Forcing diversity using AeroCom results

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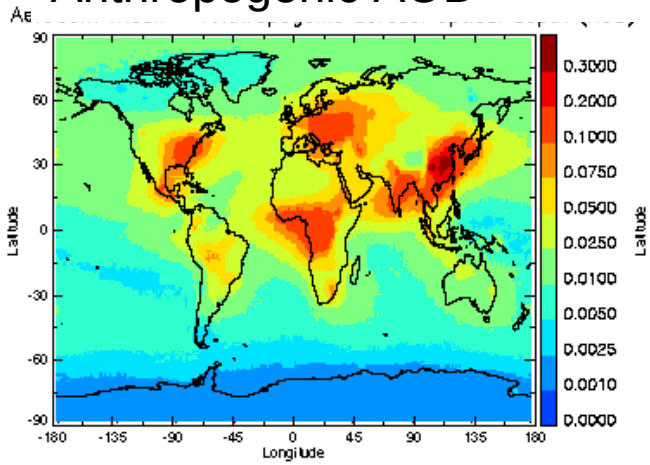
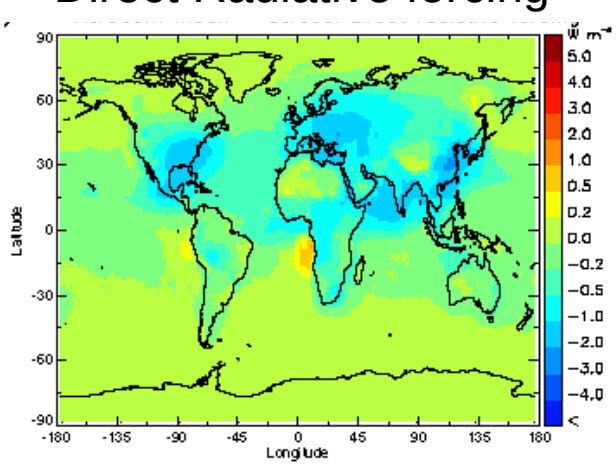
ACP 2006 revised version submitted

9 model AeroCom mean (and local standard deviation = diversity)

