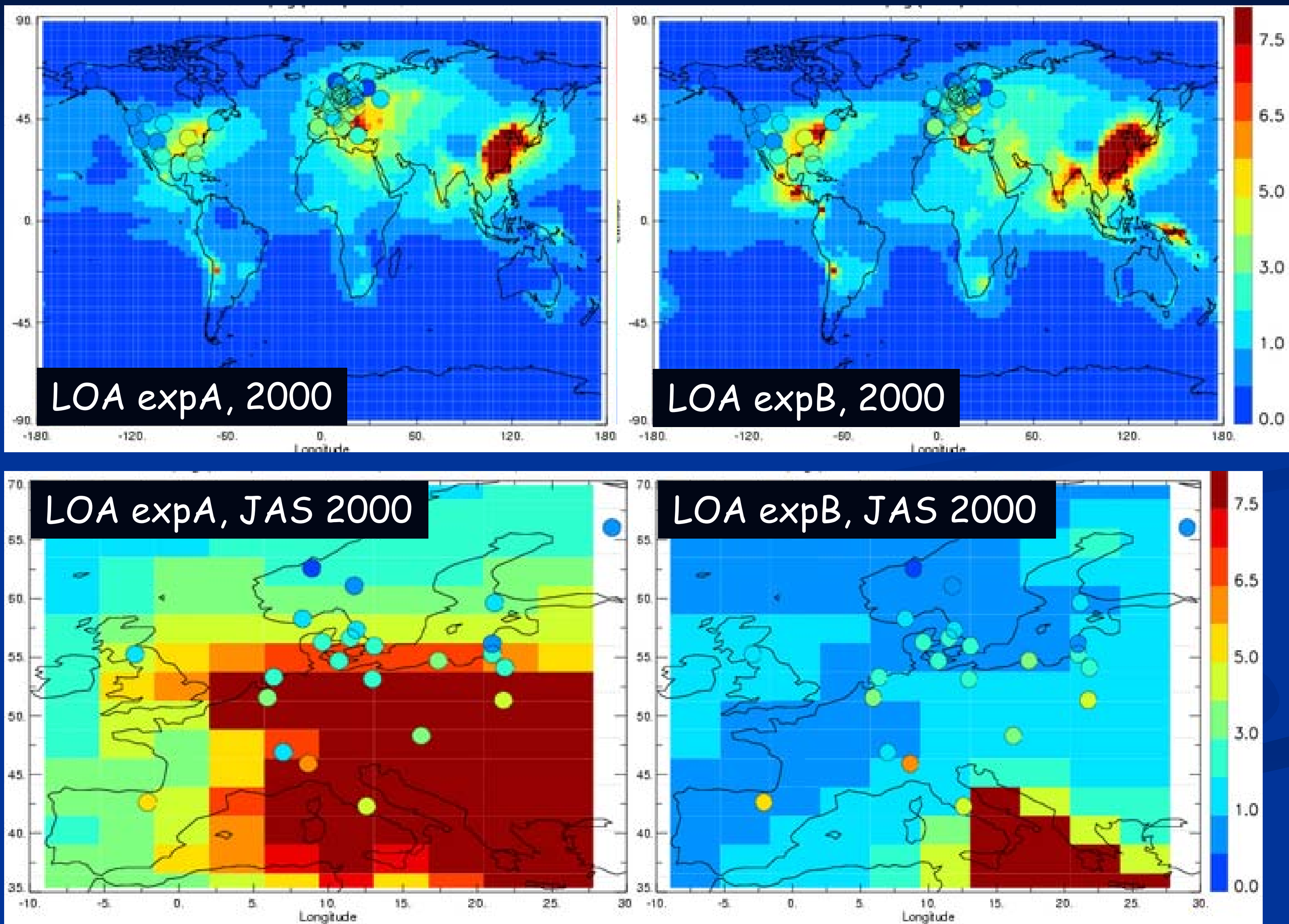
For all models, decrease of CONC 3D_SO4

Clim, year 9999



SO_4 concentration (6)

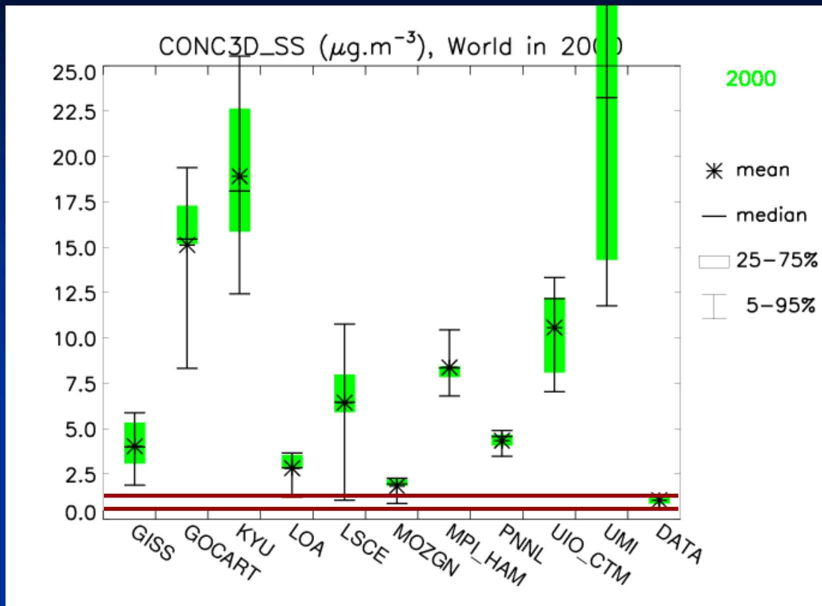
Decrease of concentration over Europe, during the summer

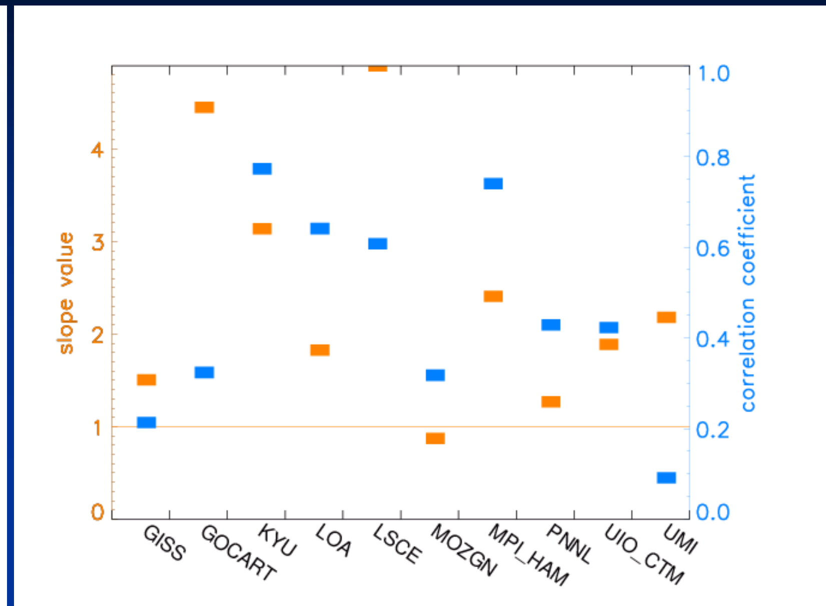


Sea Salt concentration (1)

Experiment A

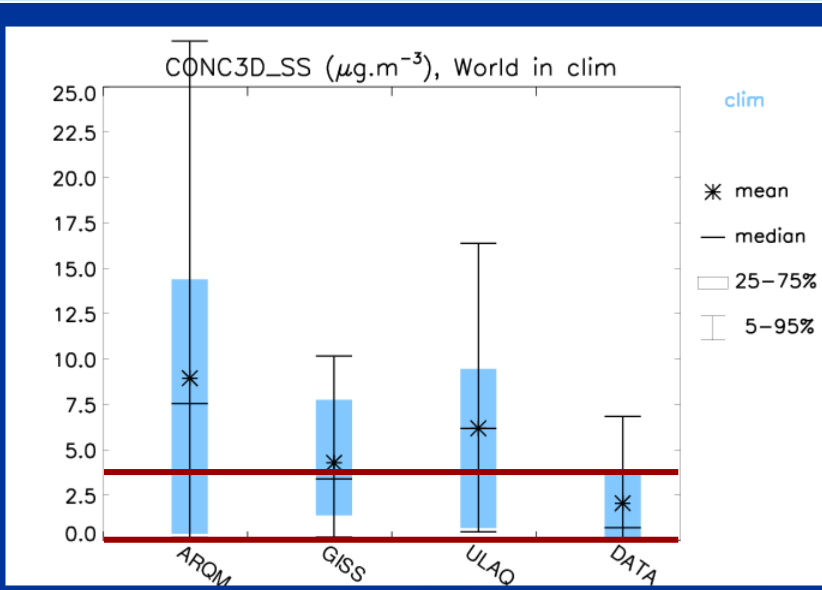
Nudged, year 2000

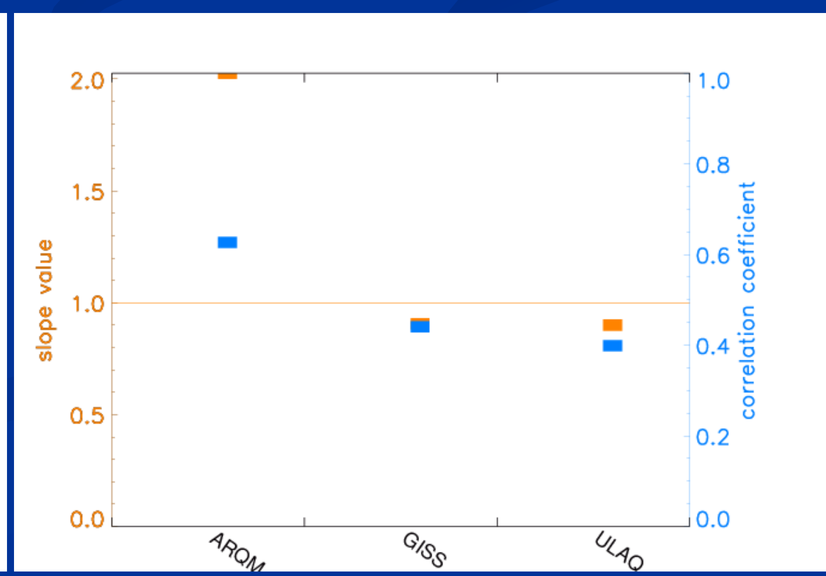




Overestimation by all models for 2000 (except MOZGN)

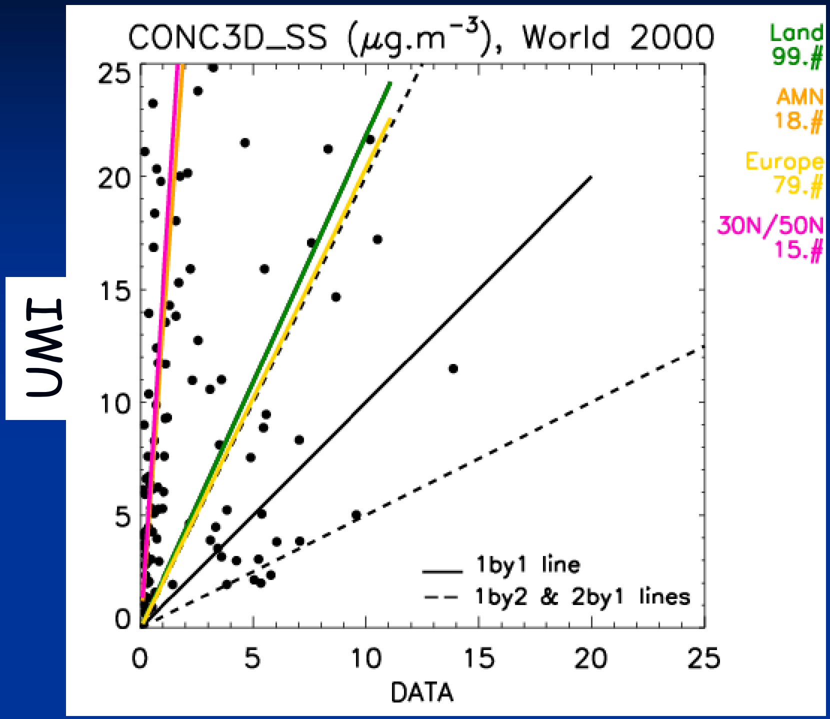
Clim, year 9999

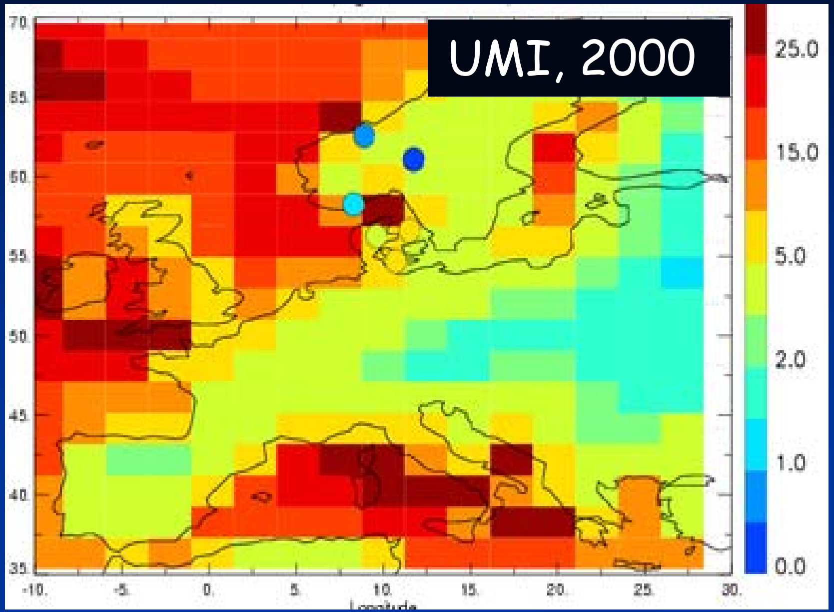


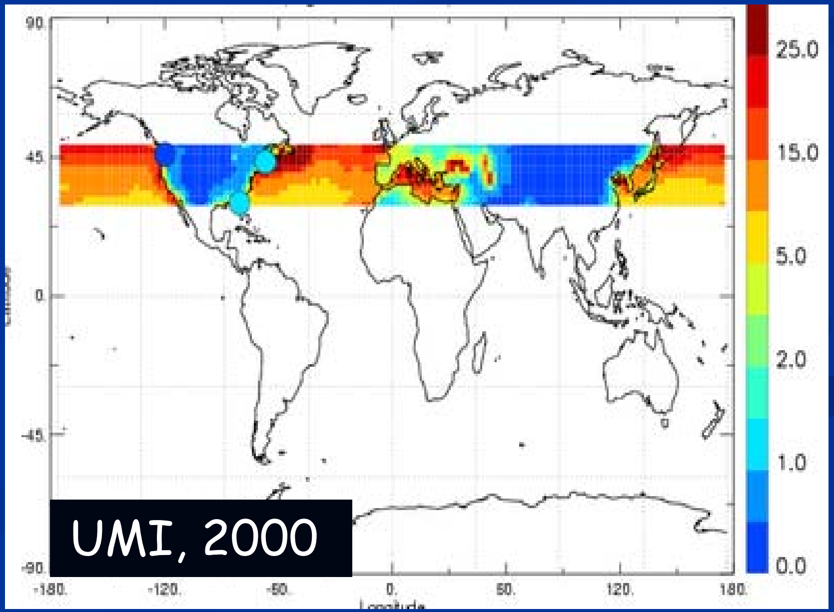


Sea Salt concentration (2)

Experiment A





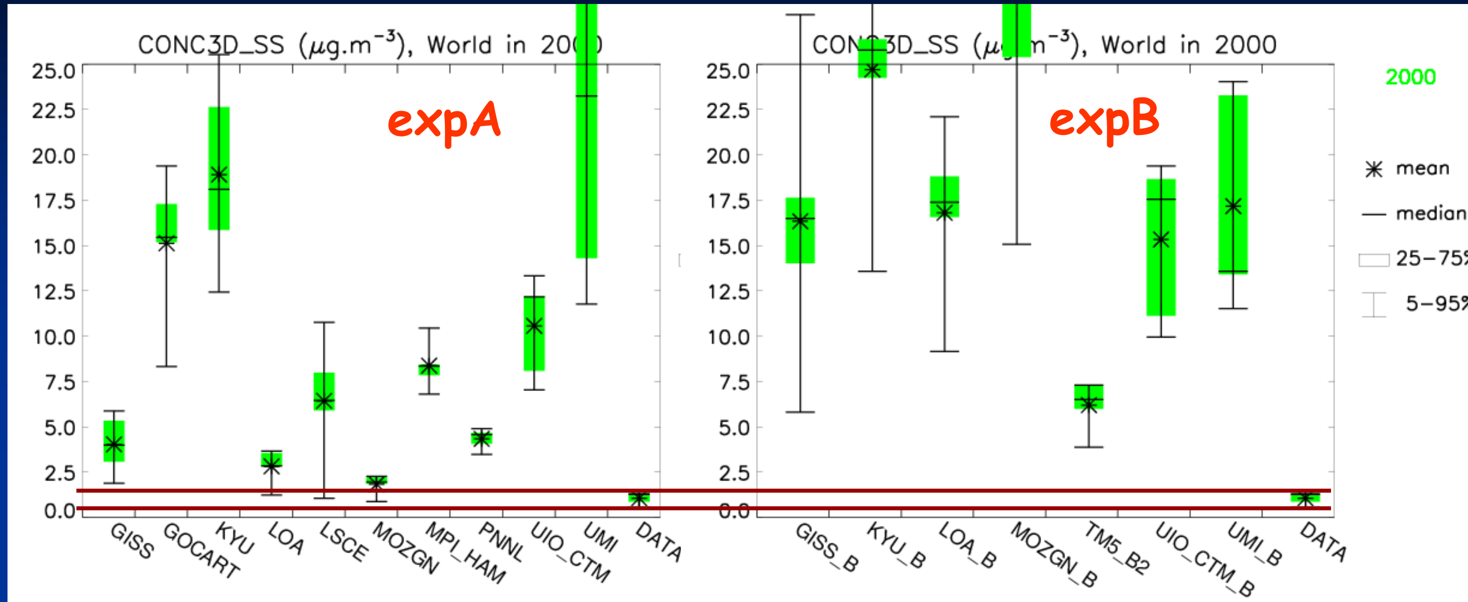


Too few stations, on the continent
=> Bias when comparison to data

Overestimation by all models
→ partially due to cut off size in the measurements
models with larger particles

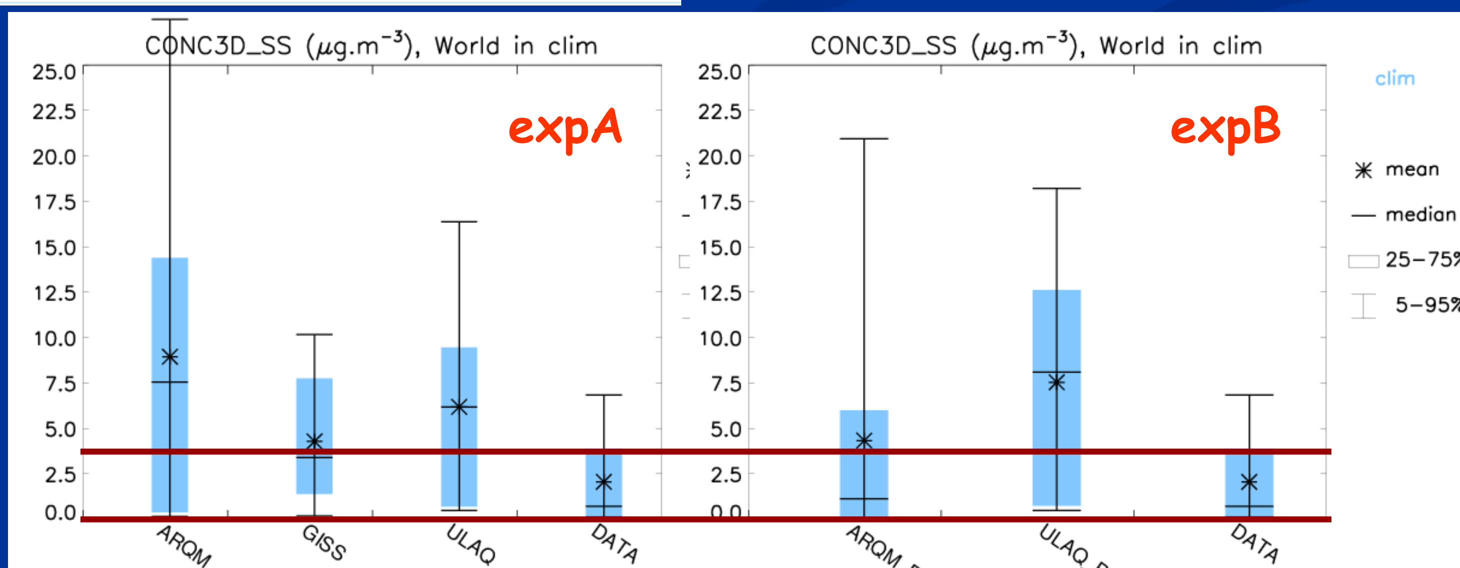
Sea Salt concentration (3)

