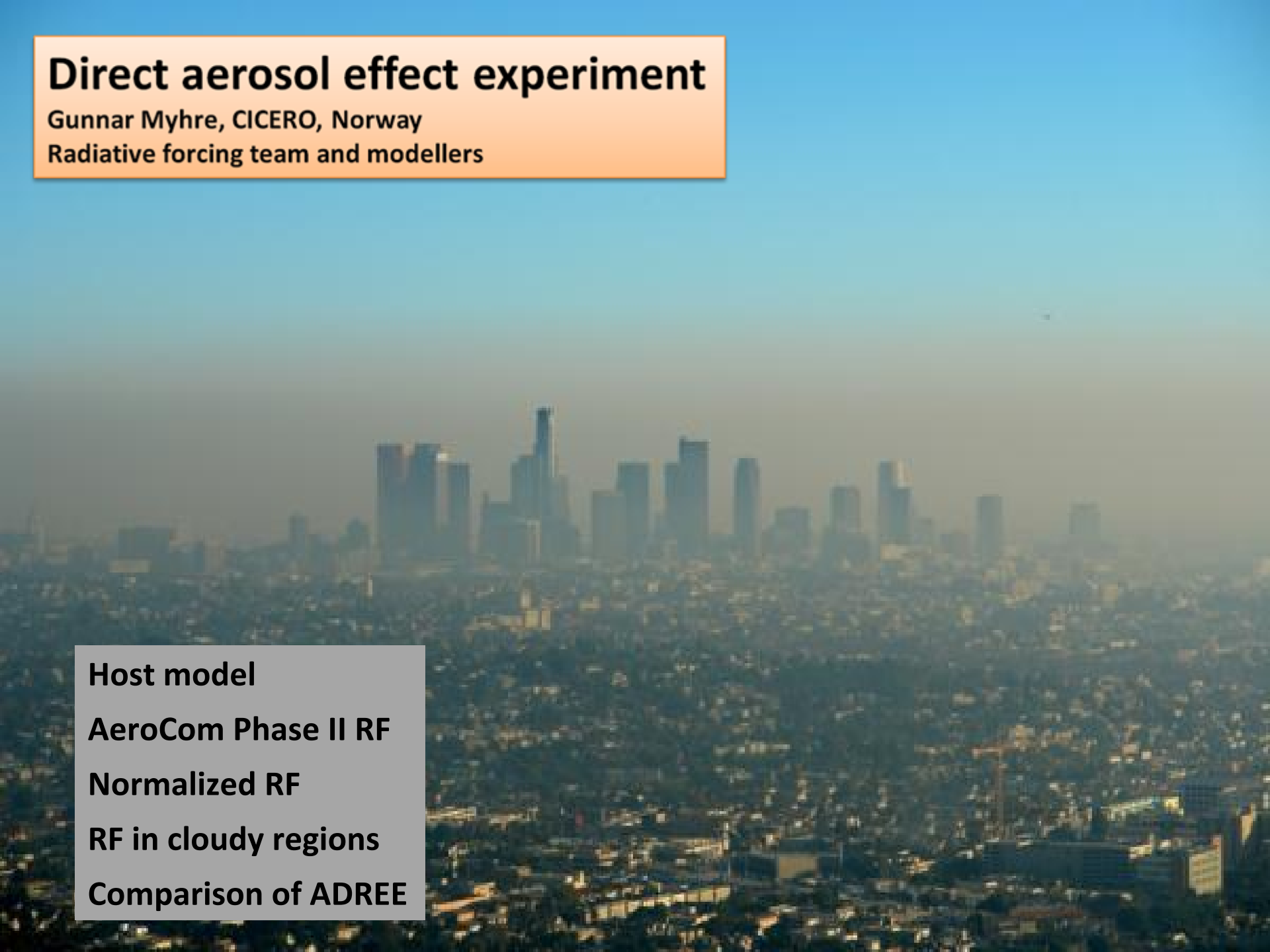
Direct aerosol effect experiment

Gunnar Myhre, CICERO, Norway
Radiative forcing team and modellers



Host model

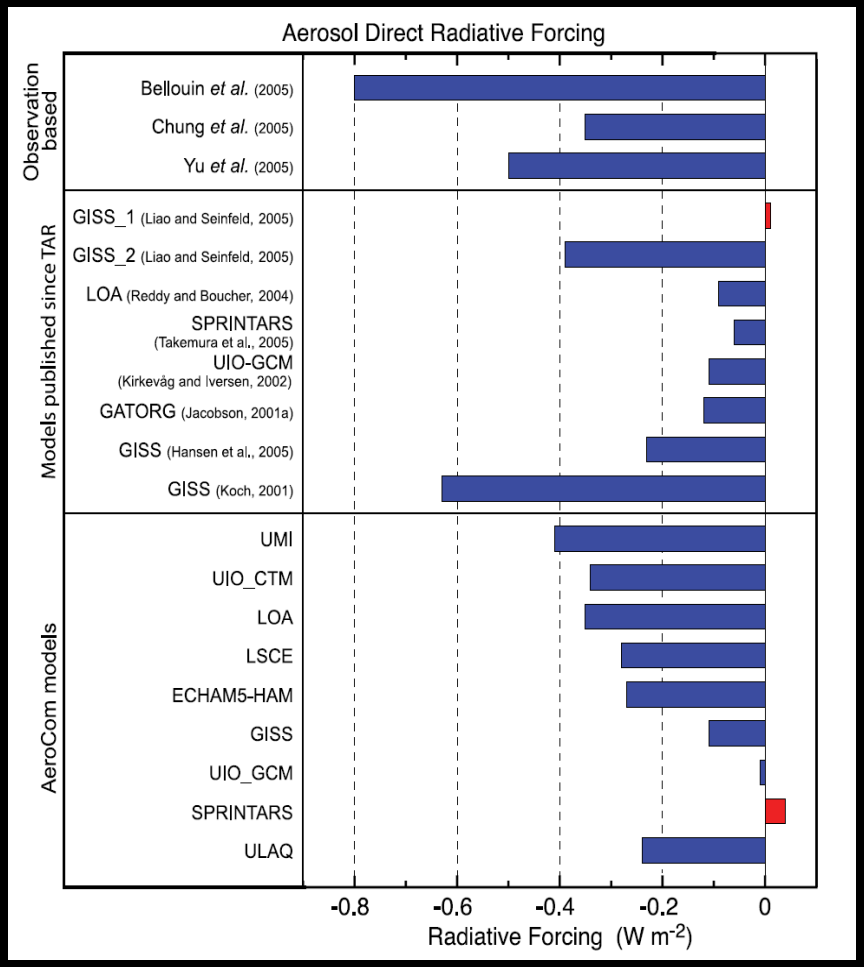
AeroCom Phase II RF

Normalized RF

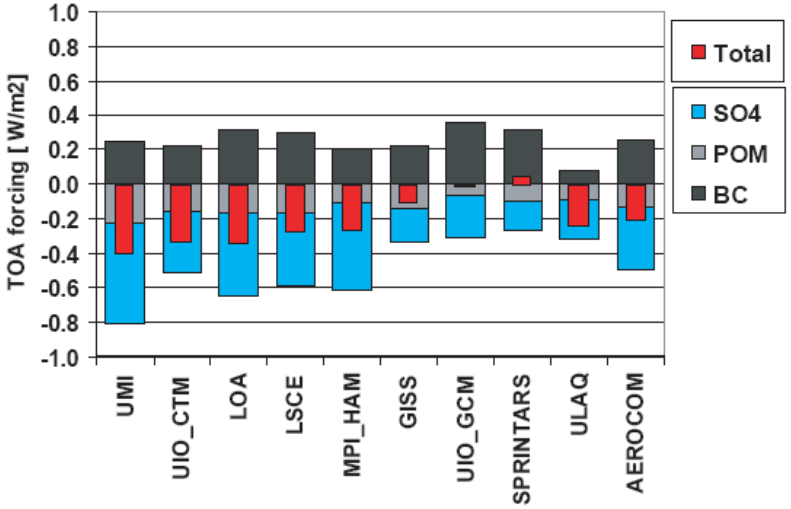