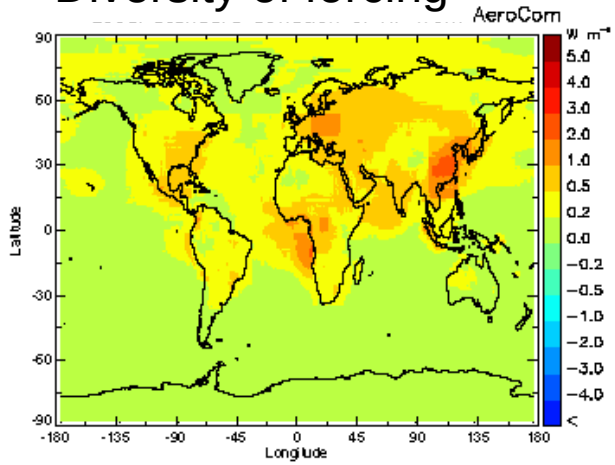
Anthropogenic AOD



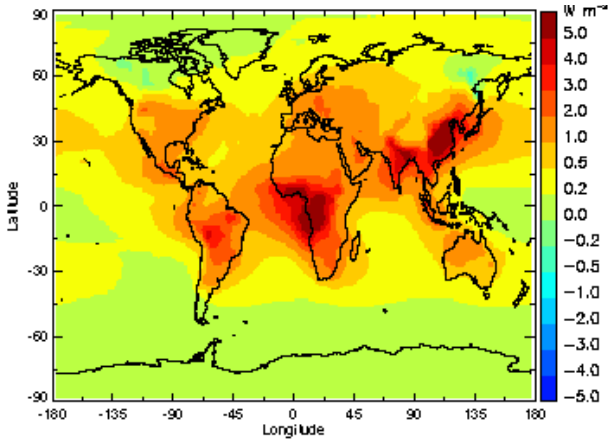
Direct Radiative forcing



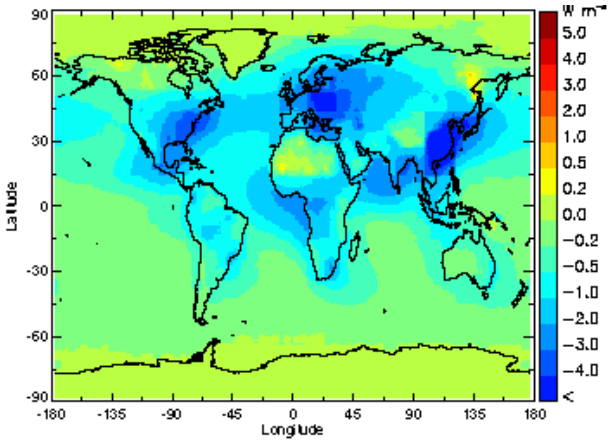
Diversity of forcing



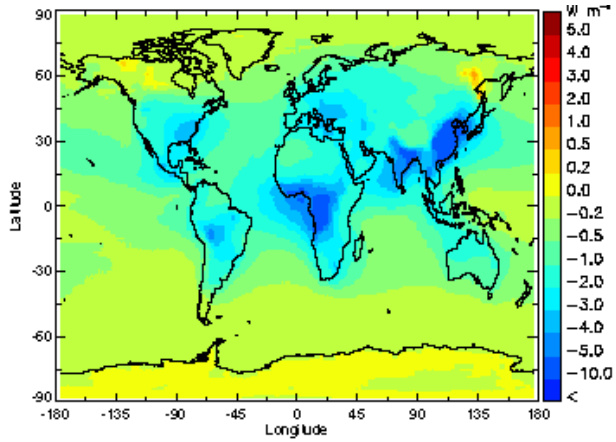
Atmospheric forcing



Clear-sky forcing



Surface forcing



Decomposing reasons for forcing diversity

Precursor emissions (SO2, NOx, VOC)

chemical production, condensation

Primary aerosol emissions (BC, POM, dust, sea salt)

Residence times

Transport, dispersion, wet and dry deposition

Aerosol Loads

Optical properties

Mass extinction/absorption coefficient

Aerosol Optical Depth

Forcing efficiency per unit optical depth

Single scattering albedo

Hemispheric Backscatter

Vertical Distribution of aerosol

Cloud and aerosol position

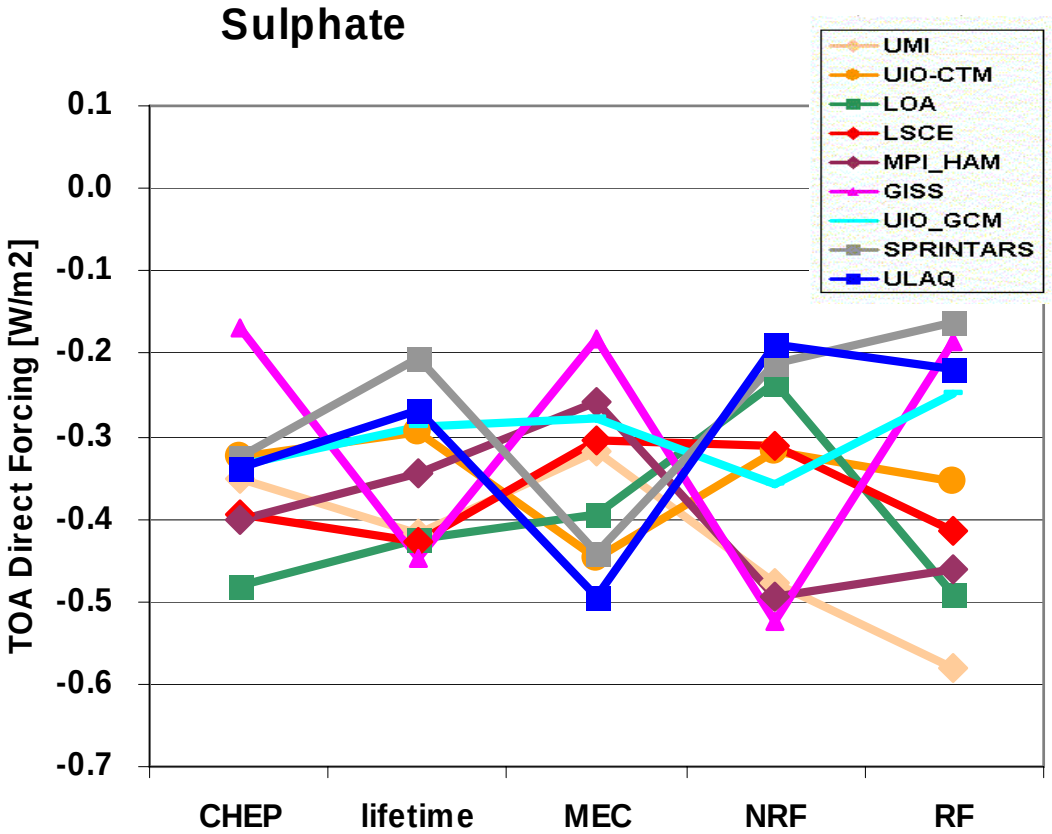
Direct radiative forcing

Interdependence of processes ??