Nudged, year 2000

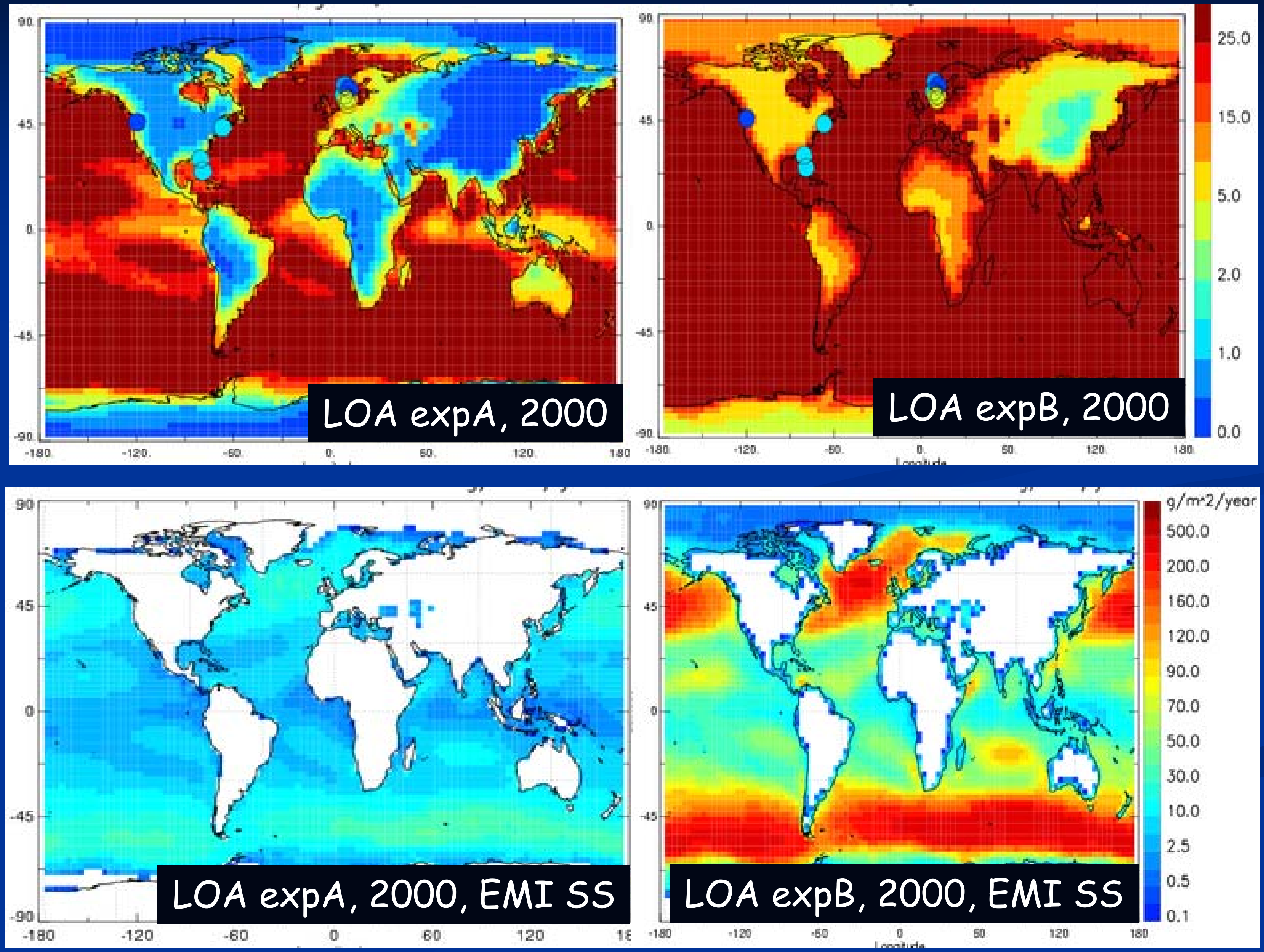


Larger overestimation with expB

Clim, year 9999



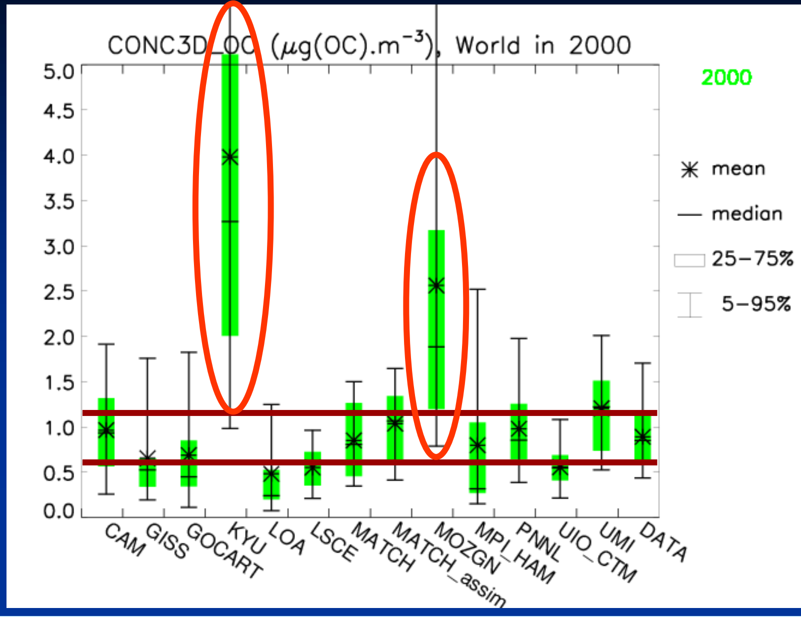
Sea Salt concentration (4)

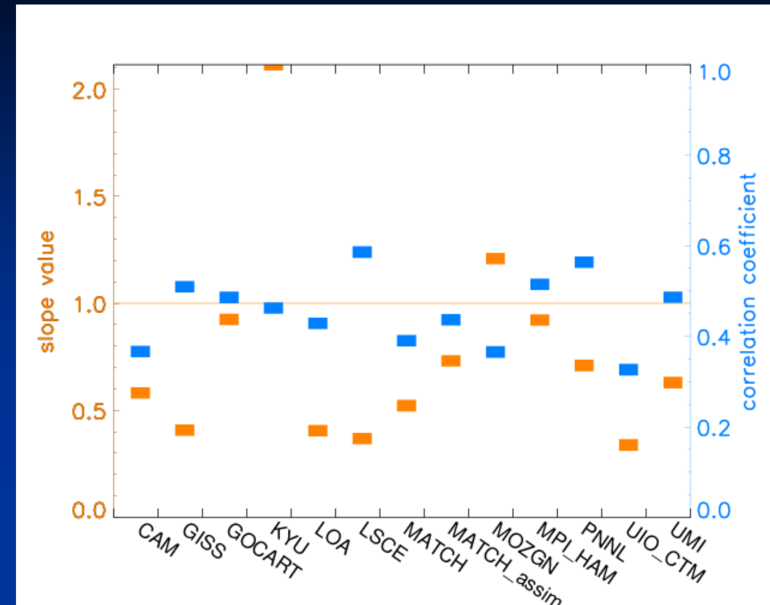


OC concentration (1)

Experiment A

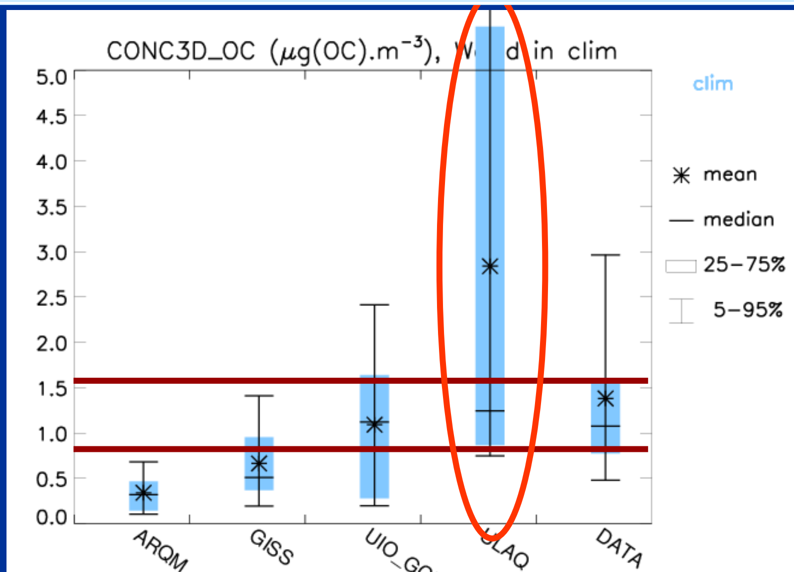
Nudged, year 2000

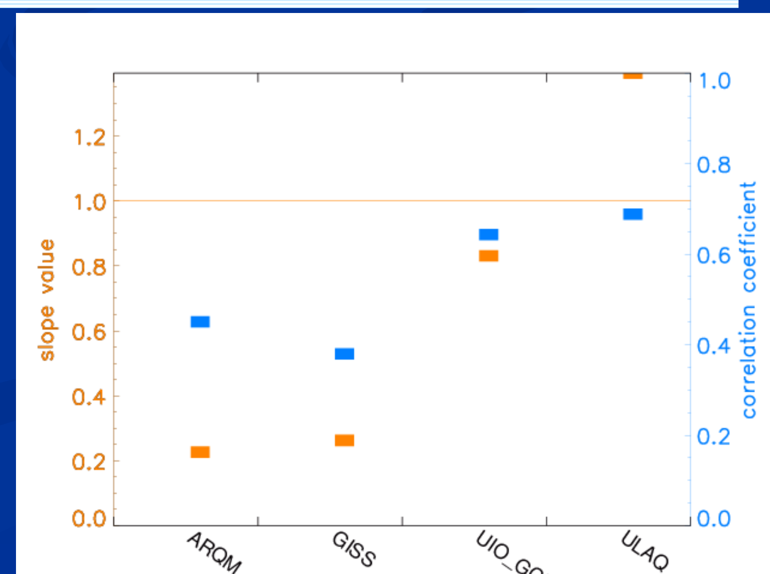




Underestimation by all models except GOCART, MPI_HAM (agreement) and KYU, MOZGN and ULAQ (overestimation)

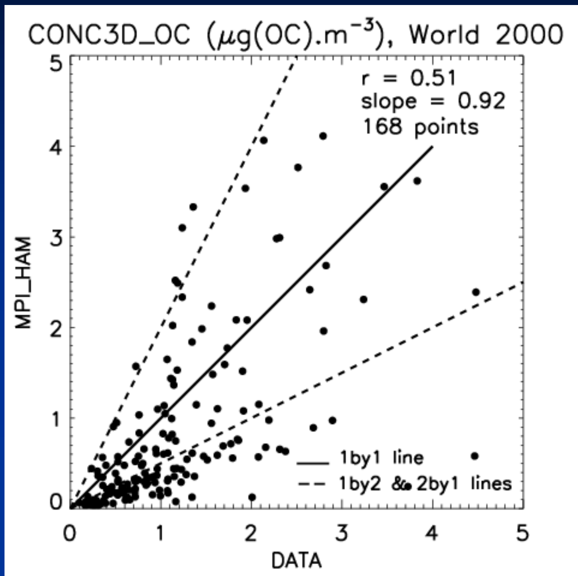
Clim, year 9999





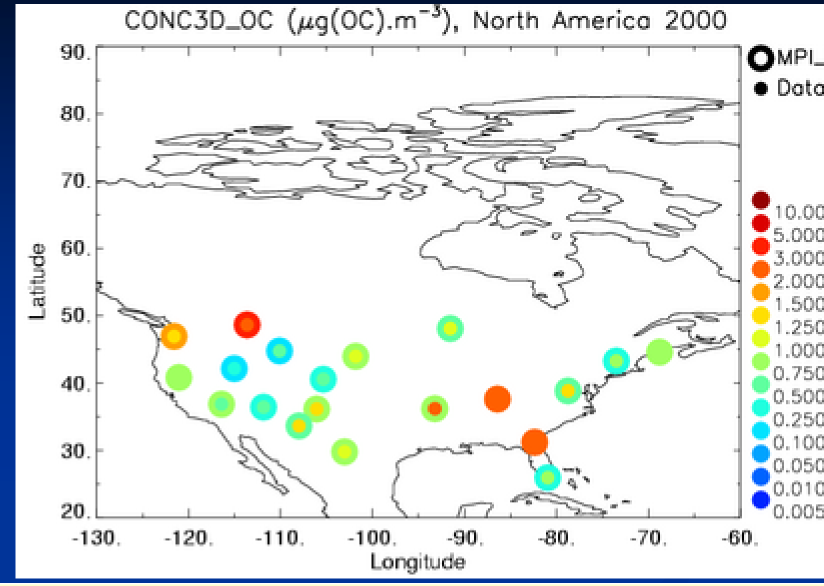
OC concentration (2)

Experiment A

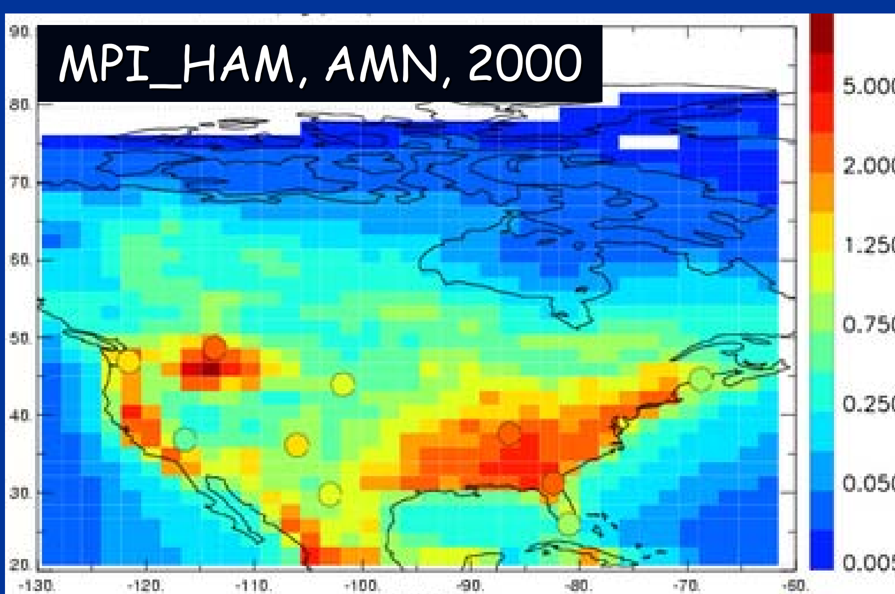


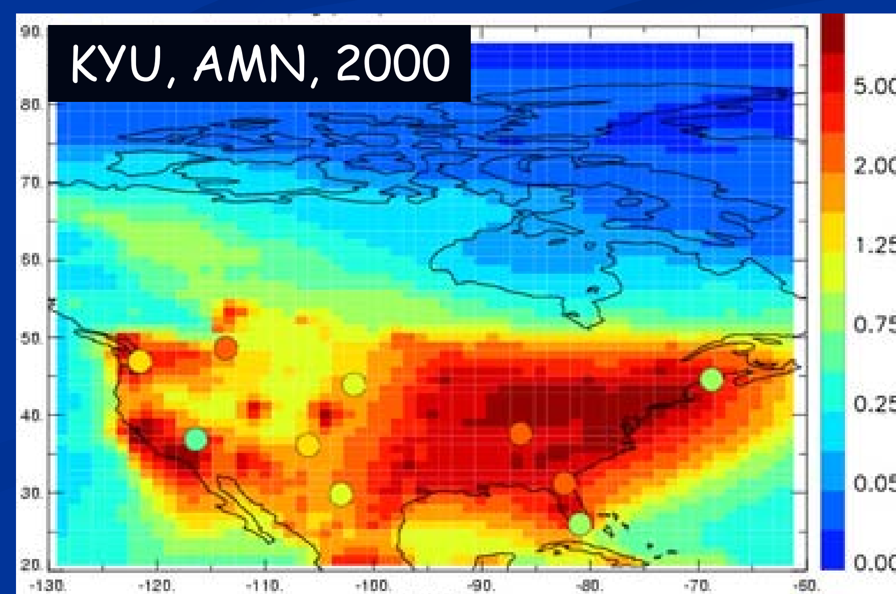
Exemple of MPI_HAM

World
r = 0.51
slope = 0.92



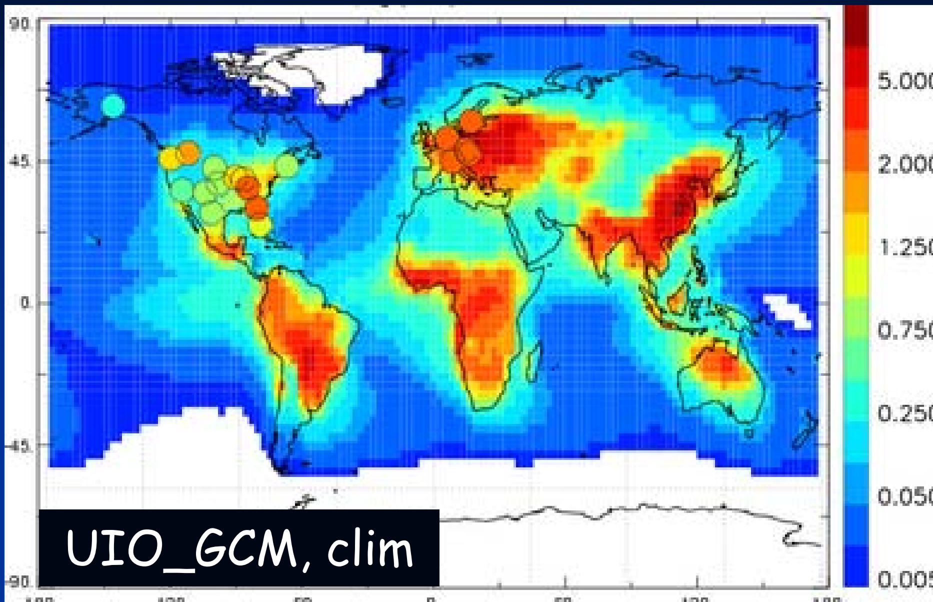
All stations in North America (IMPROVE)





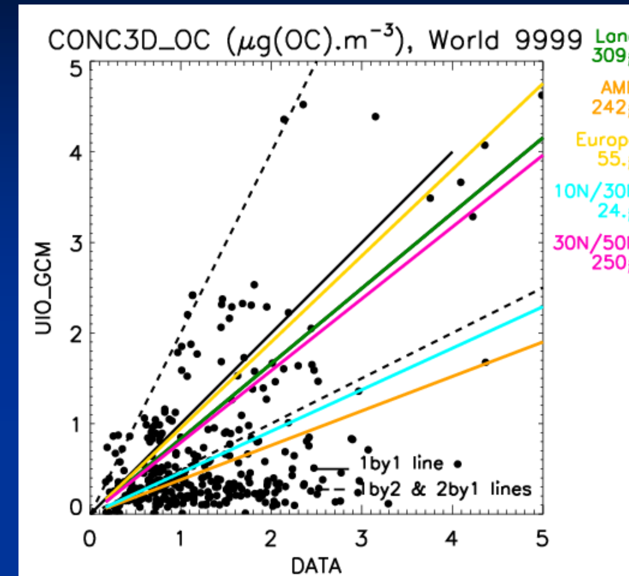
OC concentration (3)