RF in cloudy regions

Comparison of ADREE

DIRECT AEROSOL EFFECT EXPERIMENT



IPCC, 2007

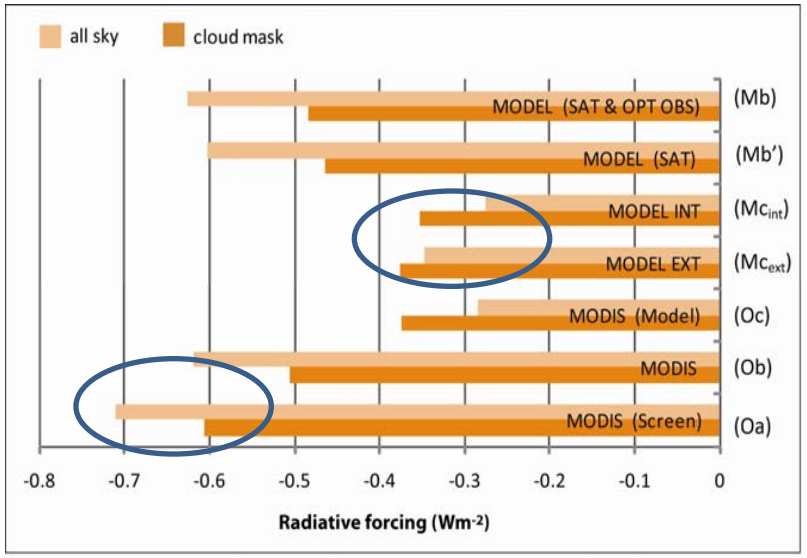


Atmos. Chem. Phys., 6, 5225–5246, 2006

Radiative forcing by aerosols as derived from the AeroCom present-day and pre-industrial simulations