Partial sensitivity analysis of impact of different properties on forcing estimate

How much would the simulated forcing vary
***IF** the variations of only one factor would determine forcing ?*

Forcing (RF) = chemical production (CHEP) x lifetime
x extinction_coefficient (MEC) x forcing efficiency (NRF)

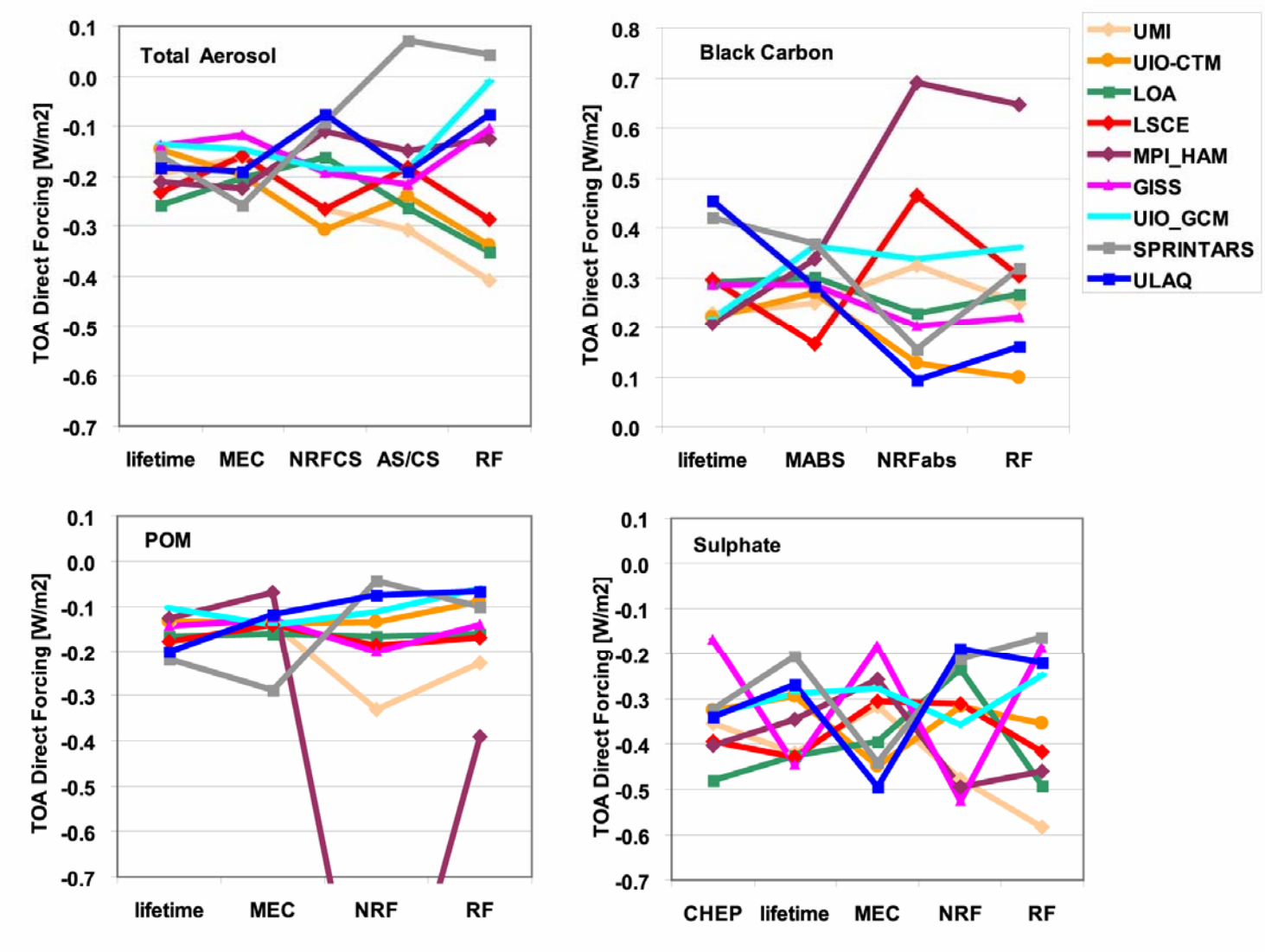


⇒ compensation of short life time and MEC because aerosol would reside in low levels in model with short lifetime?

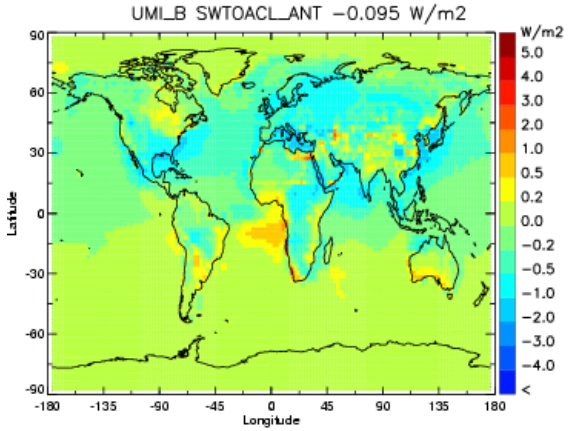
⇒ diversity (=uncertainty?) only ca. +- 0.2 W/m2