Experiment A



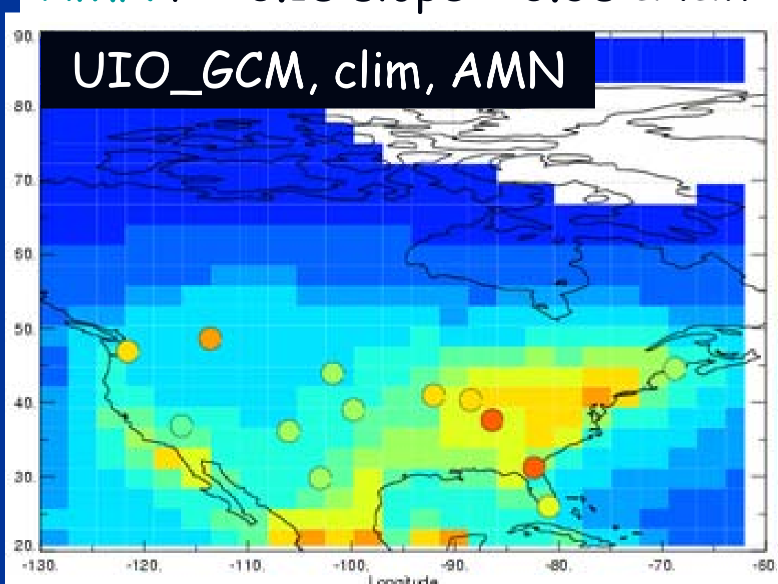
Exemple of UIO_GCM

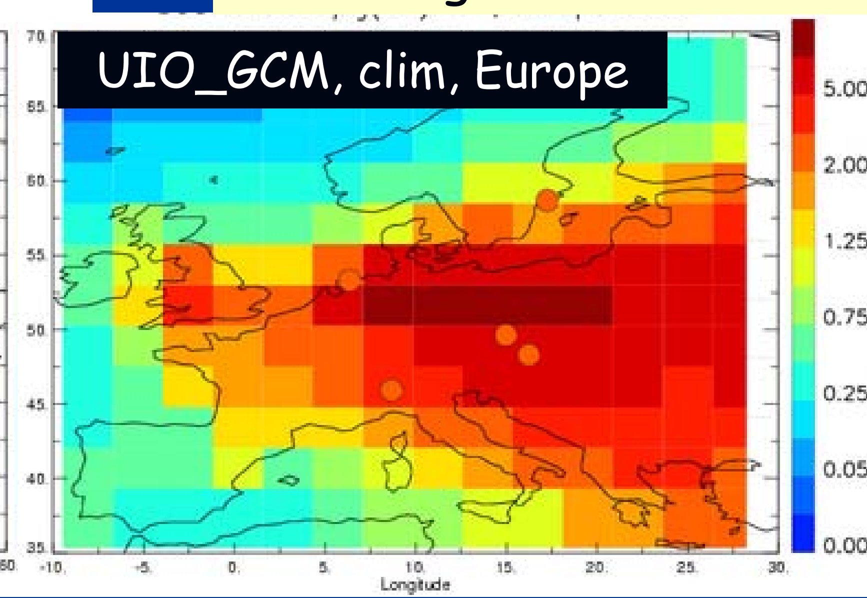
r = 0.64
slope = 0.83
309#



AMN r = 0.18 slope = 0.38 242#

Better agreement in Europe

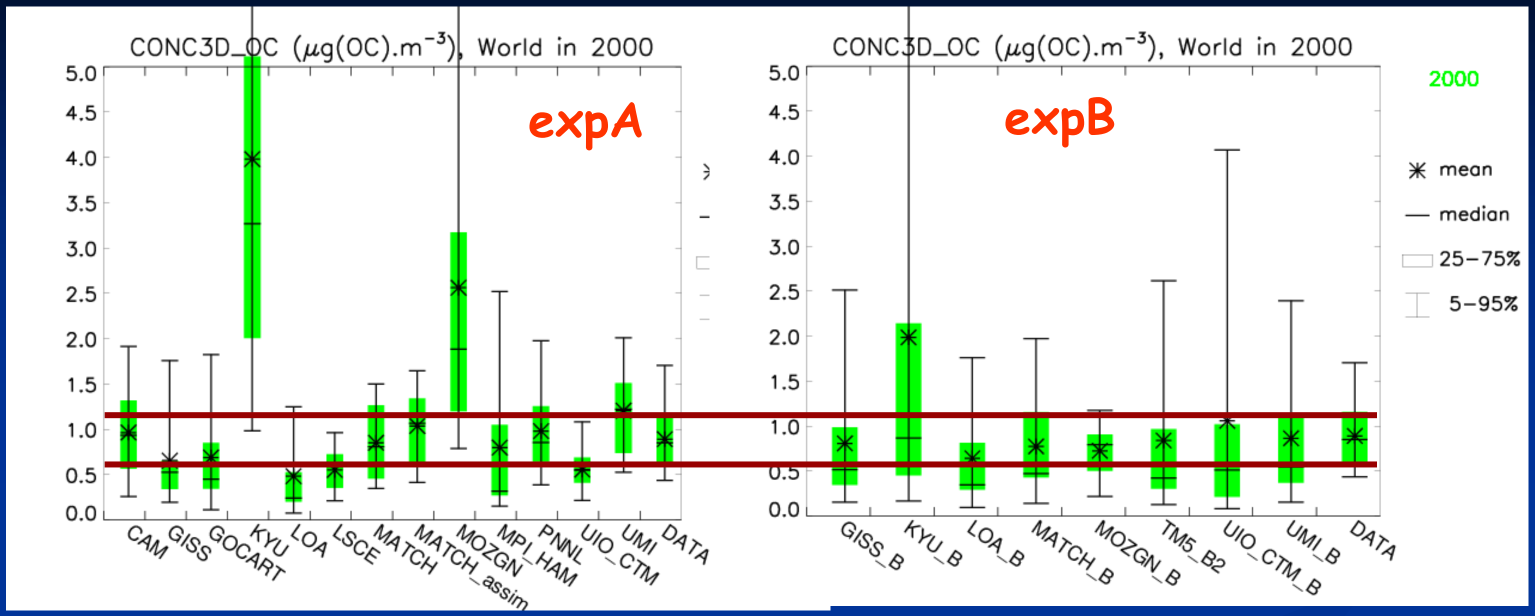




Europe
r = 0.19
slope=0.95
55#

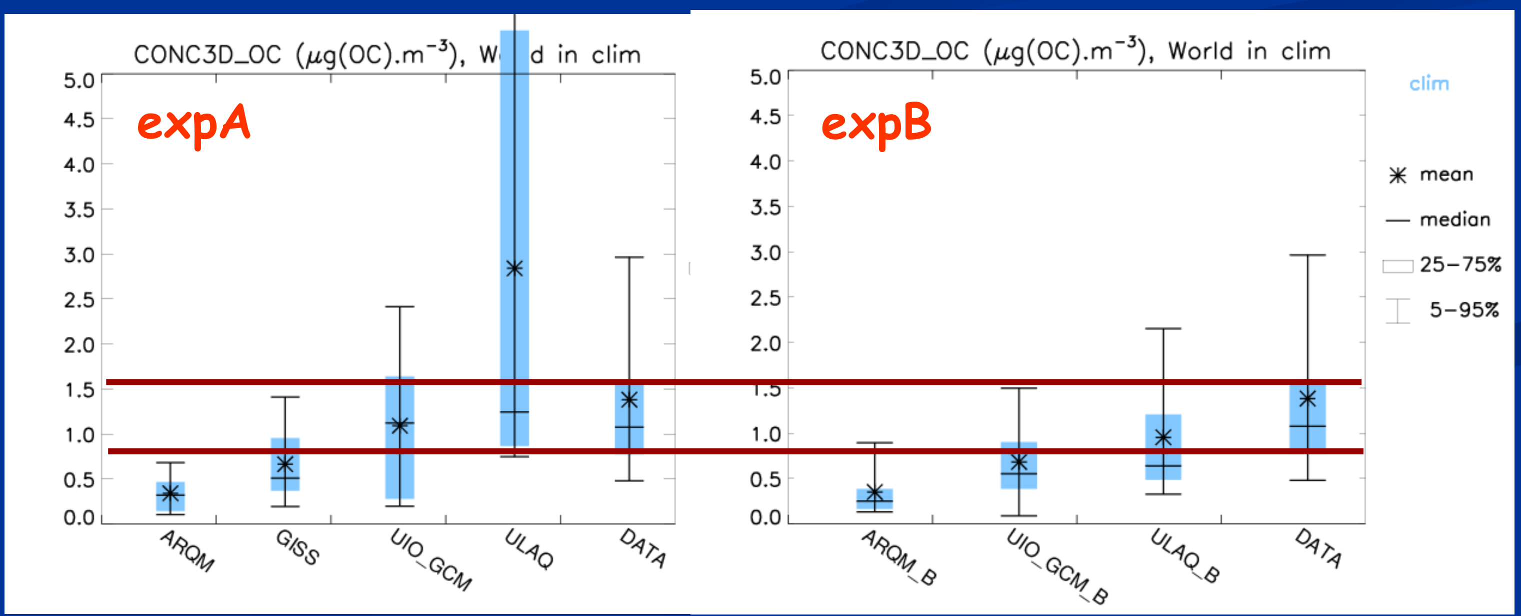
OC concentration (4)

Nudged, year 2000

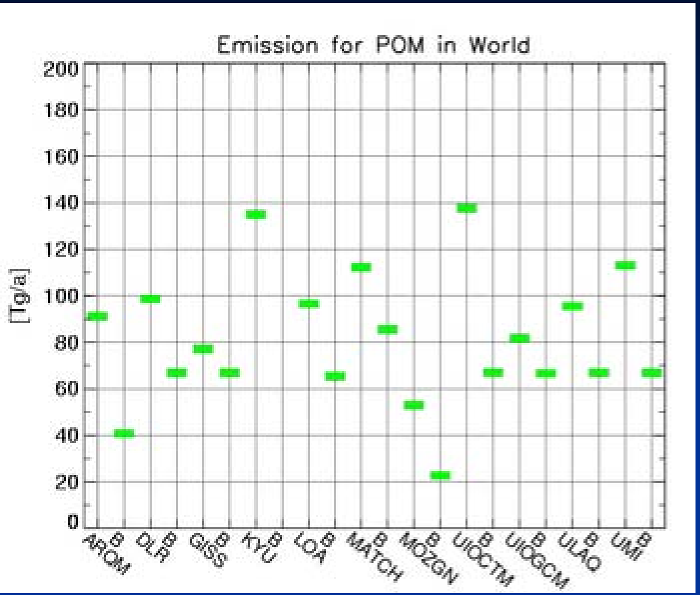


Better agreement for expB except clim models

Clim, year 9999

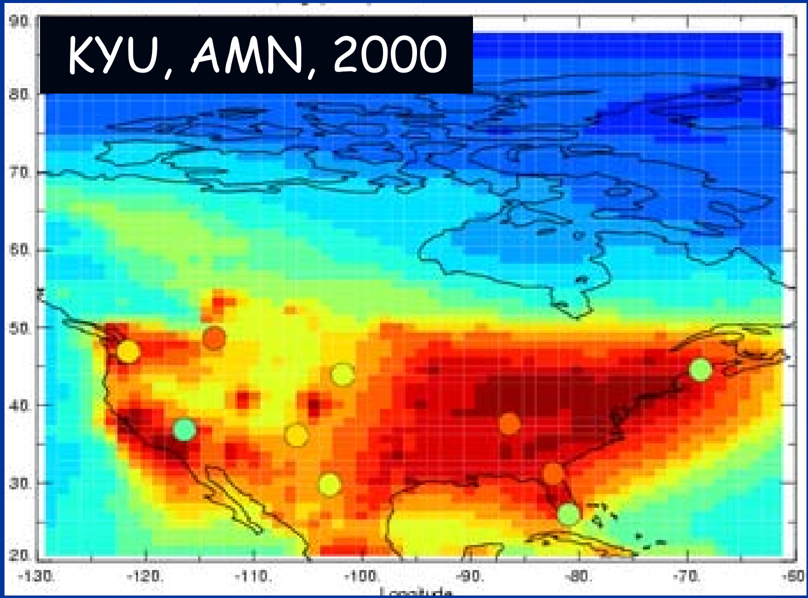


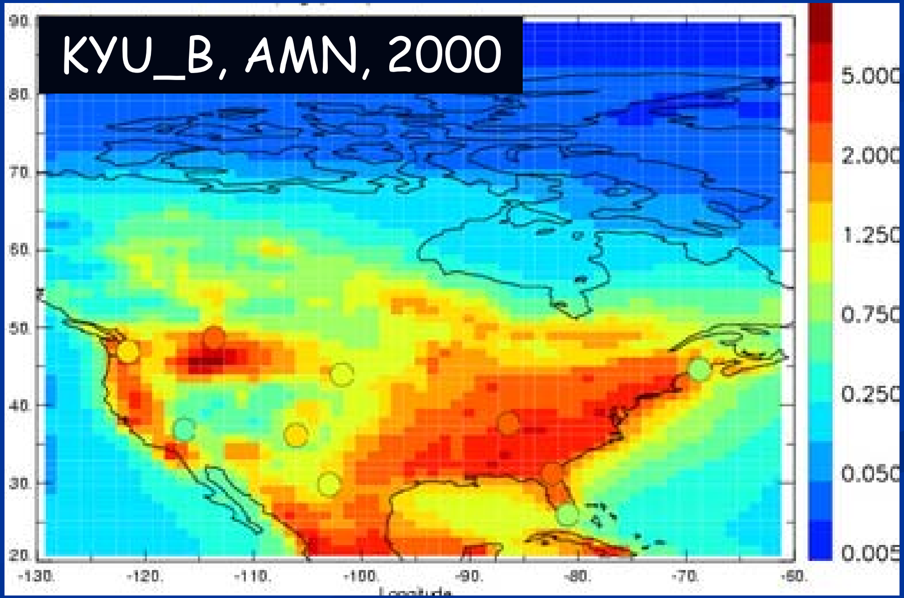
OC concentration (5)



POM emissions decrease with expB
⇒ concentrations decrease ???

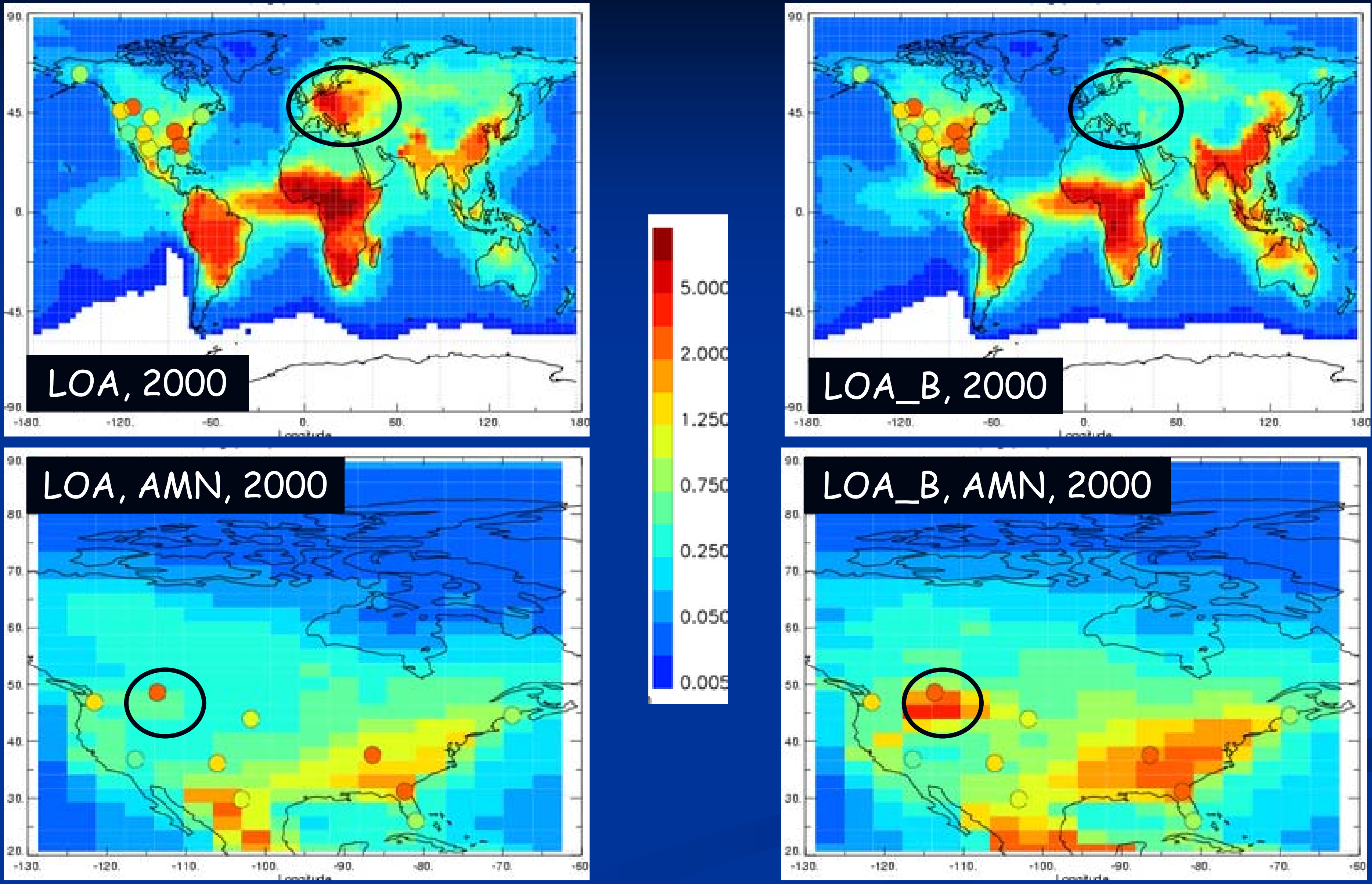
see exemple of KYU (and MOZGN)





For other models, conc decrease around the world but increase in AMN

OC concentration (6)

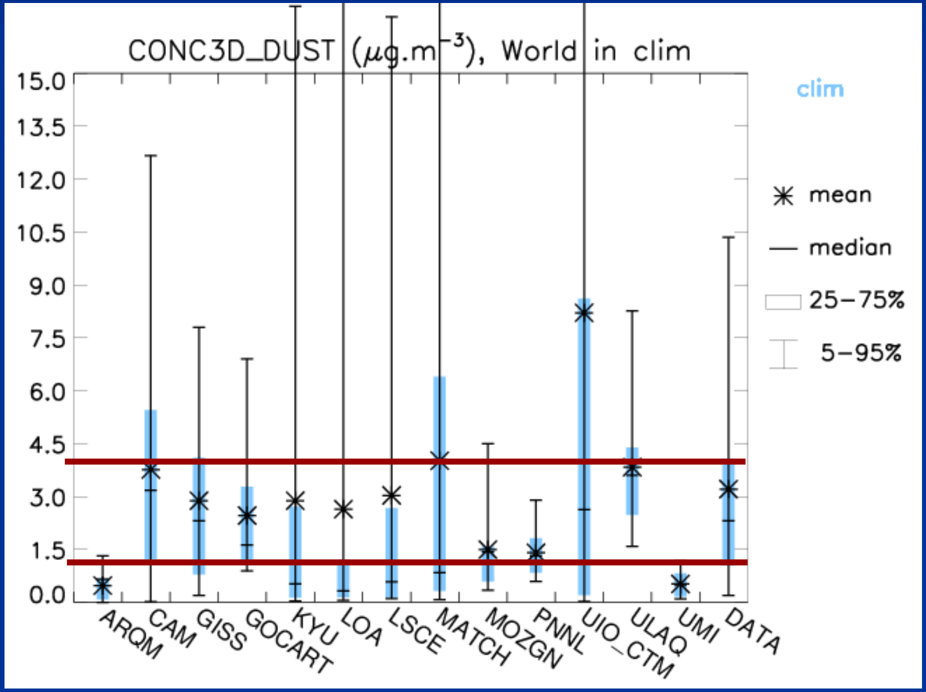


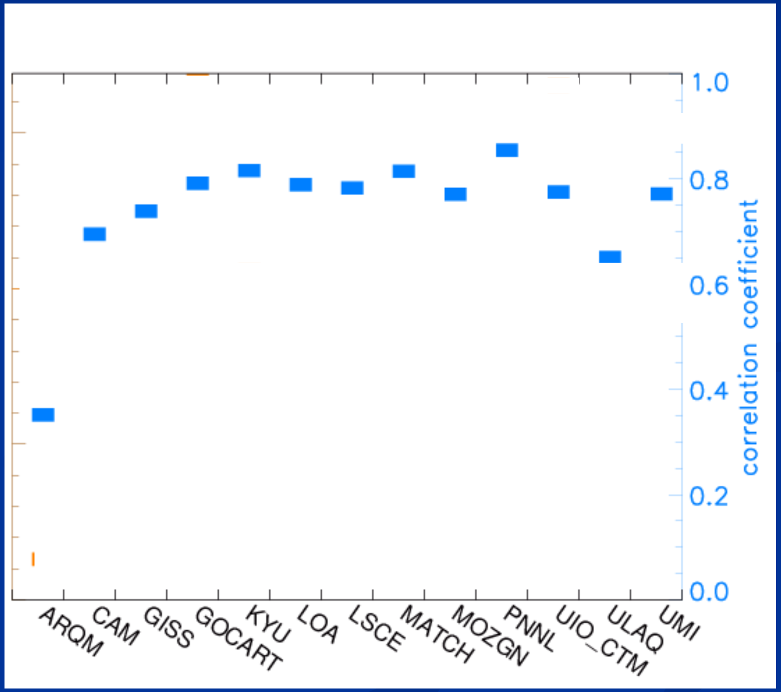
Decrease in Europe explain fewer agreement for clim models

DUST concentration (1)

Experiment A

Only clim comparison : clim models + average of nudged models over the available years
(+ year 2000 for MPI_HAM, CAM, UMI, UIO_CTM)

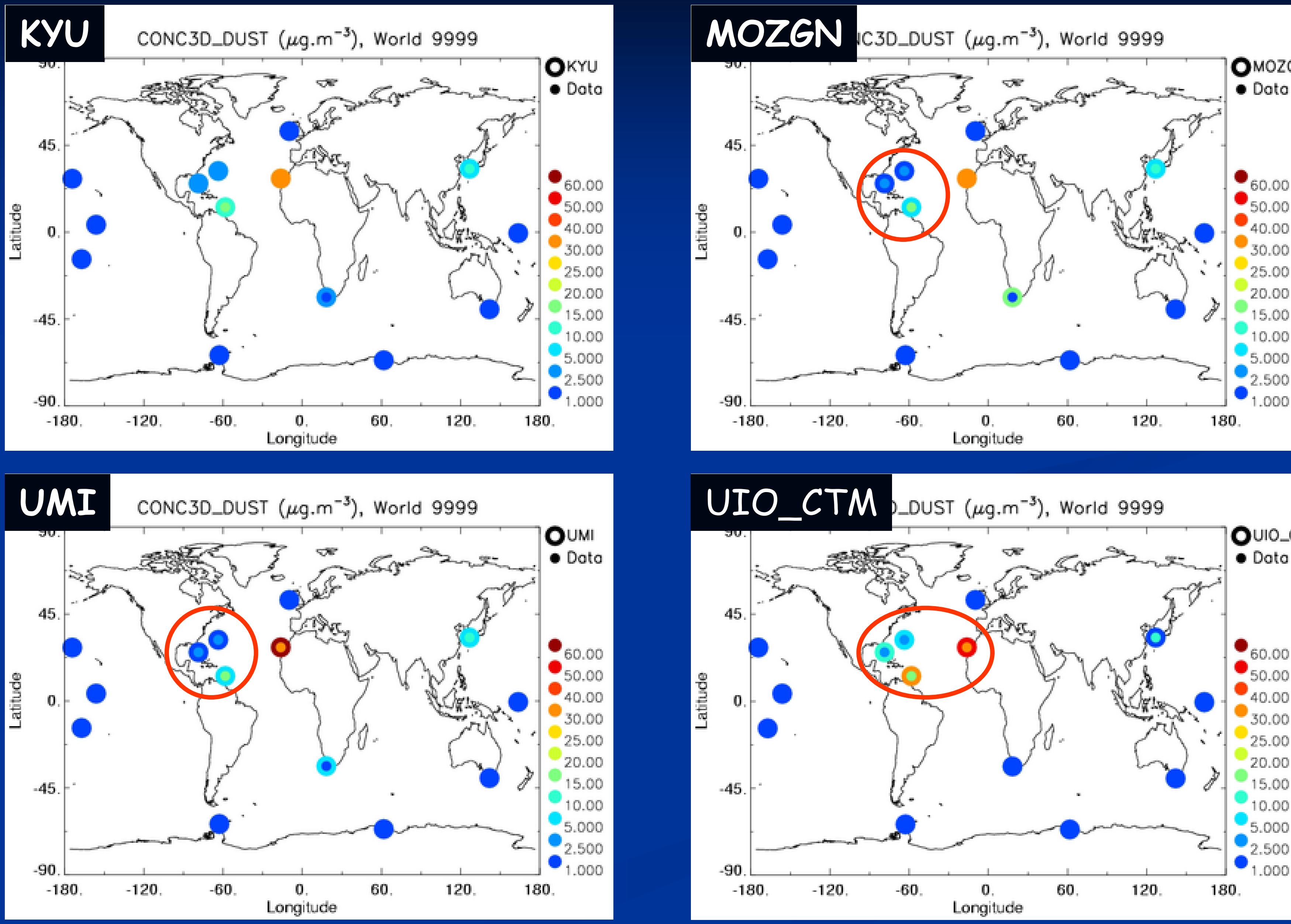




Slope values can't be considered : big range of data with lots of small values and some very large values

