ACCMIP: www.giss.nasa.gov/projects/accmip

Overall goals

- Document radiative forcing (RF) in CMIP5 models (CMIP5 documents CO2 forcing & year 2000 aerosols only)

- Understand the differences in aerosol and ozone RF produced by various composition models

- Evaluate chemistry modeling underlying CMIP5 simulations (against observations)

- Improve understanding of sensitivities to changes in natural emissions & to differing socio-economic scenarios/sectors

Historical simulations

Emissions/Configuration	1850	1890	1910	1930	1950	1970	1980	1990	2000
Emissions and SSTs/GHGs for given year	C	1	1	C	1	1	C	1	C
Year 2000 emissions/ 1850 SSTs & GHGs									C

Co-leads Jean-Francois Lamarque (NCAR) & Drew Shindell (NASA GISS)

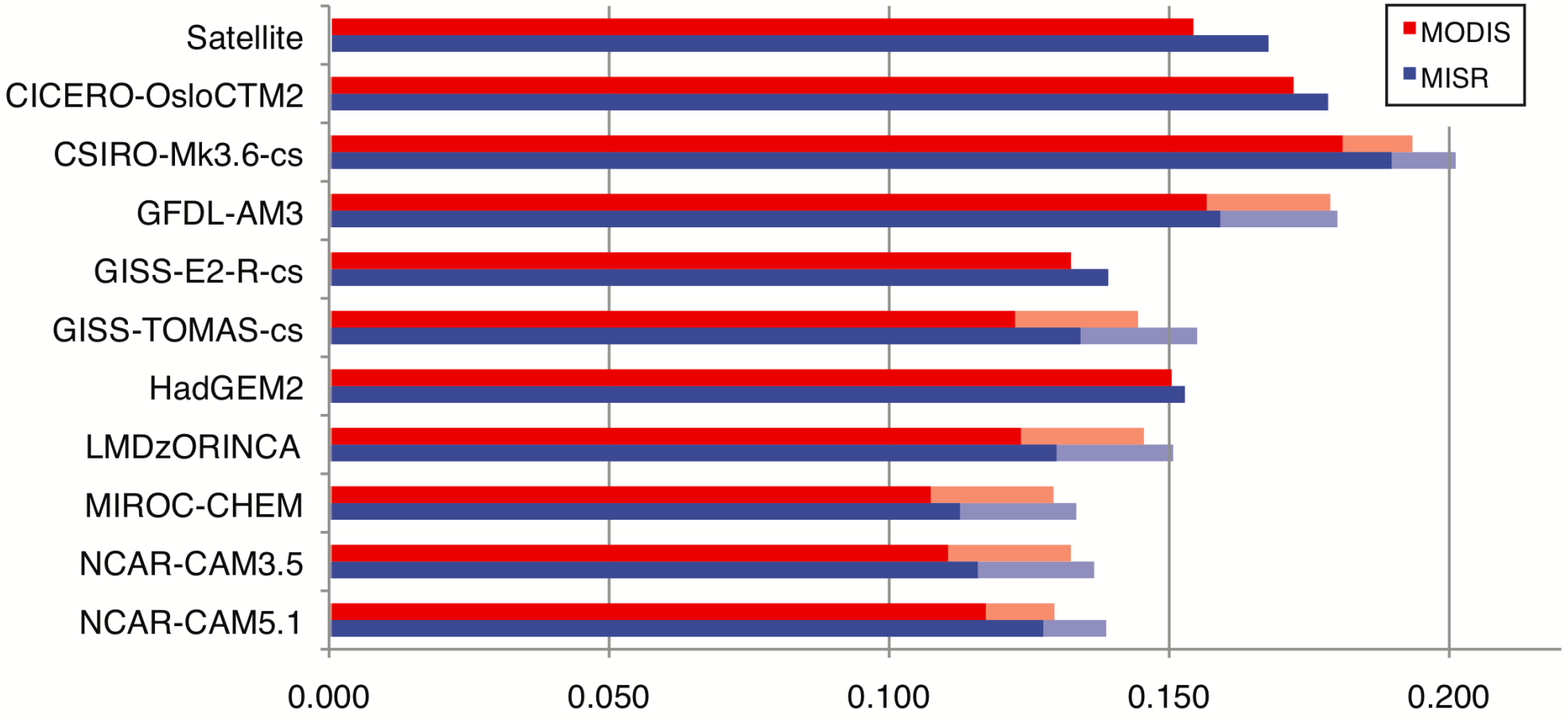
ACCMIP Radiative Forcing Analysis

Radiative forcing in the ACCMIP historical and future climate simulations

D. T. Shindell, J.-F. Lamarque, M. Schulz, M. Flanner, C. Jiao, M. Chin, P. Young, Y. H. Lee, L. Rotstayn, G. Milly, G. Faluvegi, Y. Balkanski, W. J. Collins, A. J. Conley, S. Dalsoren, R. Easter, S. Ghan, L. Horowitz, X. Liu, G. Myhre, T. Nagashima, V. Naik, S. Rumbold, R. Skeie, K. Sudo, S. Szopa, T. Takemura, A. Voulgarakis, and J.-H. Yoon

Atmos. Chem. Phys. Discuss., 12, 21105–21210, 2012

ACCMIP Radiative Forcing Analysis



Global mean annual avg AOD

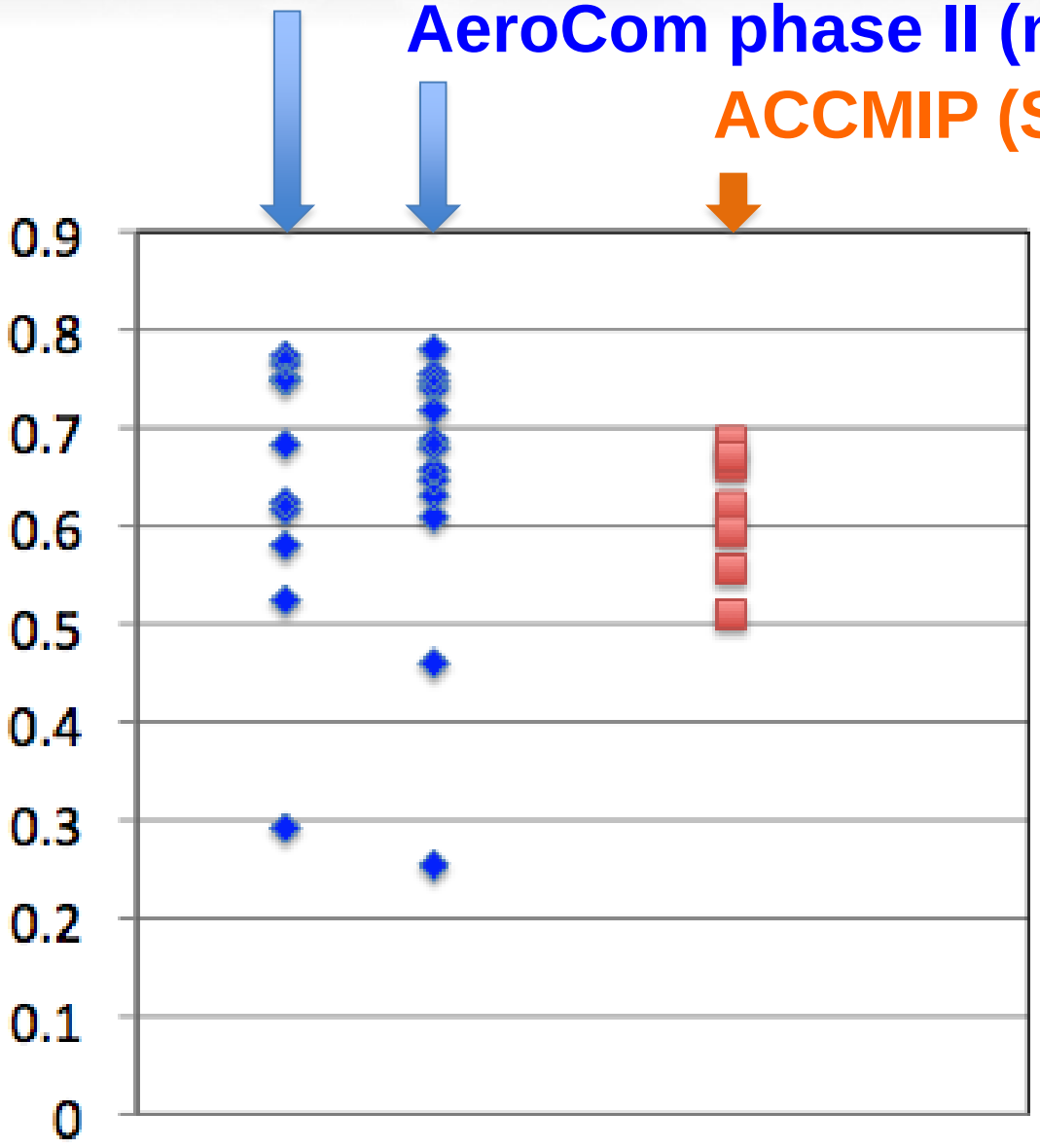
shaded area adds missing components

ACCMIP Radiative Forcing Analysis

Table 2. Annual average AOD (550 nm) compared with observations.