M. Schulz[1], C. Textor[1], S. Kinne[2], Y. Balkanski[1], S. Bauer[3], T. Berntsen[4], T. Berglen[4], O. Boucher[5,11], F. Dentener[6], S. Guibert[1], I. S. A. Isaksen[4], T. Iversen[4], D. Koch[3], A. Kirkevåg[4], X. Liu[7,12], V. Montanaro[8], G. Myhre[4], J. E. Penner[7], G. Pitari[8], S. Reddy[9], Ø. Seland[4], P. Stier[2], and T. Takemura[10]

DIRECT AEROSOL EFFECT EXPERIMENT



Consistency Between Satellite-Derived and Modeled Estimates of the Direct Aerosol Effect

Gunnar Myhre

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- **Two** independent methods giving similar results provides improved understanding and reduced uncertainty
- **To** further enhance the understanding of the direct aerosol effect improved understanding of model differences are needed

Quantify the model differences

Aerosol

- Vertical profile
- Spatial distribution
- Optical properties

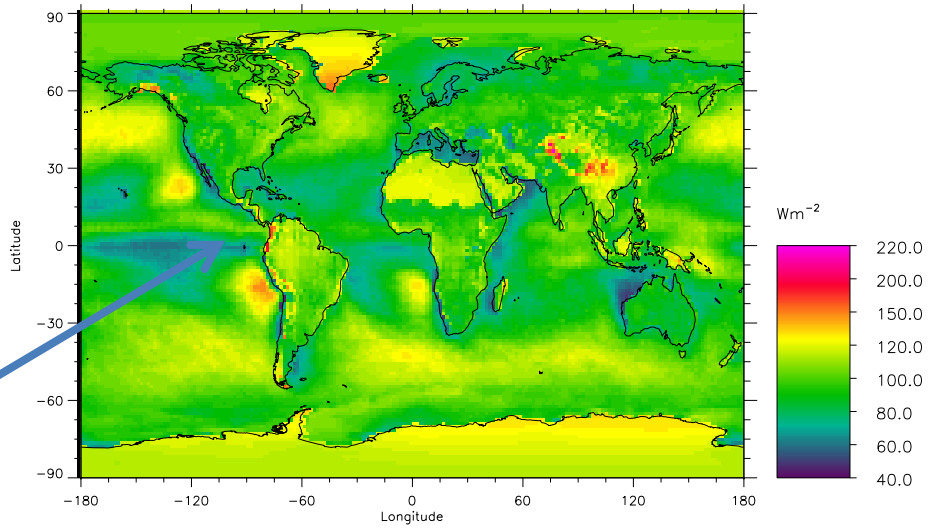
Surface albedo

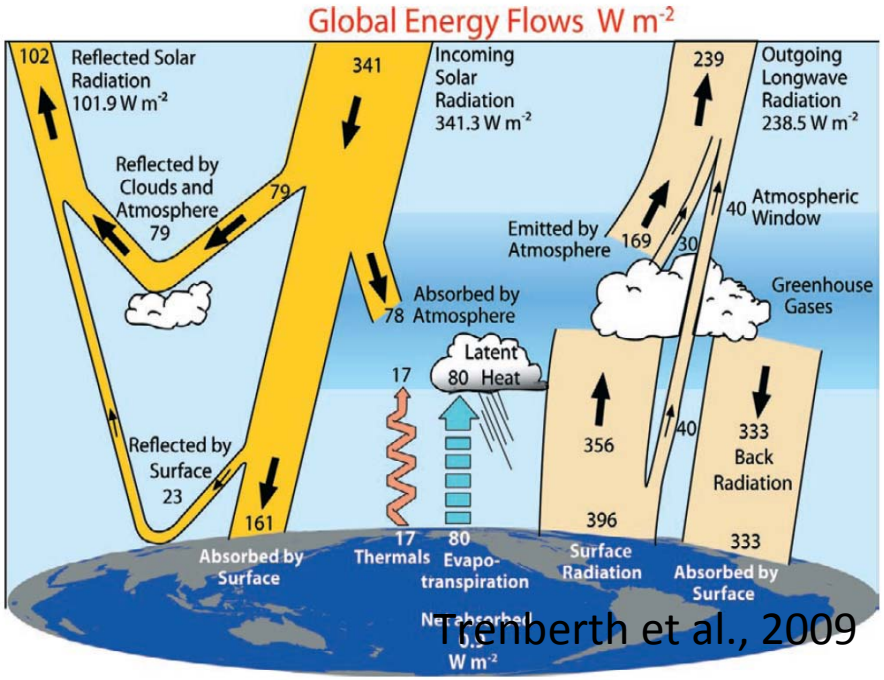
TOA albedo

Atmospheric absorption

- Gases and aerosols

Cloud radiative forcing



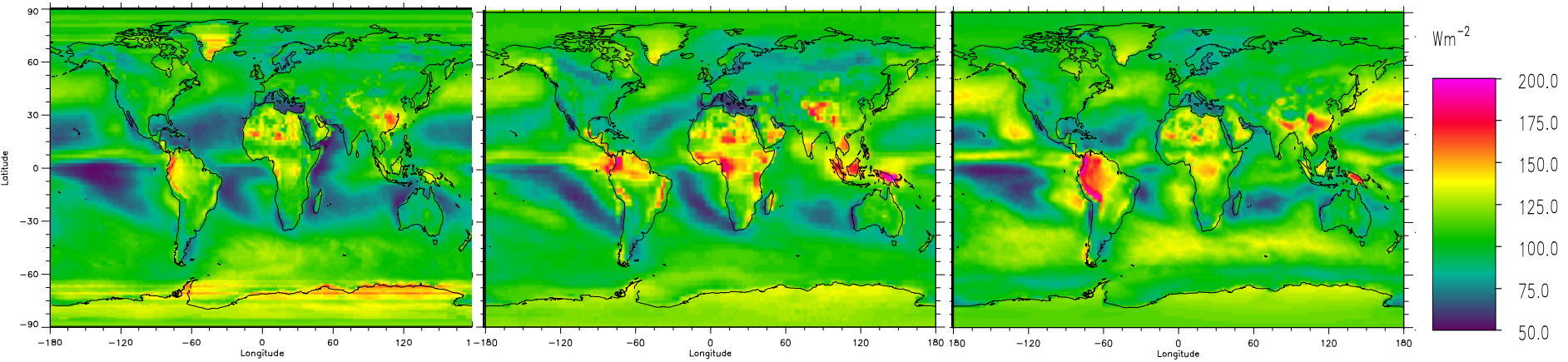


Trenberth et al., 2009

CERES 2001-2004

CAM4-Oslo

HadGEM2-ES

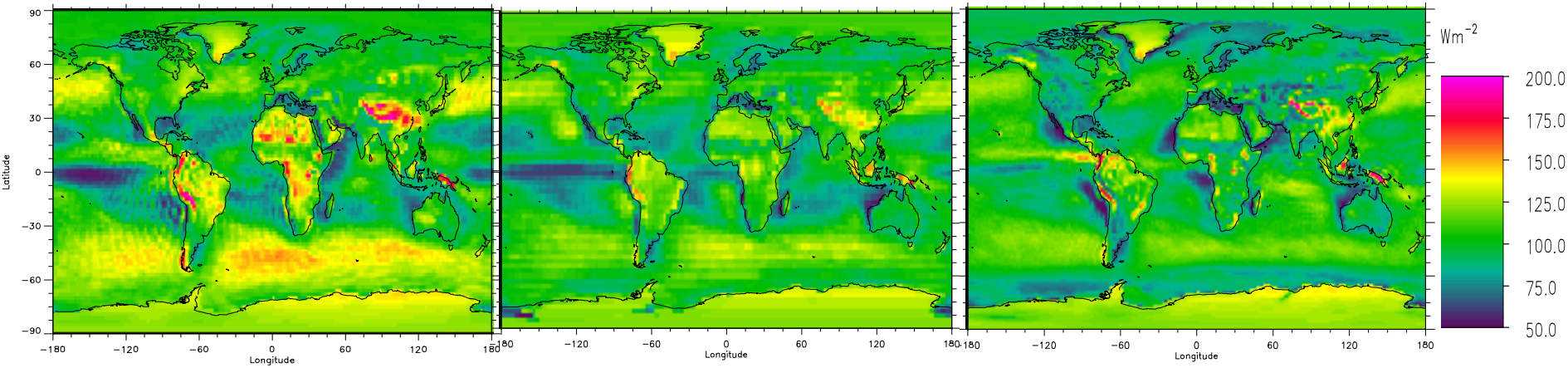


CERES	CAM4-Oslo	HadGEM2-ES	MPIHAM	OsloCTM2	Sprintars
99	104	106	108	102	101

MPIHAM

OsloCTM2

Sprintars

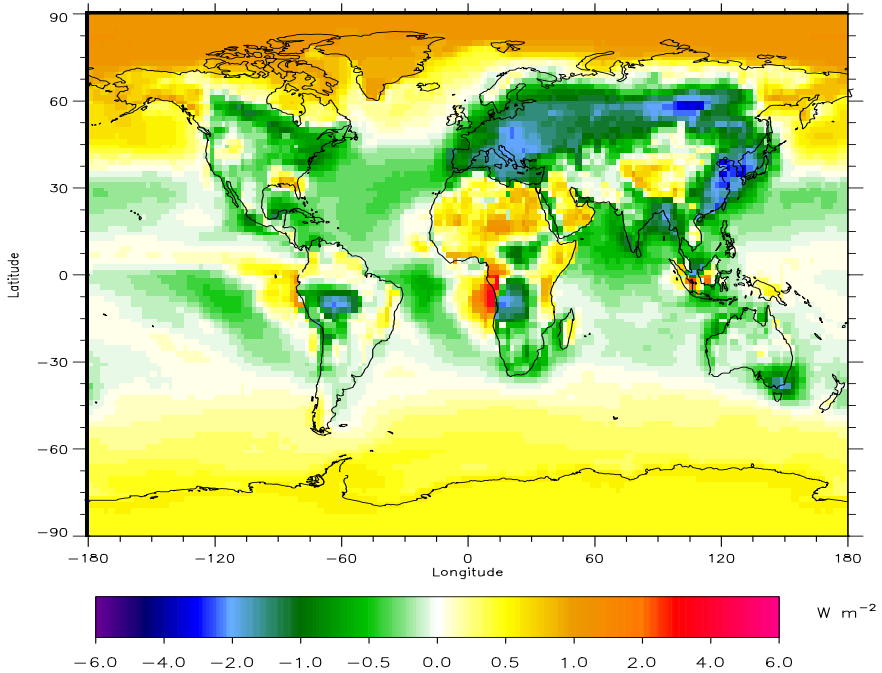


Radiative forcing (RF)

