# An AEROCOM Intercomparison Exercise in Organic Aerosol Modeling

Kostas Tsigaridis, Maria Kanakidou, Nikos Daskalakis
and the OA AEROCOM team

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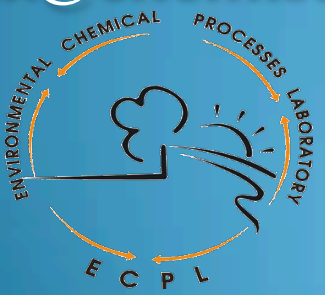




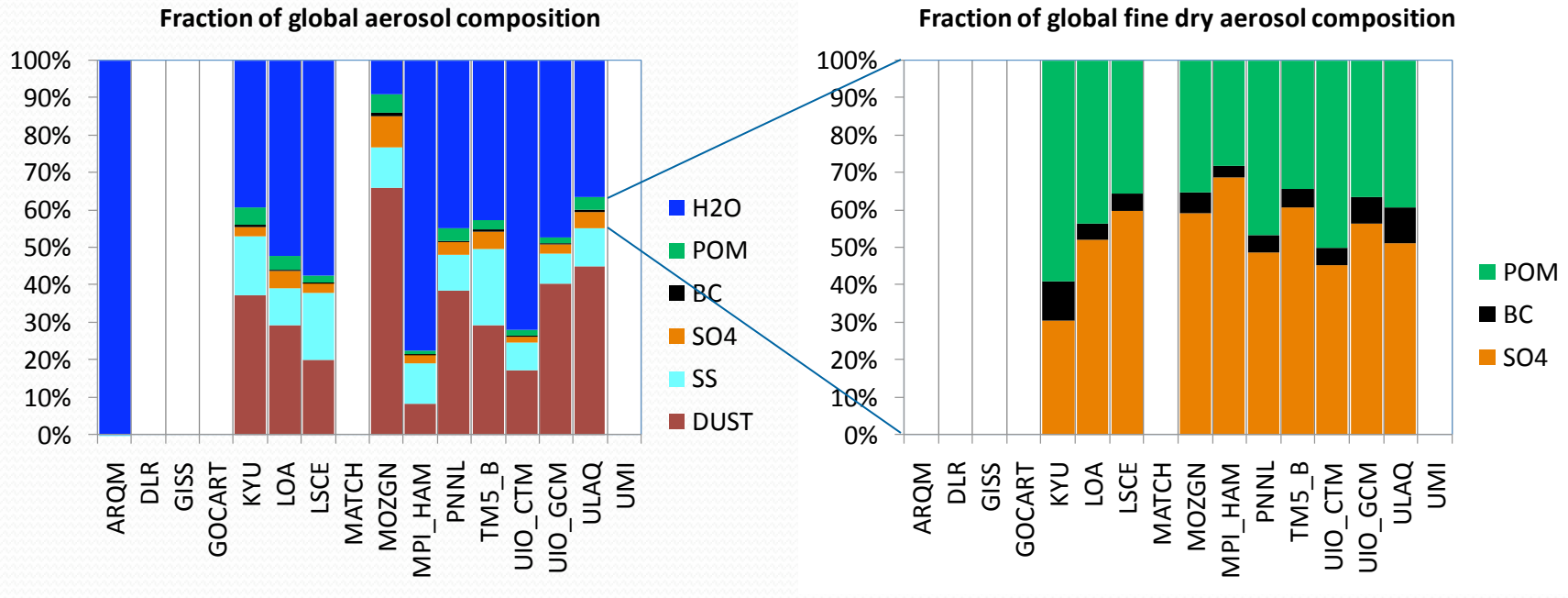
# The OA AEROCOM team : Contributors

- AEROCOM modelers
  - Alf Kirkevåg (CAM-Oslo)
  - Angela Benedetti (ECMWF)
  - Kirstie Pringle, Jos Lelieveld (EMAC)
  - Gabriele Curci (GEOS-Chem)
  - Shantanu Jathar, Peter Adams (GISS II' UBS)
  - Graham Mann (GLOMAPmode)
  - Thomas Diehl (GOCART)
  - Toshi Takemura (SPRINTARS)
  - Nicolas Bellouin (HadGEM2)
  - Jenny Stavrakou (IMAGES)
  - Kai Zhang (MPIHAM)
  - Kostas Tsigaridis, Maria Kanakidou (TM3)
  - Maria Kanakidou, Stelios Myriokefalitakis, Nikos Daskalakis (TM4-ECPL)
  - Kostas Tsigaridis, Dorothy Koch (GISS modelE)
  - Susanne Bauer, Dorothy Koch (GISS modelE + MATRIX)
- Measurements
  - Lynn Russell, Ranjit Bahadur
  - Jose-Luis Jimenez, Qi Zhang, Sally Ng
  - Jean Sciare
  - Nikos Mihalopoulos

# The challenge:

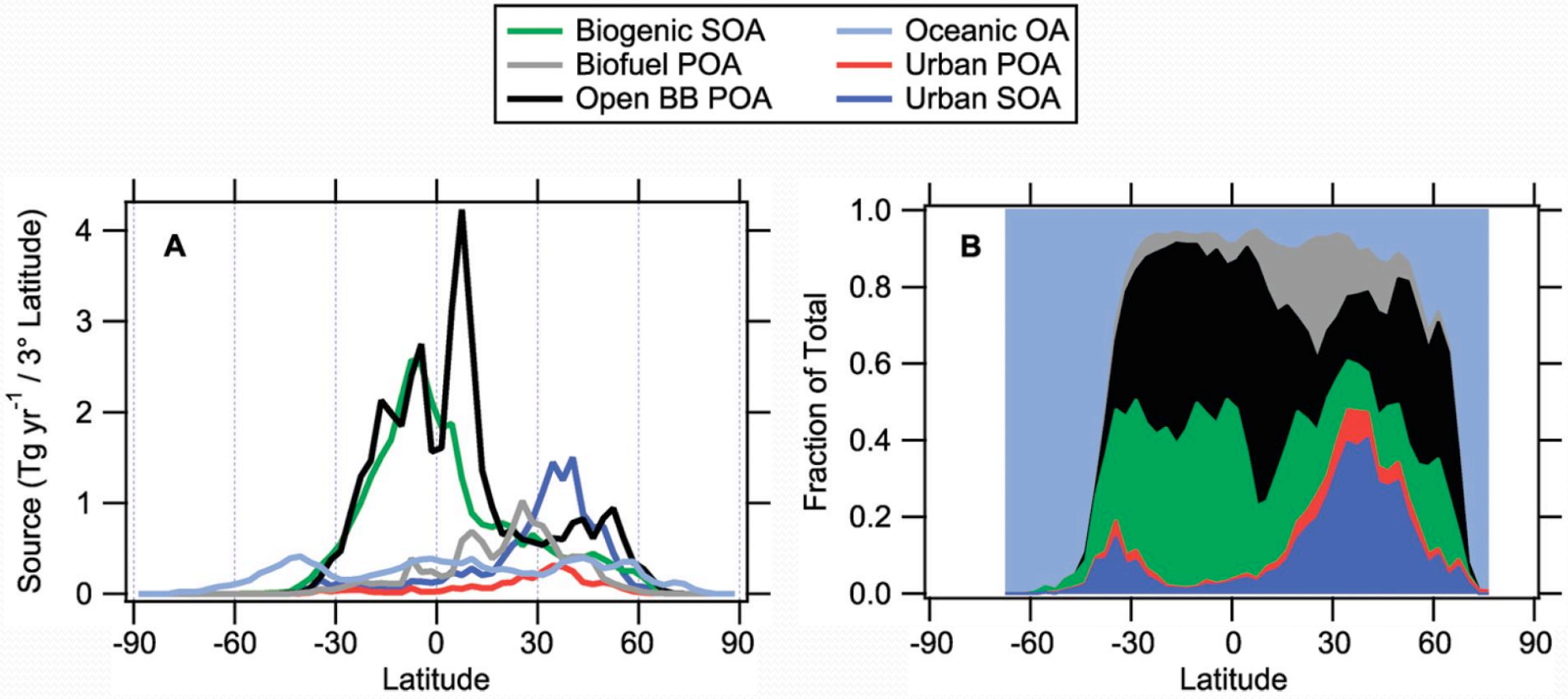
- chemical complexity
- different properties
- uncertainties /unaccounted sources