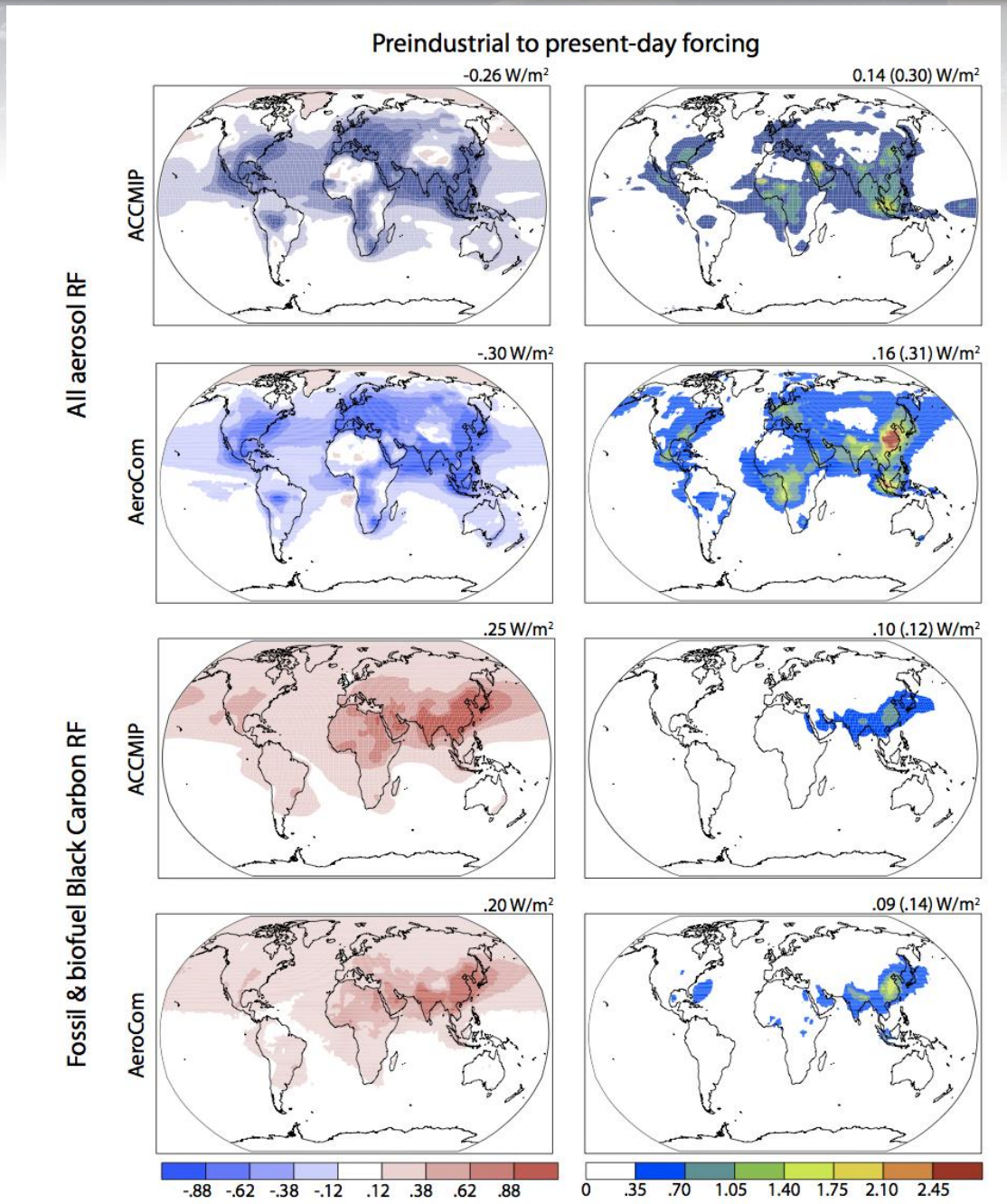
Model	*R* vs. MODIS	*R* vs. MISR	*R* vs. SurfObs	Bias vs. MODIS	Bias vs. MISR	Bias vs. SurfObs
CICERO-OsloCTM2	0.71	0.76	0.69	12	6	25
CSIRO-Mk3.6	0.71	0.71	N/A	7	4	N/A
CSIRO-Mk3.6-cs	0.68	0.68	N/A	17	13	N/A
GFDL-AM3	0.69	0.73	0.51	2	−5	15
GISS-E2-R	0.56	0.63	0.56	53	46	77
GISS-E2-R-cs	0.62	0.71	0.61	−14	−17	−8
GISS-E2-R-TOMAS*	0.59	0.71	0.56	−21	−20	19
HadGEM2	0.66	0.69	0.65	−3	−9	−2
LMDzORINCA	0.70	0.68	0.54	−20	−23	−5
MIROC-CHEM	0.55	0.63	0.44	−30	−33	−22
NCAR-CAM3.5	0.70	0.71	0.58	−28	−31	−13
NCAR-CAM5.1	0.50	0.54	0.56	−24	−24	−22
10 Model mean	0.64	0.68	0.57	−11	−14	−1
Absolute biases				24	26	16

ACCMIP Radiative Forcing Analysis



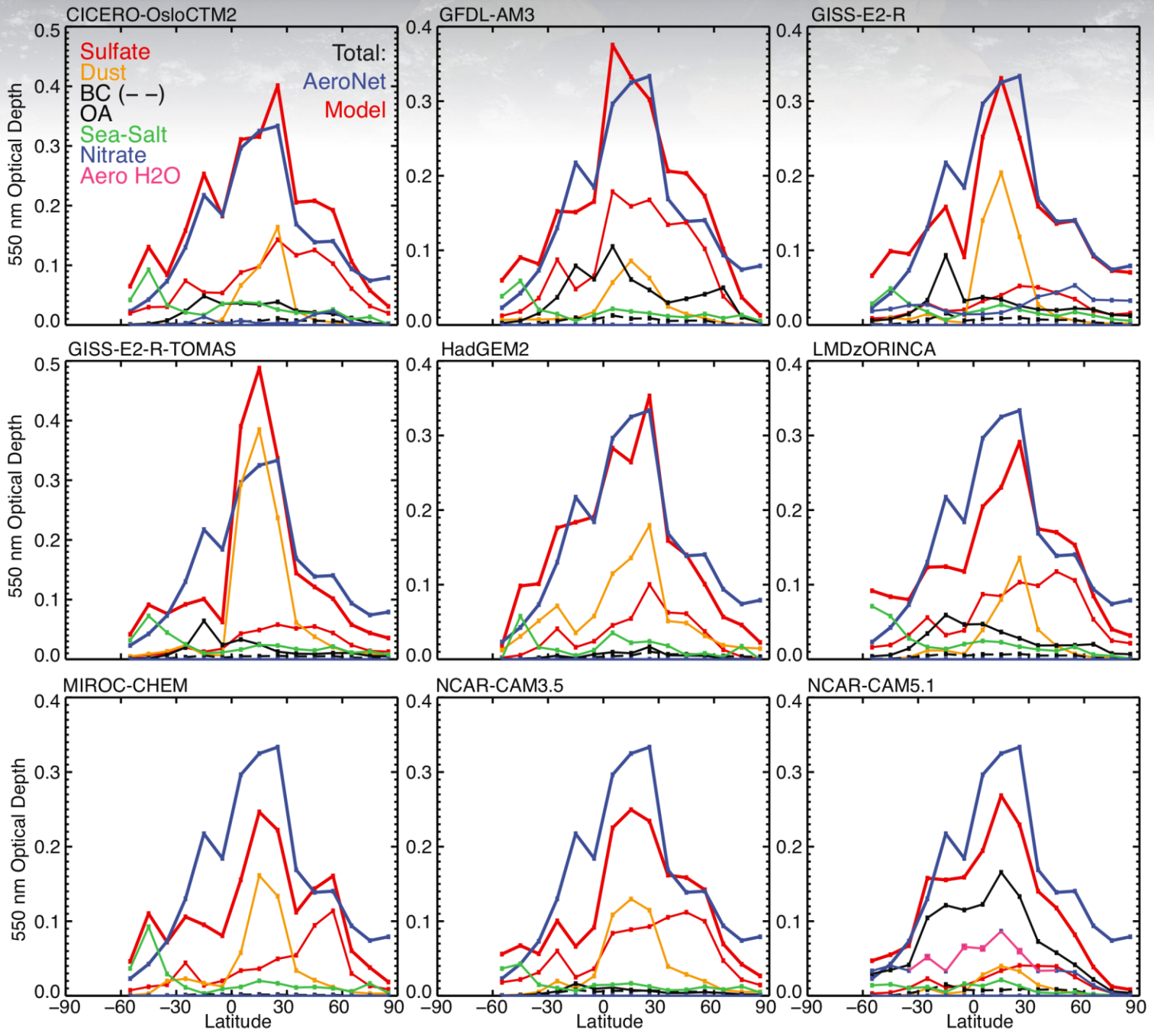
550 nm AOD correlations
3327 months with data
338 Aeronet sites
In years 2000-2009