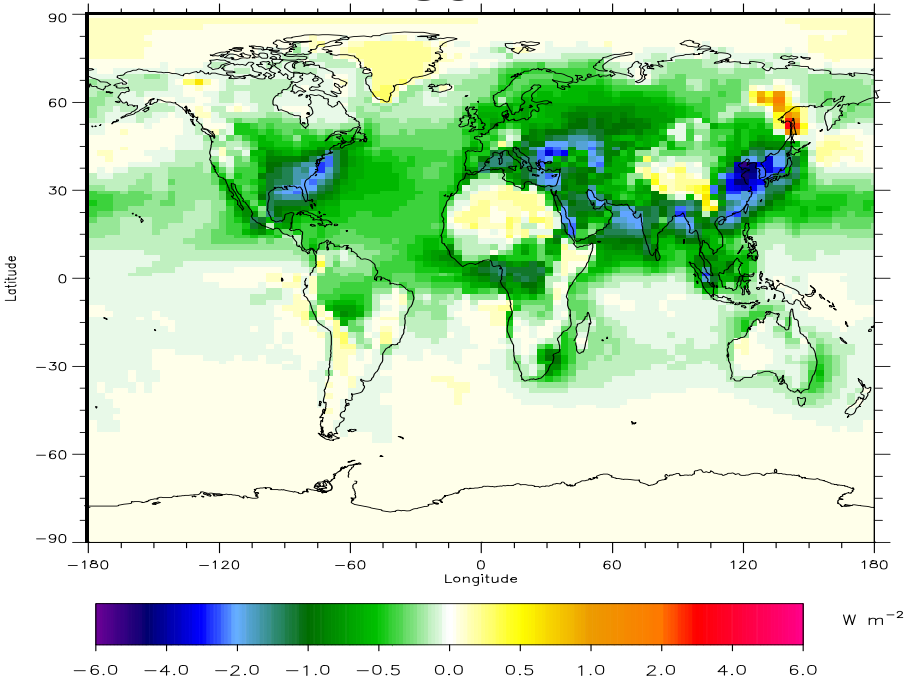
- Preliminary: All preliminary results, so far 5 models
- Direct RF: CTRL and PRE experiments must be performed with the same meteorology and only the direct aerosol effect included (no indirect aerosol effects included).
- Nudging: For GCMs with nudging we recommend that you nudge for current climate and aerosol distribution.
- Individual RF: For the RF of the individual species (SO4, BC FF, OC FF, BB, SOA, NO3) we highly recommend that these simulations are performed as a difference between the CTRL and a new simulation with only the aerosol component in question set to emissions as in the PRE simulation.
- Details: Look at recent email from M. Schulz