# Aerosol composition (modeling)




Modified from Textor et al., 2006

# Latitudinal distribution




De Gouw and Jimenez, 2009

# OA model intercomparison – AEROCOM

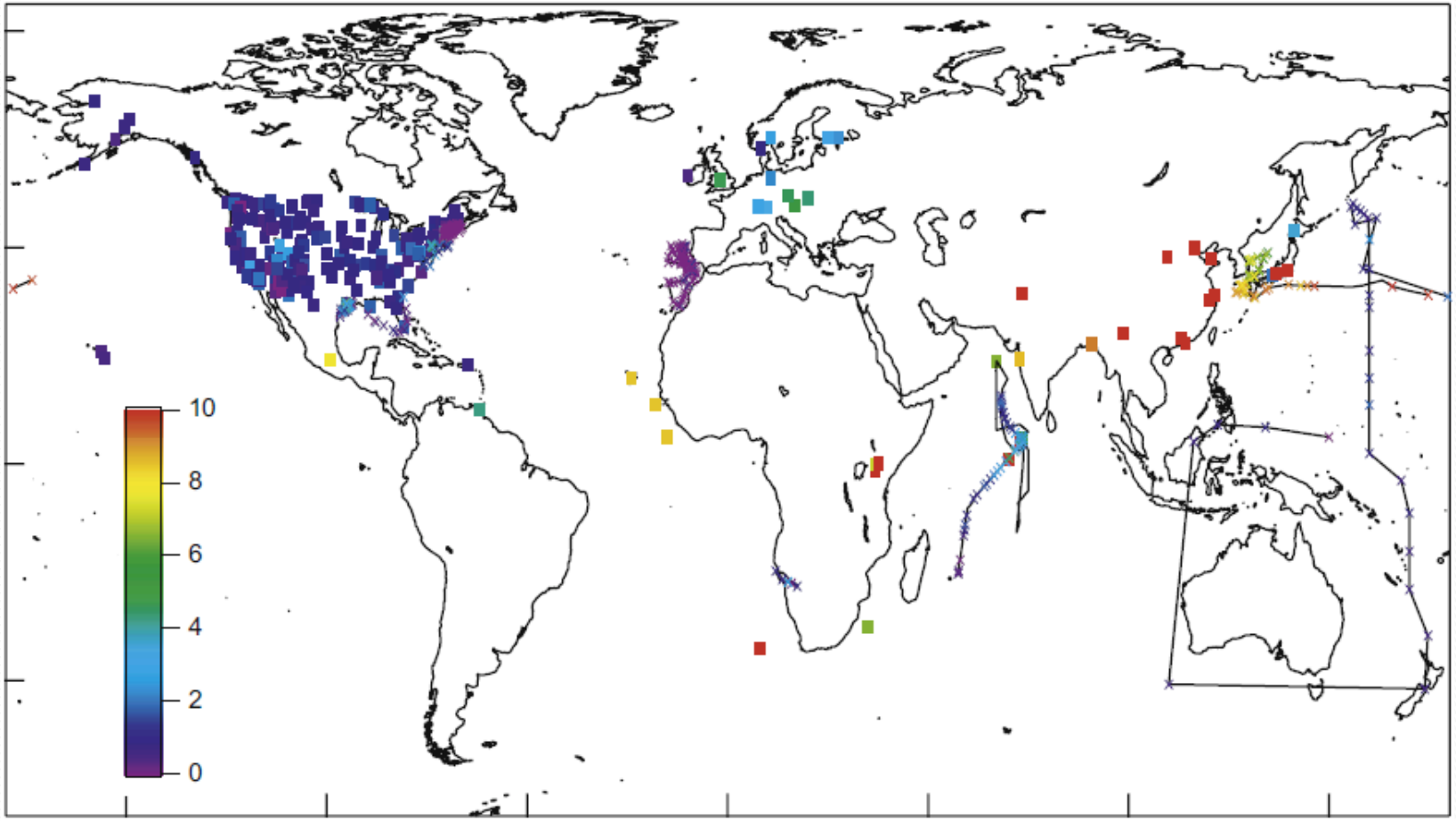
- http://dataipsl.ipsl.jussieu.fr/AEROCOM/

- Compare models against measurements
- Study organic aerosol composition, not only bulk

- Until now:
  - 15 global models (1 more at least is expected)
  - OC obs (mainly from Bahadur et al., 2010)
  - OA obs (mainly from Zhang et al., 2007)
  - OC obs - Amsterdam island (Sciare et al., 2009)
  - OC obs - Finokalia Crete, Greece (Koulouri et al., 2008 & Mihalopoulos unpublished)