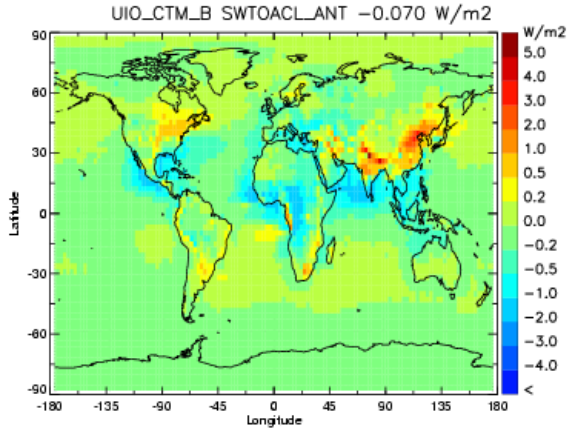
Sensitivity analysis of impact of different properties on forcing estimate

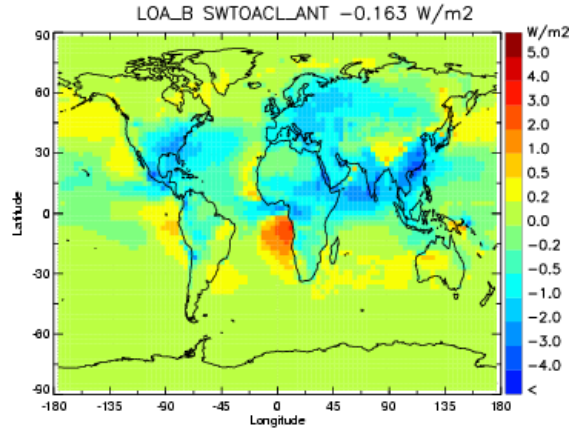
Forcing = emission x lifetime x extinction_coefficient x forcing efficiency

