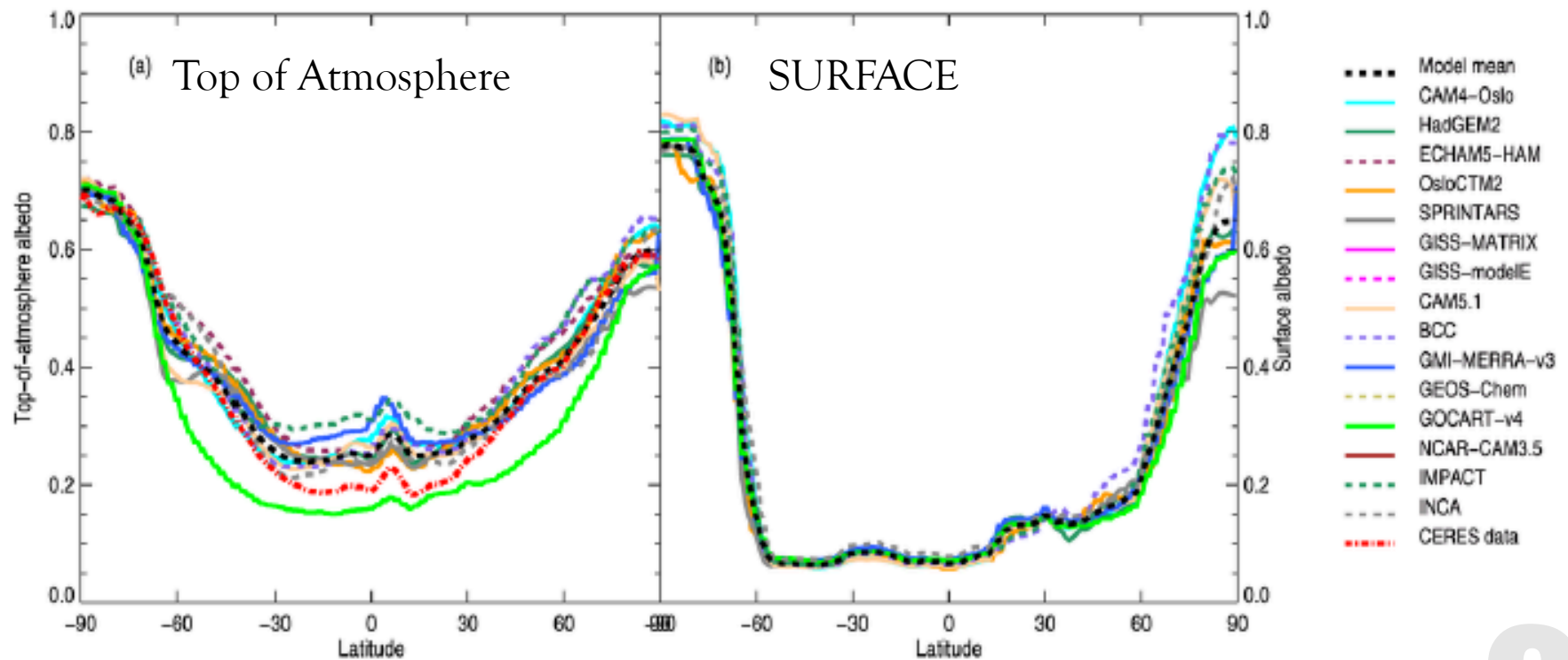


*Present and future aerosol Forcing:  
gaps and uncertainties*

Yves Balkanski, Rong Wang, Shu Tao

# Zonal mean albedo from global models

*Myhre et al., 2012*



# Steps to compute aerosol direct radiative forcing

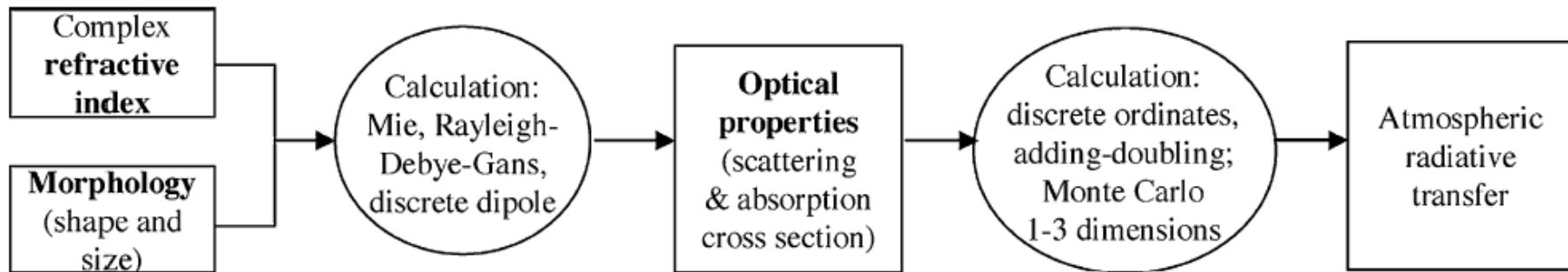


FIG. 1. Calculating radiative transfer

# What are optical parameters?

## Optical Parameters to Compute the Aerosol Direct Forcing

✓ Light can be either scattered or absorbed. Both processes lead to extinction.

We define 3 parameters in order to compute the Aerosol Direct Forcing:

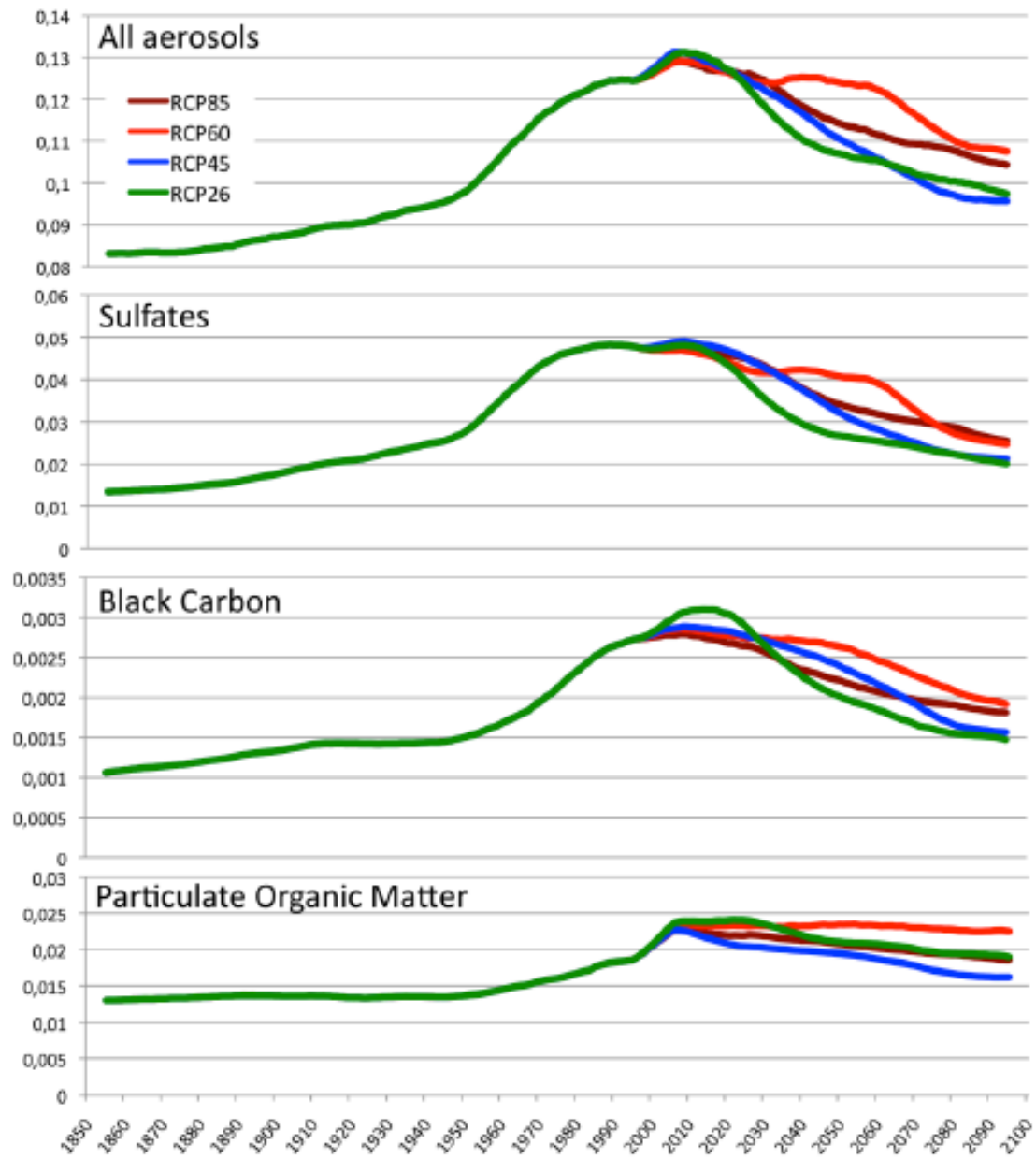
- 1/ Aerosol Optical Depth (*AOD*)      often noted       $\tau$
- 2/ The *asymmetry parameter* (or the phase function)       $\beta$
- 3/ The *single scattering albedo*      often noted       $\omega_0$

*AOD* is a measure of the integrated vertical column of aerosol present,

*Asymmetry parameter* gives information on the ratio of backward to forward light scattering,