ACCMIP Radiative Forcing Analysis



Comparison of ACCMIP and AeroCom models shows quite similar in many respects

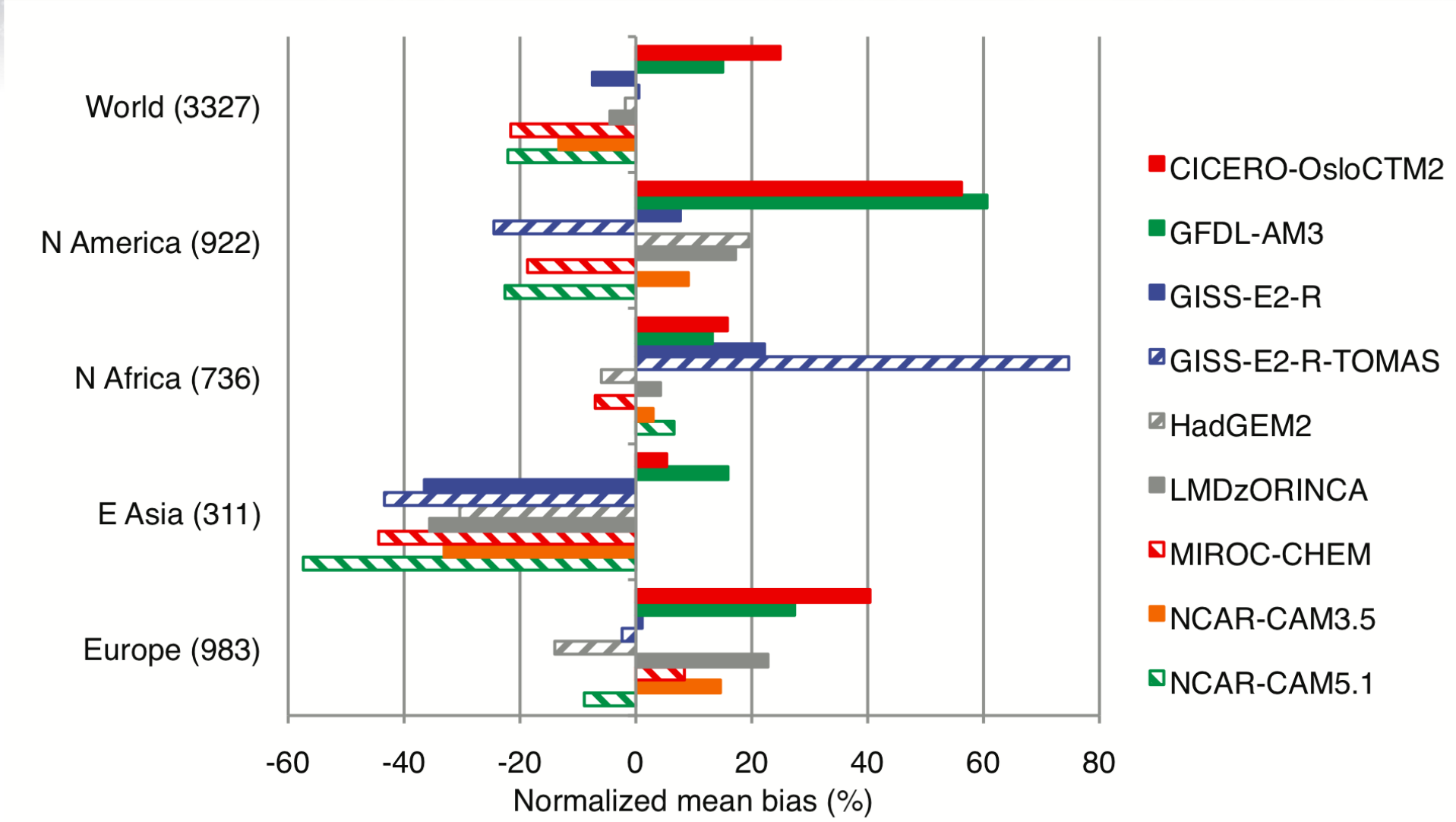
ACCMIP Radiative Forcing Analysis



Comparison with MODIS & MISR screened by top decile of mass

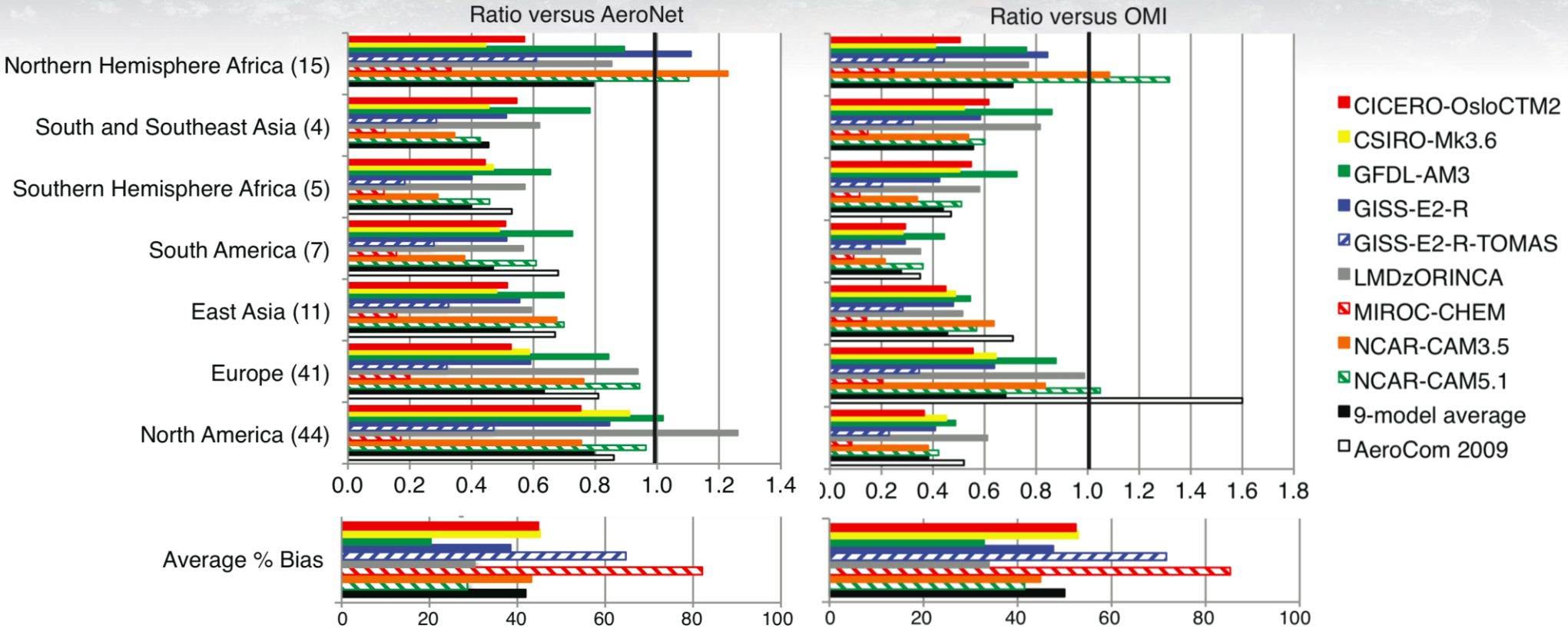
Shows, e.g.: CICERO SO4+ TOMAS Dust+ MIROC OA- CAM3.5 OA-