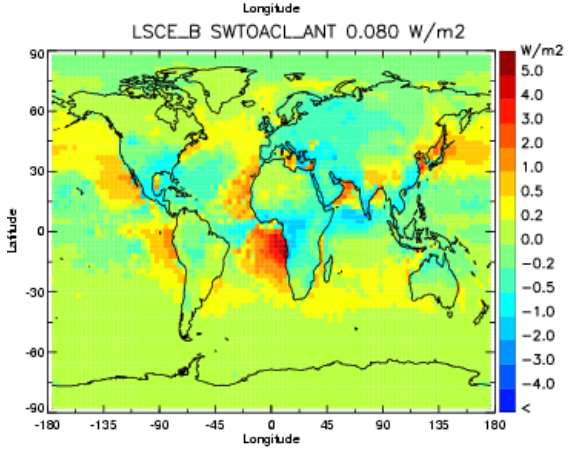


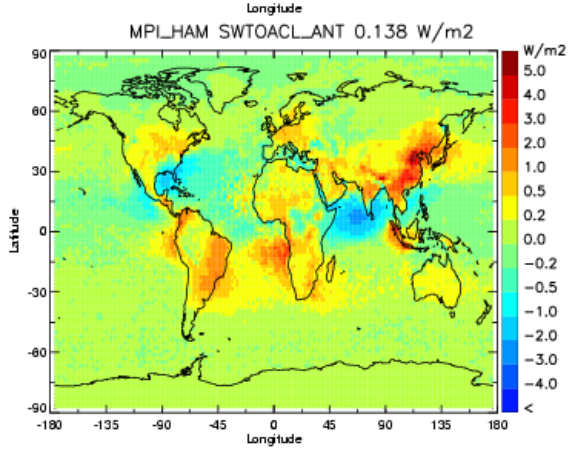
Aerosol focing in cloudy-skies

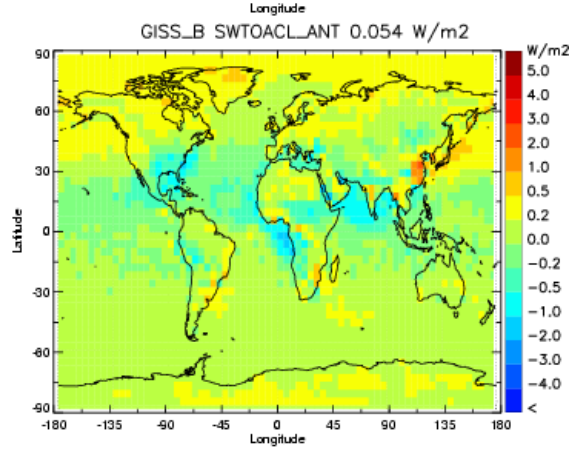


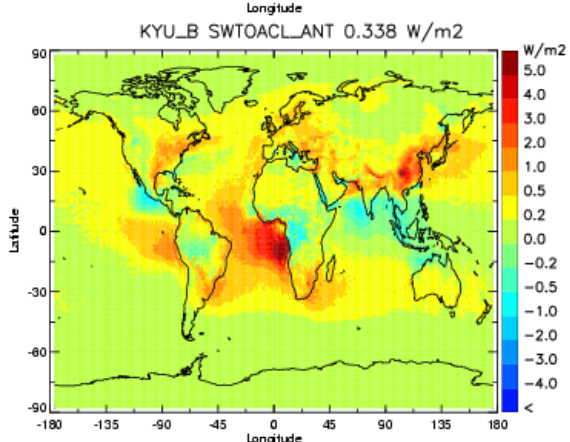




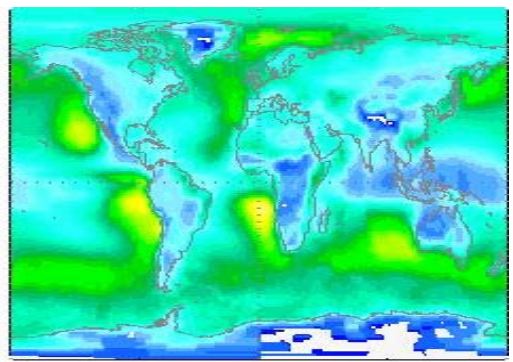








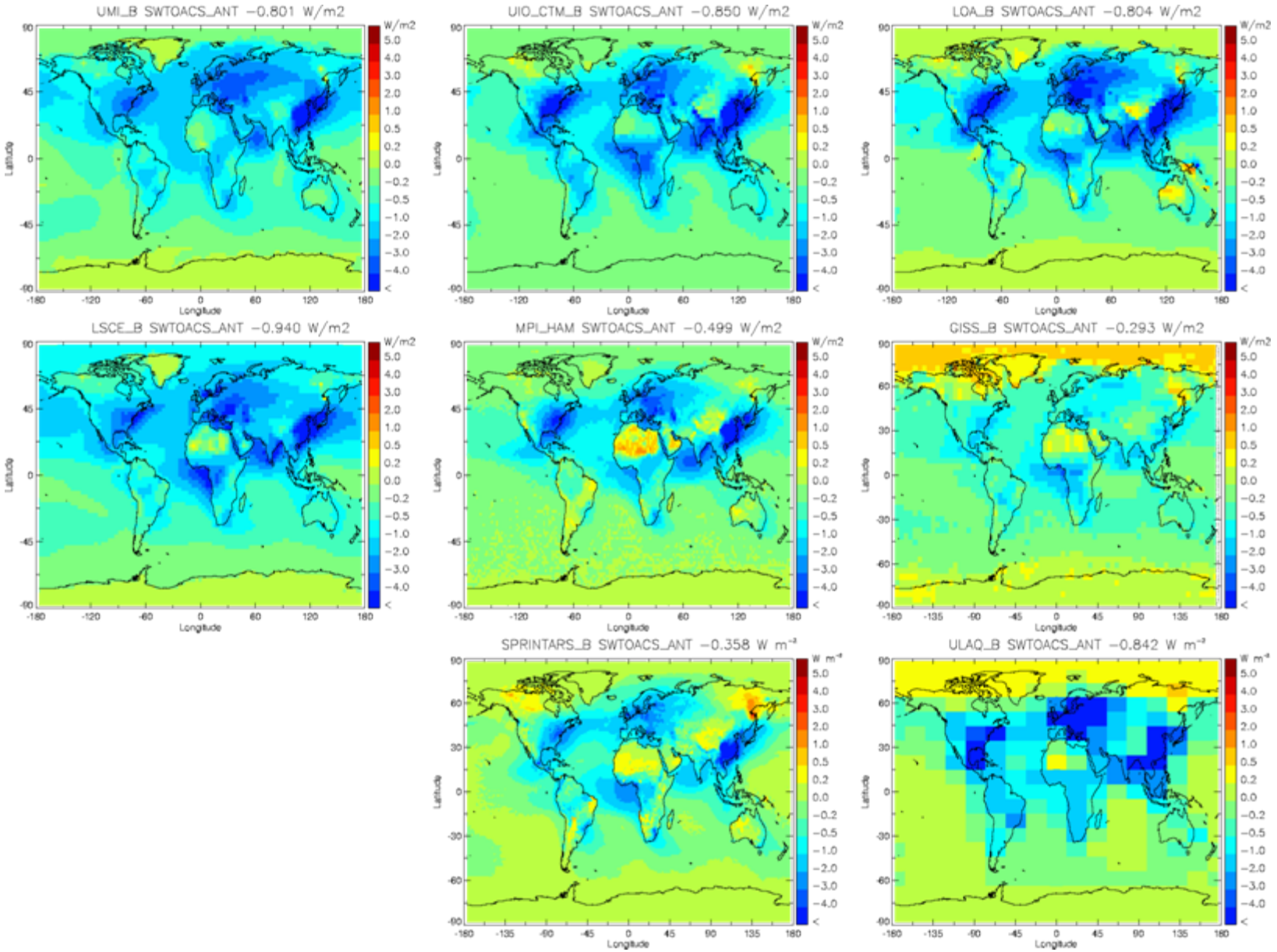
ISCCP low level cloud cover



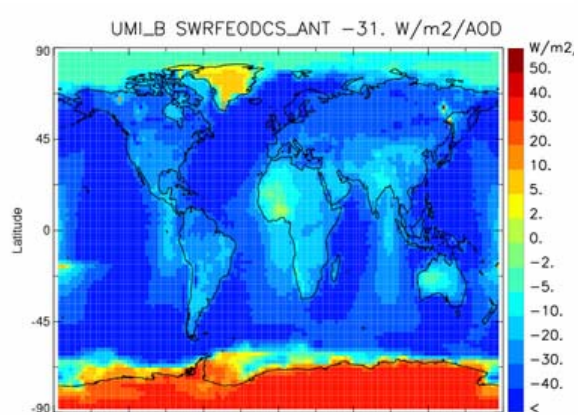
CLEAR SKY // Anthropogenic aerosol // Global but only 60°S to 60°N

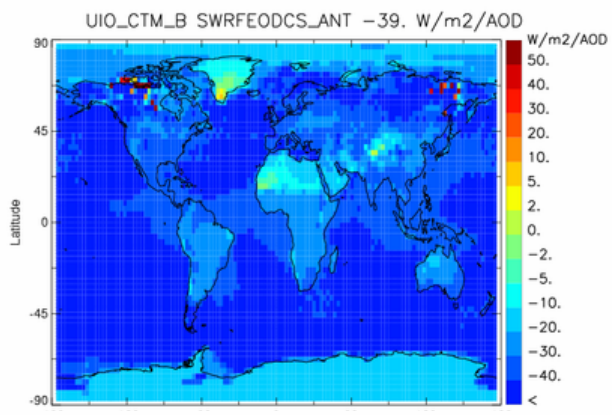
	ocean			land		
	AOD	RF	NRF	AOD	RF	NRF
Models		W m-2	W m-2 tau-1		W m-2	W m-2 tau-1
UMI	0.024	-0.68	-28	0.058	-1.33	-23