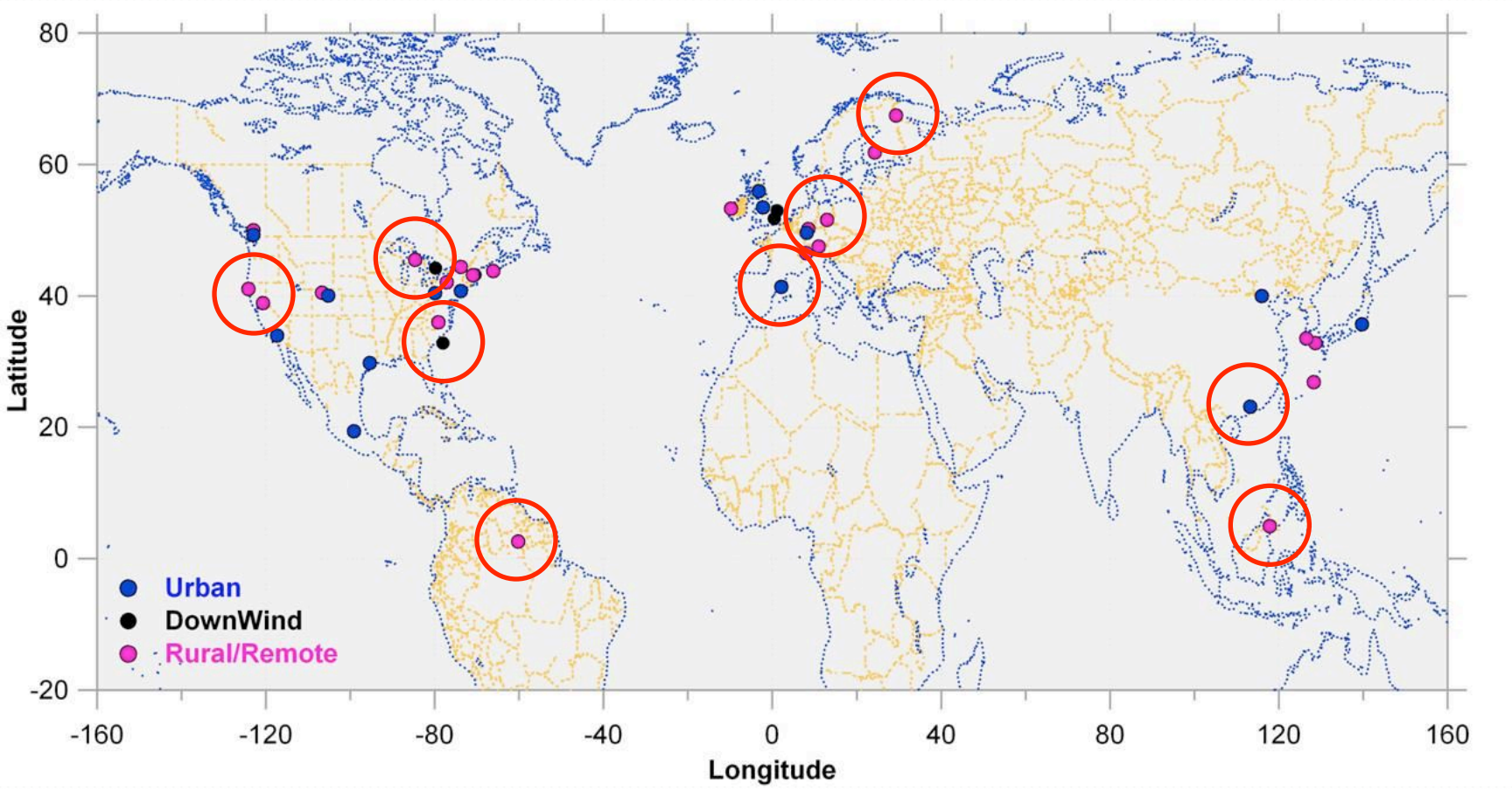
# OA measurements – $PM_{2.5}$

Bahadur et al., 2009

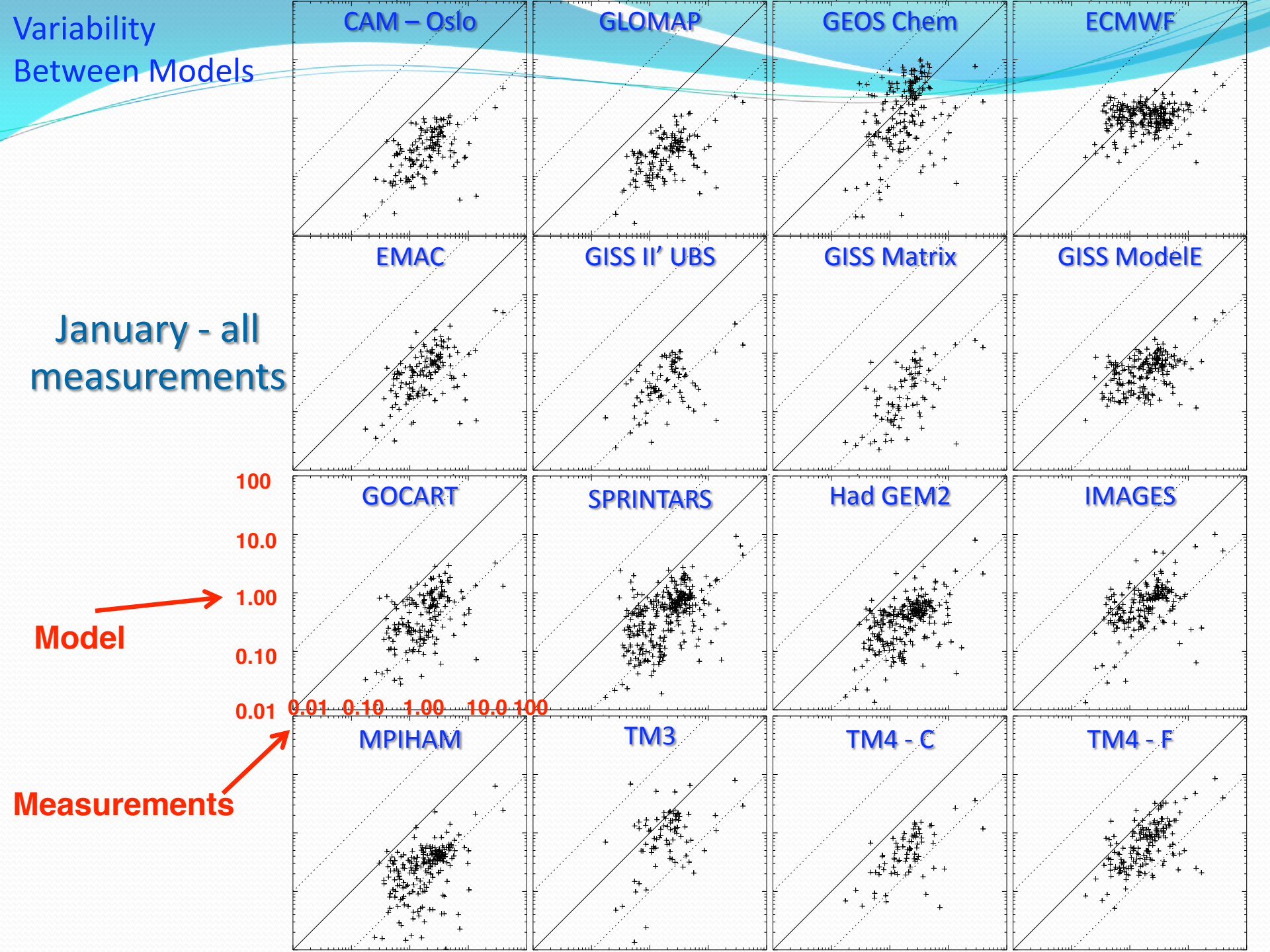


http://www.asrc.cestm.albany.edu/qz/AMS_Global_Database/gMap2.jpg

# OA measurements – AMS
# Zhang et al., 2007 + new data

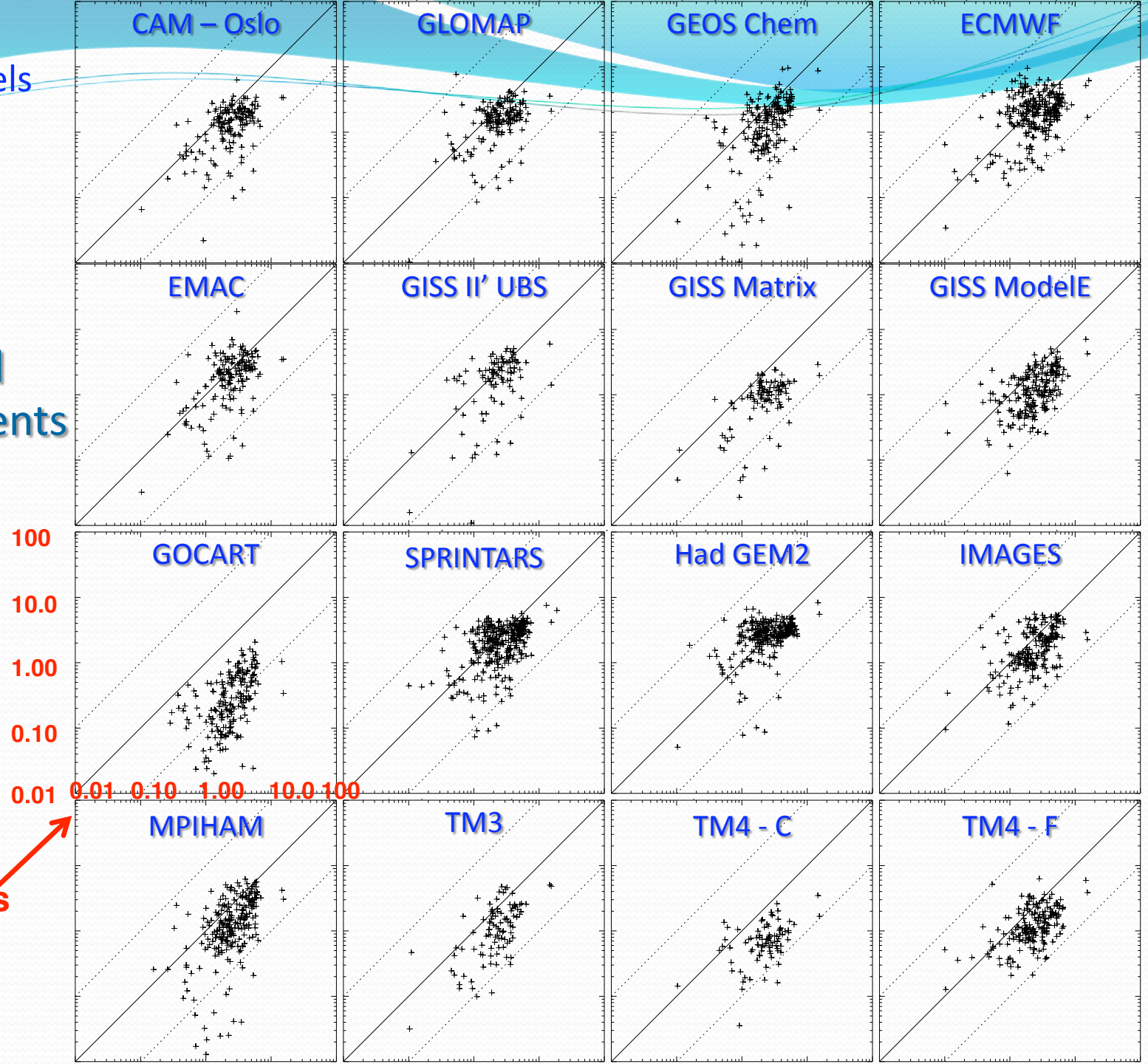


# Variability Between Models

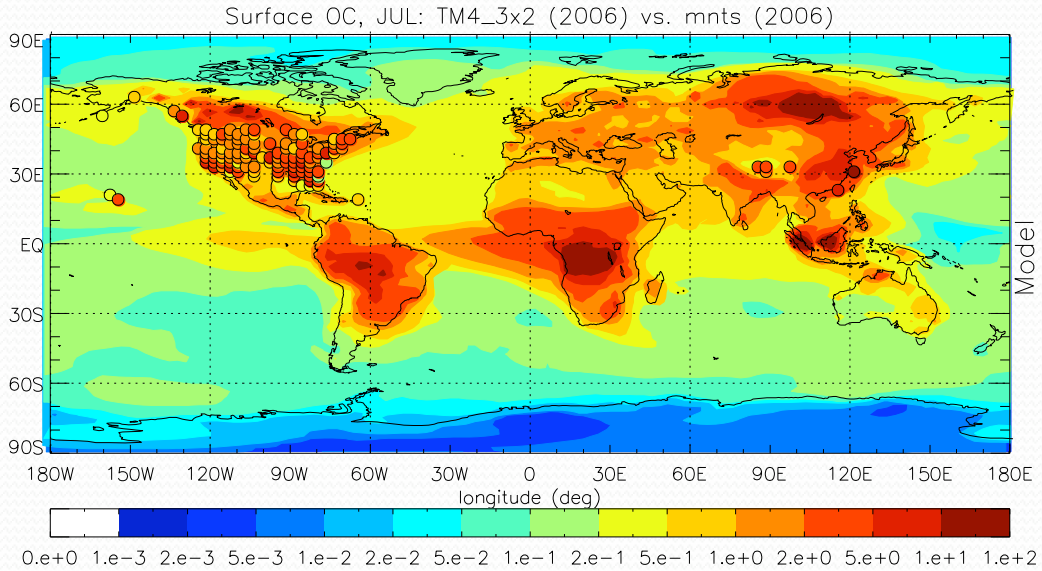