The *single scattering albedo* measures how absorbing a particle is

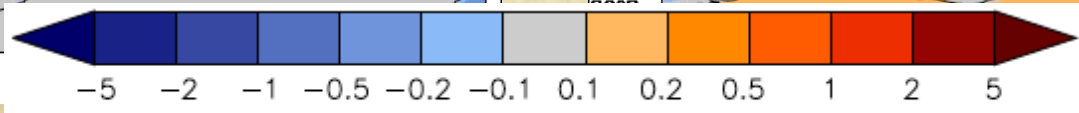
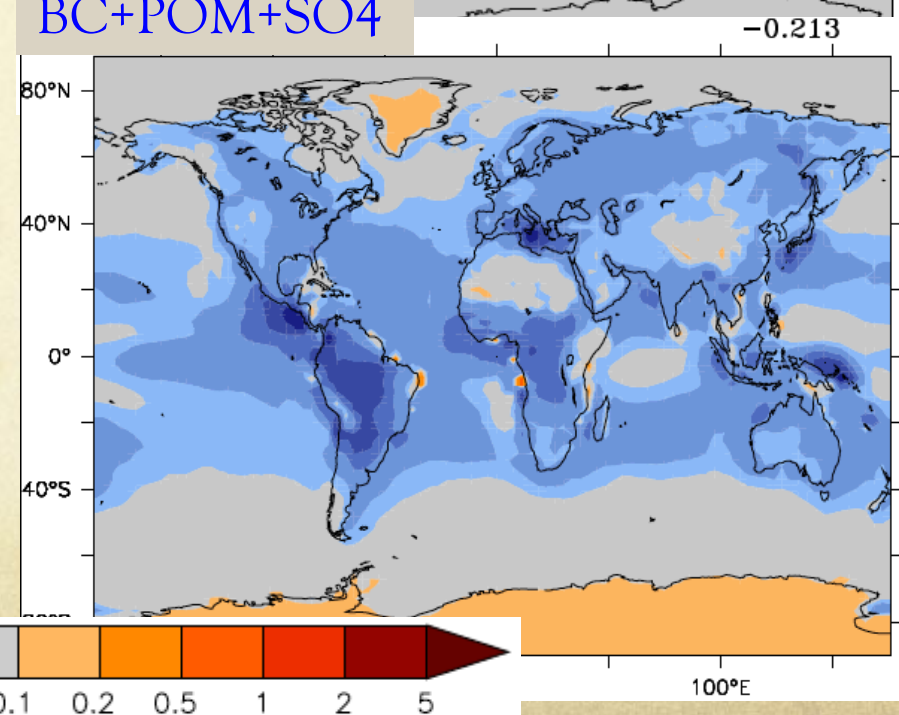
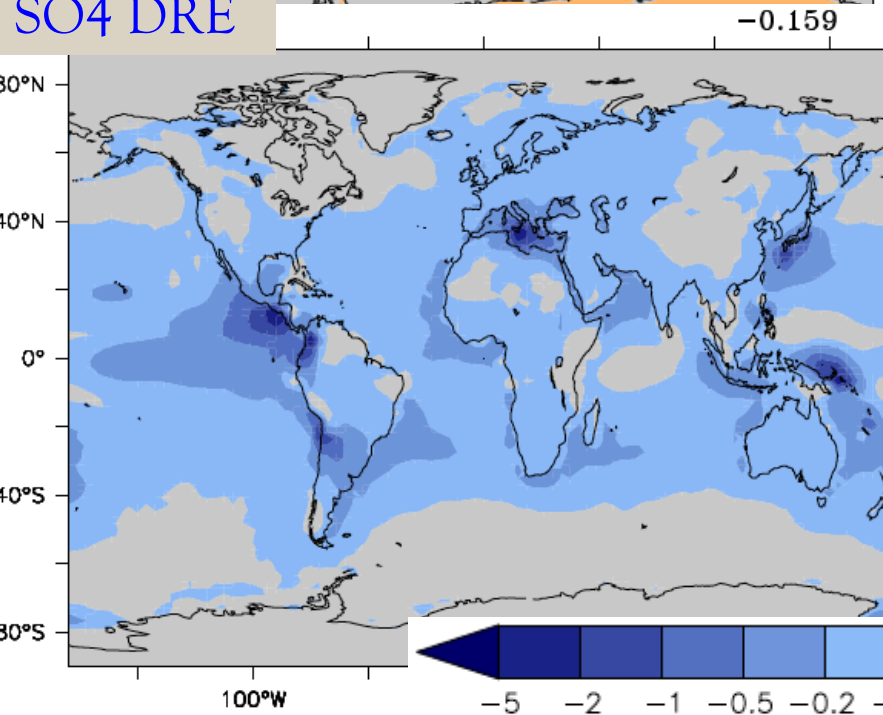
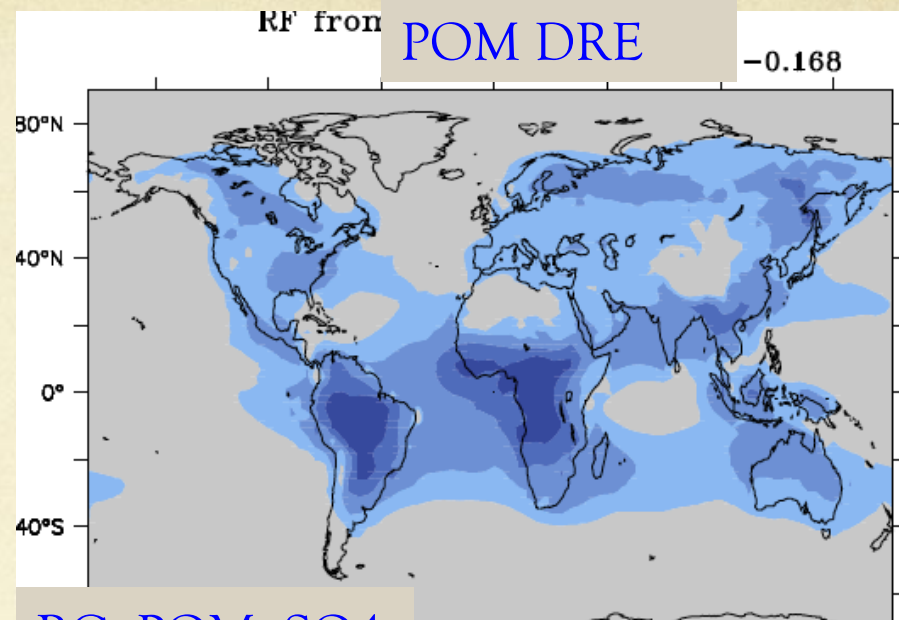
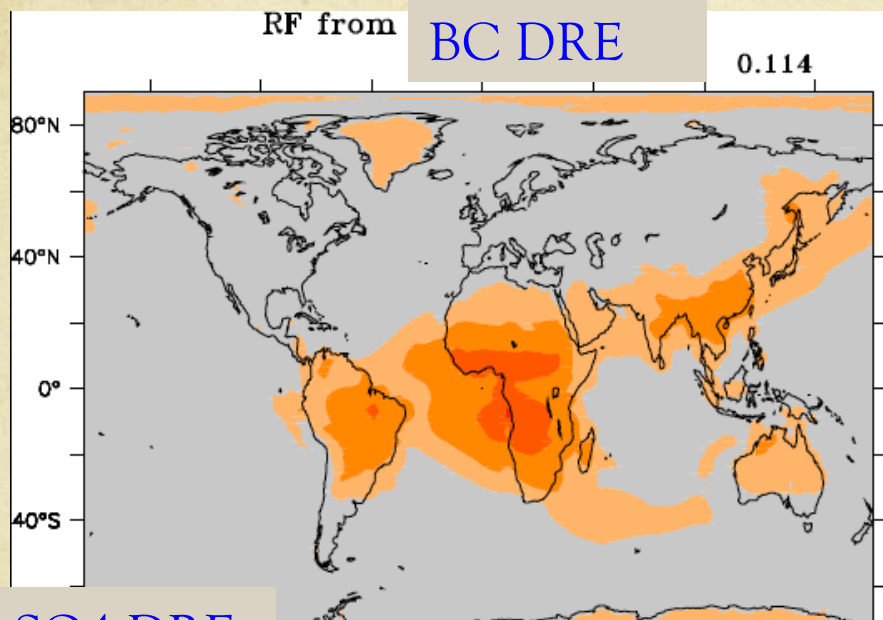
# Simulated increase of aerosol optical depth (1850-2100)