DIRECT AEROSOL EFFECT EXPERIMENT

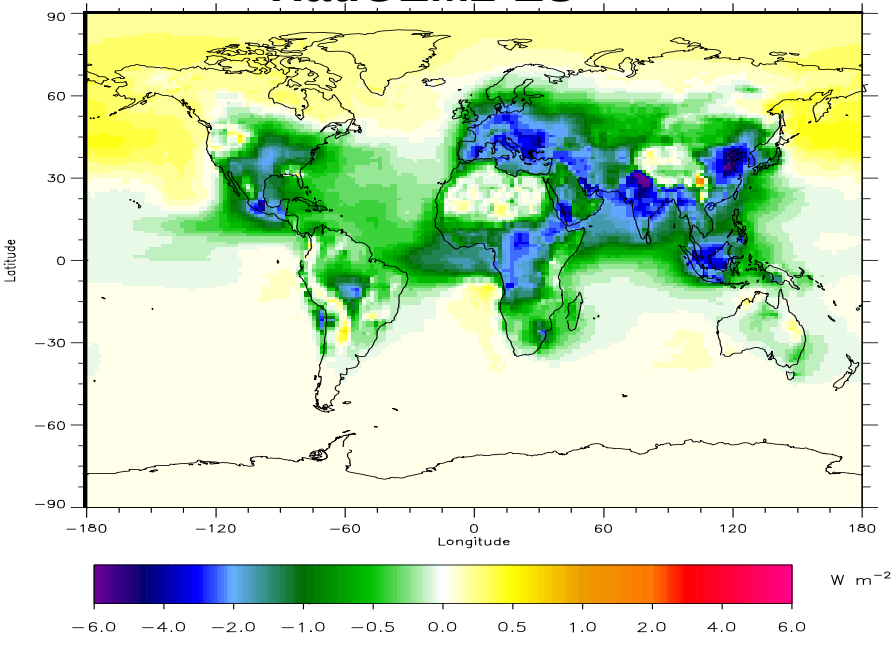
CAM4-Oslo



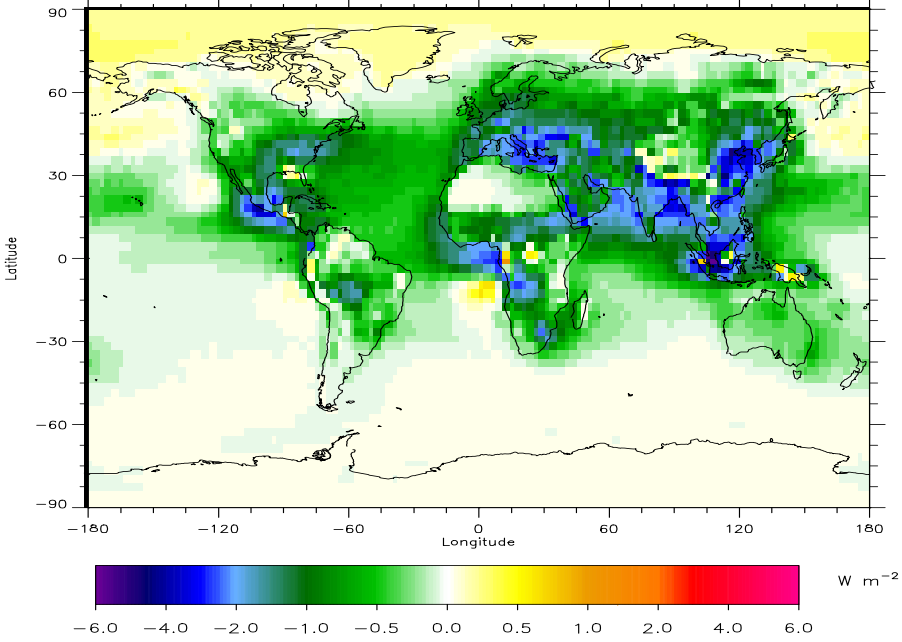
LSCE



HadGEM2-ES



Oslo CTM2



Radiative forcing (RF)

	Oslo CTM2	CAM4-Oslo	HadGEM2-ES	Sprintars	LSCE
SO4	-0.57	-0.45	-0.31	-0.37	-0.53
BC FF	0.37	0.36	0.19	0.14	
POM FF	-0.09	-0.03	-0.04	-0.02	
BB	-0.02	0.08	-0.07	-0.02	
SOA	-0.07				
NO3	-0.03		-0.11		
SUM	-0.41	-0.05	-0.33	-0.27	
Total	**-0.43**	**-0.05**	**-0.31**		**-0.24**