UIO_CTM	0.021	-0.69	-34	0.055	-1.64	-30
LOA	0.033	-0.67	-20	0.088	-1.47	-17
LSCE	0.026	-0.89	-34	0.063	-1.35	-21
MPI_HAM	0.038	-0.49	-13	0.073	-0.75	-10
GISS	0.013	-0.33	-26	0.026	-0.42	-16
SPRINTARS	0.030	-0.32	-11	0.078	-0.63	-8
AeroCom	0.026	-0.58	-24	0.063	-1.09	-18
Diversity	32%	-36%	-40%	32%	-44%	-42%
Observational based estimate						
Yu etal. 2005	0.031	-1.10	-37	0.088	-1.80	-20

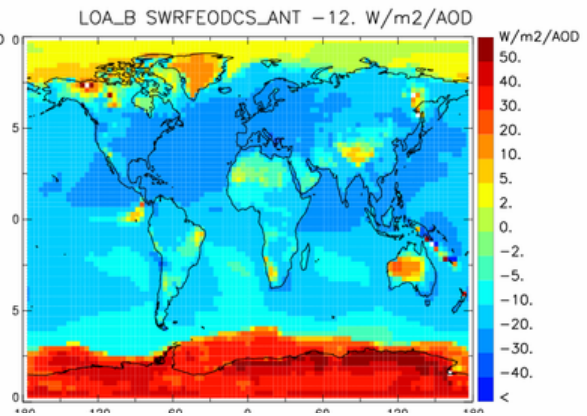
Aerosol focing in clear-skies

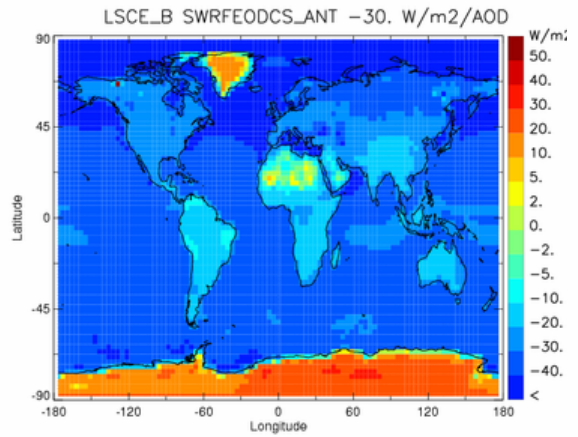


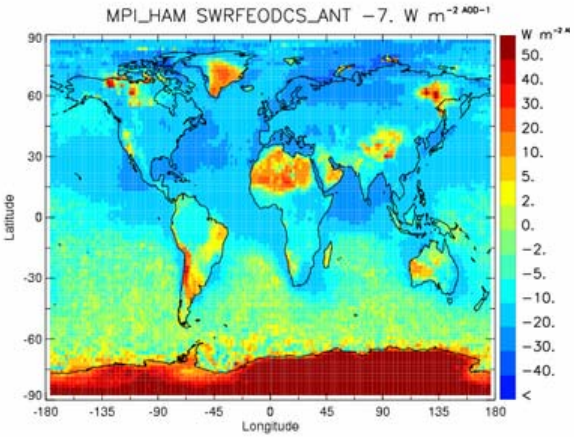
Clear sky radiative forcing efficiency per unit aerosol optical depth