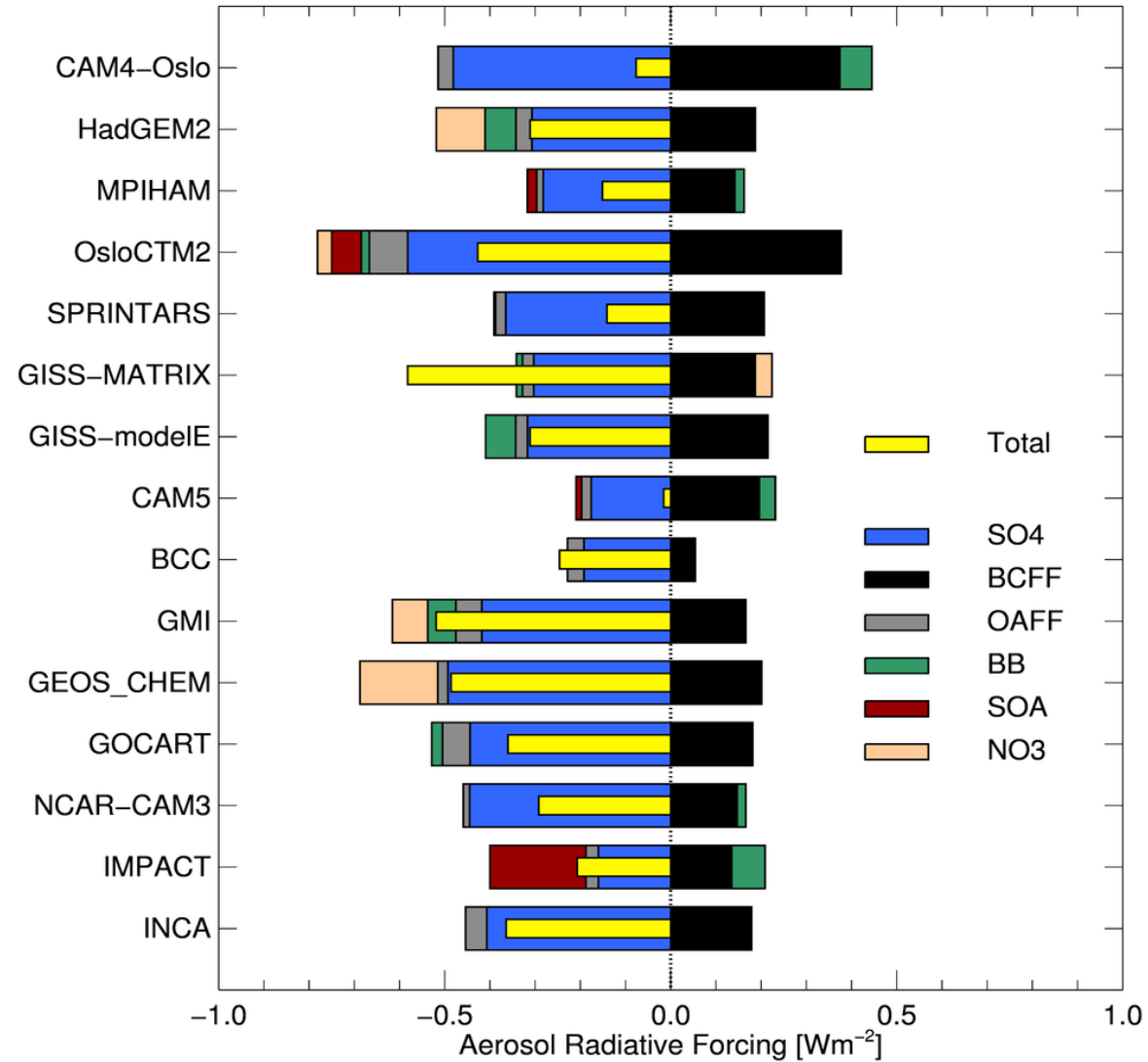
Szopa et al., (2012)



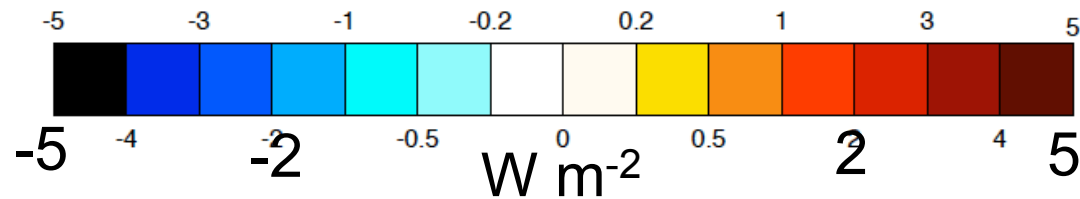
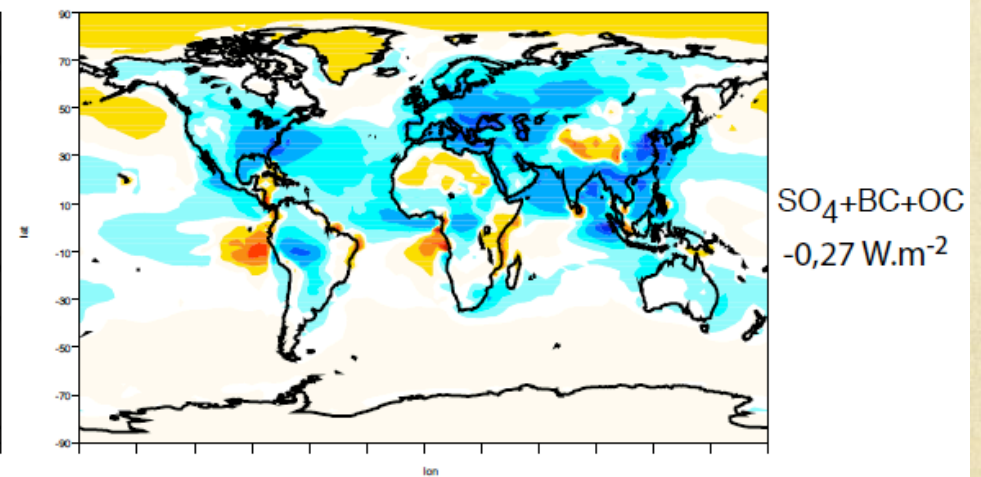
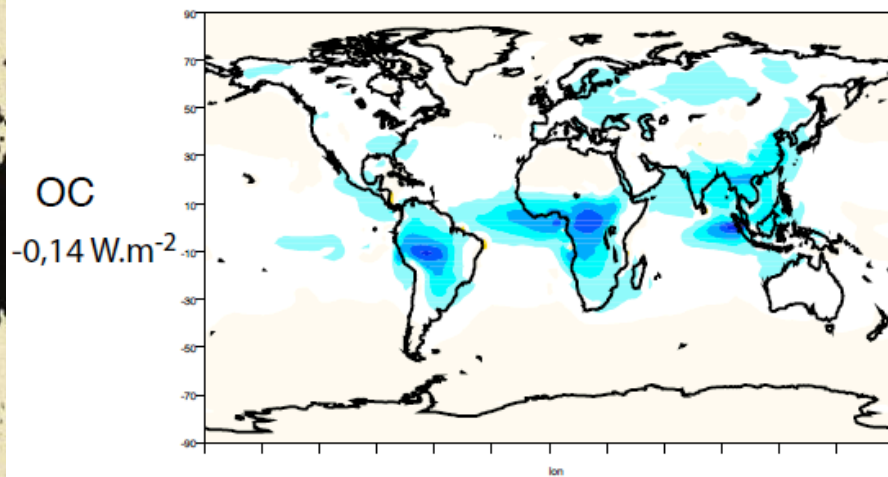
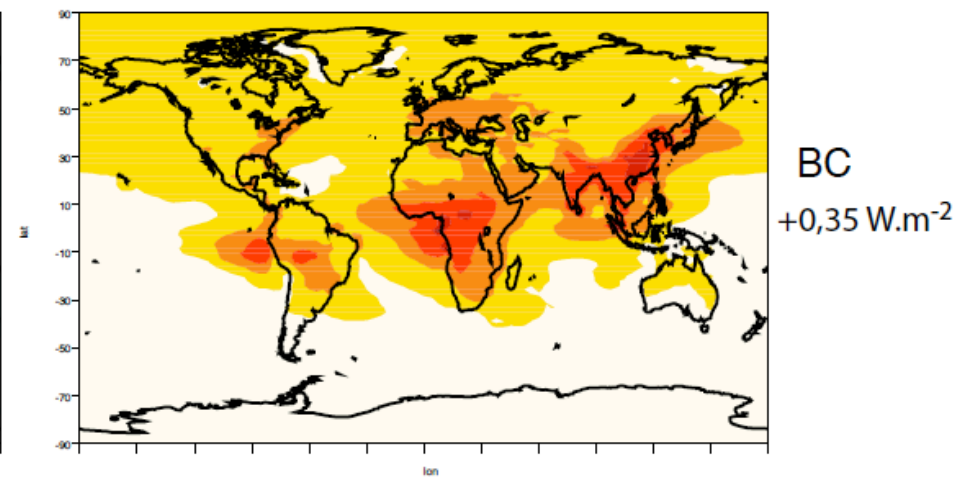
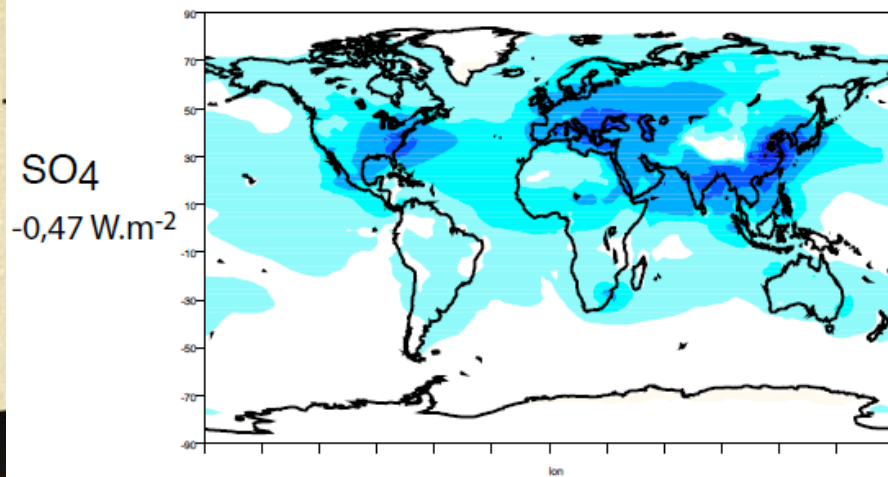
# PreIndustrial Effect of BC, OA, SO4