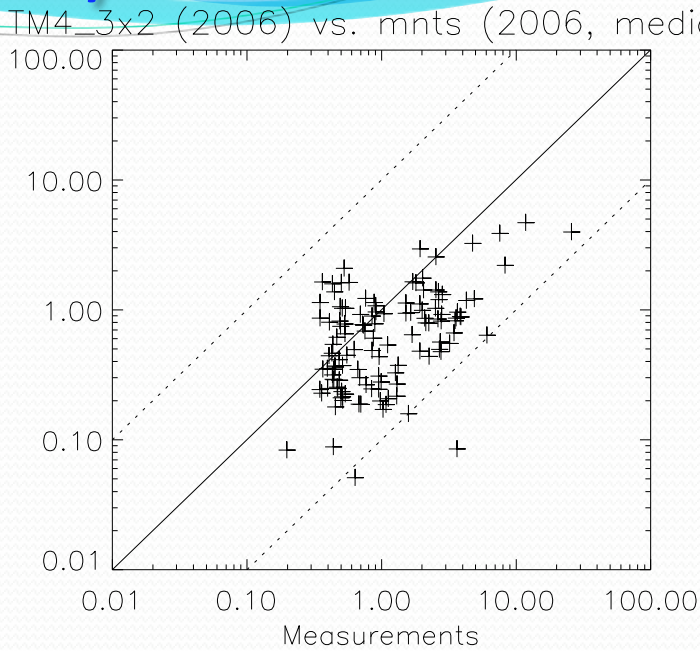
# Variability Between Models

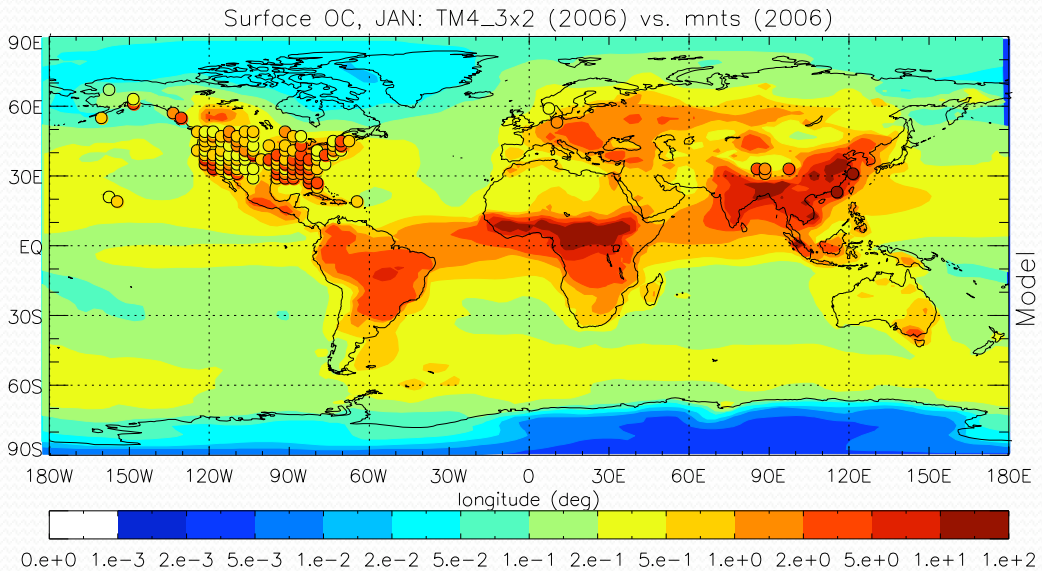
July – all measurements

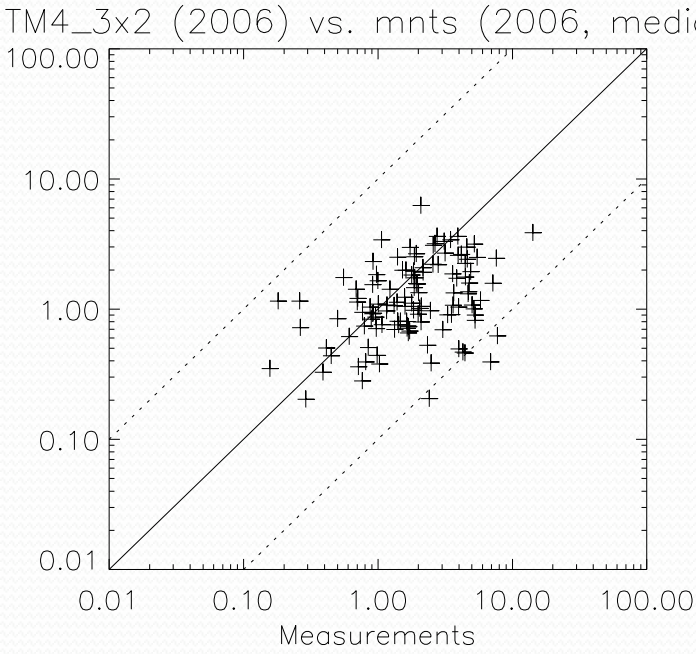


# TM4 → July / Jan seasonality



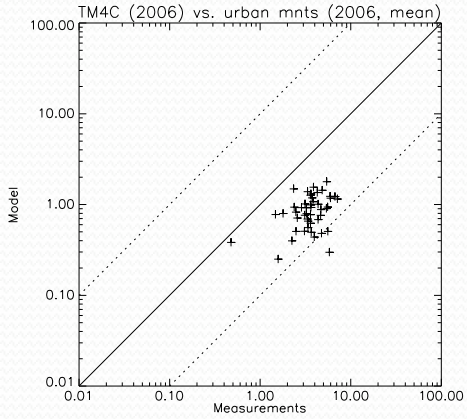



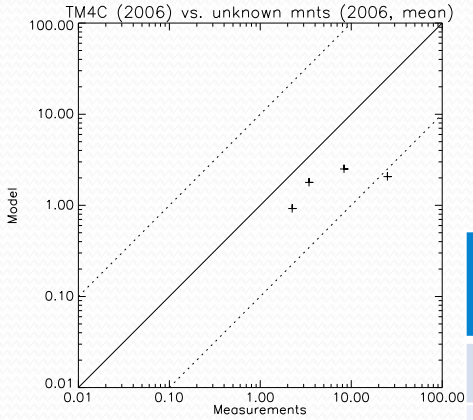




TM4 – OC model intercomparison -AEROCOM
mariak@chemistry.uoc.gr ECPL, Univ. Crete