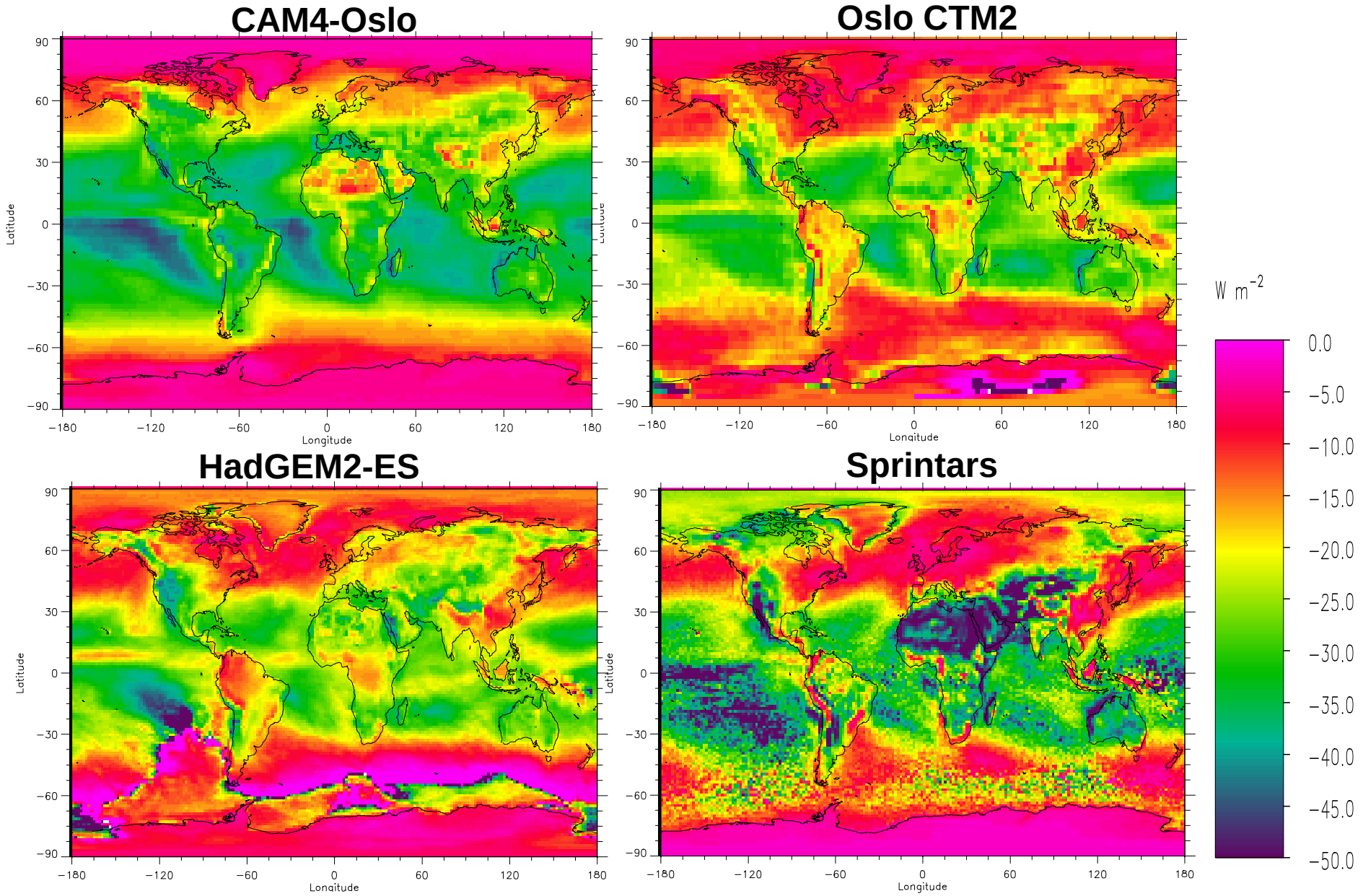
Normalized RF

Normalized RF with AOT (RF/AOT) (W m^{-2})