# Radiative Forcing from the 6 aerosol components

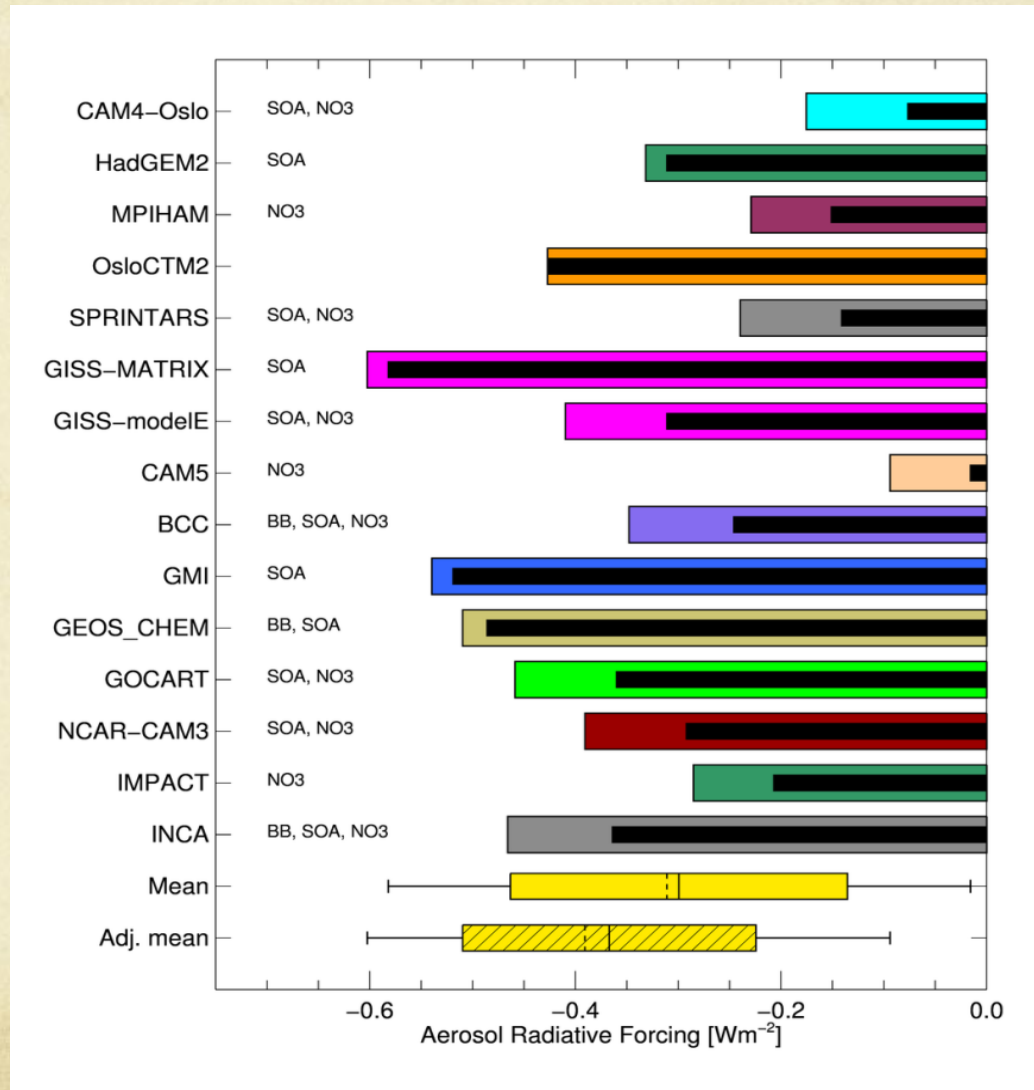


# Radiative Forcings from the ESM IPSLCM5a

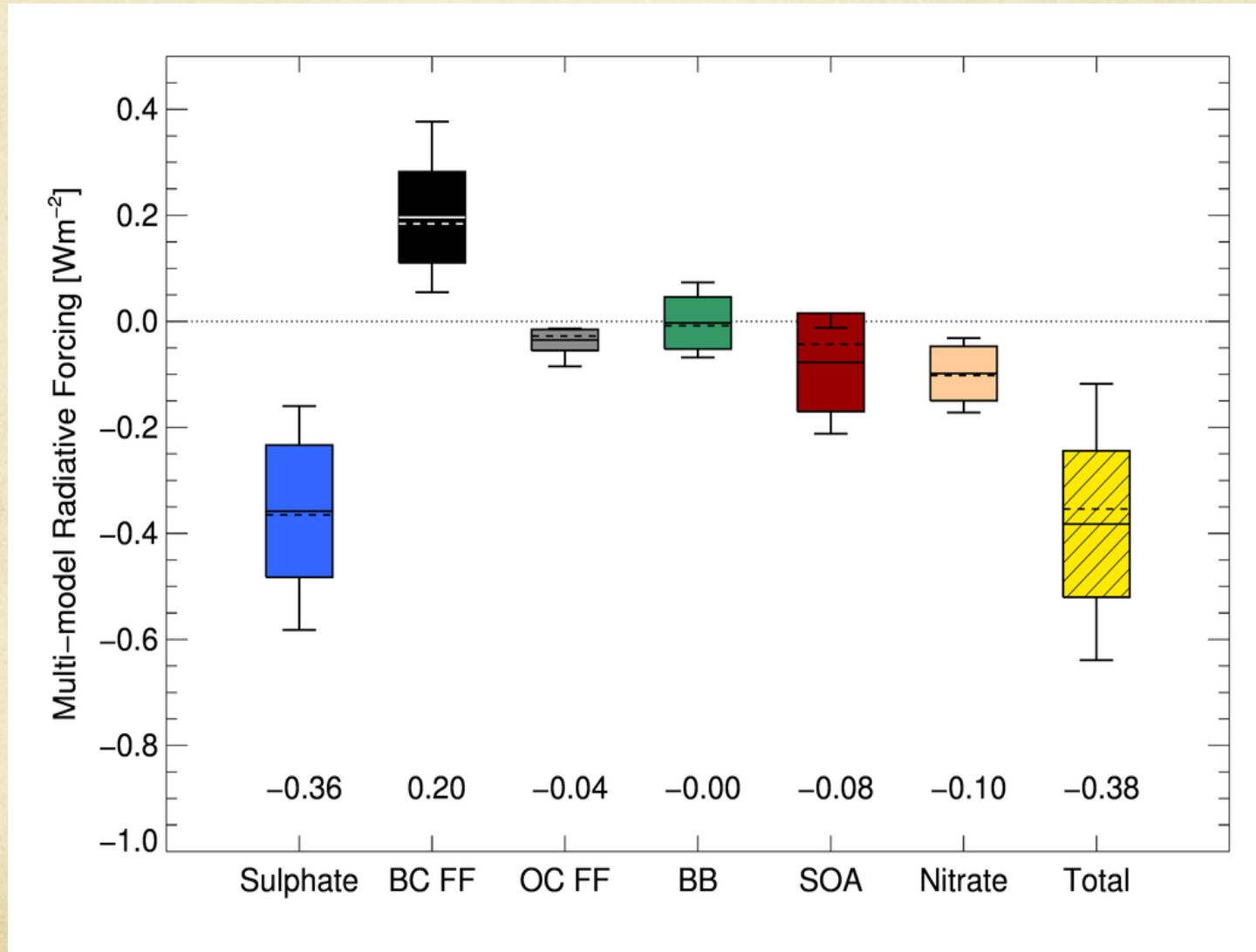




# Radiative Forcings adjusted for all the components



# Total Radiative Forcing (RF) and RF by component



# Identifying the Radiative Forcing from Emissions over China

MODEL with the Zoom