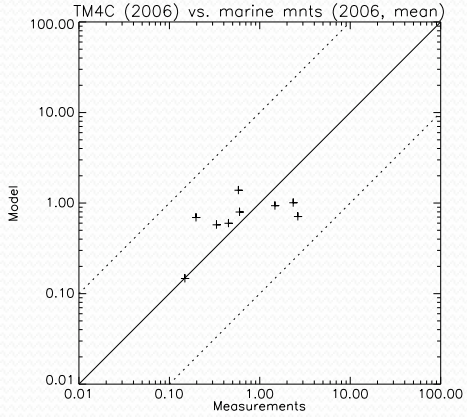
# TM4 regional variability

urban

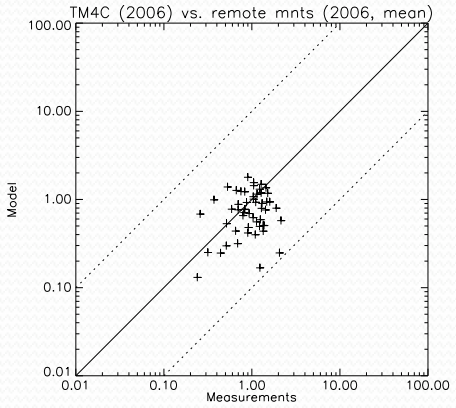


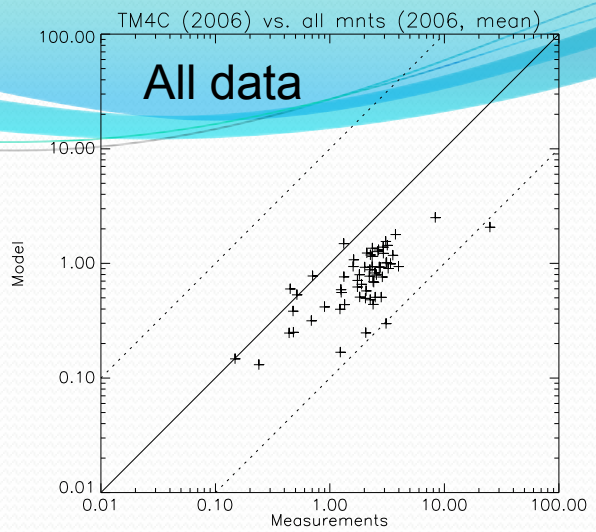

marine




remote

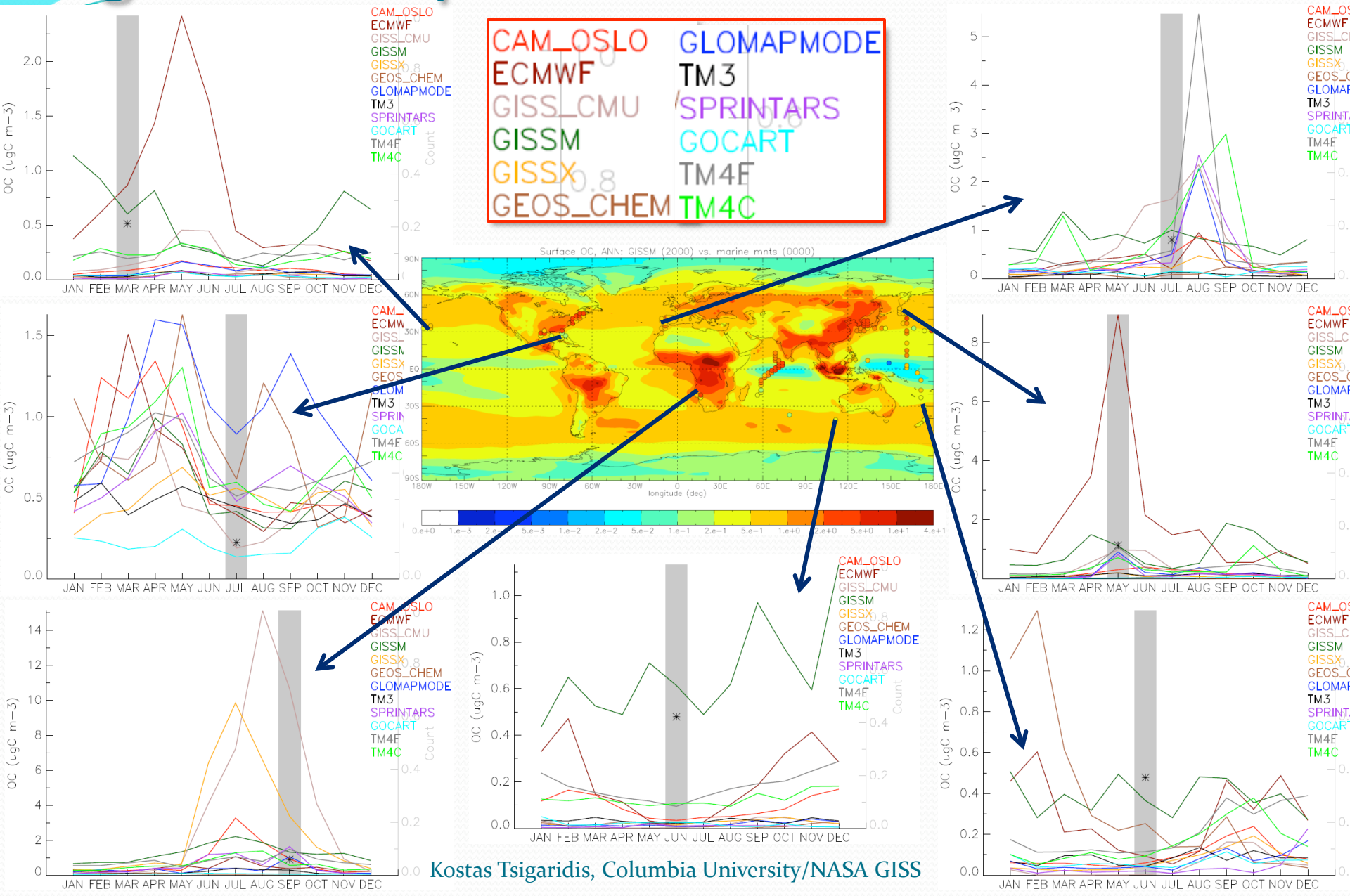



2006



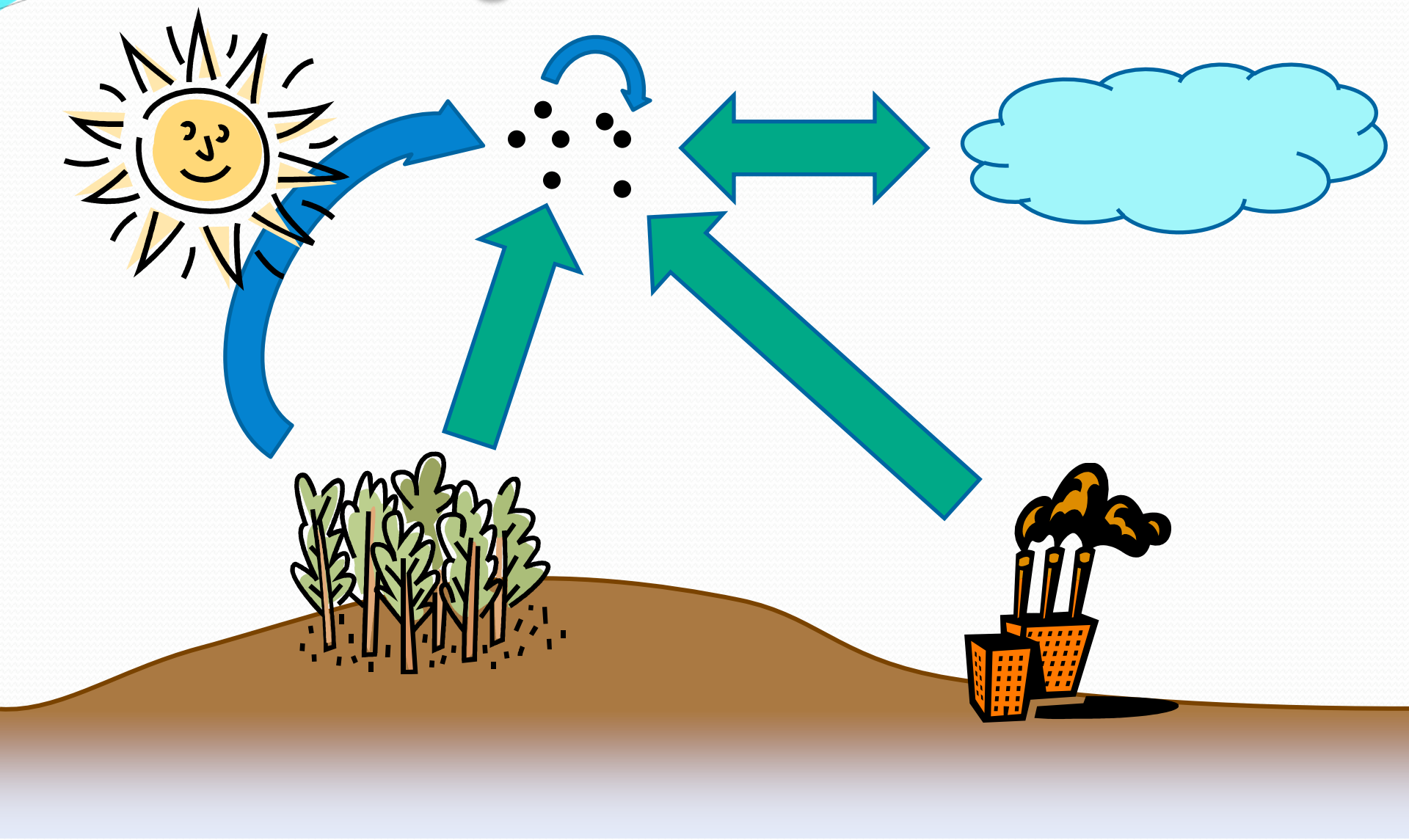

| Month | $R^2$ | Slope | MNB % | #obs | #grid boxes |
|---|---|---|---|---|---|
| Annual | -0.733 | 0.1824 | -56.08 | 35658 | 62 |
| Urban | -0.192 | 0.217 | -73.6 | 16007 | 47 |
| Remote | -0.47 | 0.6848 | -8.26 | 19185 | 52 |
| Marine | -1.747 | 0.4787 | 40.31 | 466 | 9 |
| January | -0.472 | 0.0953 | -63.2 | 3334 | 59 |
| February | -0.252 | 0.1479 | -66.7 | 2981 | 56 |
| March | 0.1015 | 0.1483 | -62.47 | 3067 | 56 |
| April | 0.3842 | 0.1872 | -64.97 | 3008 | 57 |
| May | 0.1908 | 0.1998 | -64.39 | 3127 | 57 |
| June | 0.2225 | 0.2671 | -64.04 | 2751 | 56 |
| July | -0.245 | 0.2699 | -58.21 | 2986 | 58 |
| August | -0.774 | 0.2685 | -47.73 | 2945 | 56 |
| September | -0.379 | 0.2217 | -33.03 | 2770 | 57 |
| October | -1.246 | 0.1385 | -44.98 | 2804 | 57 |
| November | -1.427 | 0.1002 | -55.83 | 2789 | 57 |
| December | 0.0751 | 0.3034 | -58.3 | 3096 | 56 |