ACCMIP Radiative Forcing Analysis



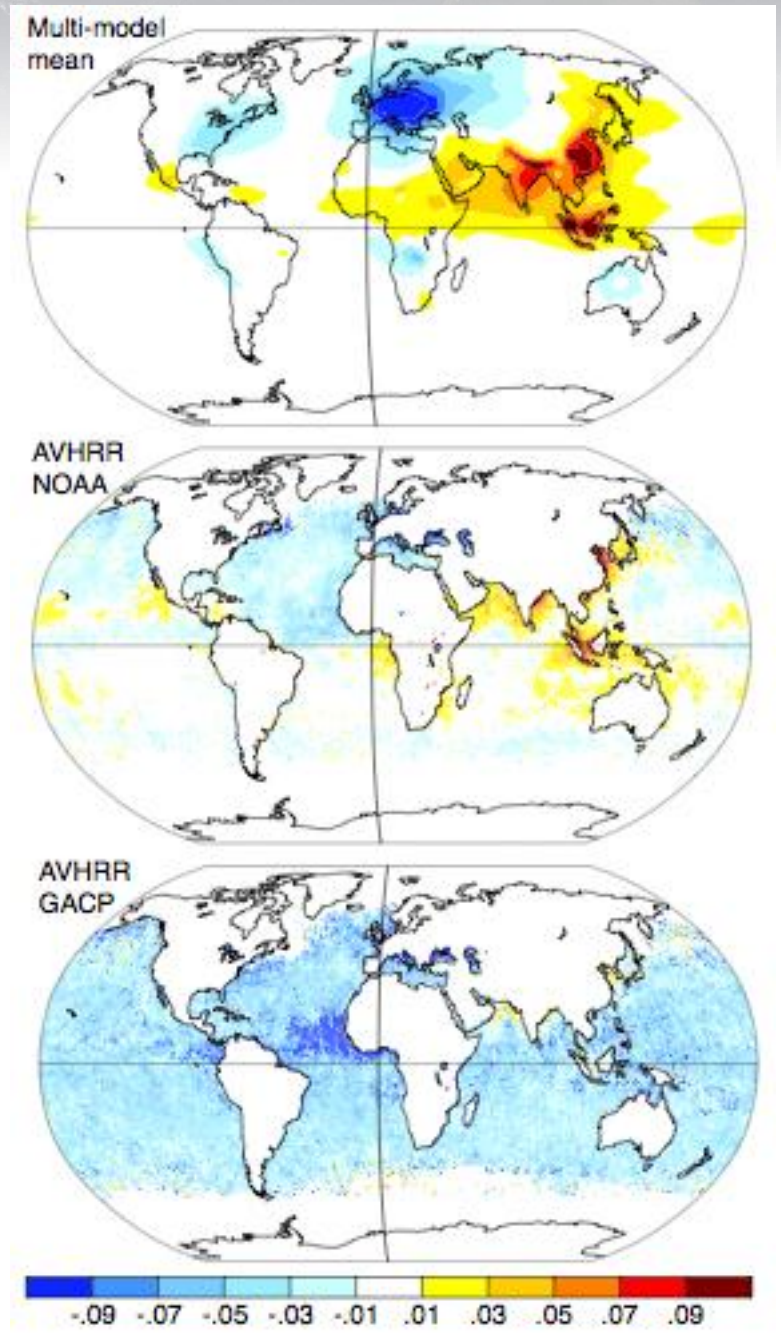
Monthly AOD vs AeroNet

ACCMIP Radiative Forcing Analysis



Ratios of monthly modeled AAOD vs AeroNet and OMI (upper panels) and bias (lower panels, avg absolute value over 7 regions)

ACCMIP Radiative Forcing Analysis

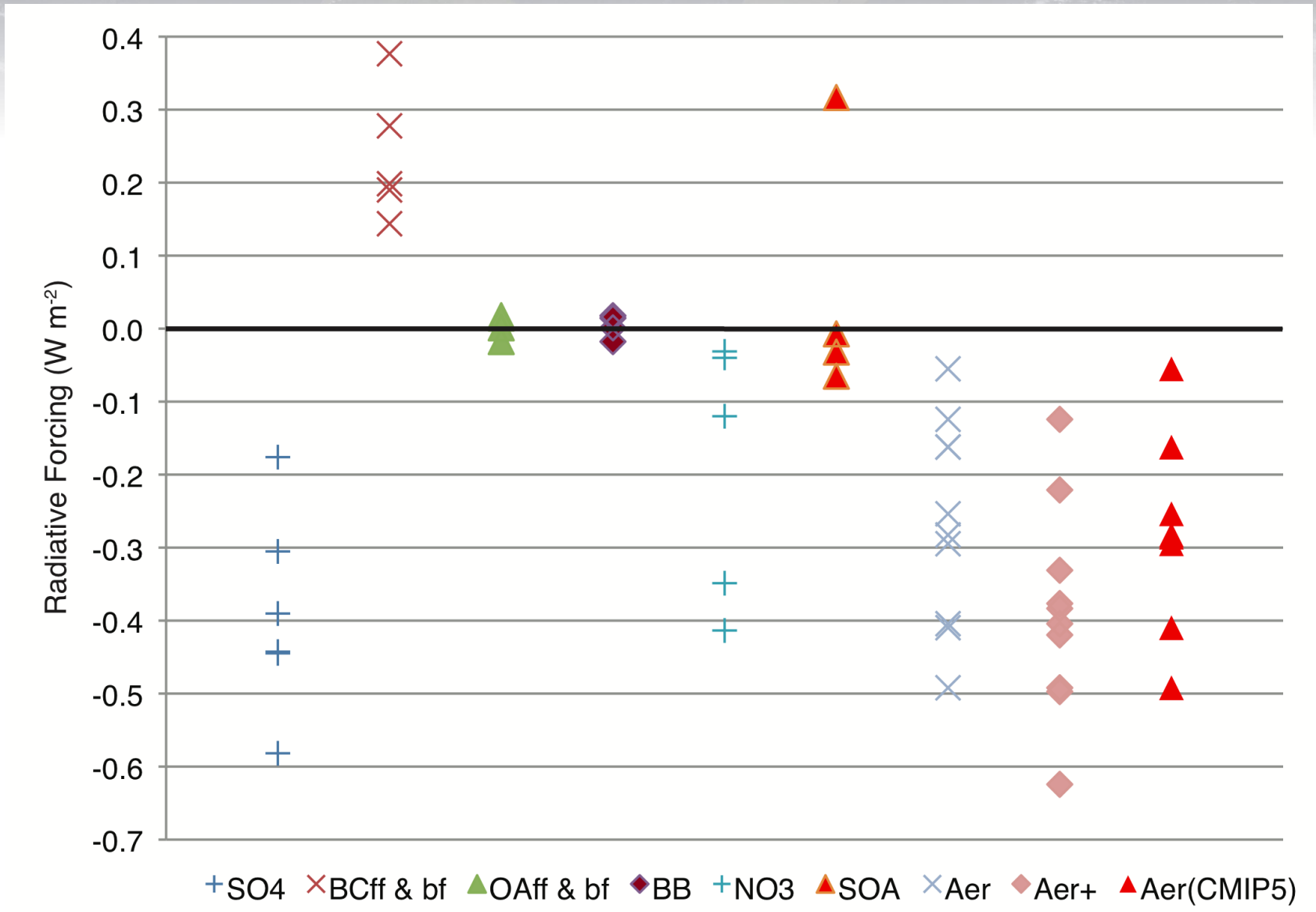


AOD trends

Models: 1980 to 2000
Satellite: 1981-1985 to 1997-2003
(El Chichon excluded)