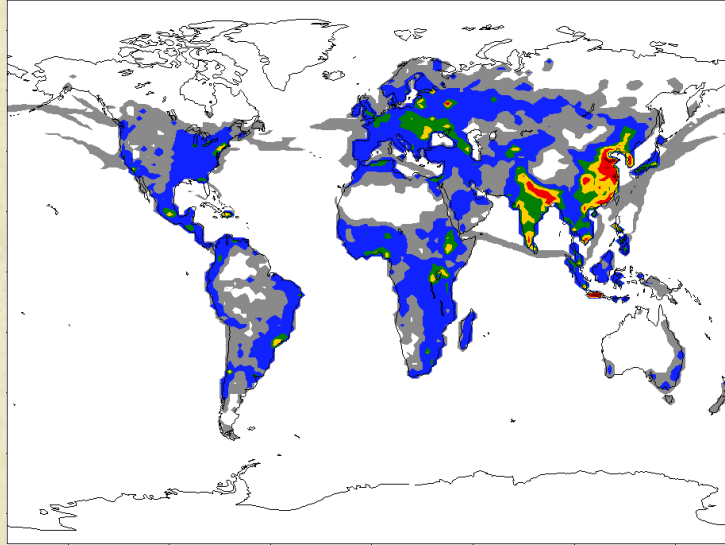
Experiment 1: ALL SOURCES

Exp. 2: SOURCES over China only

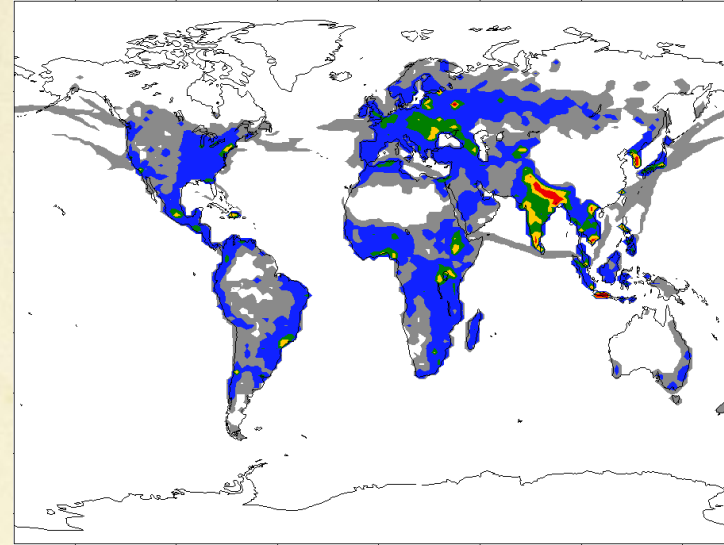
Exp. 3: SOURCES all but China

# Surface POM (Particulate Organic Matter) Emission Maps

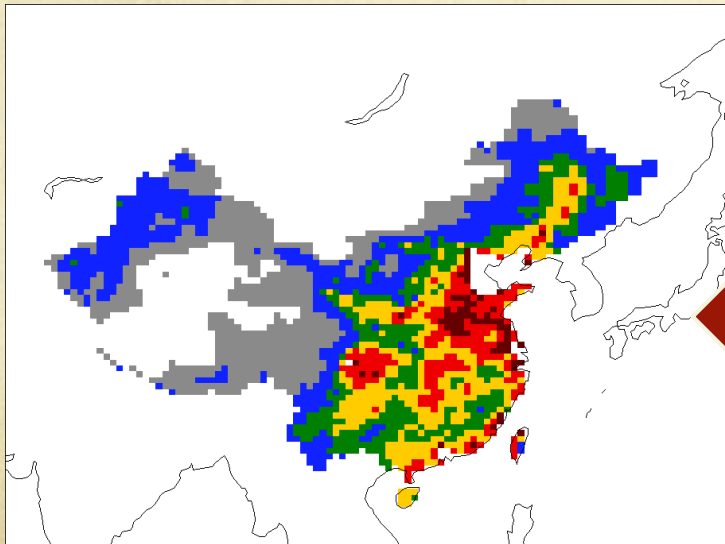
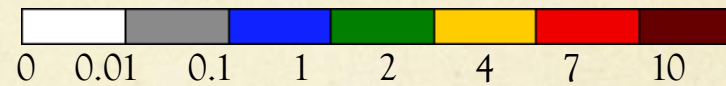
ALL SOURCES



all but China



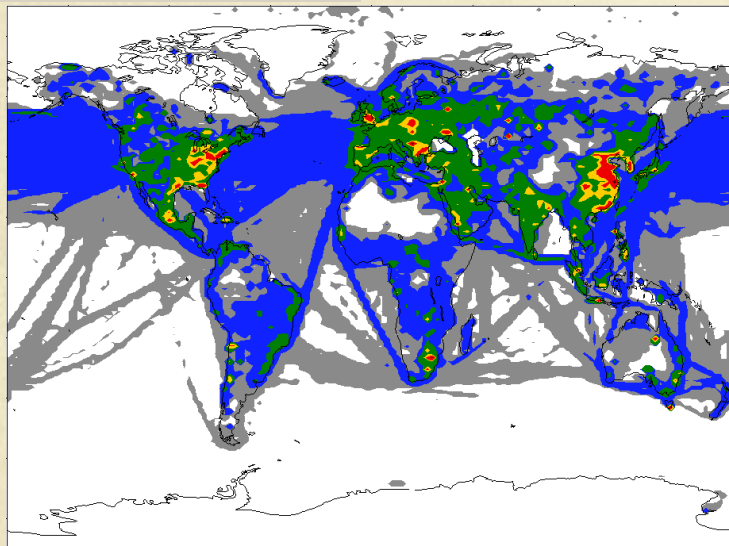