# Organics comparison with measurements



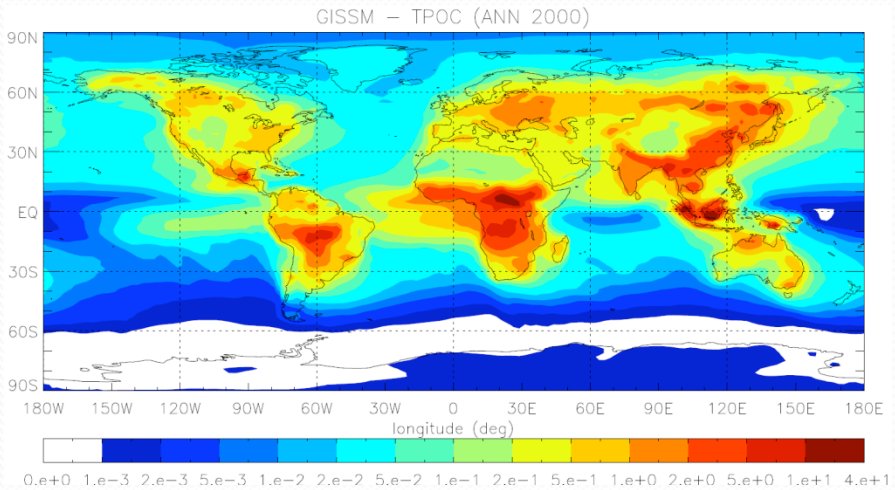

Kostas Tsigaridis, Columbia University/NASA GISS

# Terrestrial organic aerosol

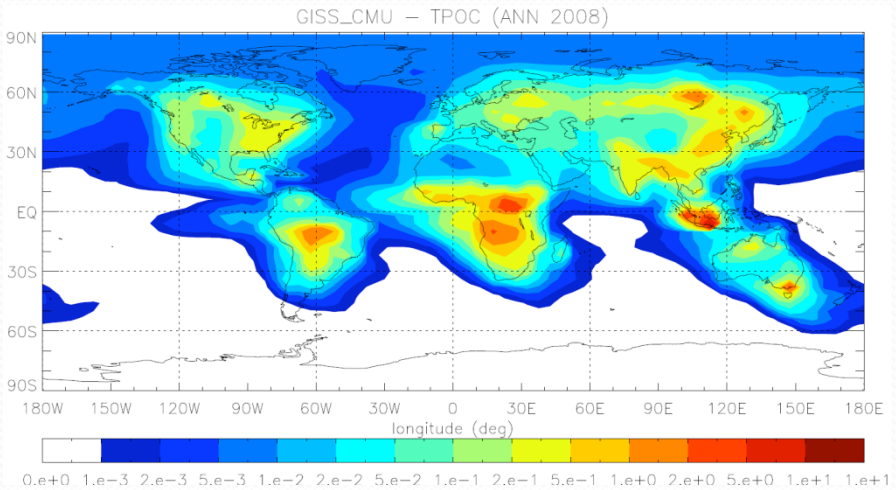


# Primary terrestrial OC

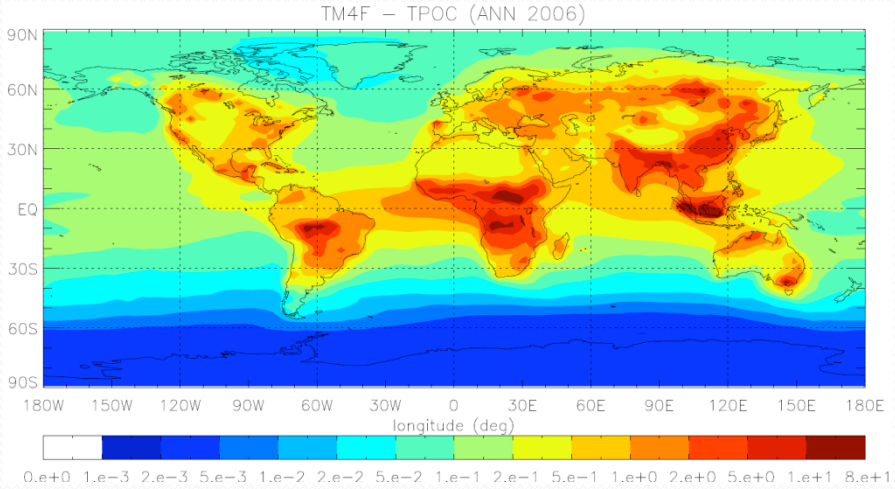
## GISS modelE




## GISS II' UBS

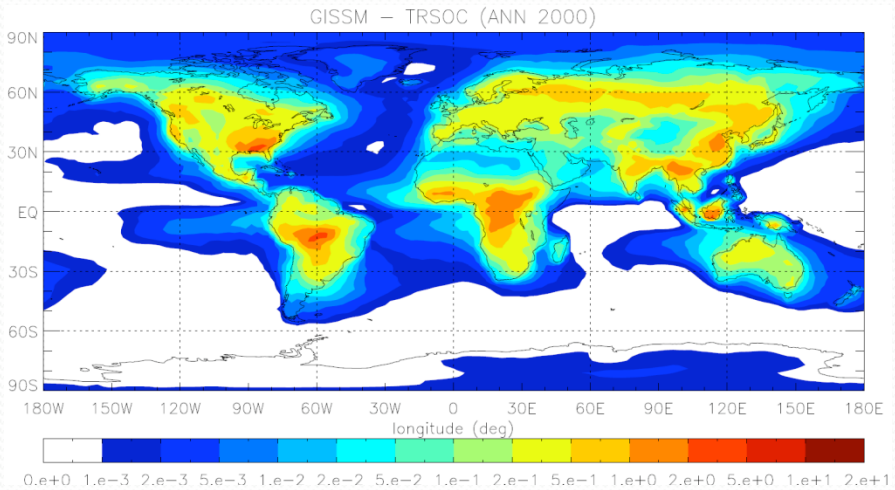



## TM4

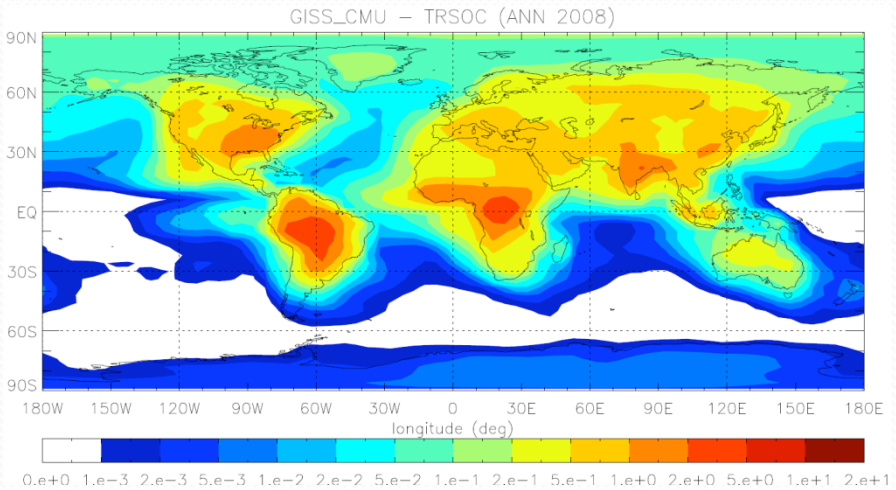


# Traditional secondary terrestrial OC

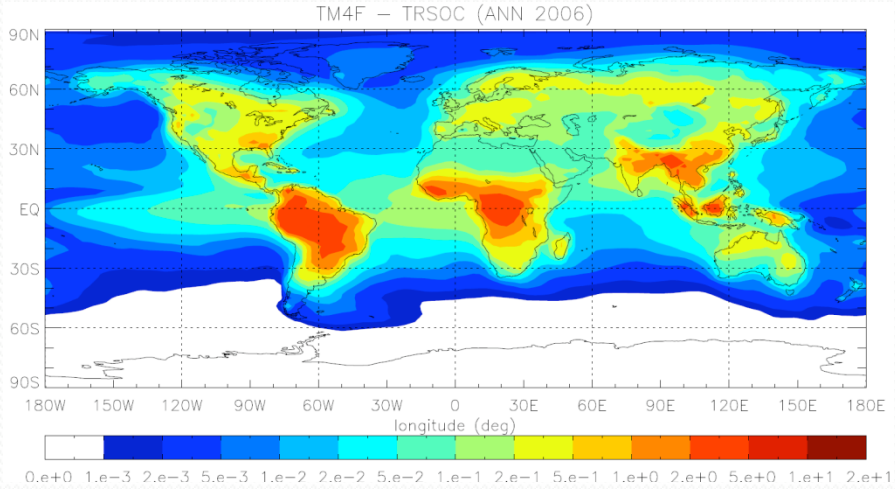
## GISS modelE




## GISS II' UBS

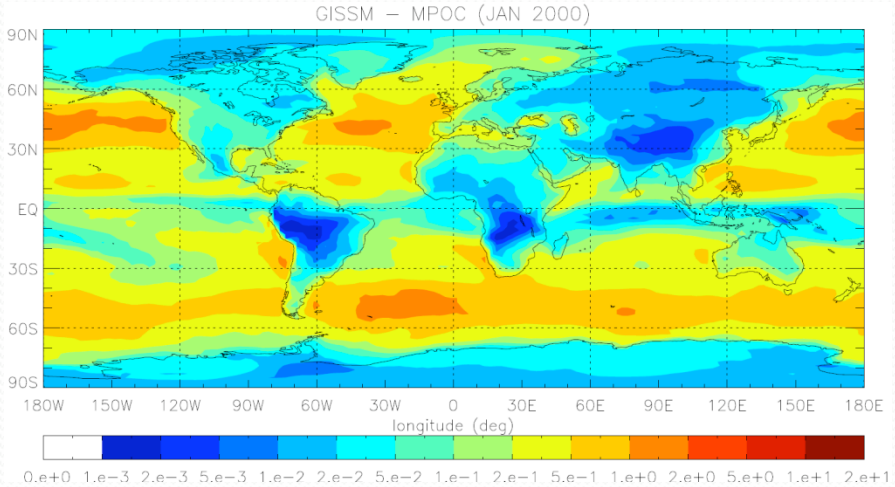



## TM4

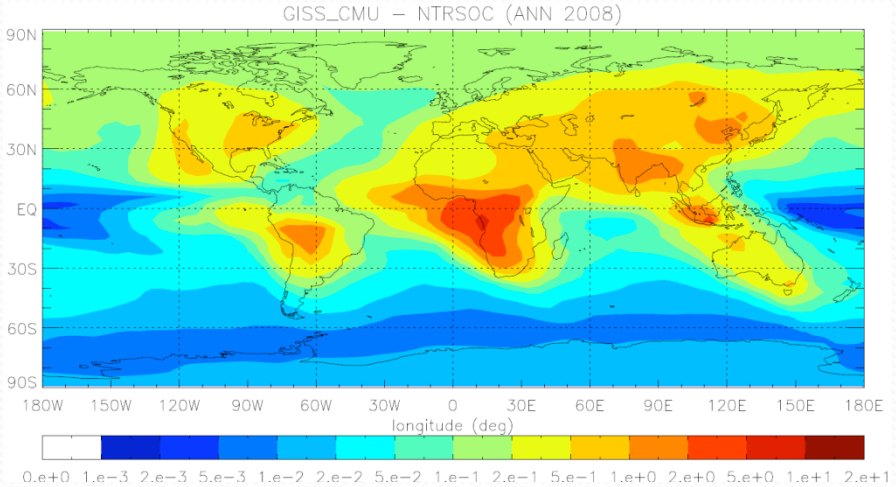