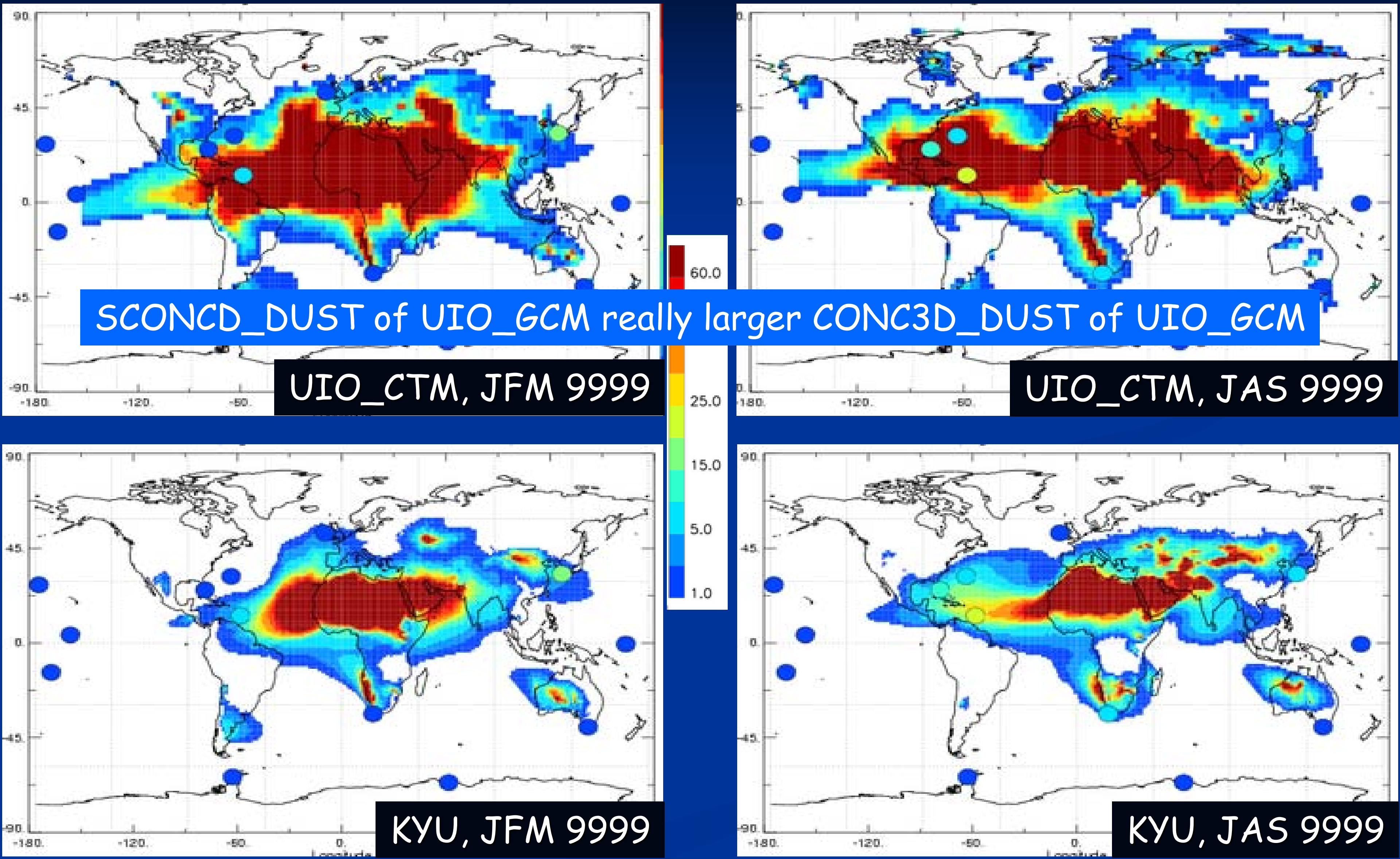
DUST concentration (2)

Experiment A



DUST concentration (3)

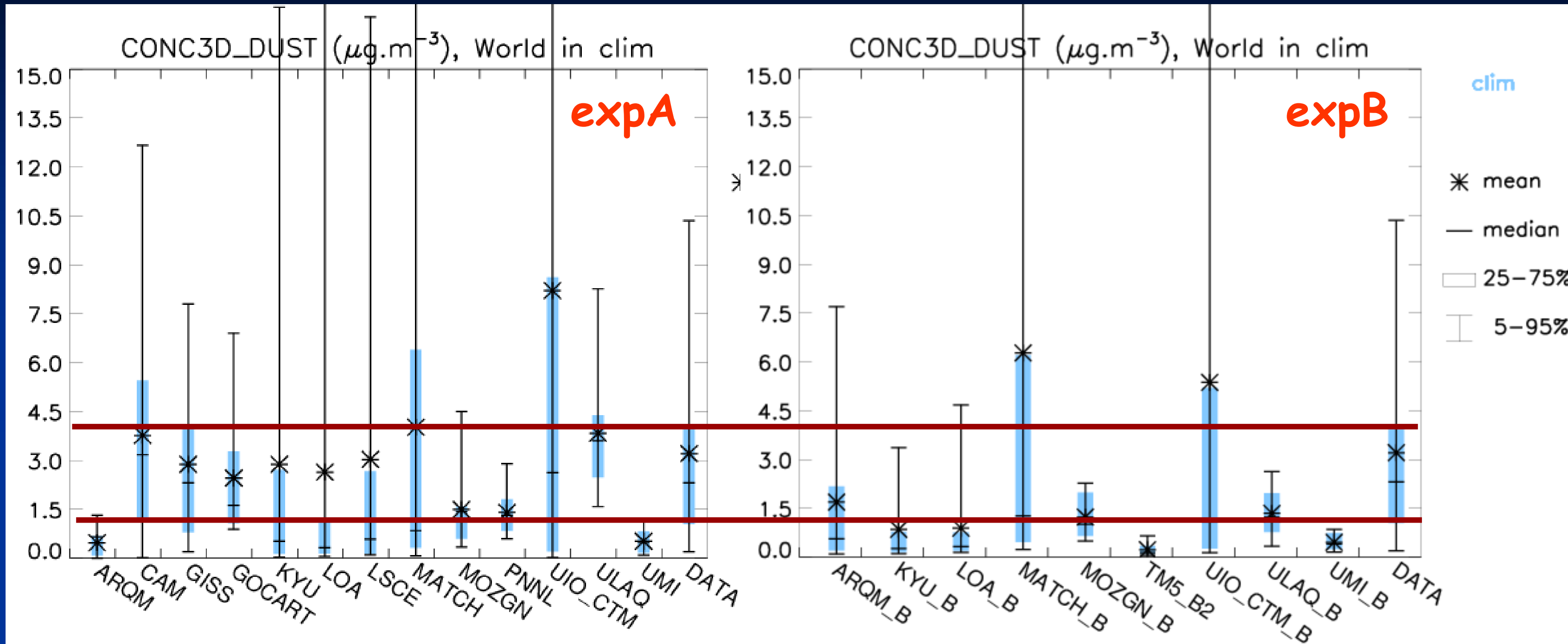
Experiment A

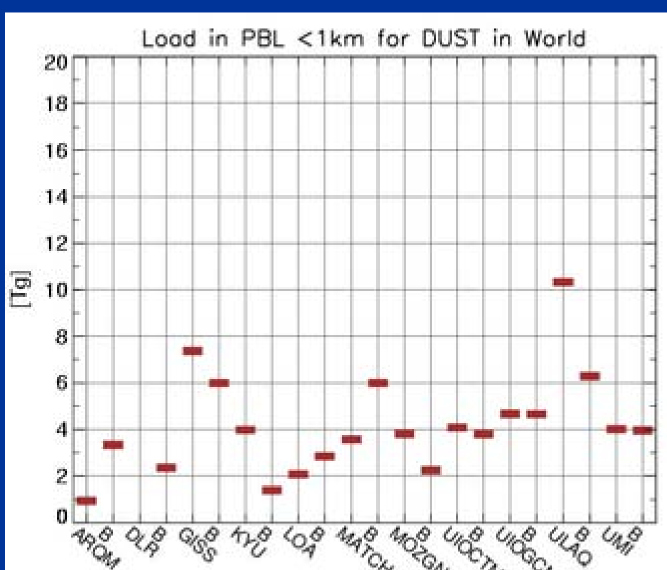


UIO_CTM transports DUST much more than KYU (EMI located over AFN for both)

DUST concentration (4)

Clim, year 9999



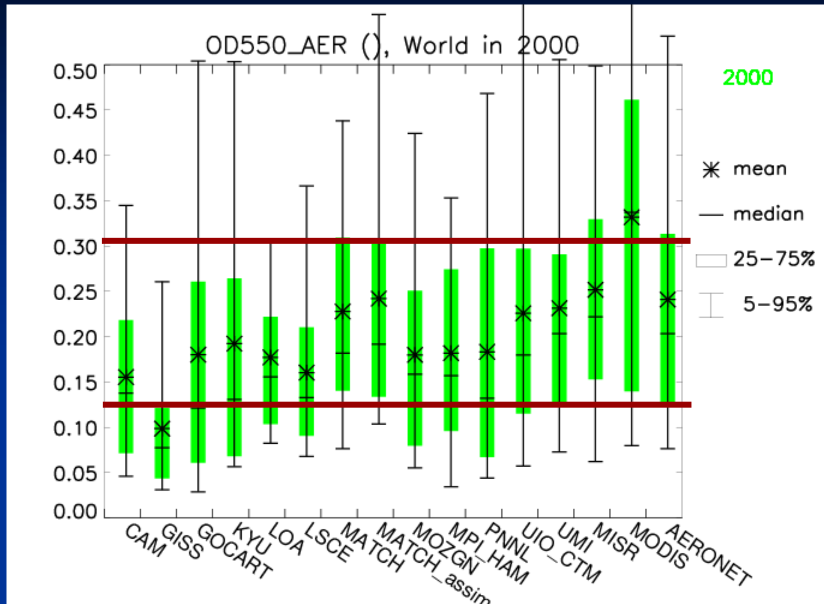


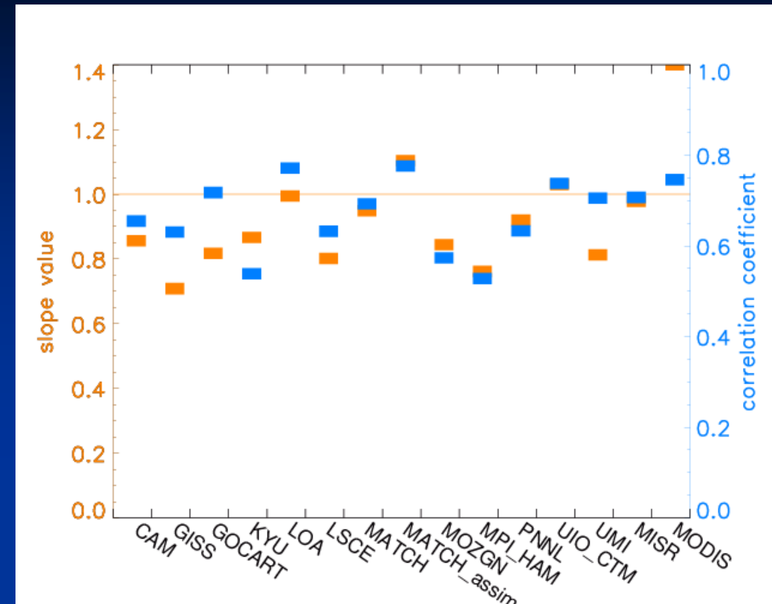
Decrease of all mean and median values except MATCH and UMI

OD550 (1)

Experiment A

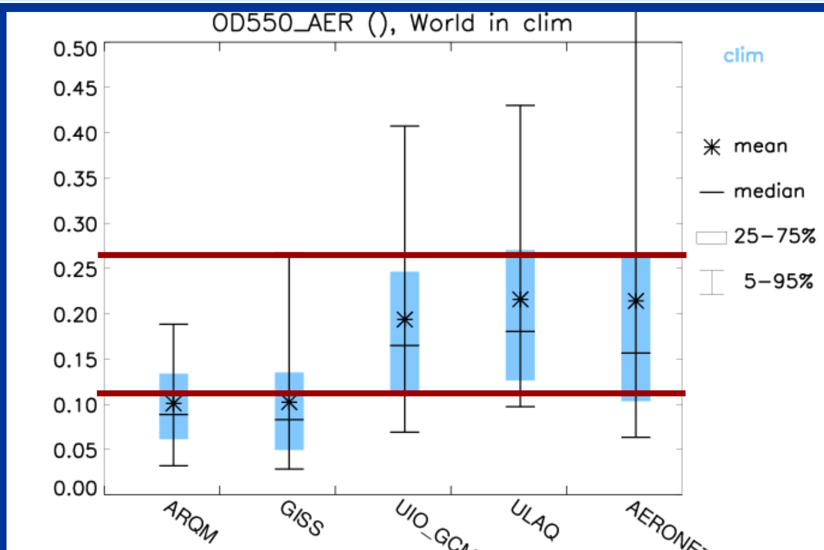
Nudged, year 2000

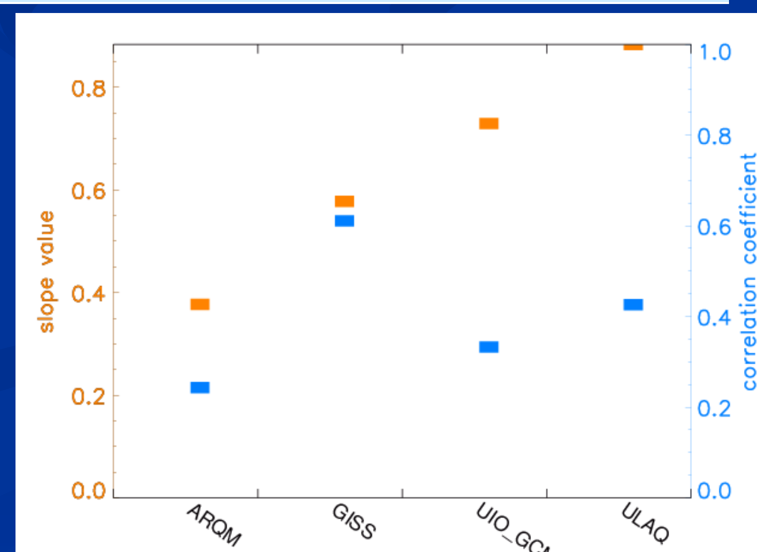




Variability not so large between all models (except clim) / Specific problems
Smaller correlation values for clim models

Clim, year 9999

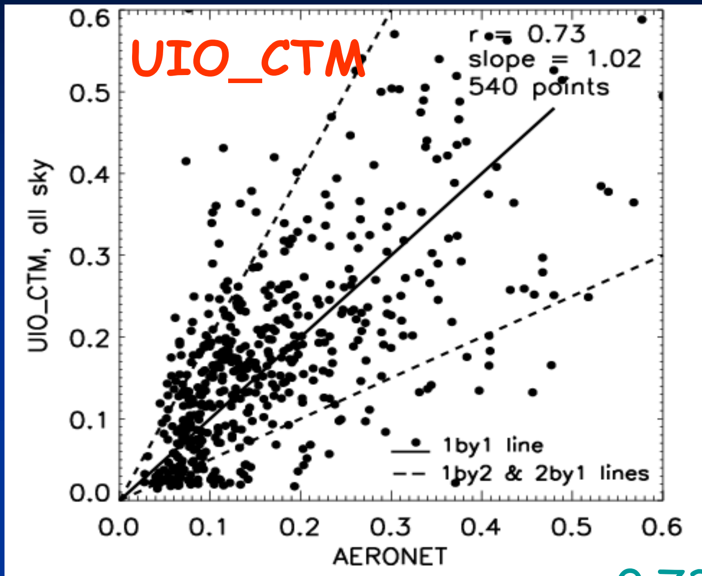


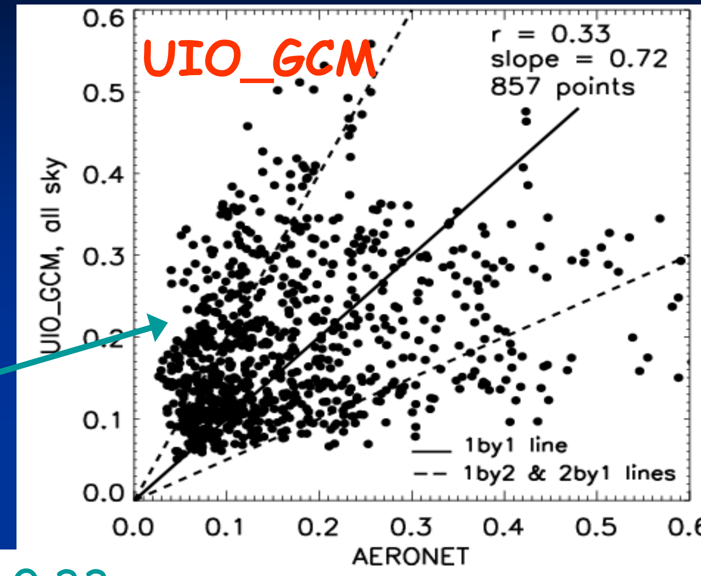


OD550 (2)

Experiment A

Exemple of UIO_CTM and UIO_GCM

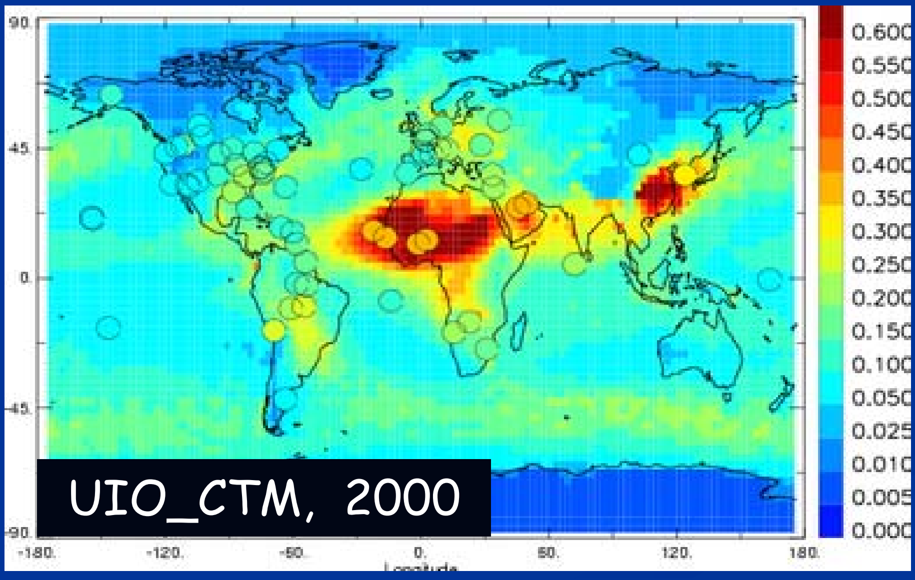


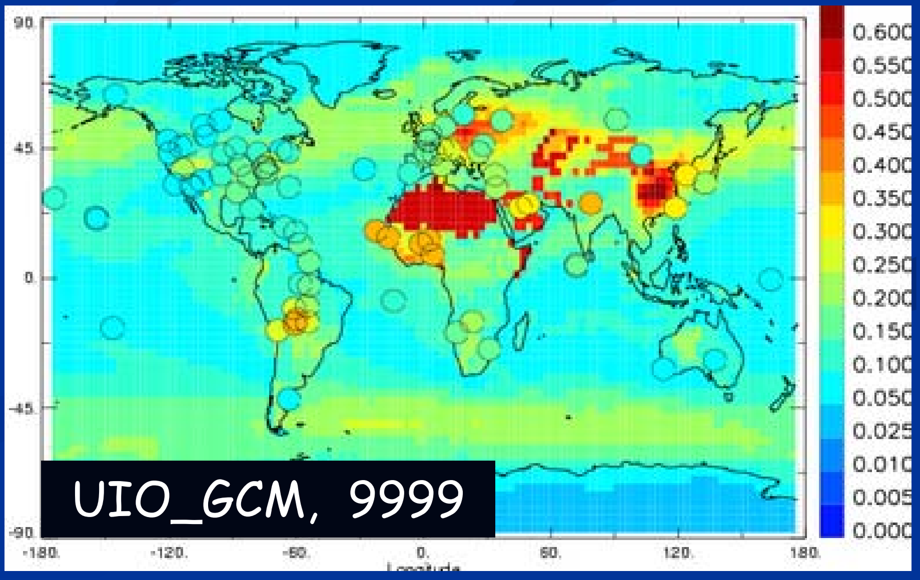


larger variablility

r = 0.73
slope = 1.02

r = 0.33
slope = 0.72



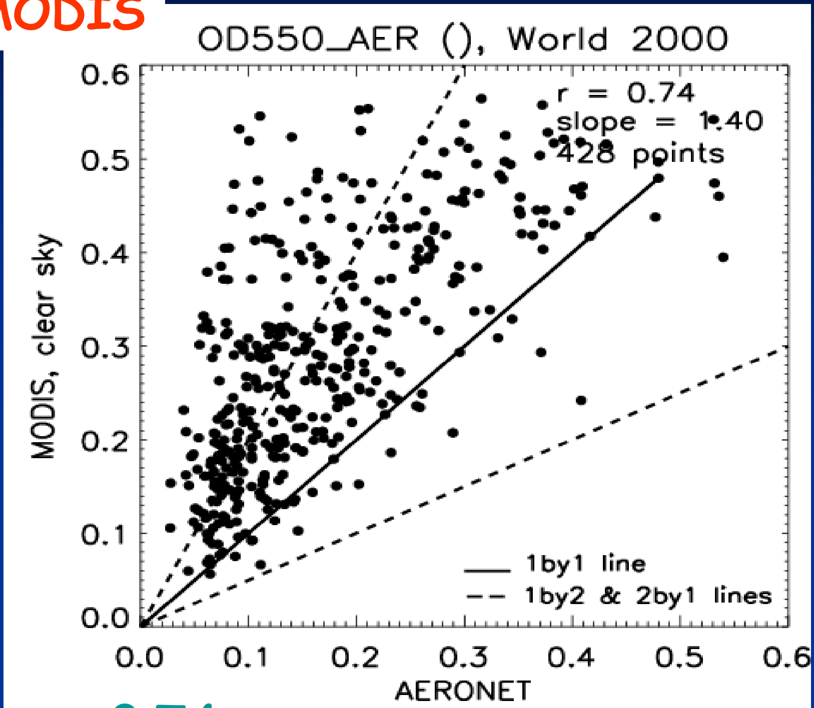


OD550 (3)