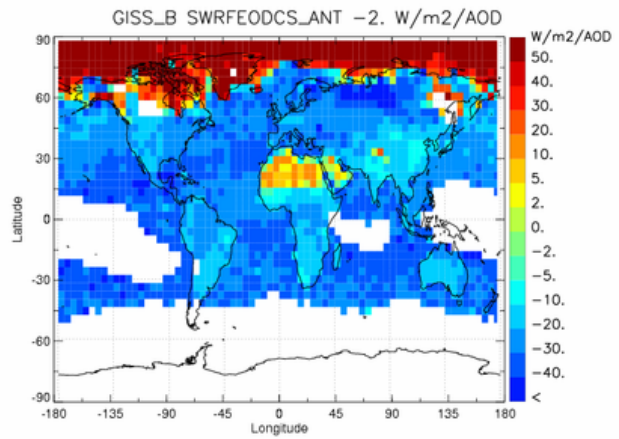


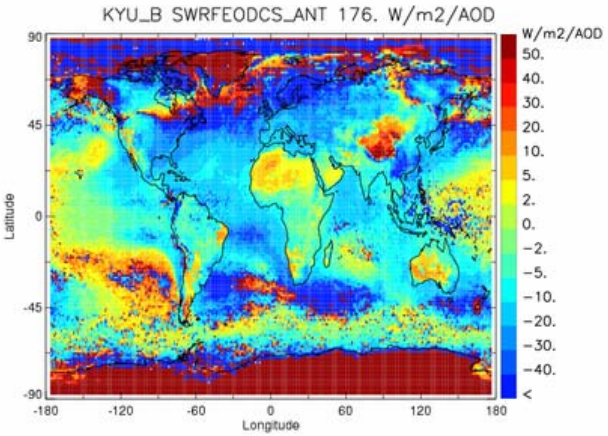




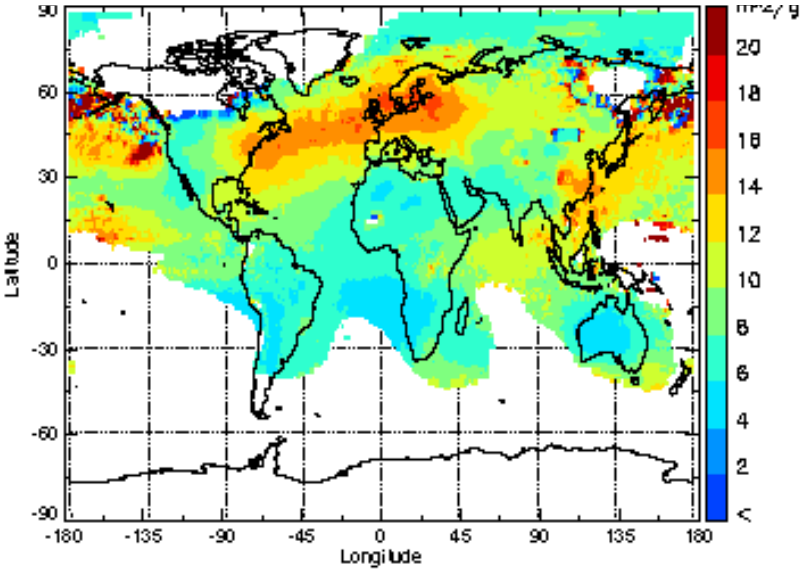




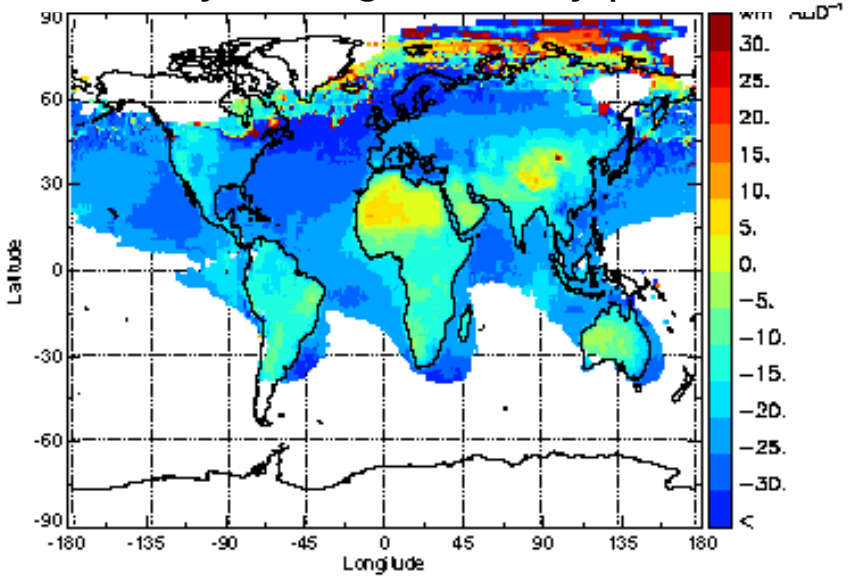




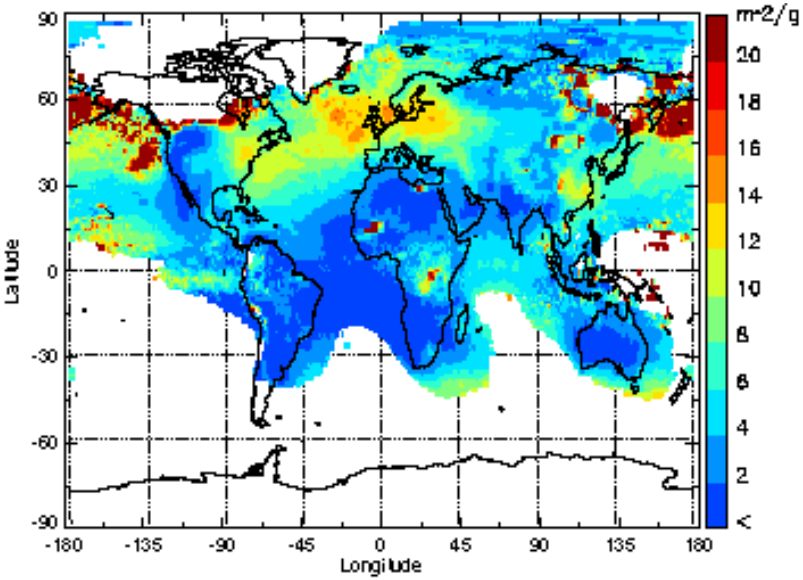
Mean mass extinction coefficient



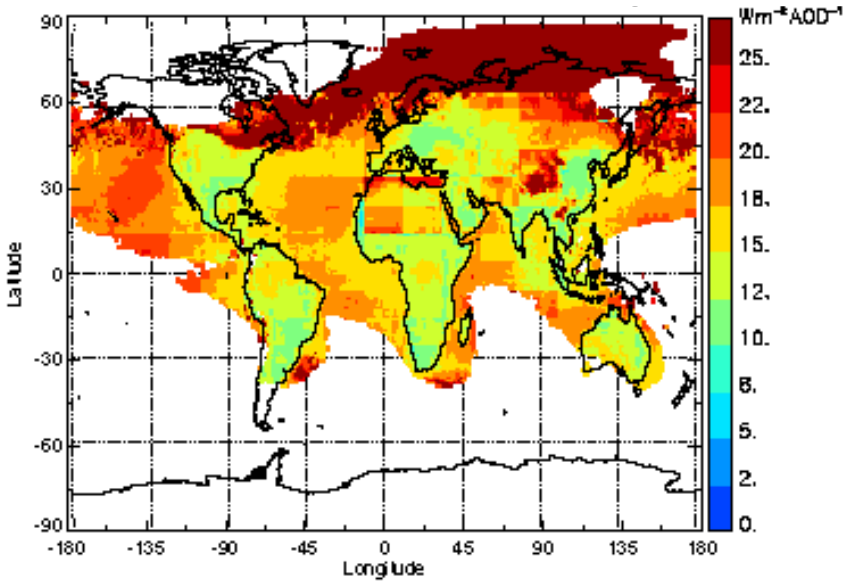
Clear-sky forcing efficiency per AOD



Diversity mass ext. coeff



Diversity forcing efficiency



AeroCom direct forcing summary

Transport & aerosol model & forcing efficiency diversity
dominate over emission assumption diversity

Clear-sky forcing is underestimated both due to lower AOD
and forcing efficiency as compared to measurement based estimates

Major differences in direct aerosol forcing can be traced back
to treatment of carbonaceous aerosol in models

Relative position of clouds and aerosol plumes
have significant impact on forcing estimate.
The sign of the cloud sky forcing is not clear.

Diversity in mass extinction coefficient follow « sulfate » plumes
and suggest humidity growth differences to be the reason

Considerable differences in surface albedo in snow/ice regions, but
also above deserts must be the reason for clear-sky forcing efficiency
diversity. Larger diversity over ocean than ‘ordinary’ land?