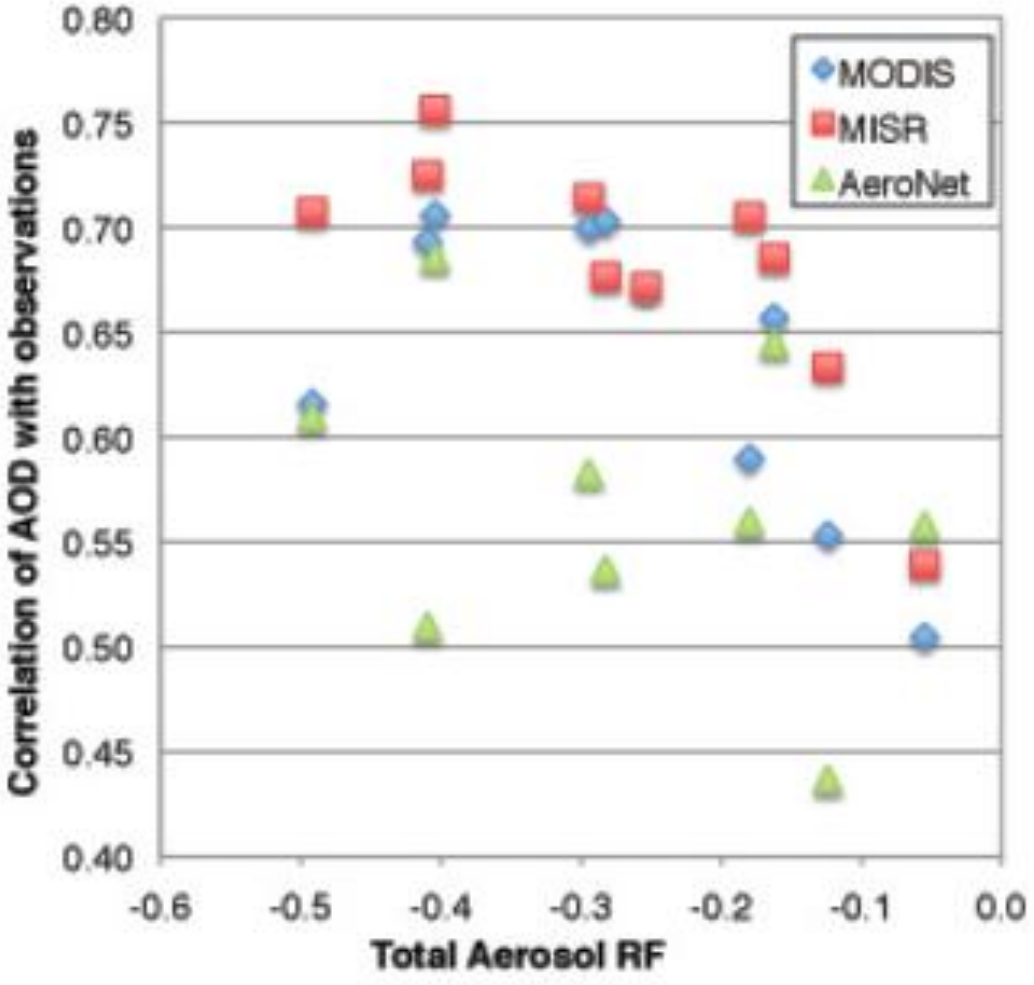
	Obs (NOAA) mean	*model*
Europe	*-0.046*	*-0.045*
G. Lakes	*-0.035*	*-0.030*
S/E Asia	*0.038*	*0.050*
Yellow Sea	*0.114*	*0.056*