# New OC sources

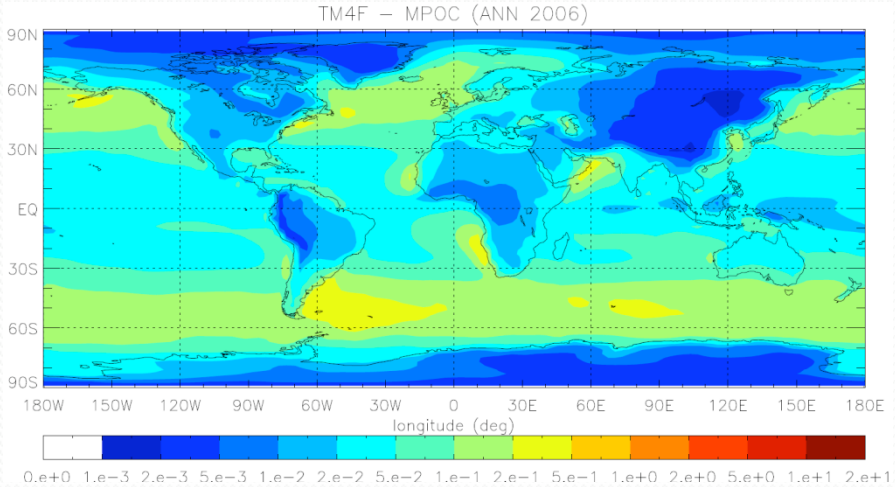
## GISS modelE: prim. oceanic



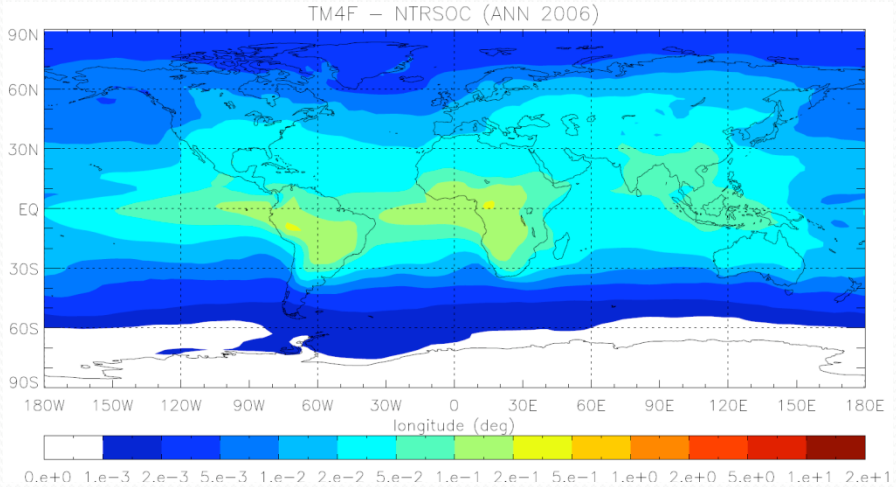

## GISS II' UBS: SV primary



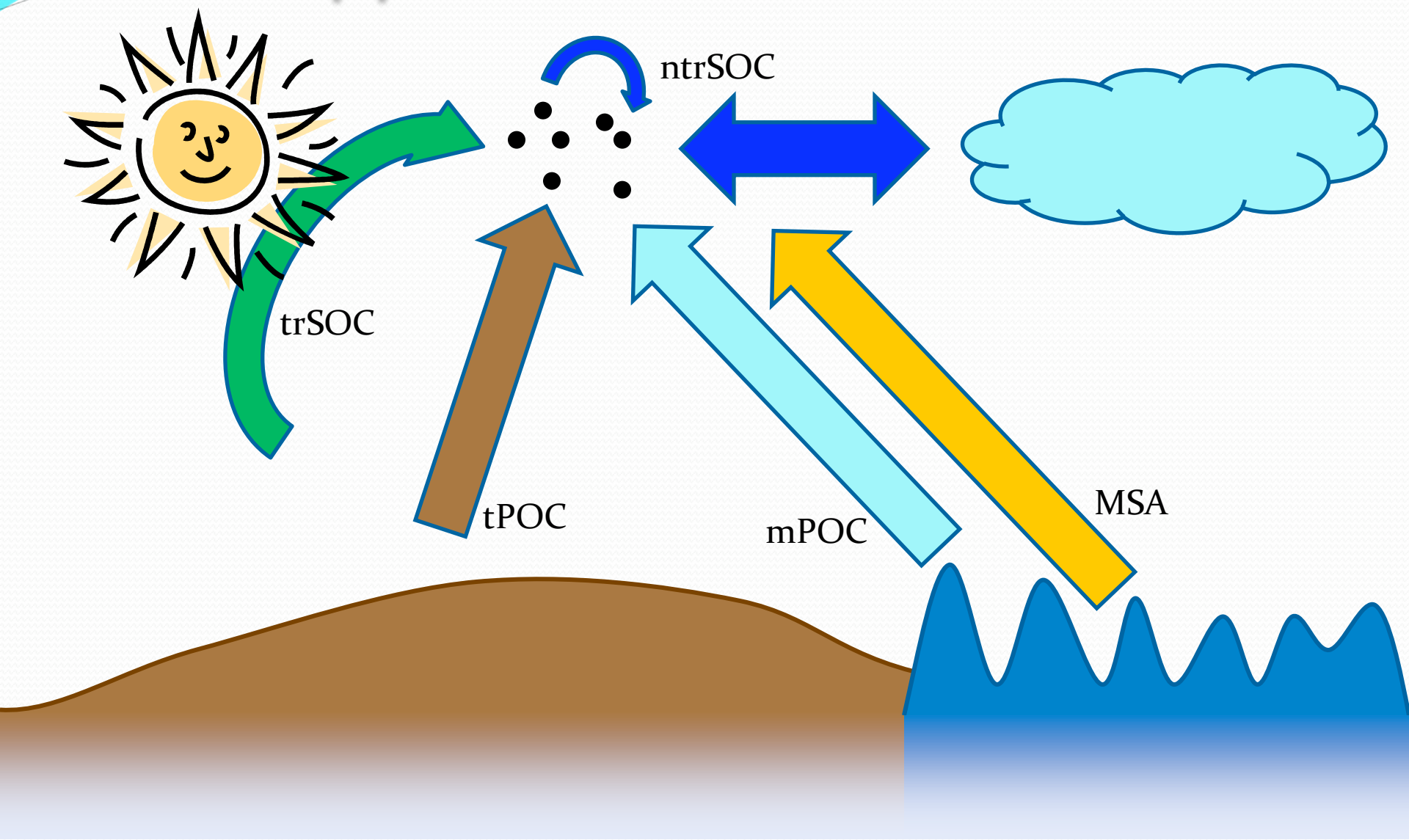

## TM4: prim. oceanic




## TM4: cloud processing



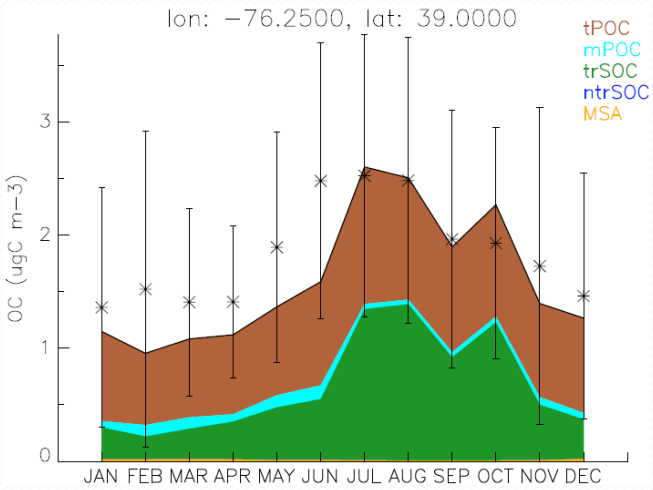
# Source apportionment



# Washington, DC

tPOC
mPOC
trSOC
ntrSOC
MSA

## GISS modelE

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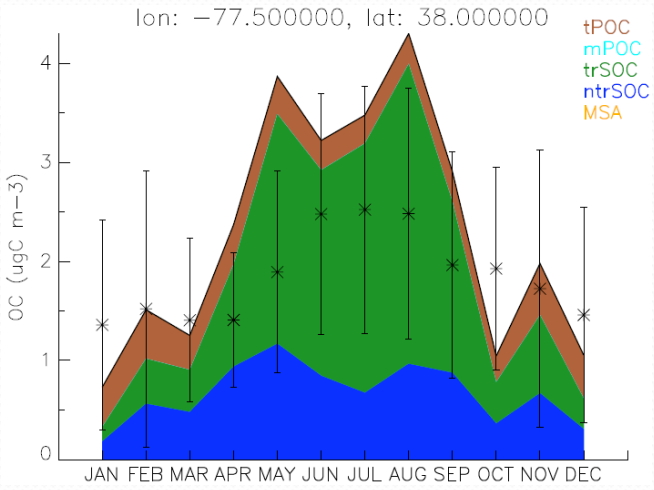


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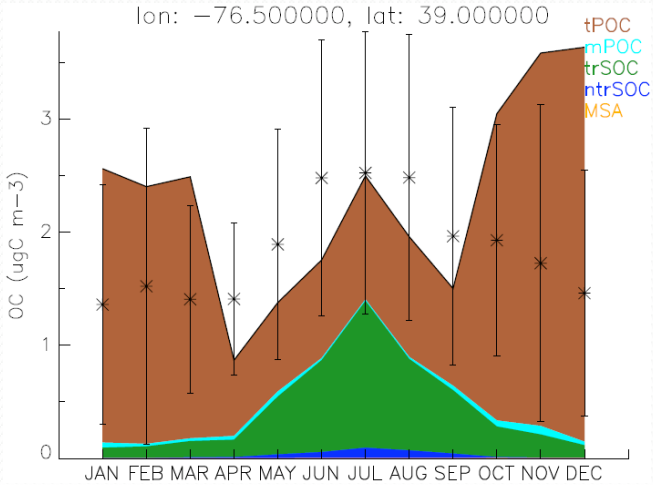
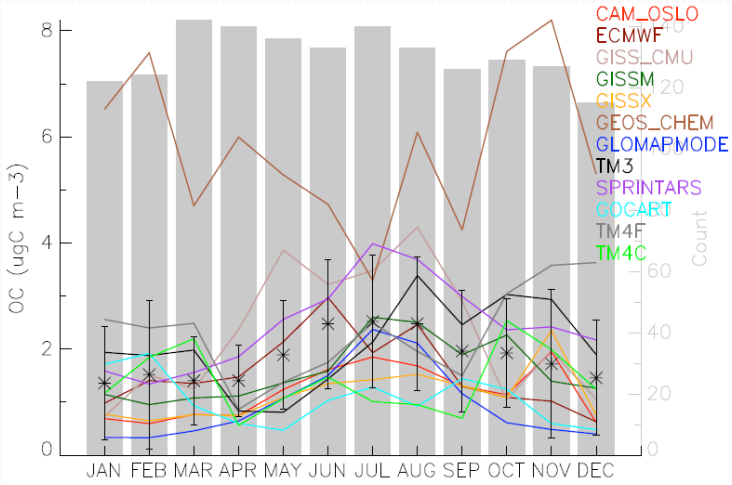