Experiment A

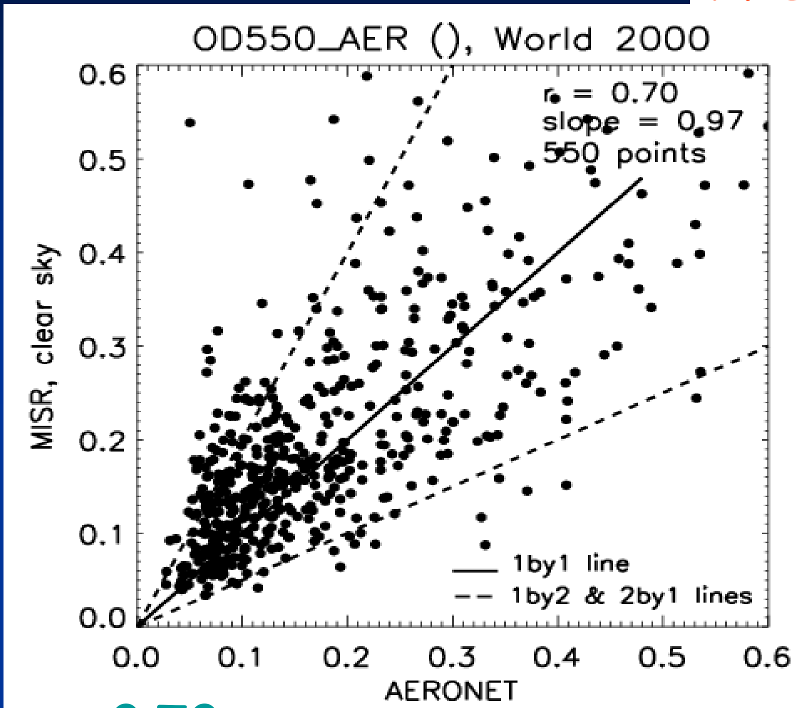
MODIS/MISR versus Aeronet

MODIS



r = 0.74
slope = 1.4

MISR



r = 0.70
slope = 0.97

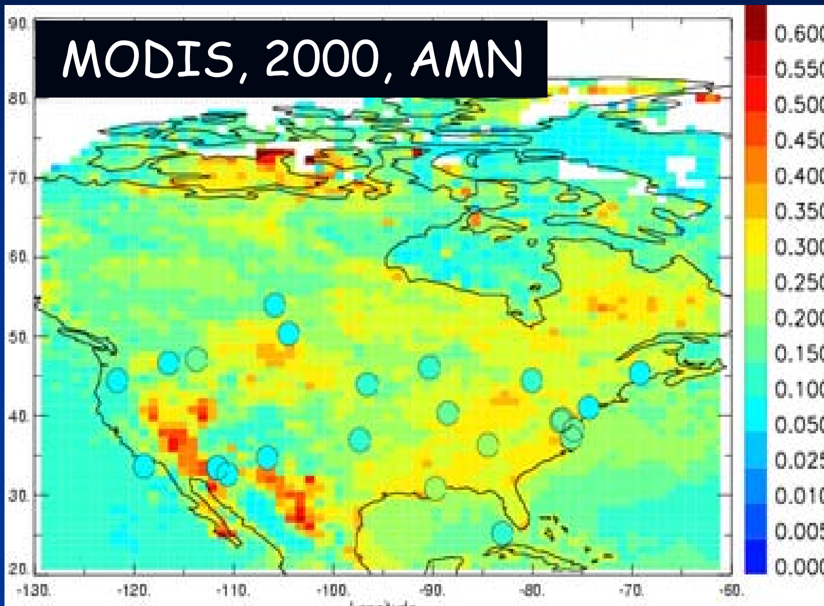
MODIS Europe	MODIS AMN	MISR Europe	MISR AMN
r = 0.46	r = 0.64	r = 0.28	r = 0.49
slope = 1.53	slope = 1.74	slope = 0.85	slope = 1.05

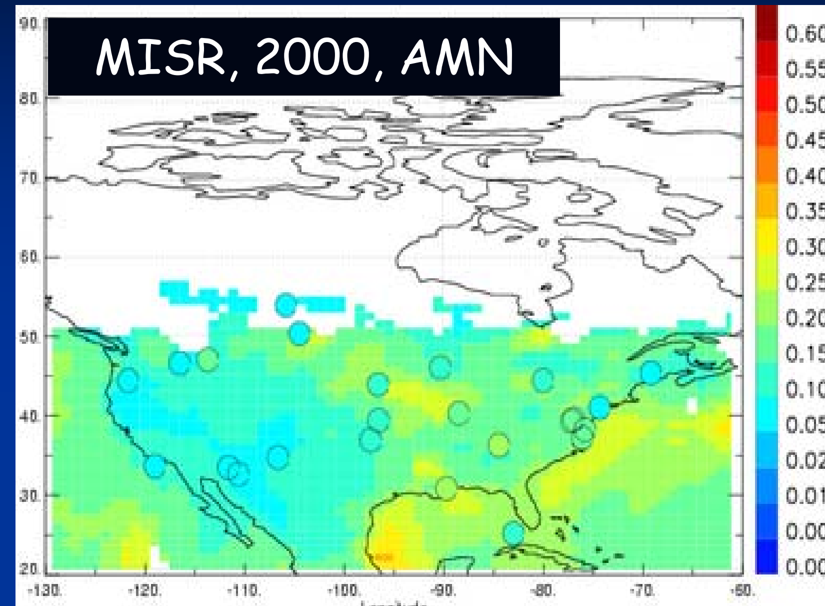
Overestimation by MODIS over the continents
Better correlation between AERONET and MODIS data

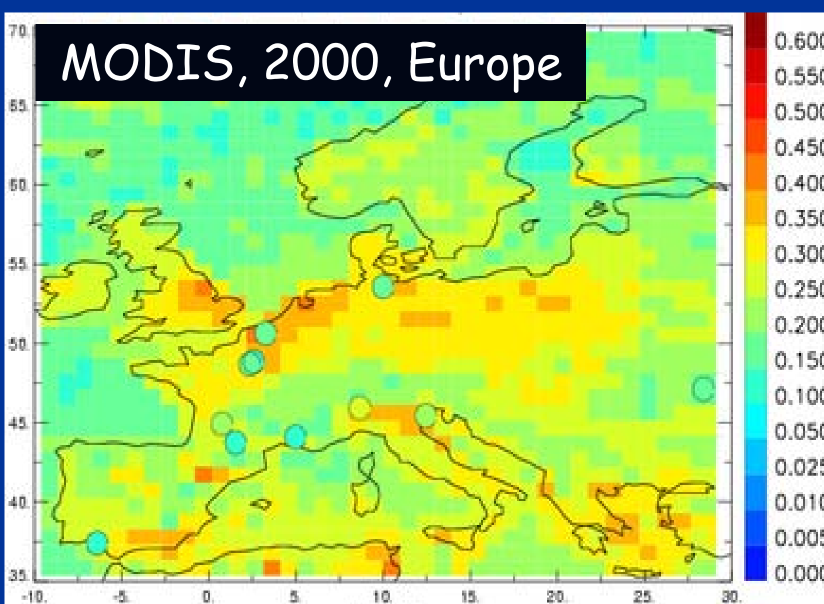
OD550 (4)

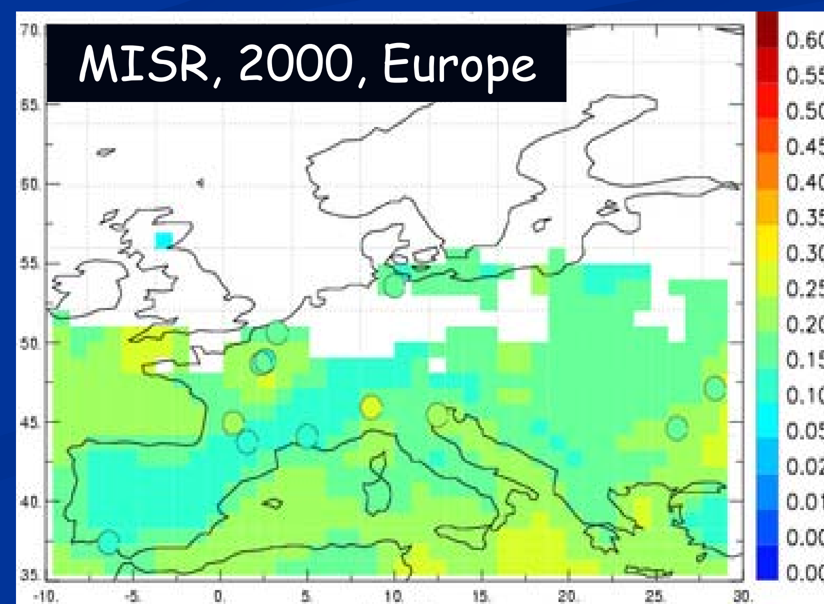
Experiment A

MODIS/MISR







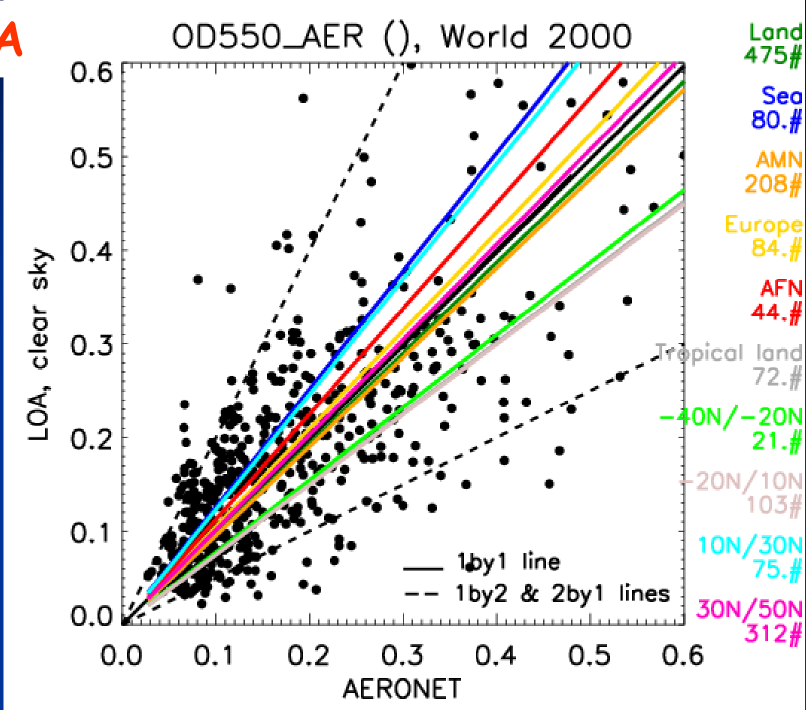


OD550 (5)

Exemple of LOA and LSCE

Experiment A

LOA

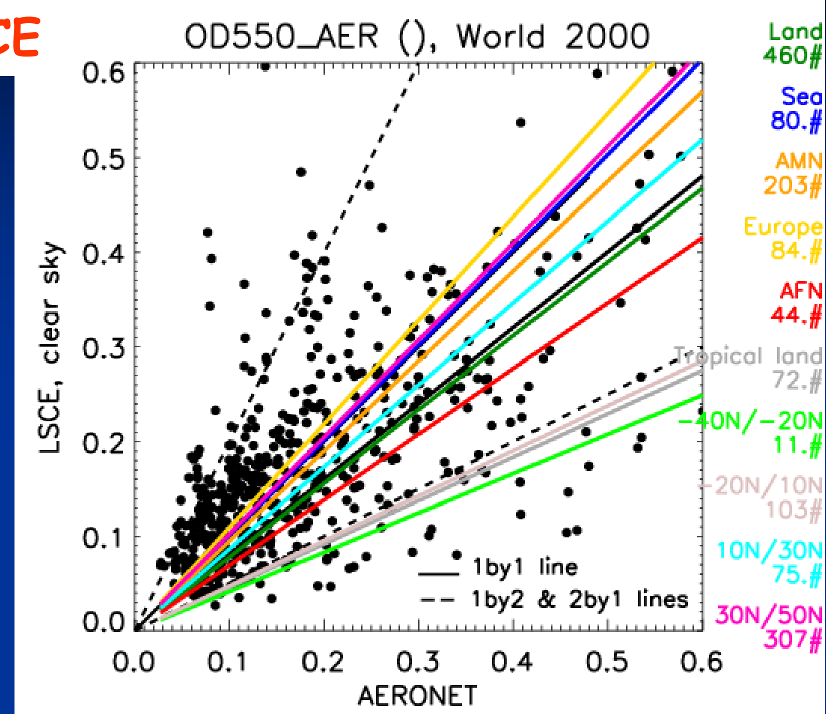


r = 0.77
slope = 0.99

AFN
r = 0.76
slope = 1.12

Band 20S/10N
r = 0.87
slope = 0.74

LSCE



r = 0.63
slope = 0.80

AFN
r = 0.44
slope = 0.69

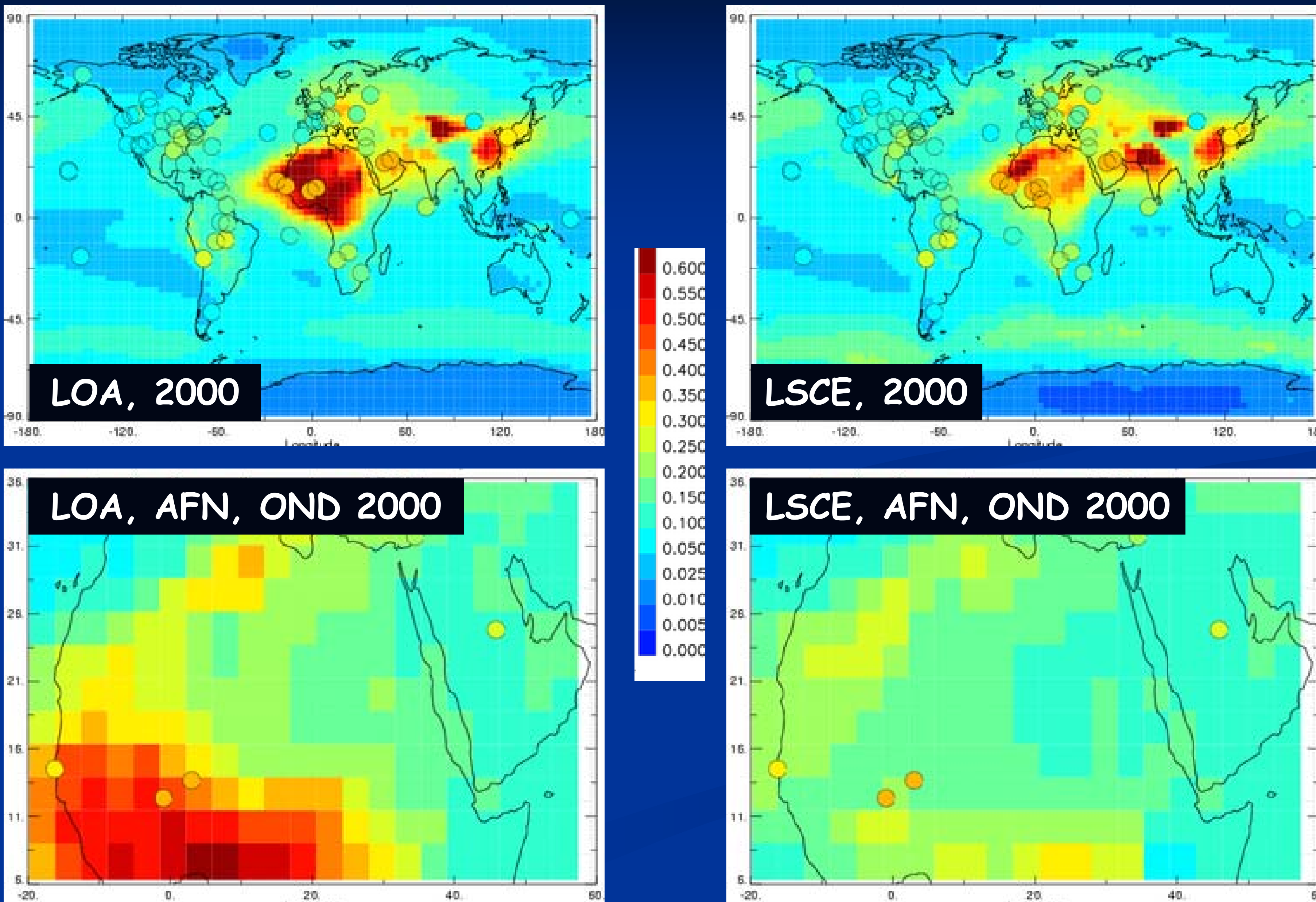
Band 20S/10N
r = 0.7
slope = 0.47

Less agreement with AERONET for INCA : problematic regions seem to be AFN and tropical band

OD550 (6)

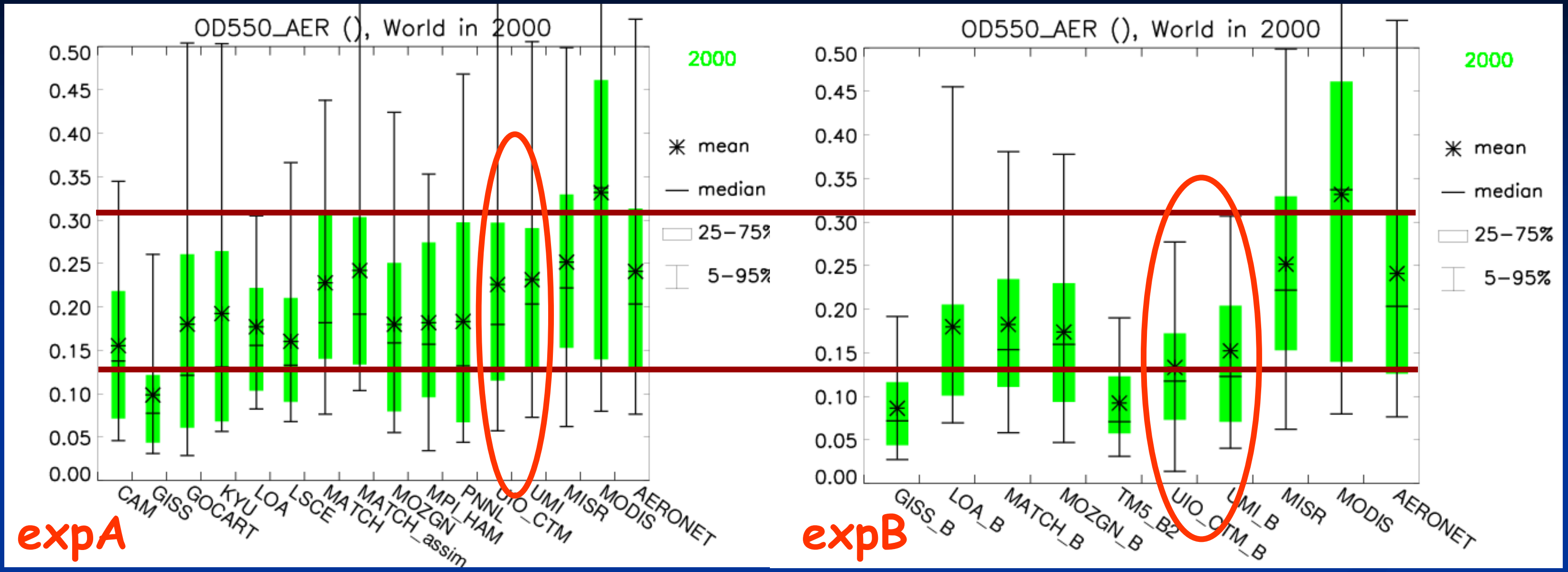
Experiment A

Exemple of LOA and LSCE



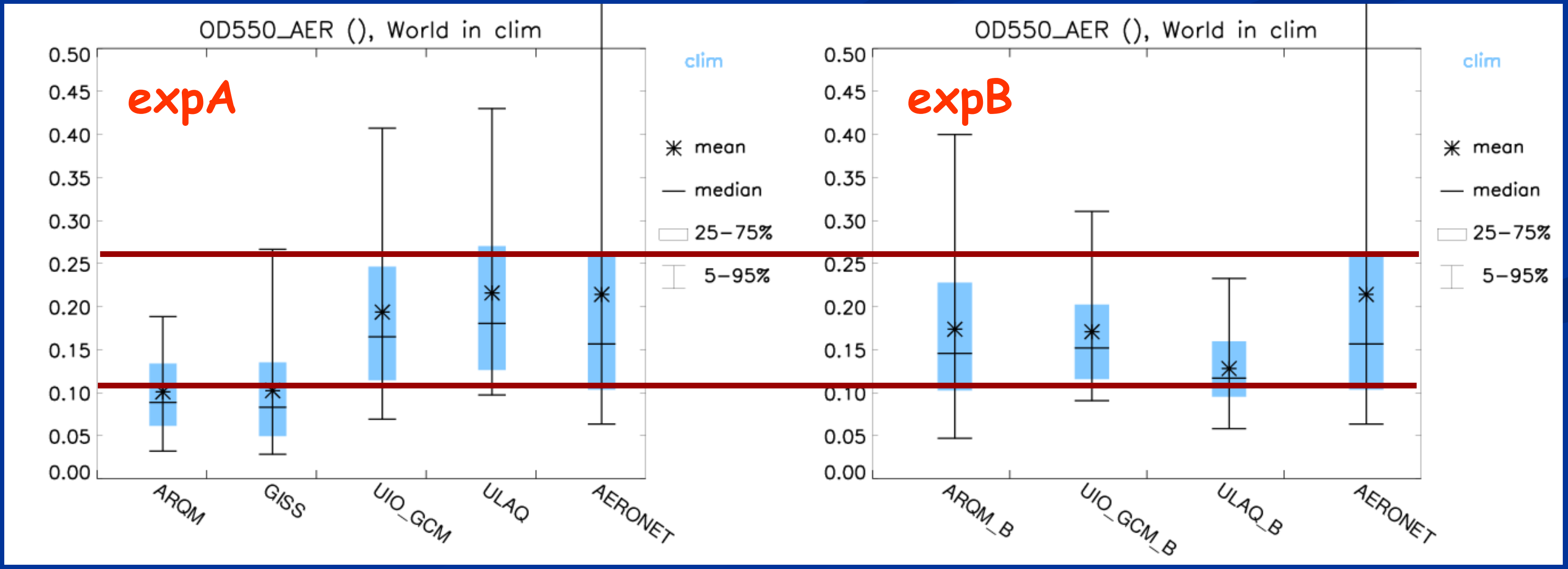
OD550 (7)