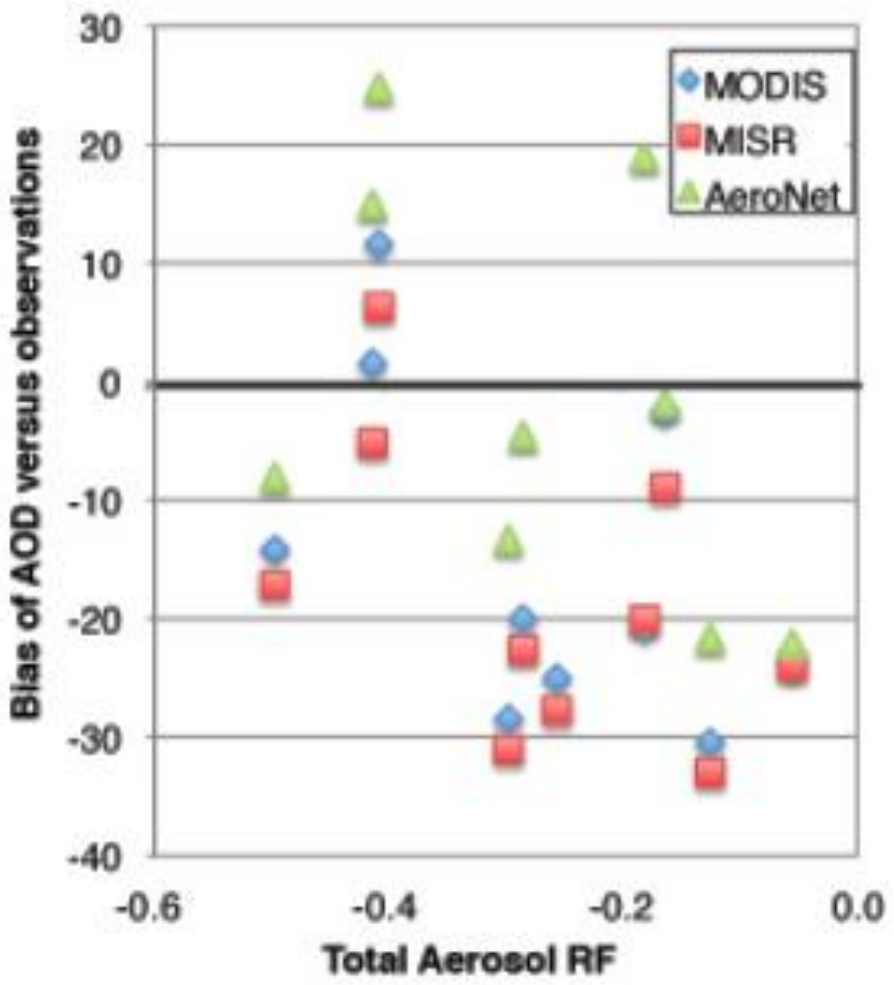
ACCMIP Radiative Forcing Analysis



Global mean aerosol DRF

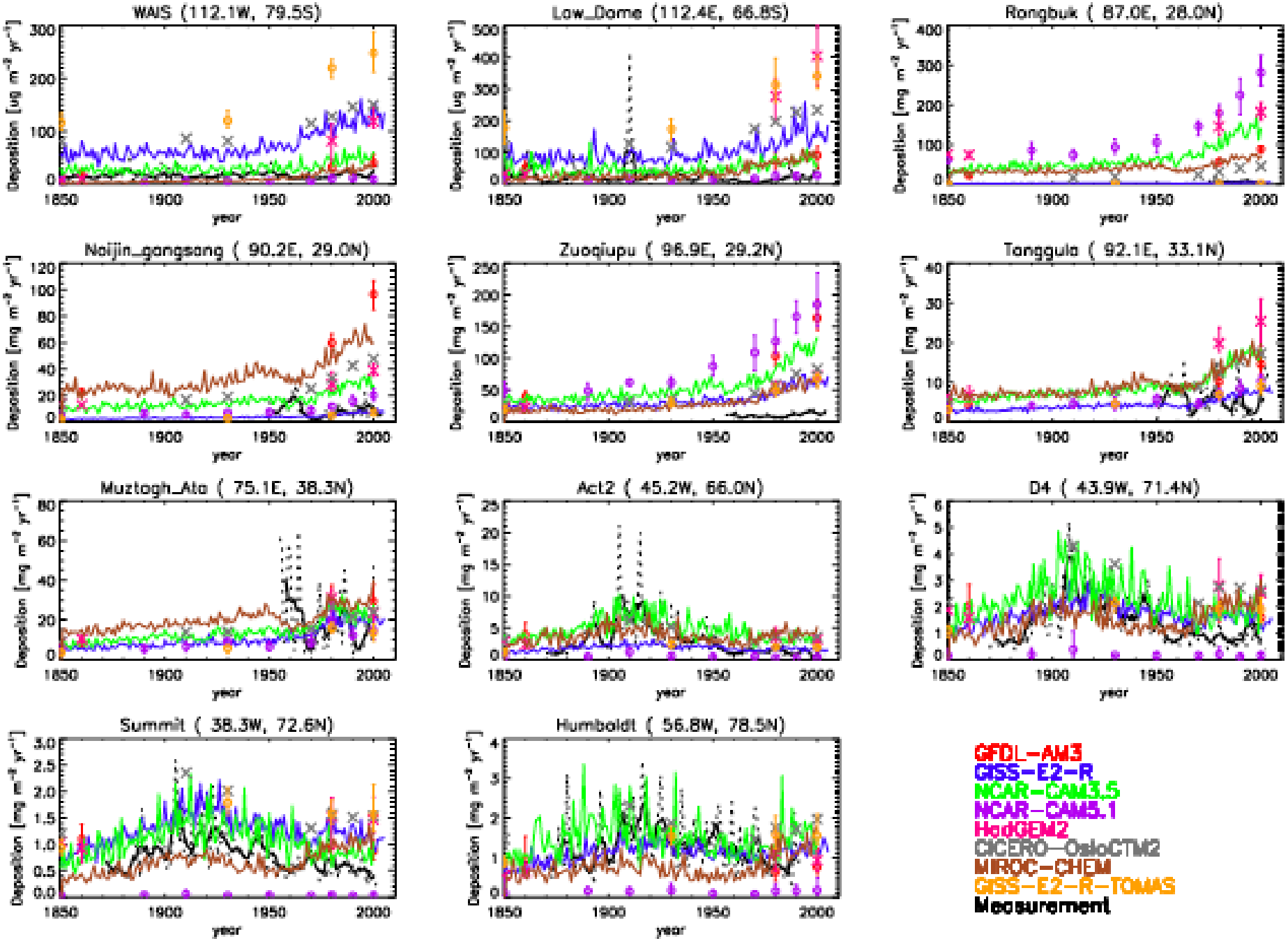
ACCMIP Radiative Forcing Analysis





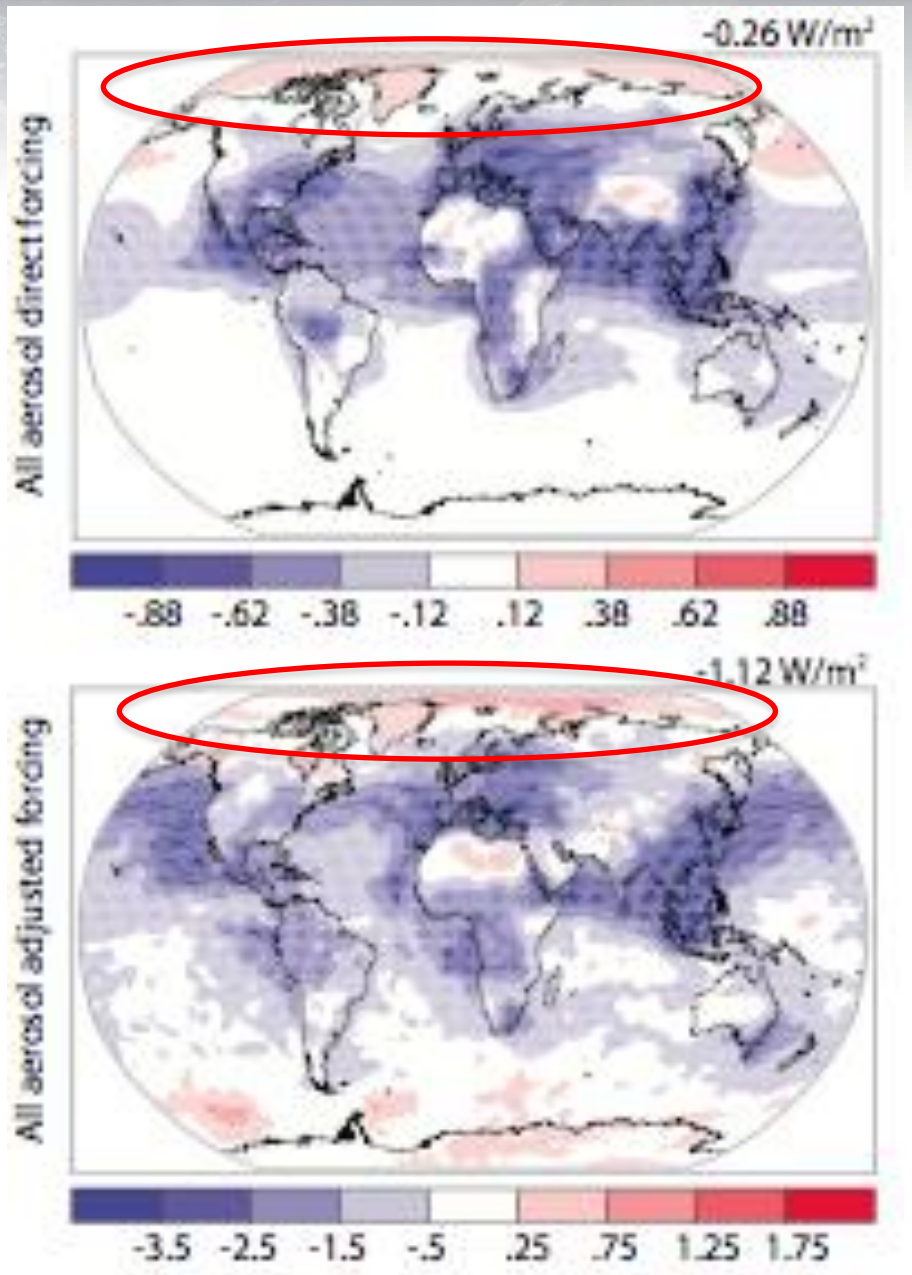
Screening based on MODIS (R, bias), MODIS fine-mode, AVHRR trends suggests range -0.16 to -0.40 W/m^2 (with missing, -0.33 to -0.50 W/m^2)