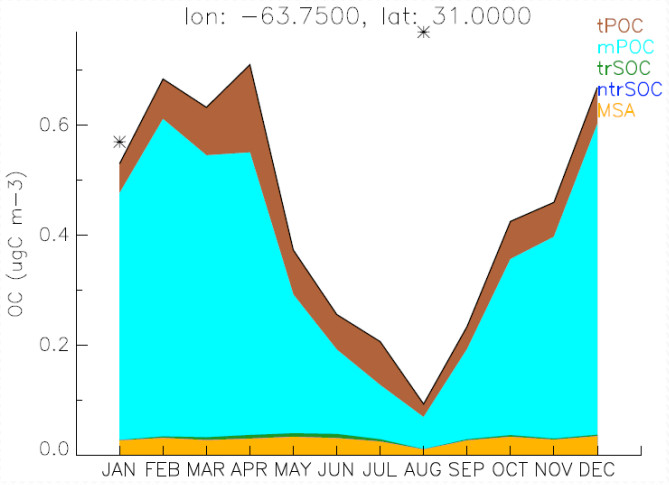

## All models



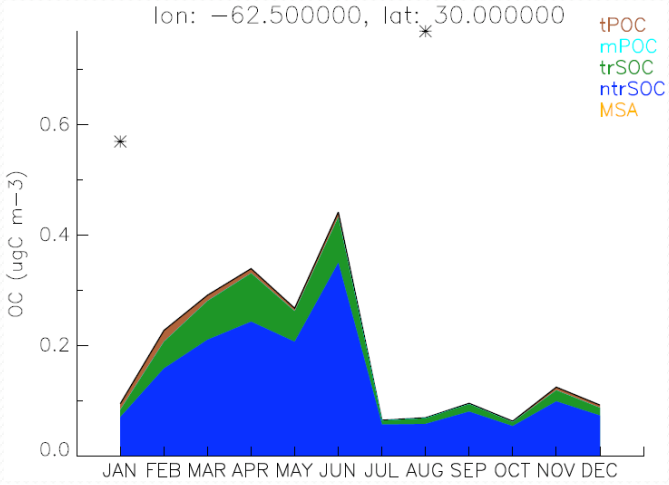
# Bermuda

tPOC
mPOC
trSOC
ntrSOC
MSA

## GISS modelE




## GISS II' UBS

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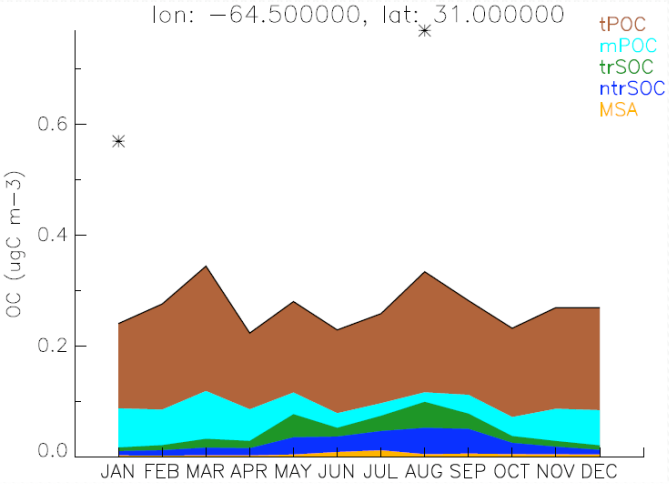


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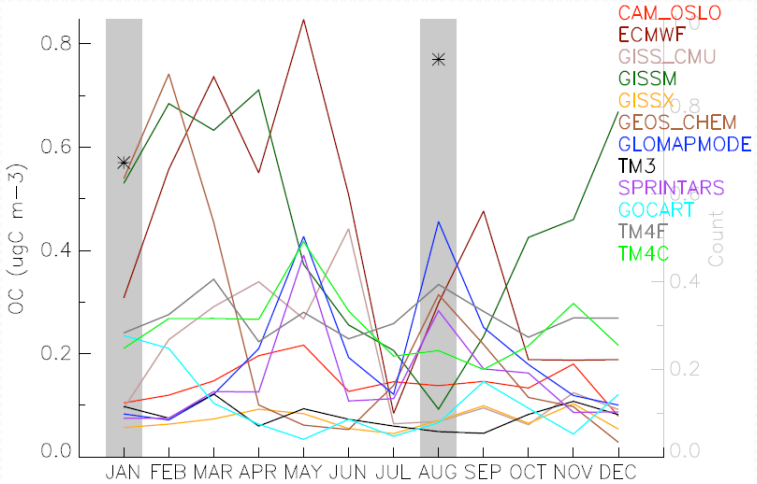
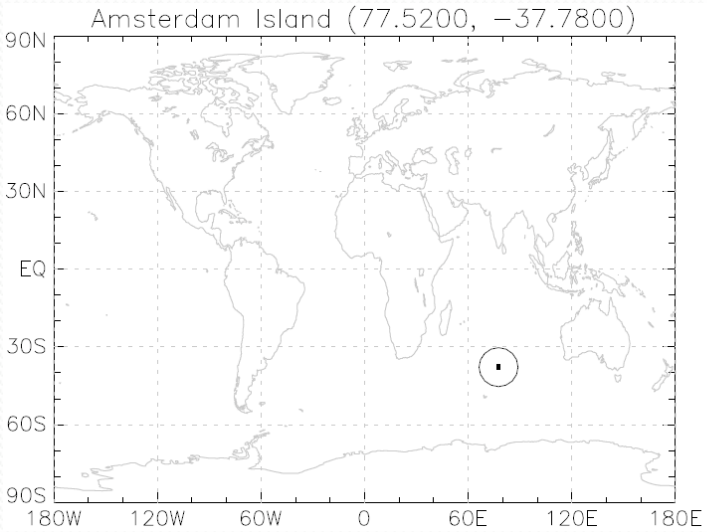
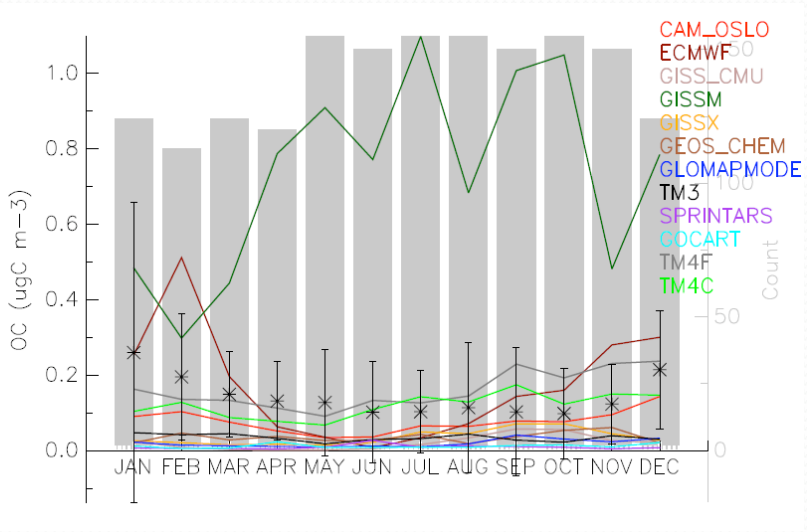
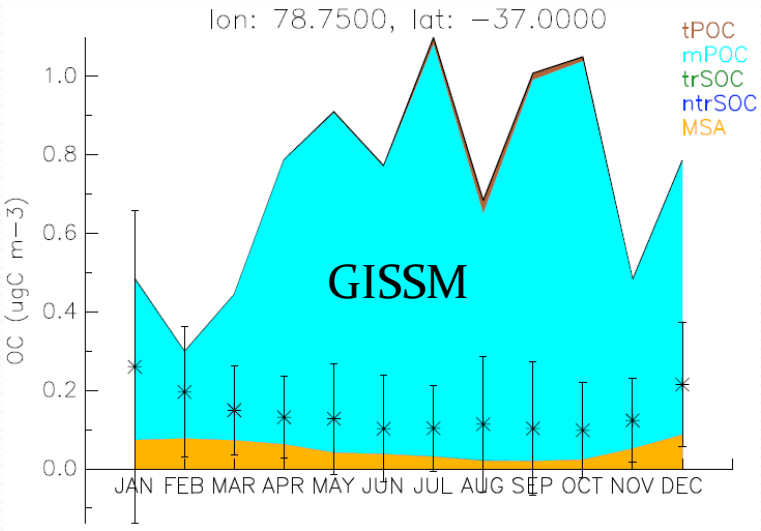
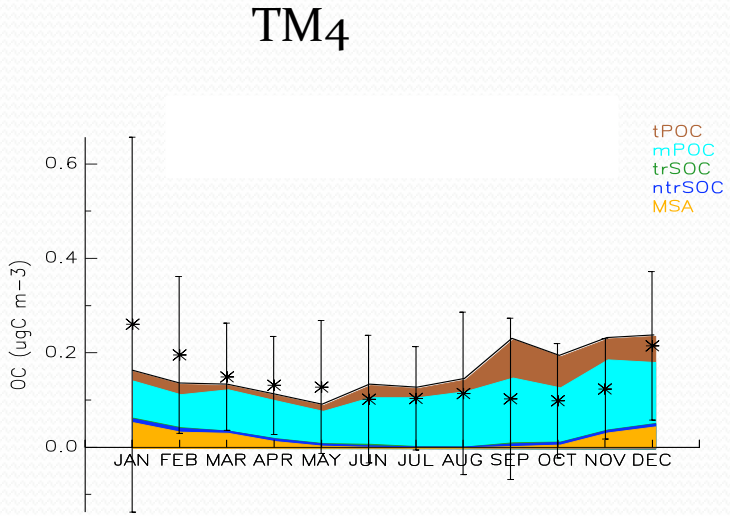


# Organics comparison with measurements



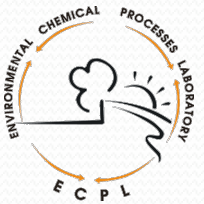
# Concluding remarks

- Oceanic source & Primary Biogenic particles
  - OA ocean source between models differs by an order of magnitude
- Chemical composition
  - Source apportionment in models is a valuable tool when comparing with measurements
  - OA sources and properties are still poorly constrained
  - OA AEROCOM budget analysis is under way, very interesting results are expected.

# Acknowledgements



This work was supported by MAP and an appointment to the NASA Postdoctoral Program at the Goddard Institute for Space Studies, administered by Oak Ridge Associated Universities through a contract with NASA.




Work at the University of Crete was supported by the EU funded project EUCAARI.


The analysis of the AMS datasets was supported by the U.S. Department of Energy's Atmospheric Science Program (Office of Science, BER), Grant No. DEFG02-08ER64627.