Emission:  $\times 10^{-11}$  kg/m<sup>2</sup>/s



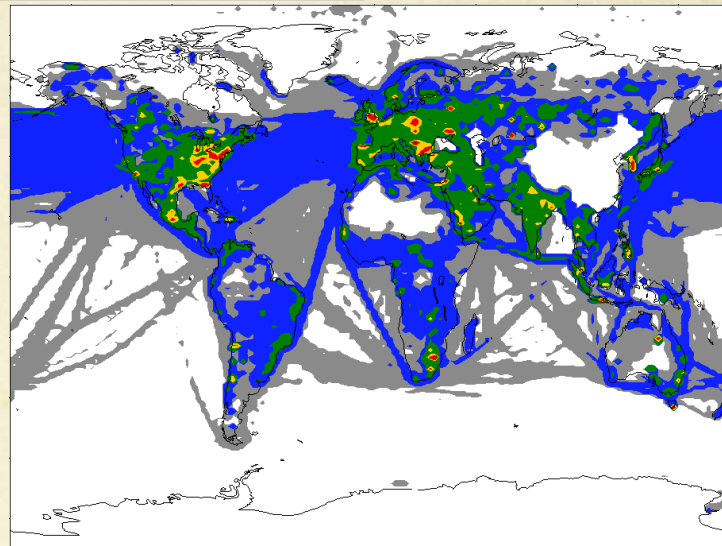
China only

# Surface SO<sub>2</sub> Emission Maps

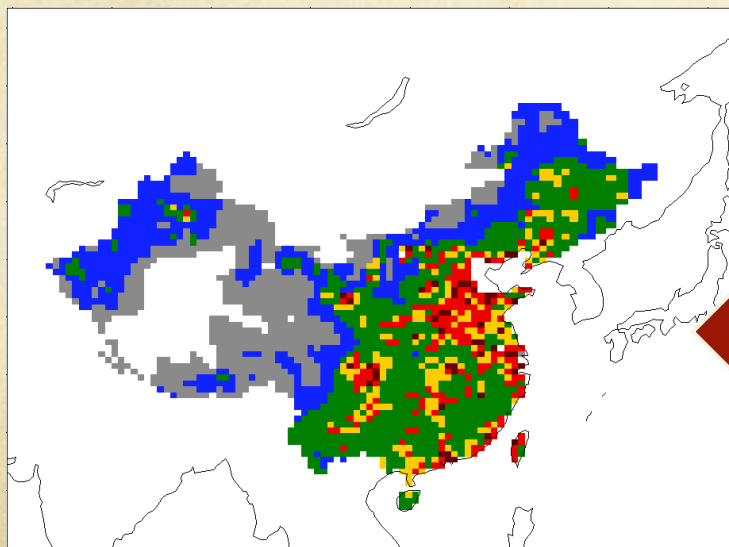
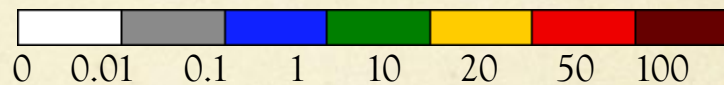
ALL SOURCES



All But China



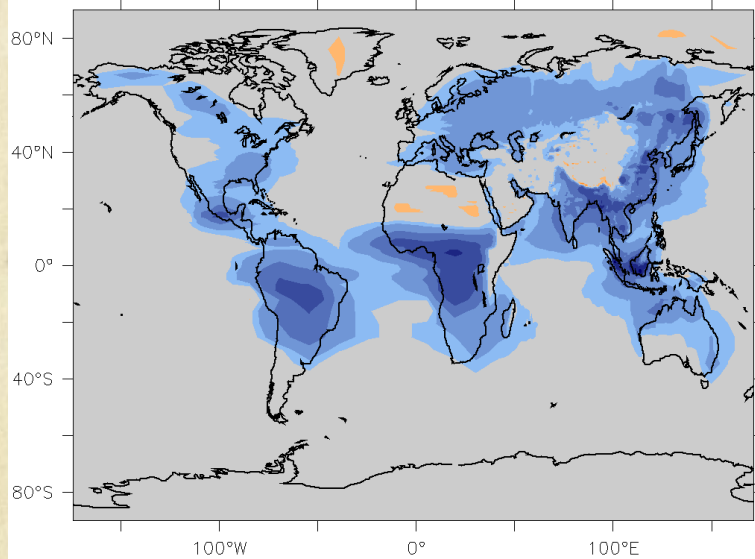
Emission:  $\times 10^{-11}$  kg/m<sup>2</sup>/s