ACCMIP Radiative Forcing Analysis

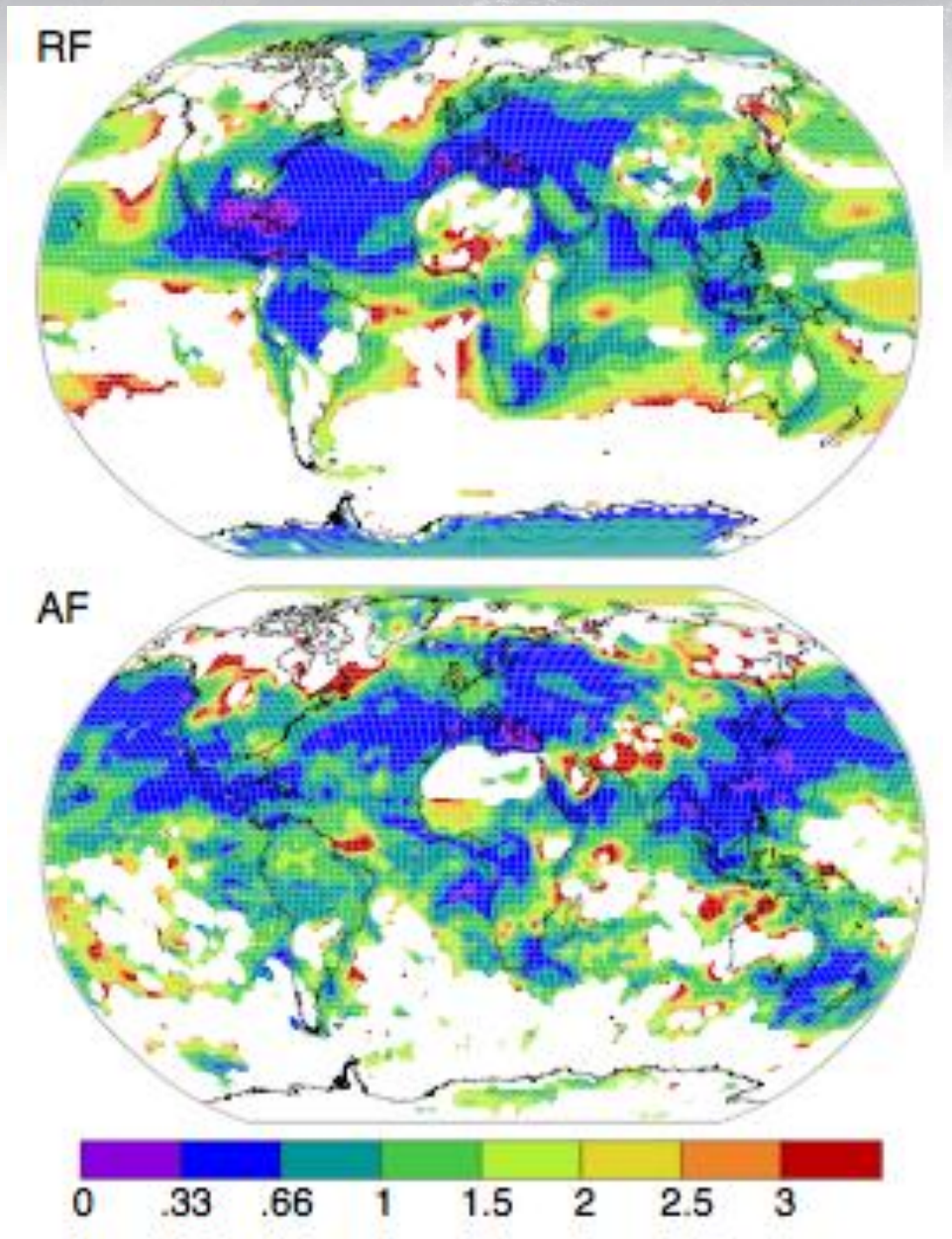


From Lee et al., ACCMIP SI

ACCMIP Radiative Forcing Analysis

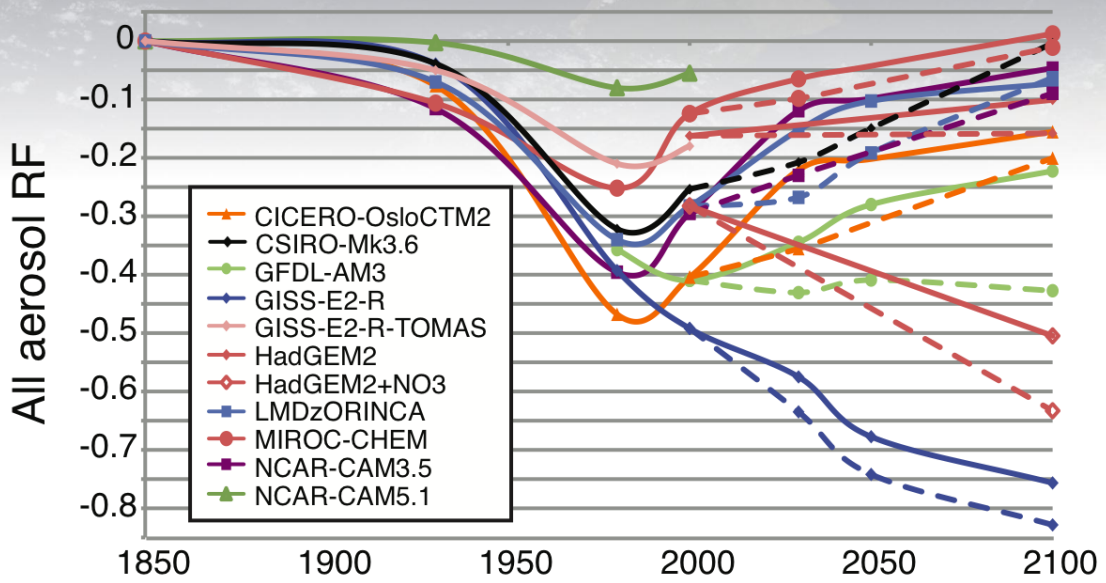


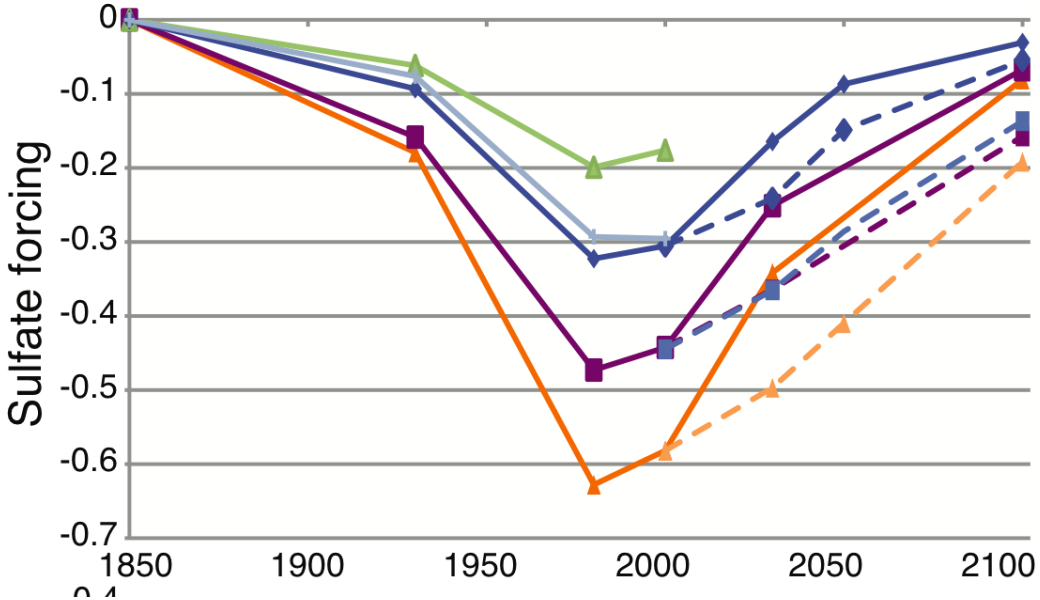
Forcing

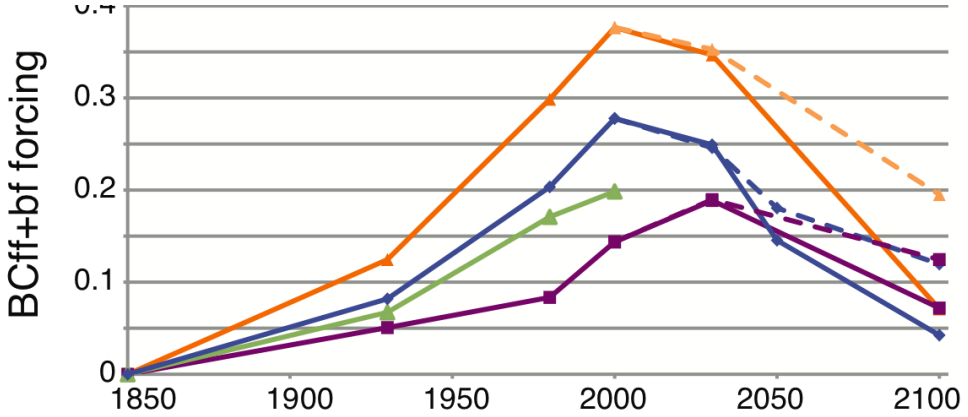


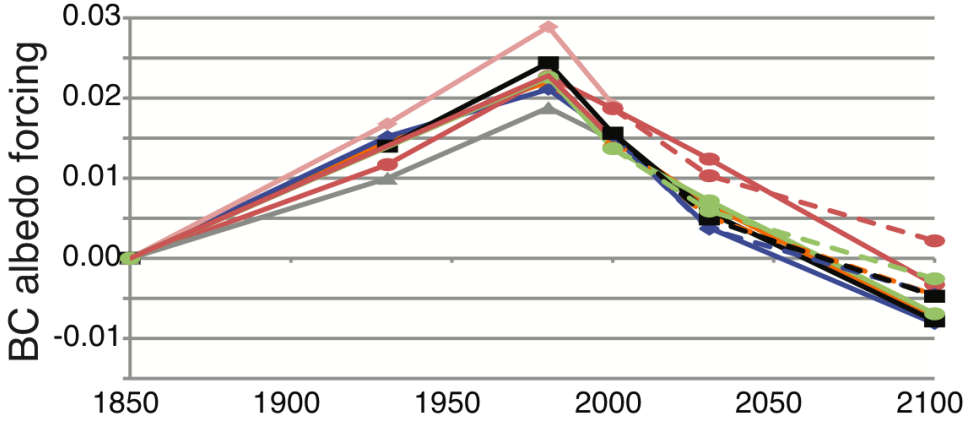
Ratio of σ to mean

ACCMIP Radiative Forcing Analysis



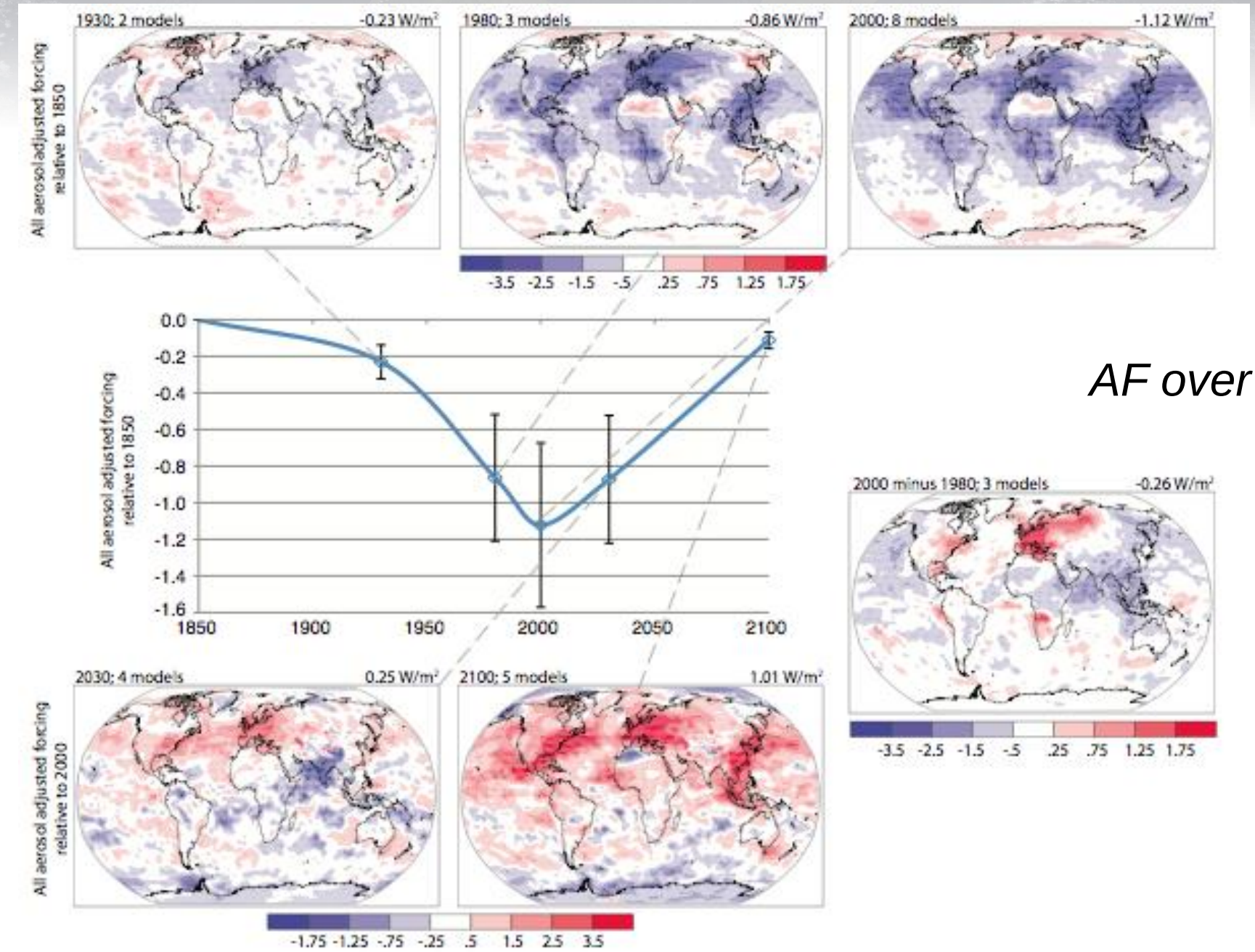






RF over time

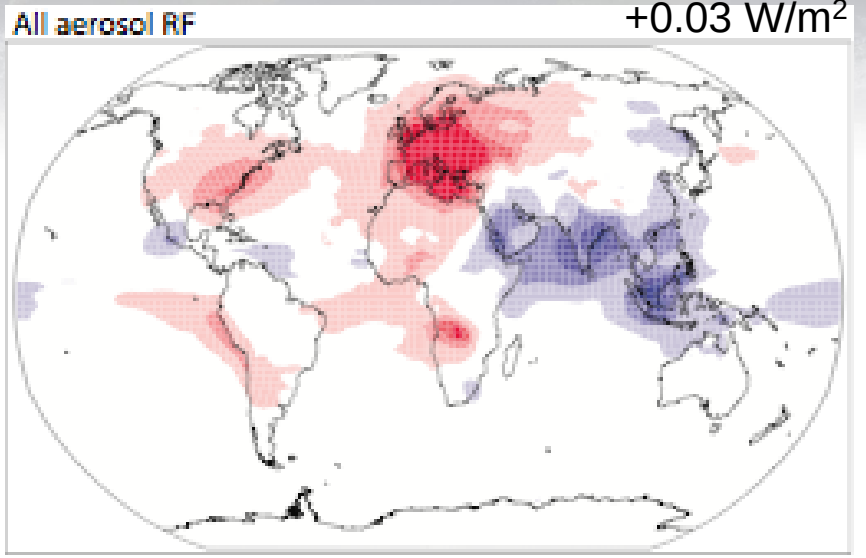