Nudged, year 2000



The spread of values decreases for each model with expB

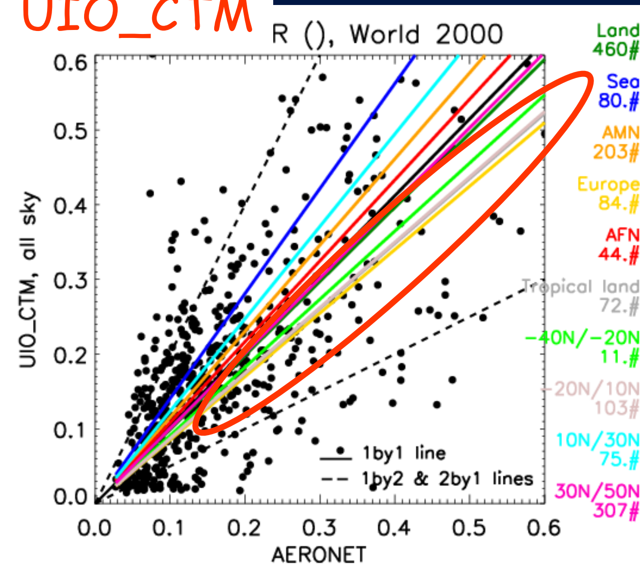
Clim, year 9999



OD550 (9)

Exemple of UIO_CTM and UMI

UIO_CTM



r = 0.73
s = 1.02

Europe
r = 0.20
s = 0.84

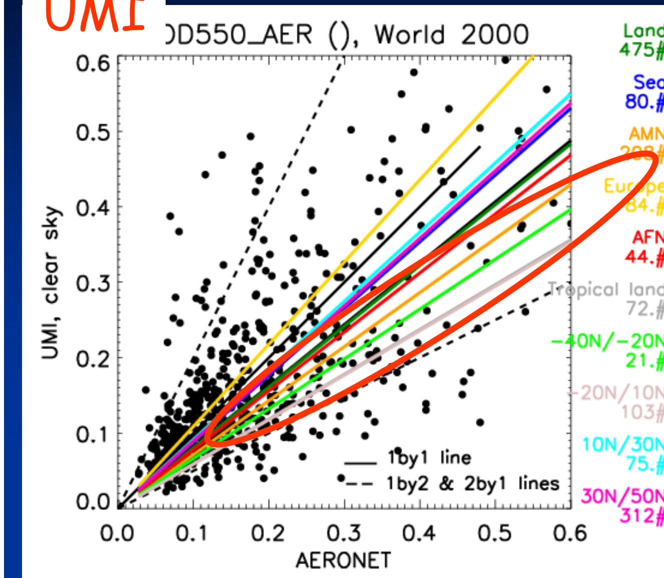
20S/10N
r = 0.72
s = 0.87

r = 0.7
s = 0.81

Europe
r = 0.30
s = 1.08

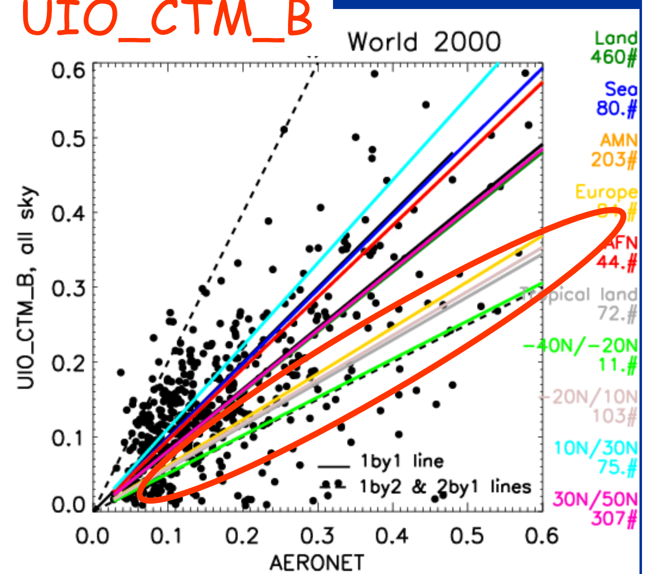
20S/10N
r = 0.71
s = 0.58

UMI



OD decreases in Europe and tropical band

UIO_CTM_B



r = 0.71
s = 0.81

Europe
r = 0.11
s = 0.61

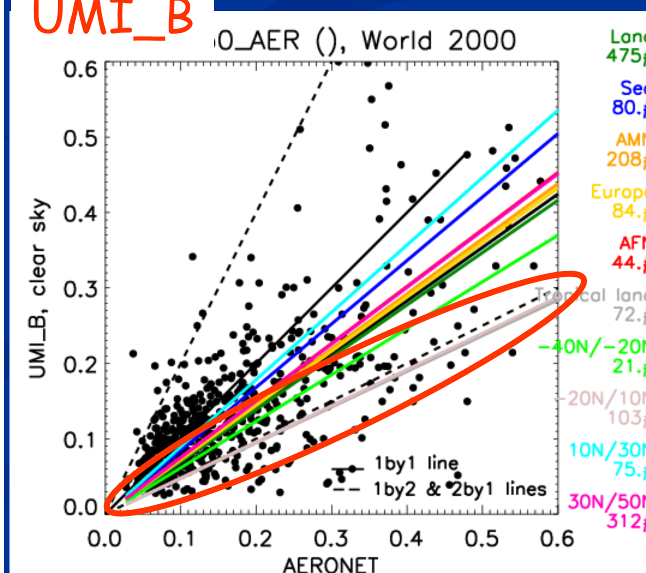
20S/10N
r = 0.81
s = 0.58

r = 0.75
slope = 0.7

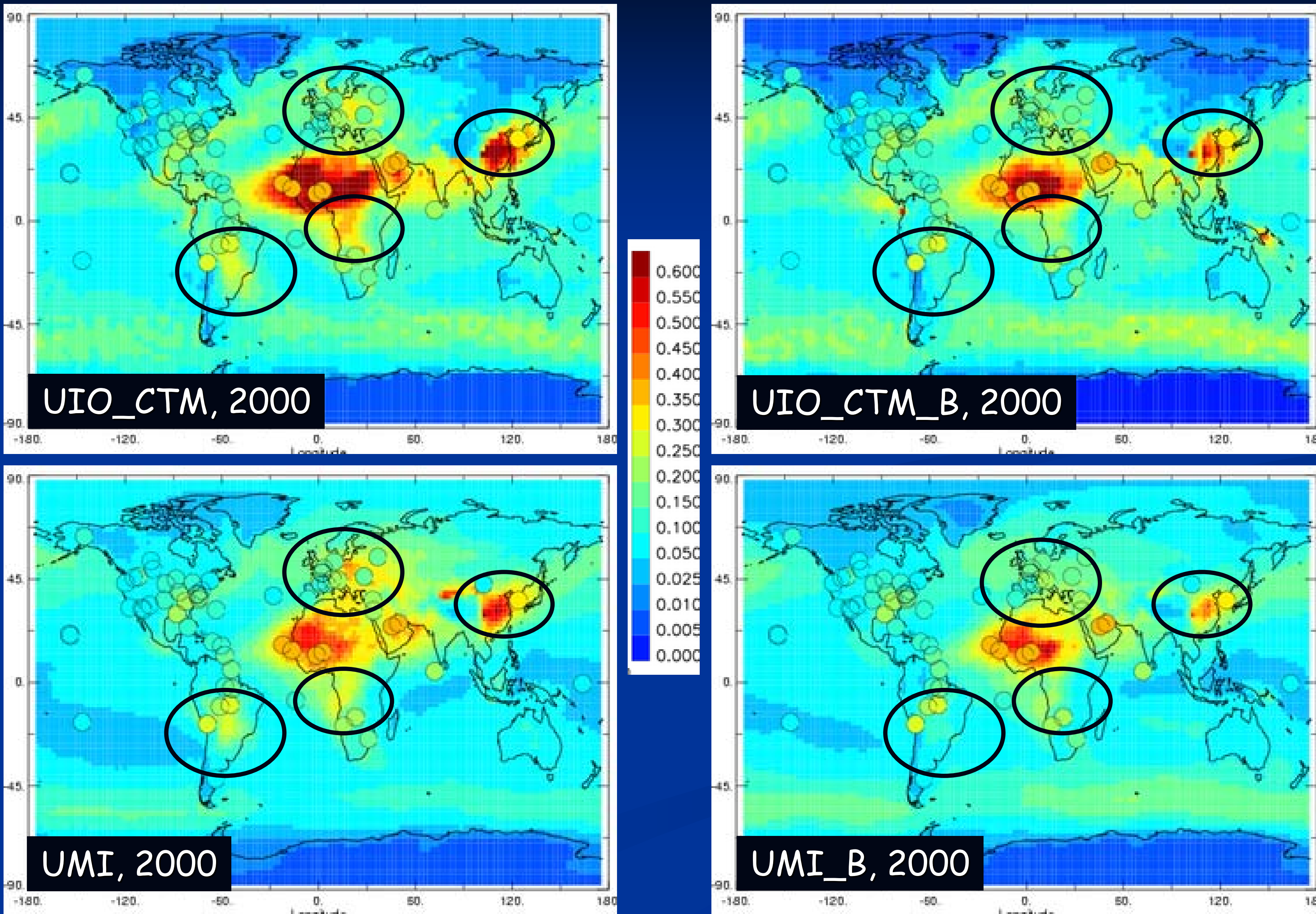
Europe
r = 0.28
s = 0.72

20S/10N
r = 0.82
s = 0.47

UMI_B



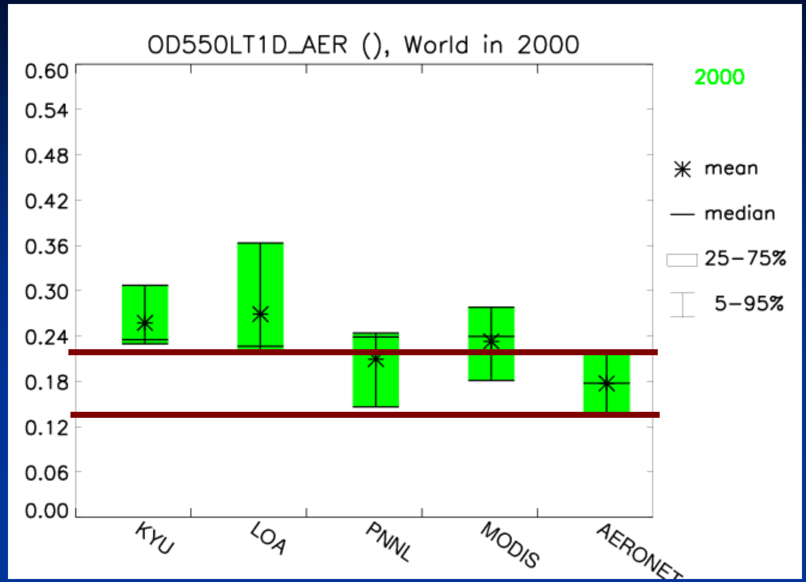
OD550 (9)

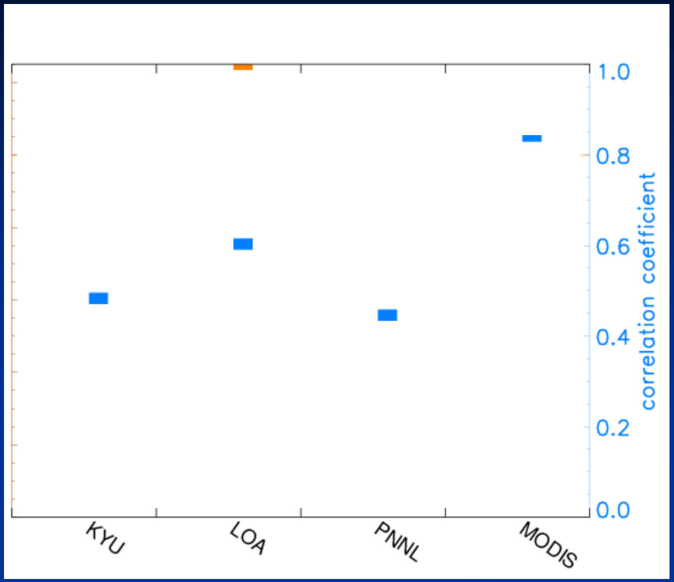

UIO_CTM, 2000
UIO_CTM_B, 2000
UMI, 2000
UMI_B, 2000
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.025
0.010
0.005
0.000
90.
45.
0.
-45.
-90.
-180.
-120.
-60.
0.
60.
120.
180
Longitude

OD550LT1 (1)

Experiment A

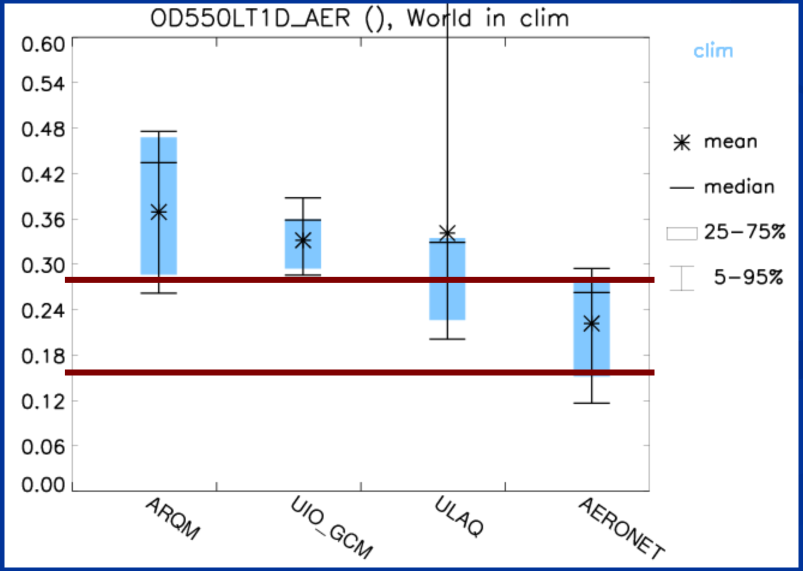
Nudged, year 2000

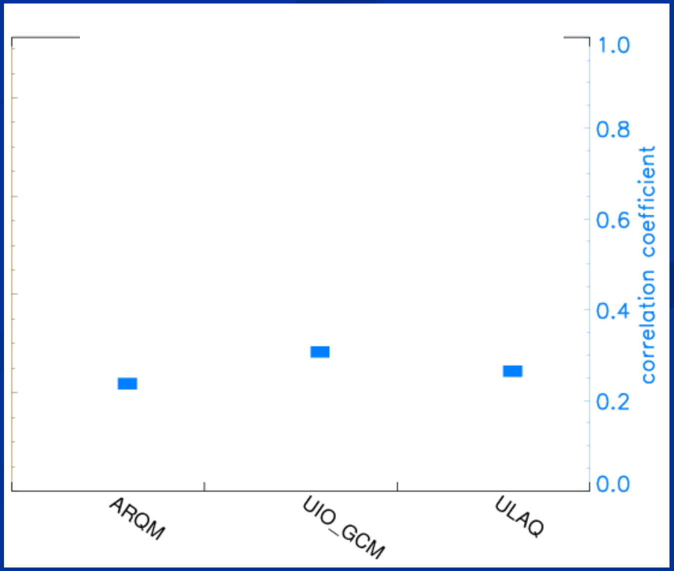




Small overestimation by all models, except PNNL. Clim models have smaller correlation coefficient.

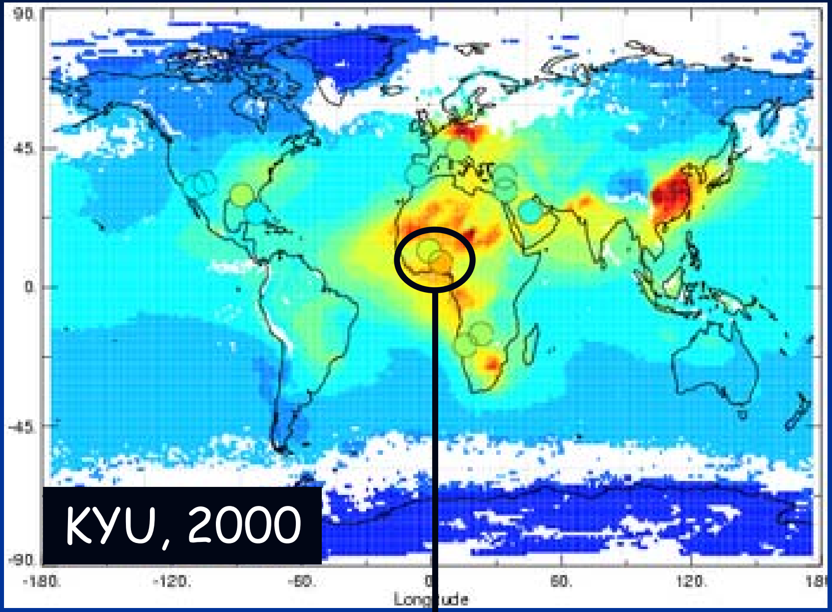
Clim, year 9999

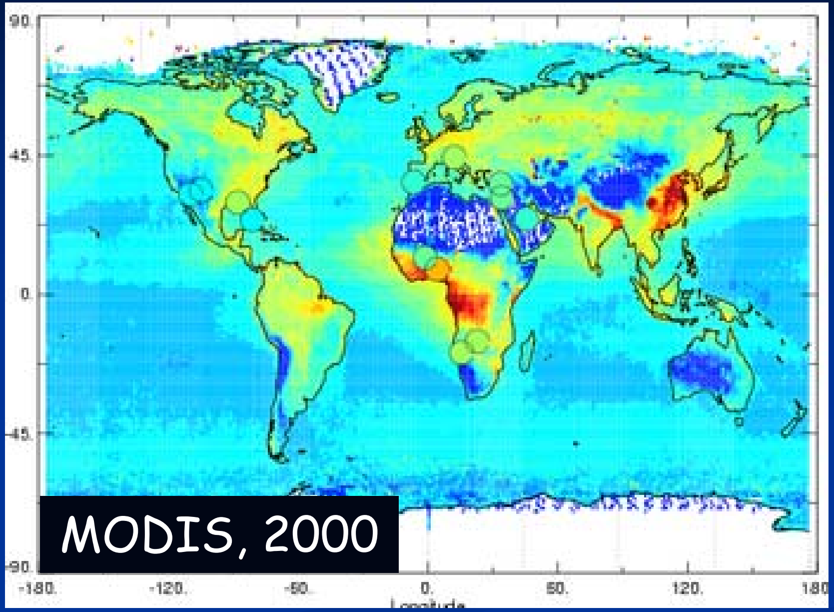




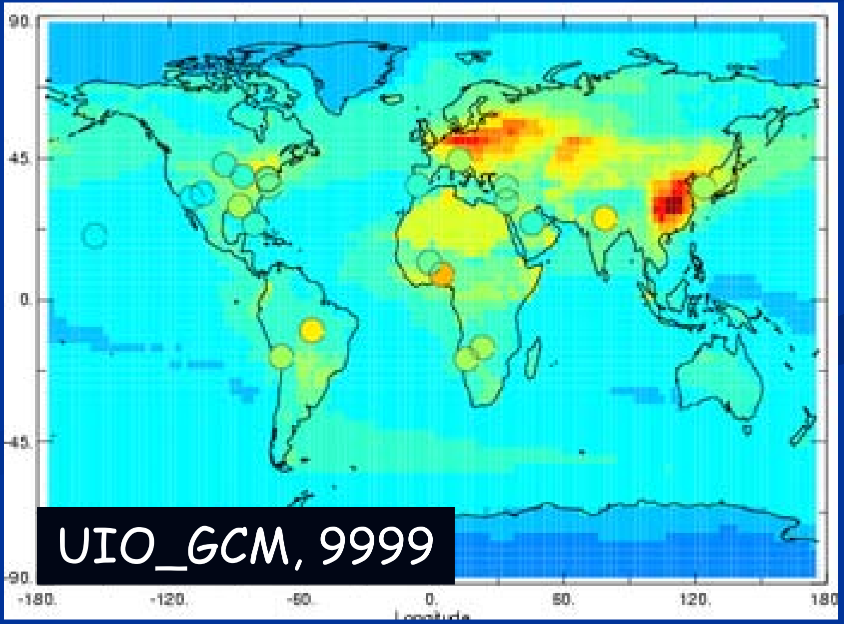
OD550LT1 (2)