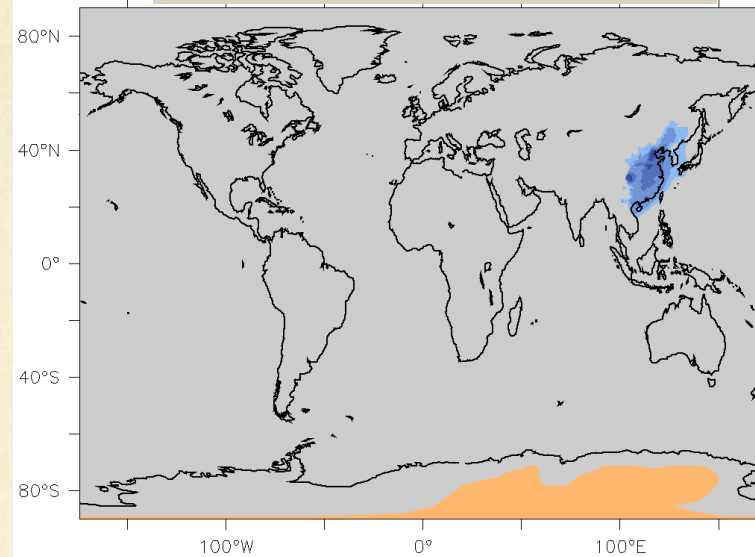
China only

# POM DRE (Direct Radiative Effect) Zoom **LSCE-zA**

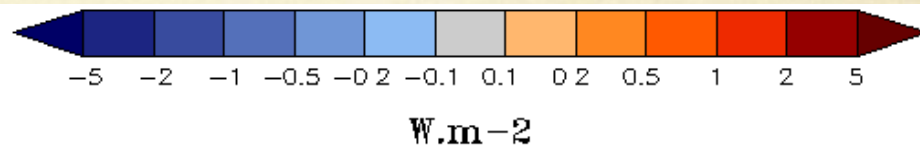
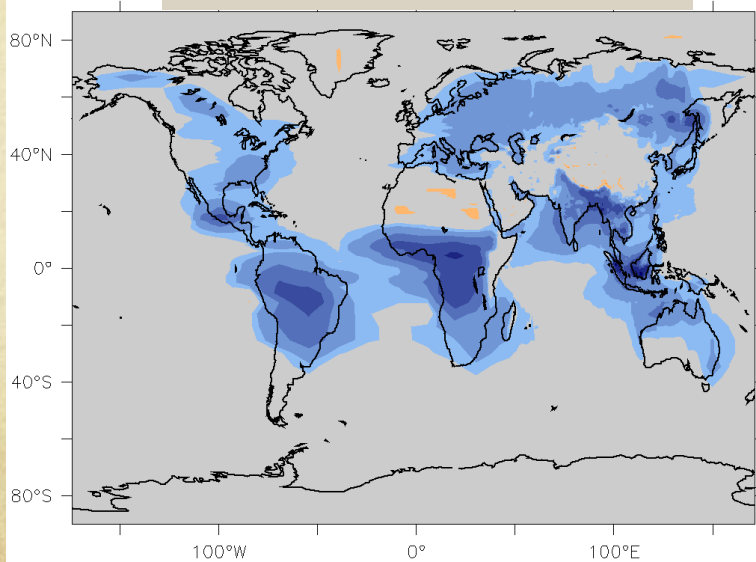
ALL SOURCES: -0.124



China only: +0.0327



RF All But China: -0.116

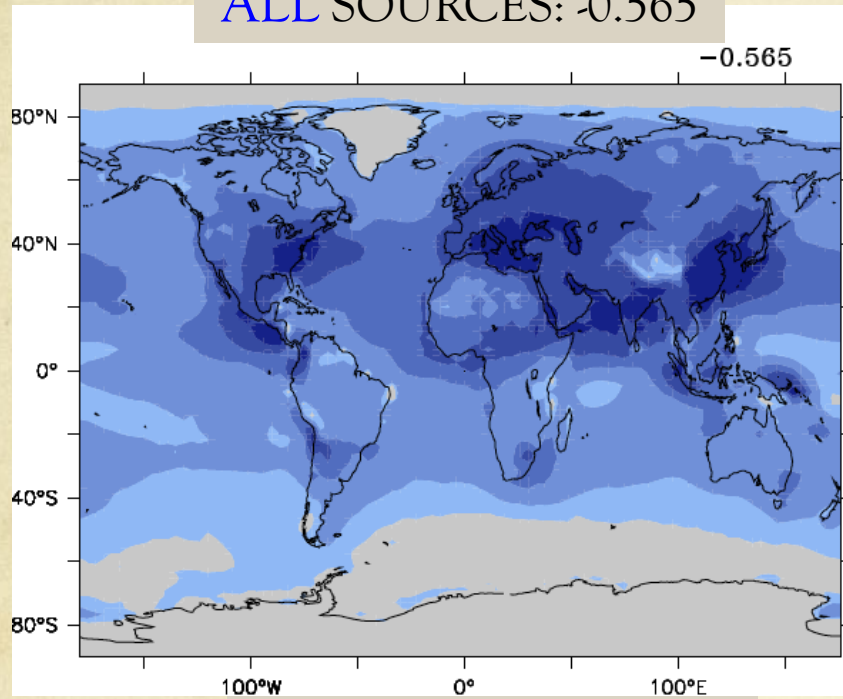


## Organic Matter Direct Radiative Effect (Zoom version)

	ALL SOURCES	SOURCE over CHINA ONLY	SOURCE ALL but CHINA	Delta (ALL-China-All but China)
GLOBAL	-0.12	+0.03	-0.12	-0.03
CHINA	-0.29	-0.18 (62%)	-0.06	-0.05
ALL BUT CHINA	-0.12	+0.04 (opp. sign!)	-0.12	-0.04
ASIA	-0.34	-0.04	-0.27	-0.03

# Results: Sulfate Direct Radiative Effect by zoomed version **LSCE-zA**

ALL SOURCES: -0.565



China only: -1.63