ACCMIP Radiative Forcing Analysis



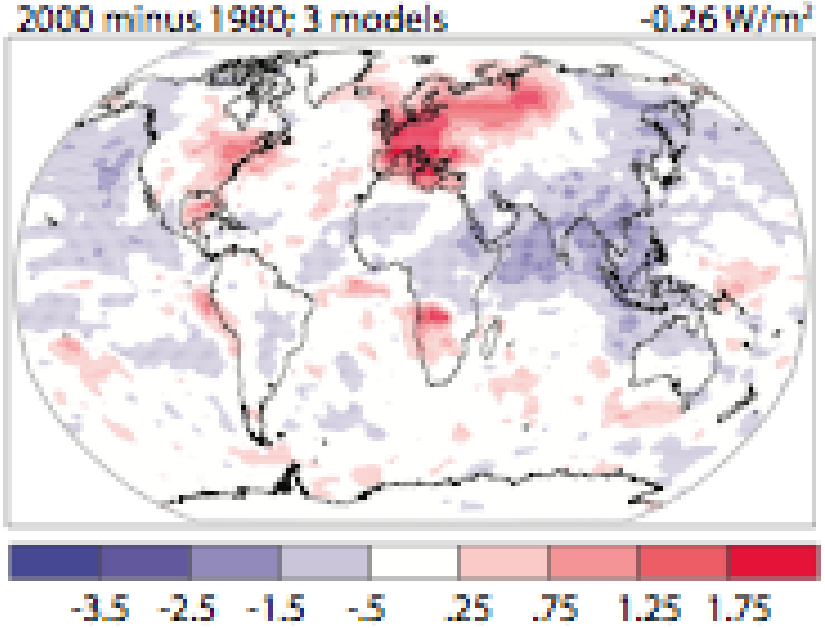
AF over time

ACCMIP Radiative Forcing Analysis

RF

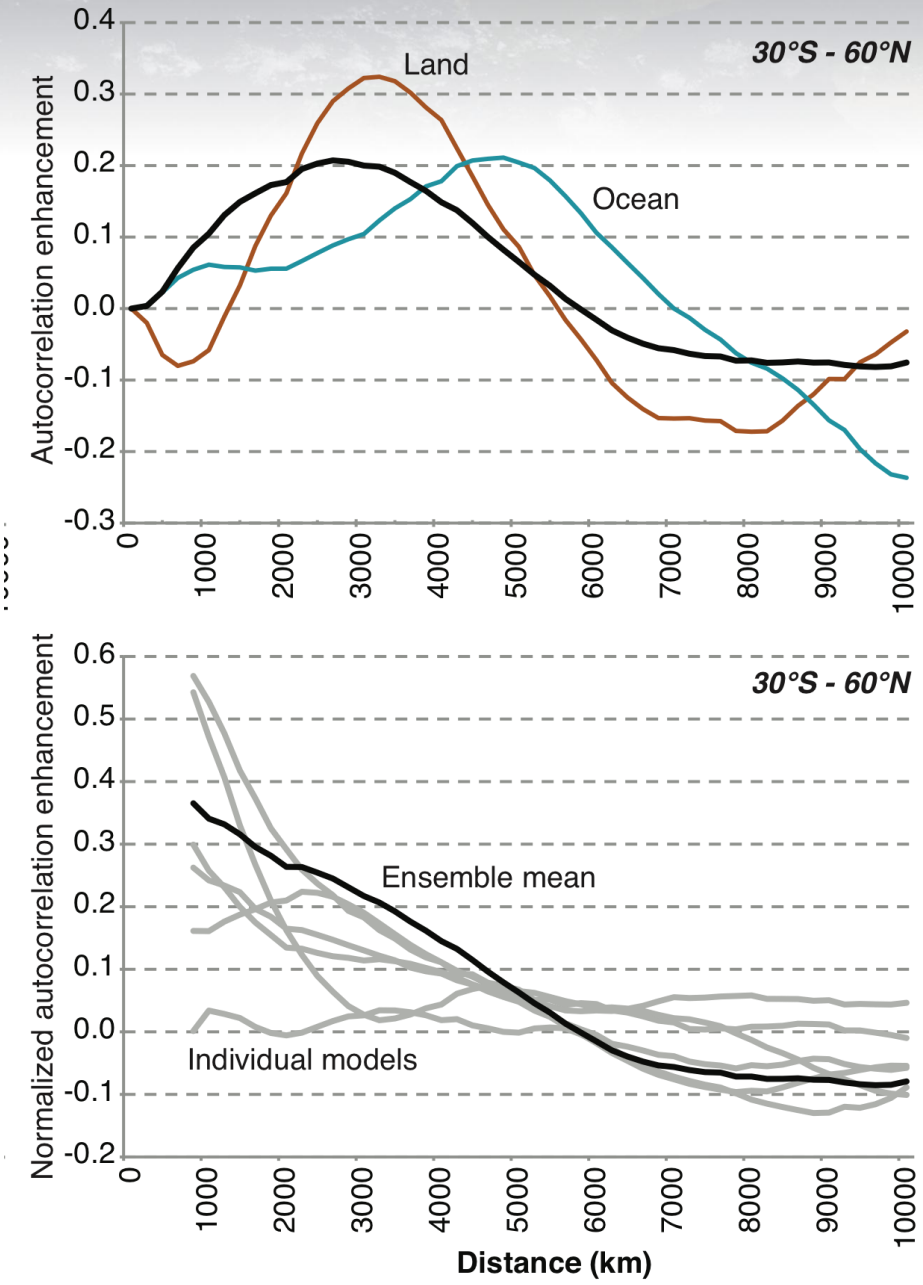


AF



2000 vs 1980

ACCMIP Radiative Forcing Analysis



Forcing & Response

Length scales for aerosol+O3 forcing show greatest impact out to ~3500 km over land, ~5000 km over oceans

Normalization shows strong effect locally, tapering off with distance (e-folding ~4000 km) in most, but not all, models

ACCMIP Radiative Forcing Analysis