Experiment A

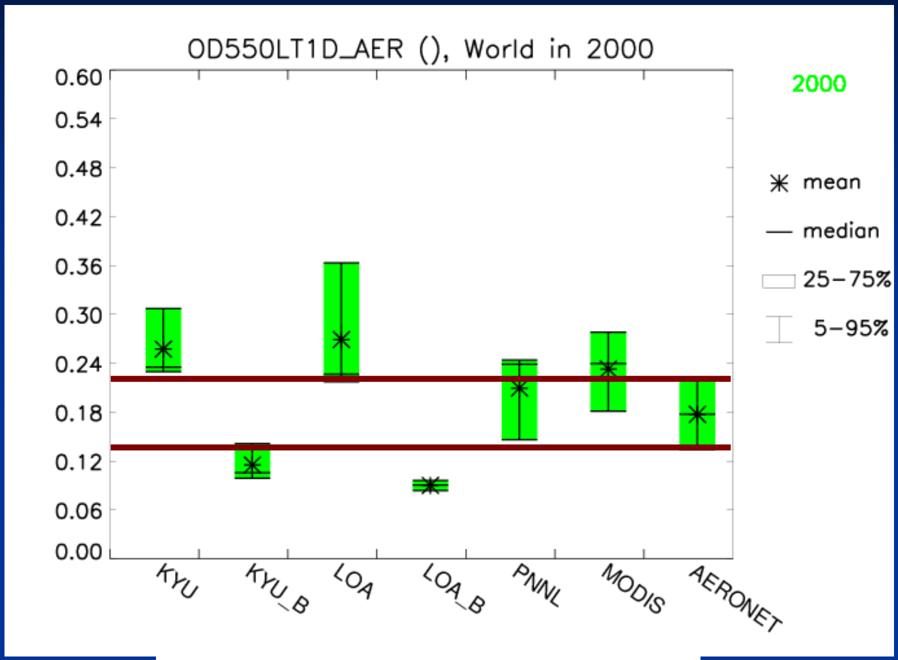




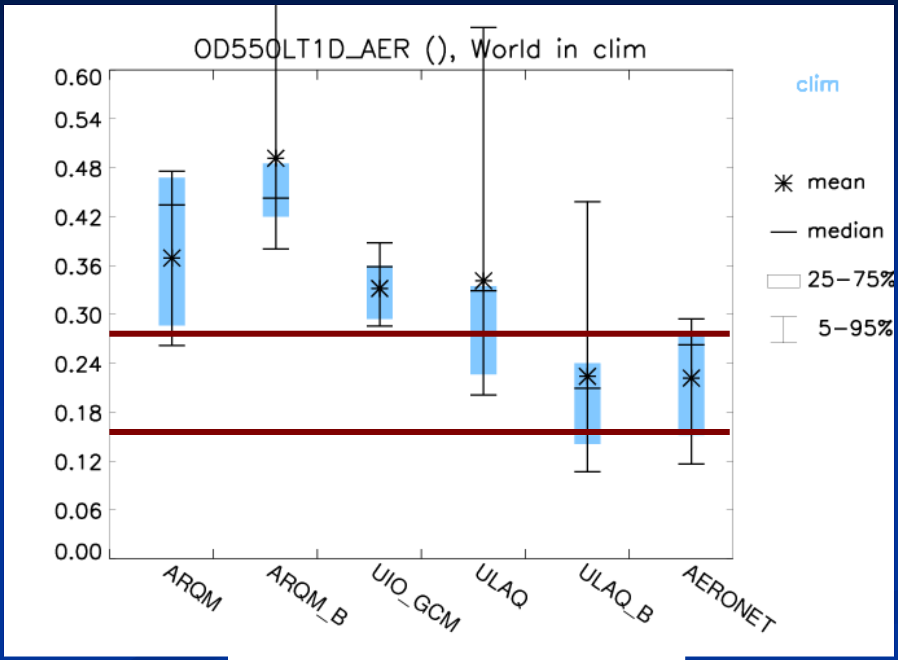
Only 3 months of data
⇒ not considered for
yearly mean calculation
and scatterplot



OD550LT1 (1)



Nudged, year 2000

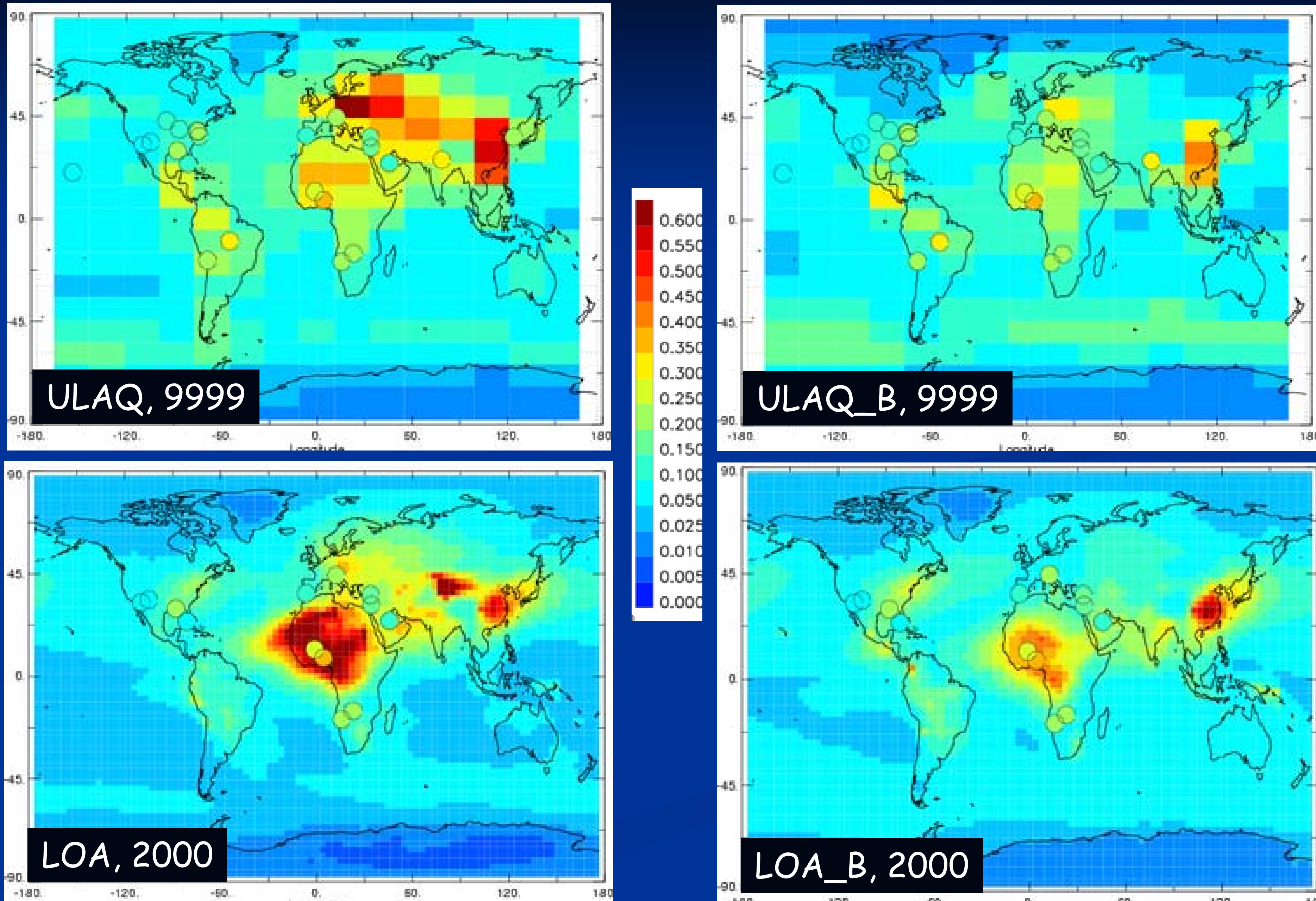


Clim, year 9999

Decrease of OD550LT1D between expA and expB.

We see for OD550 that values decrease in Europe and in Asia : locations of small particules => OD550LT1D decrease

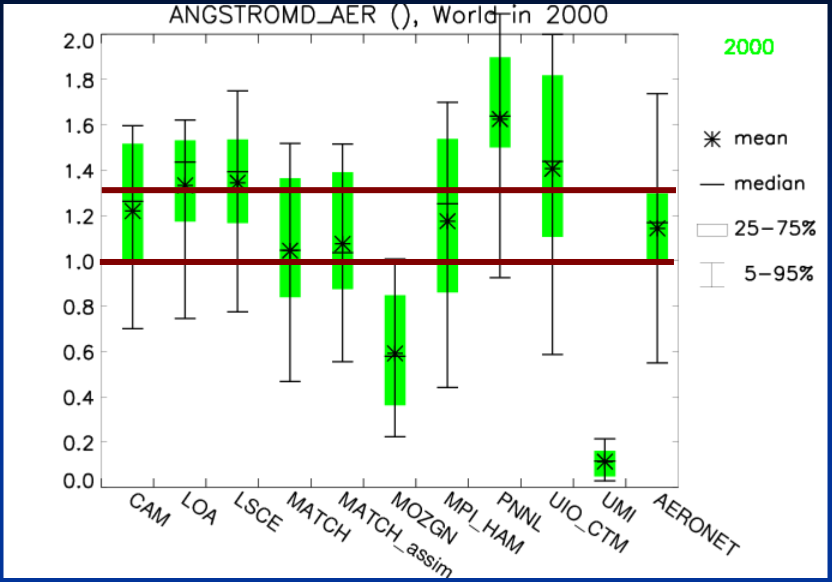
OD550LT1 (1)

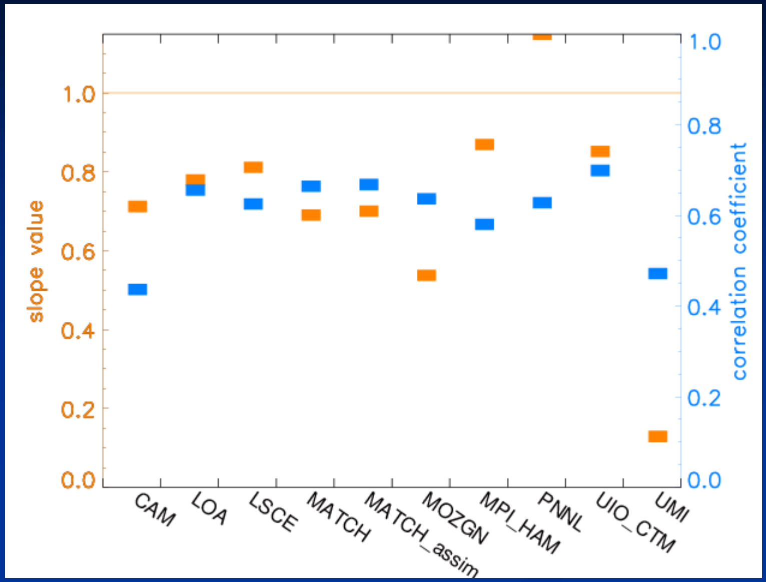

ULAQ, 9999
ULAQ_B, 9999
LOA, 2000
LOA_B, 2000
0.600
0.550
0.500
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.025
0.010
0.005
0.000

Angström coefficient (1)

Experiment A

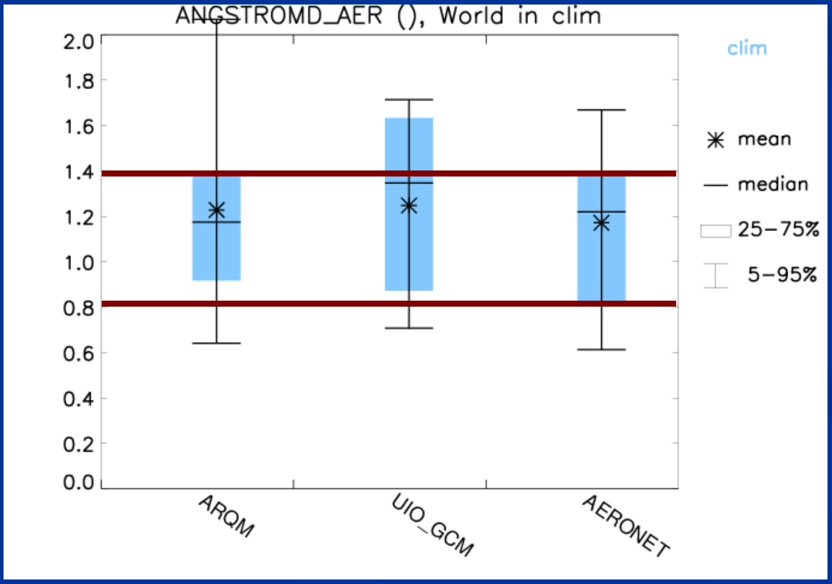
Nudged, year 2000

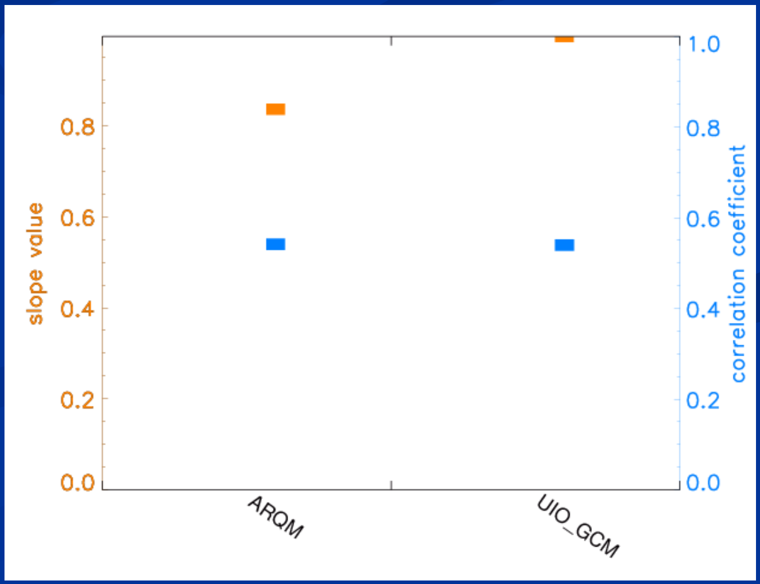




Underestimation by most models in 2000 + UMI & MOZGN : problems

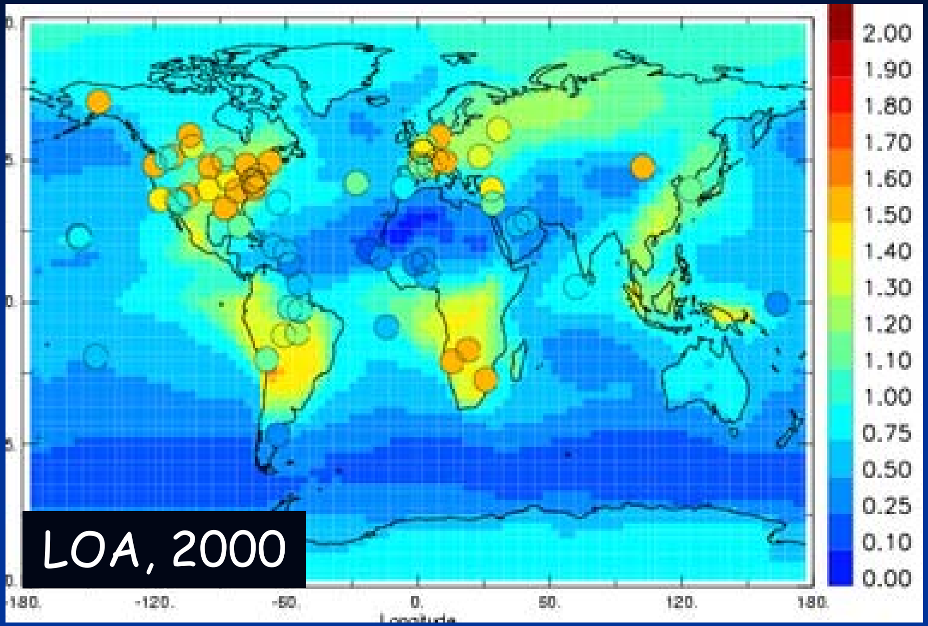
Clim. year 9999

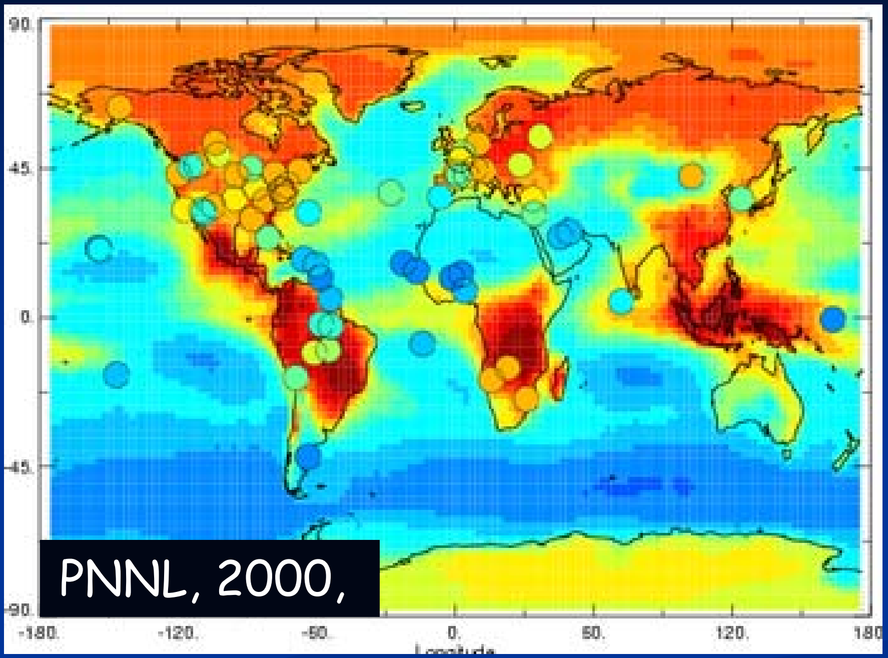


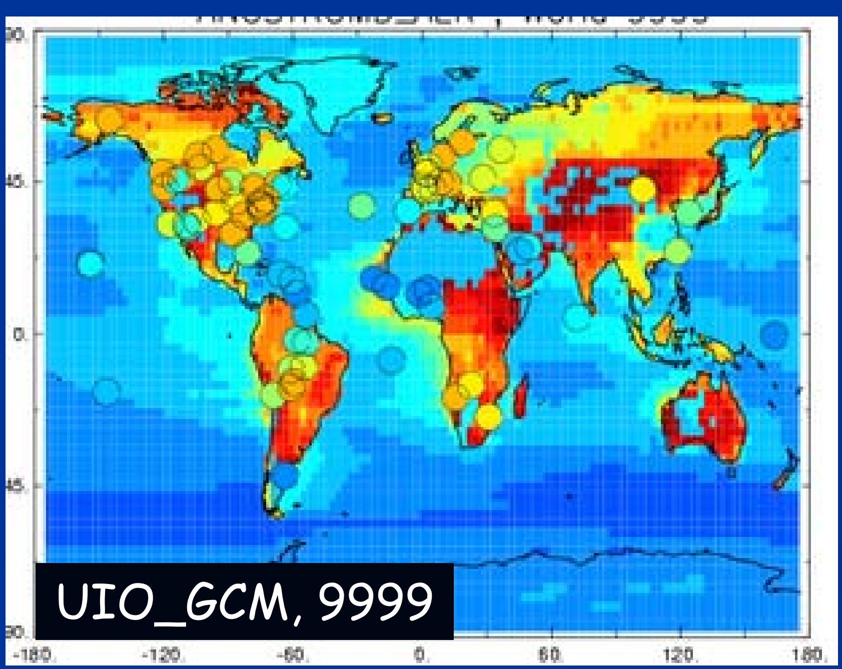


Angström coefficient (2)

Experiment A

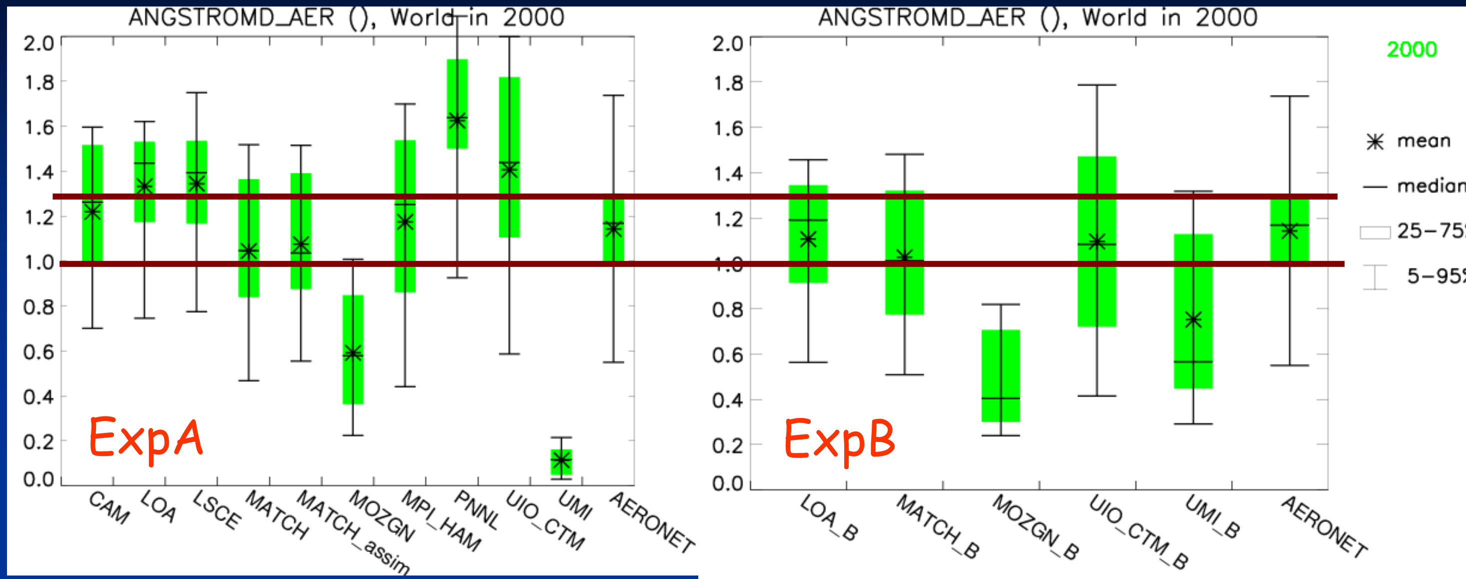




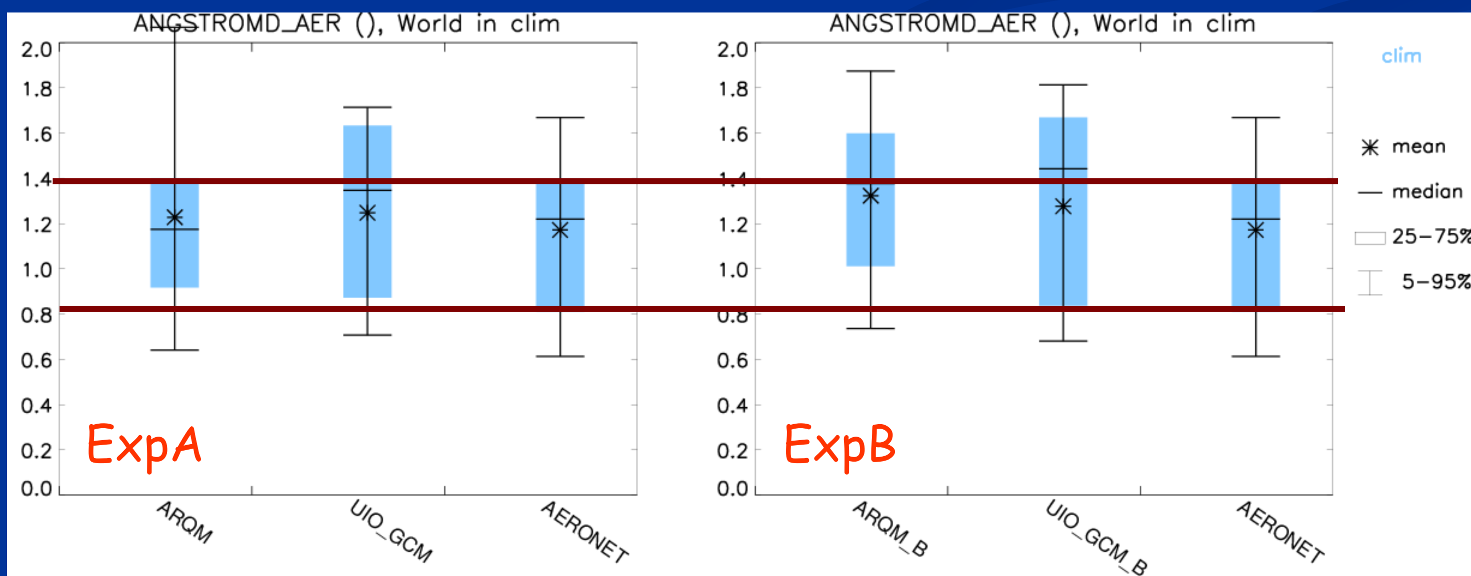


Angström coefficient (3)

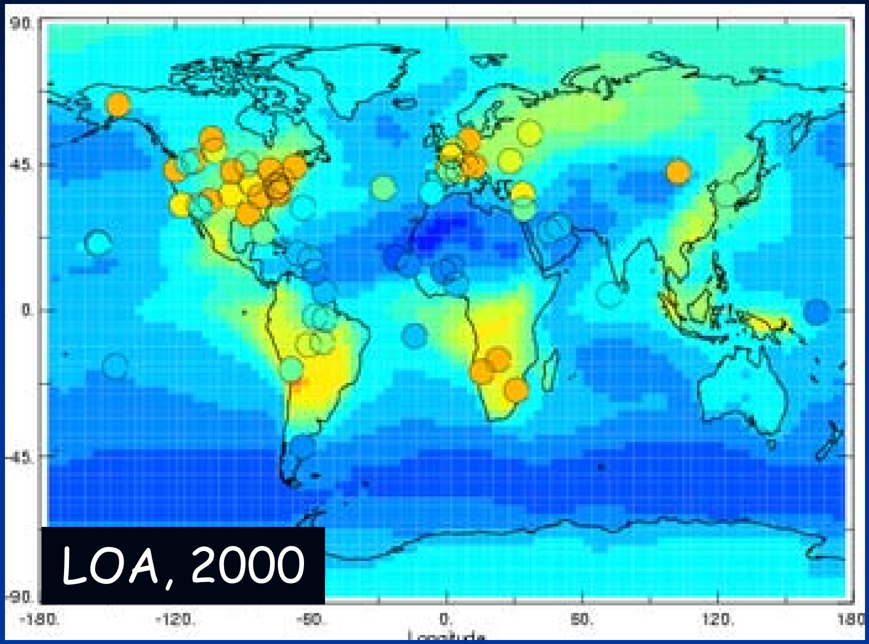
Nudged, year 2000

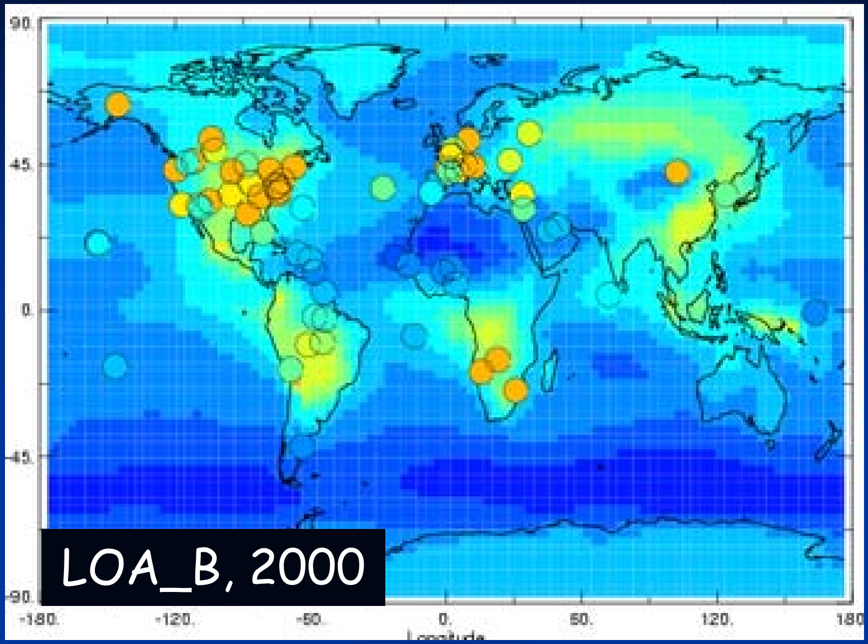


Clim. year 9999



Angström coefficient (4)





Decrease of angstrom component in Europe, AMS, AFS

Conclusion

Surface observations

Models / measurements comparisons :

- collection of observational data (from web sites)

EMEP SS and SO4 conc Europe – until 2000 – 32 stations

IMPROVE : BC, OC, SS and SO4 concentration
North America – 1996 to 2002 – 26 stations

GAW SS ans SO4 concentrations 5 stations – 1996

AIRMON SO4 concentration 2 stations – 1996&1997

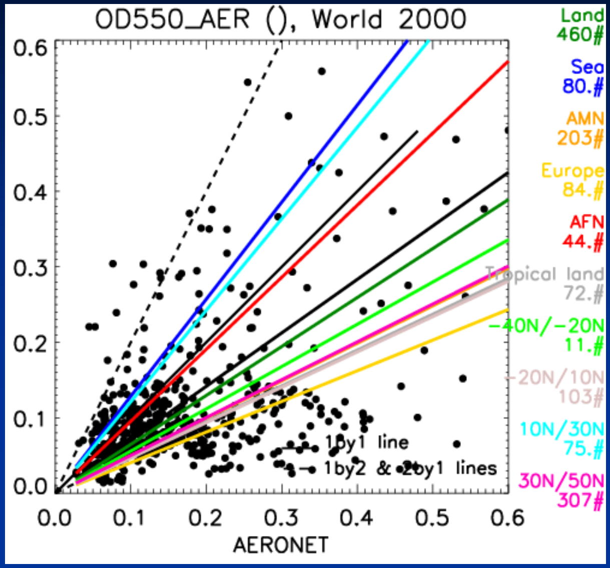
Paul Scherrer Institute : BC conc 3 stations – 96 to 2001

AERONET OD550 and Angstrom coefficient
98 stations – 1996 to 2001 (1998 to 2001 for Angstrom)

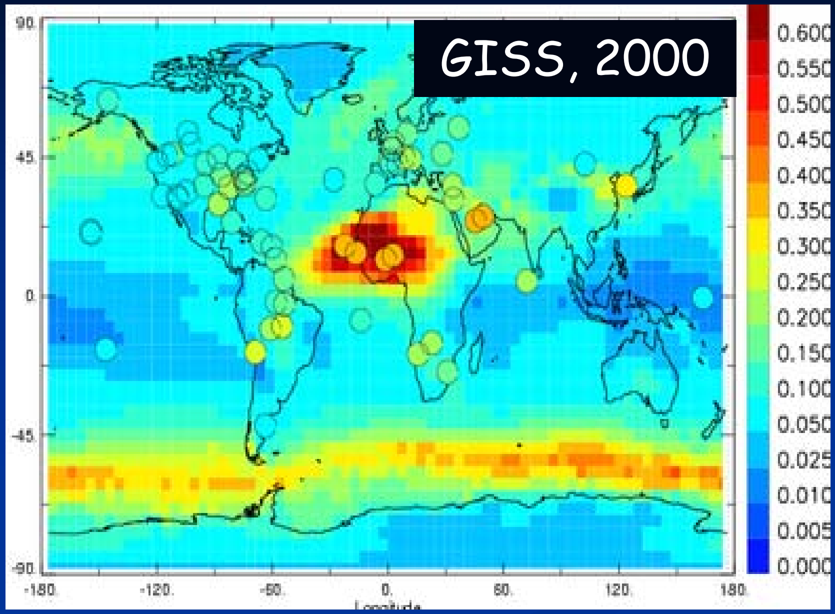
- model output to 166 station locations
- analysis of time series, global maps, scatter plots and synthesis graphs

OD550

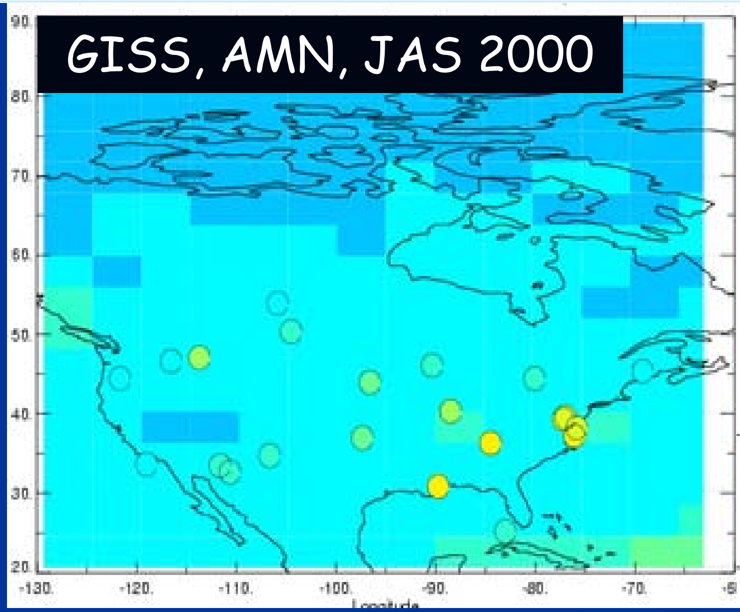
Experiment A

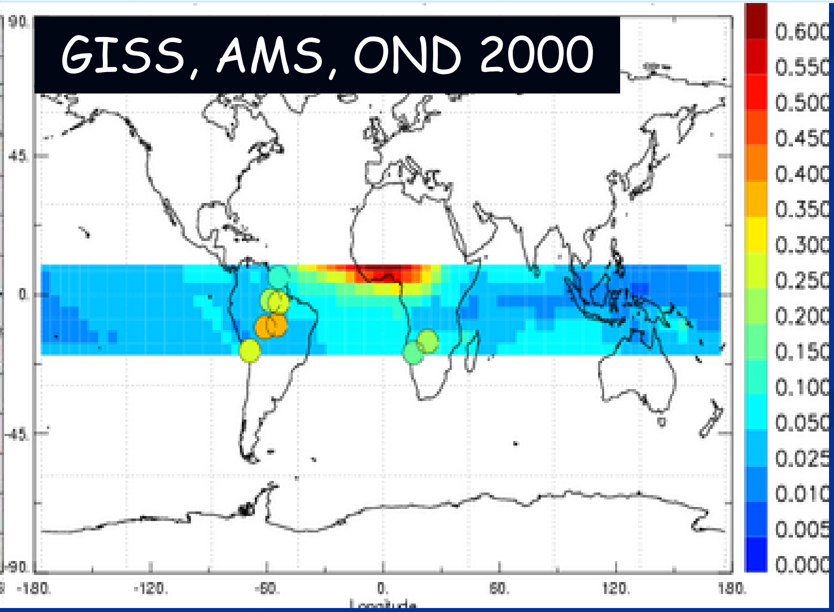


Exemple of GISS



OD too small over land : especially AMN (during summer) and AMS (during winter)

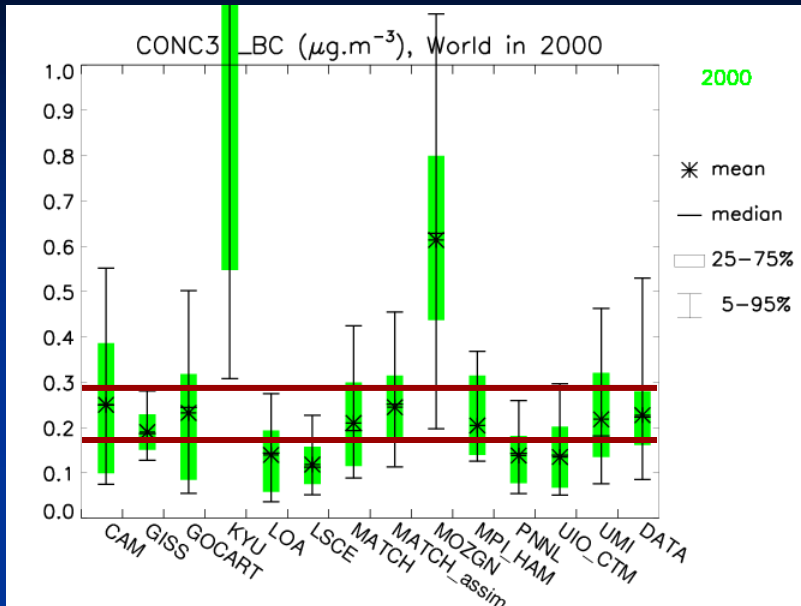


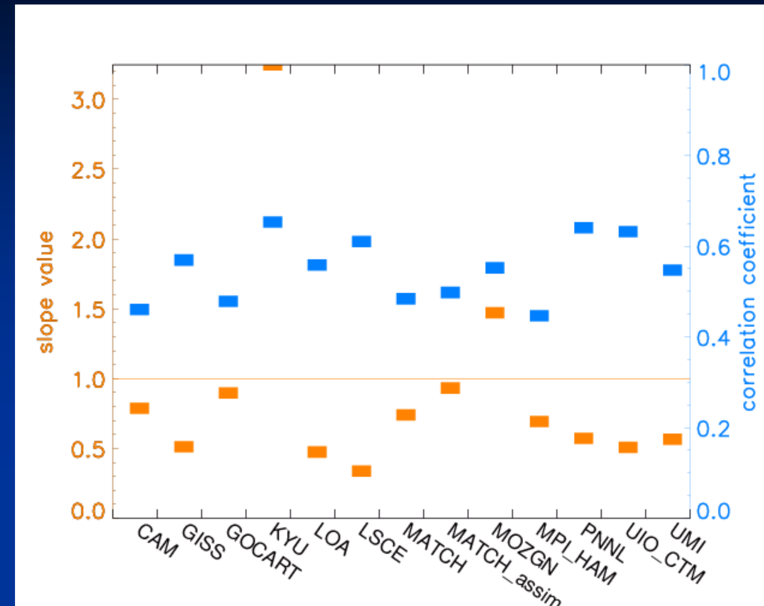


BC concentration (1)

Experiment A

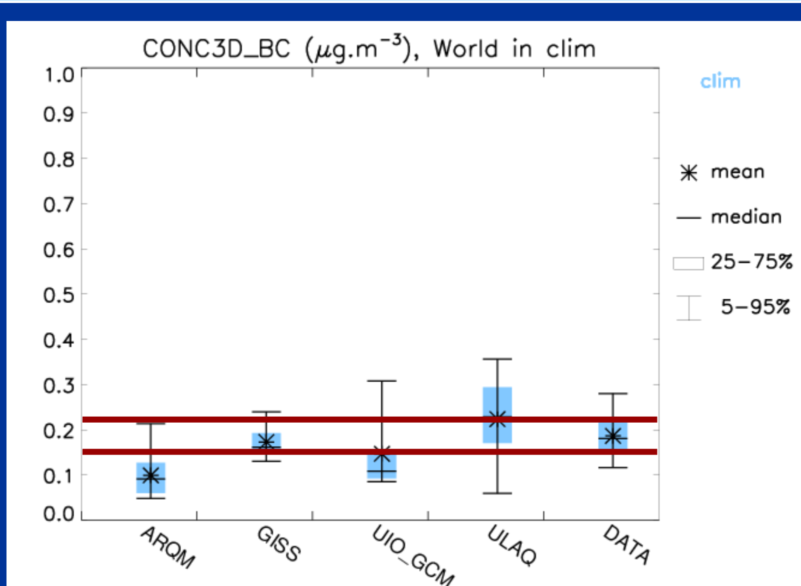
Nudged, year 2000

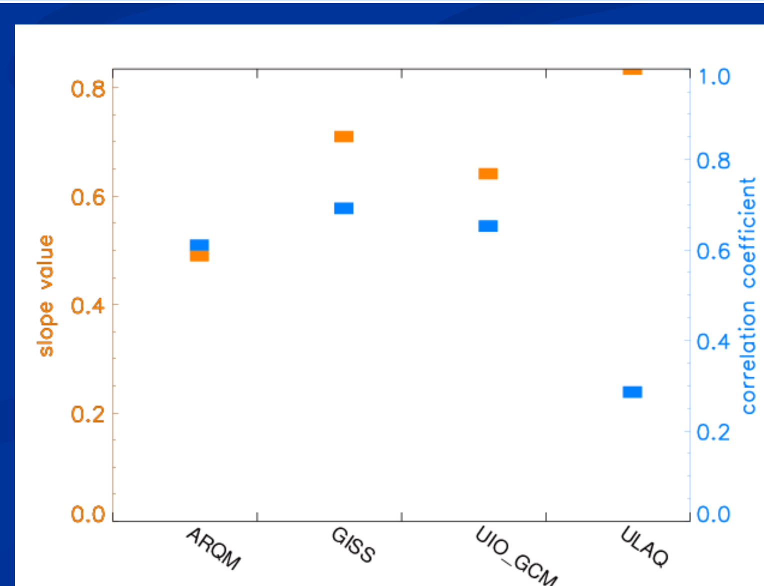




Same as OC conc : underestimation by all models except KYU and MOZGN

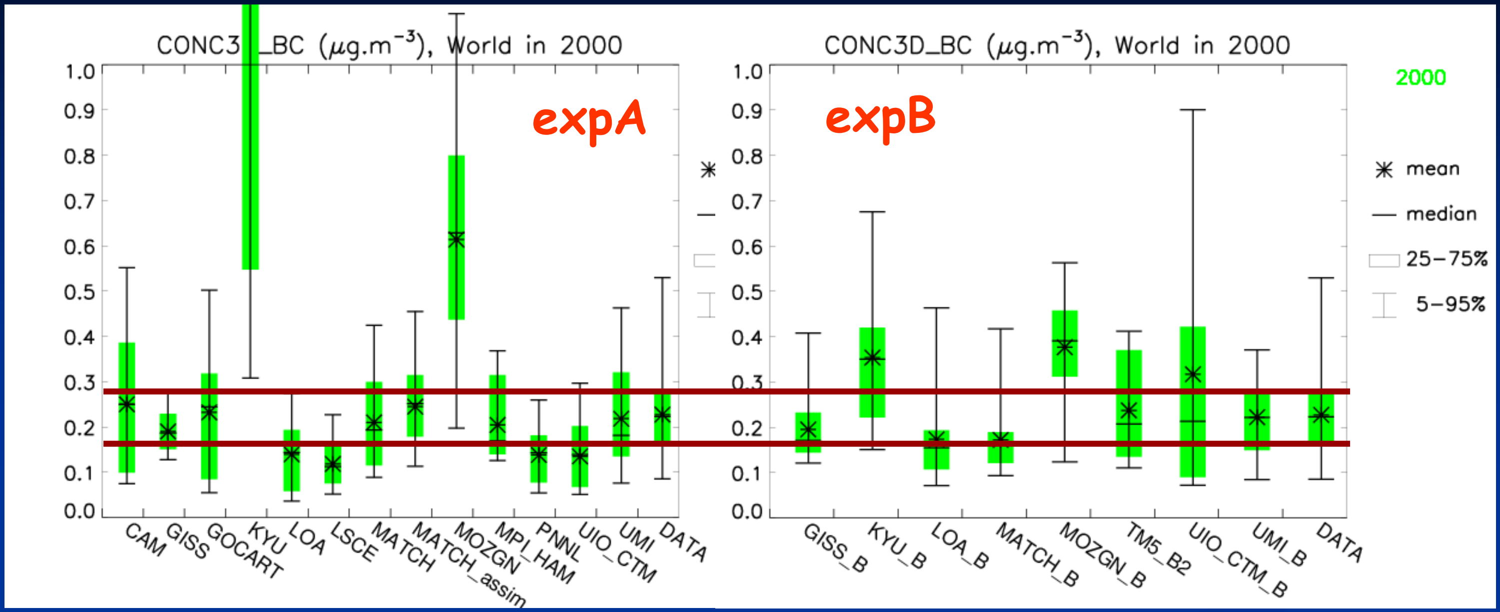
Clim, year 9999





BC concentration (4)

Nudged, year 2000



In general, better agreement with expB

Clim, year 9999