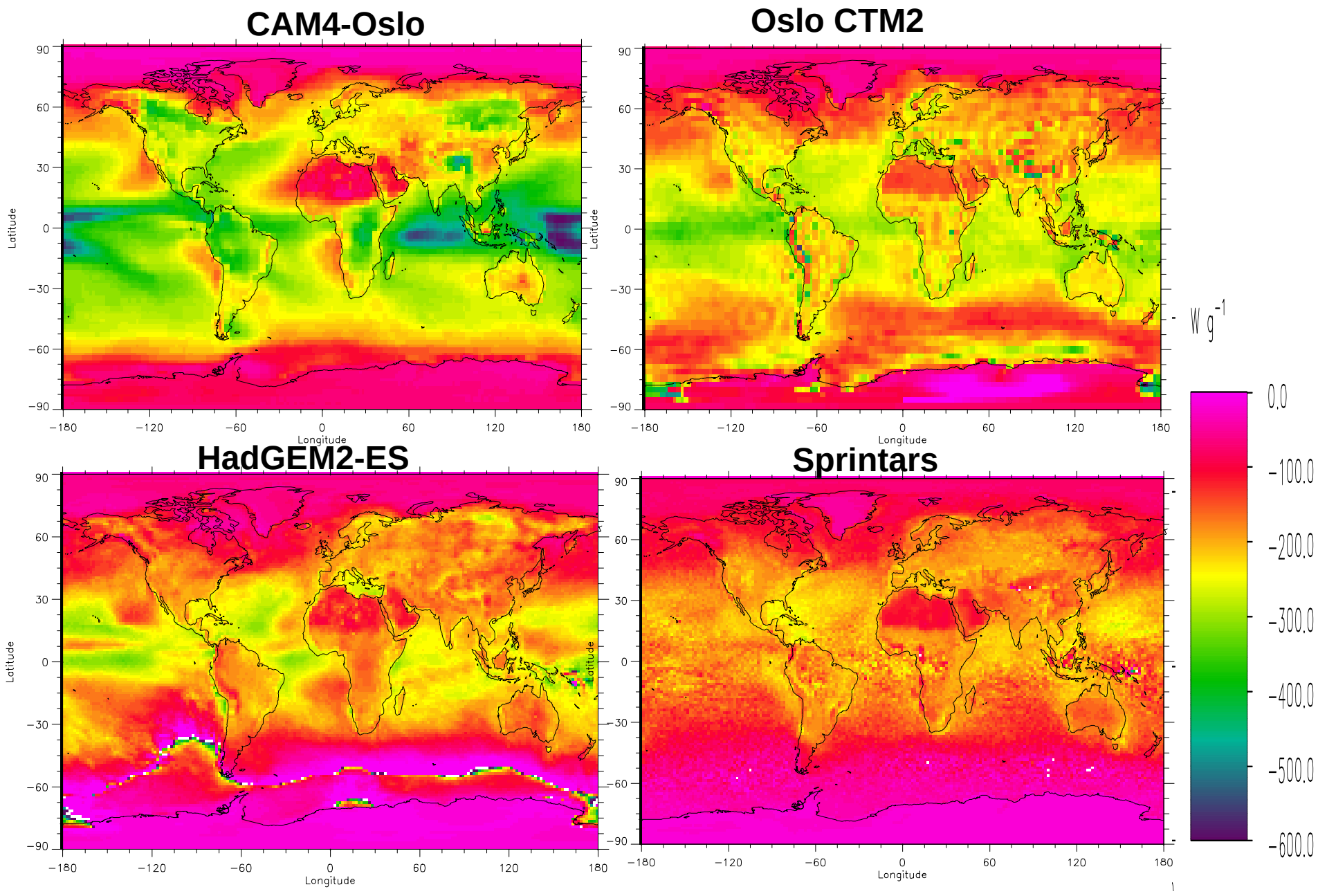
Normalized RF with AOT (RF/Burden) (W g^{-1})

Mass extinction coefficient (m^2 g^{-1})

Normalized RF (RF/AOT)



Normalized RF (RF/Burden)

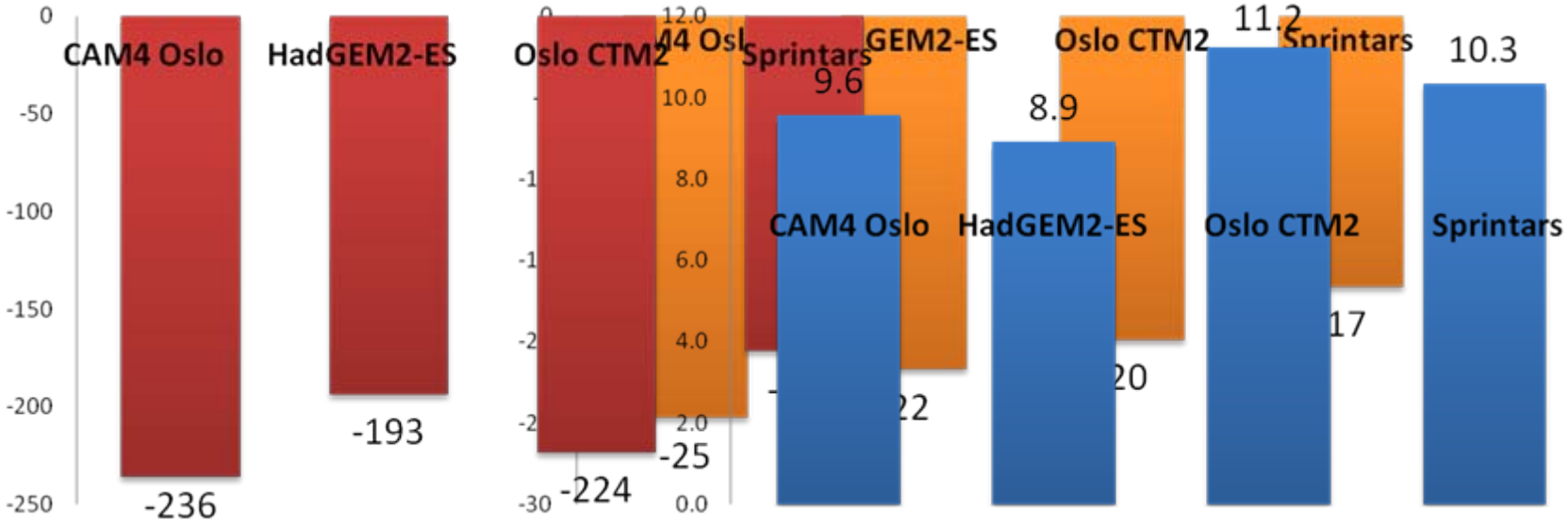


Normalized RF with AOT (RF/AOT) (W m^{-2})

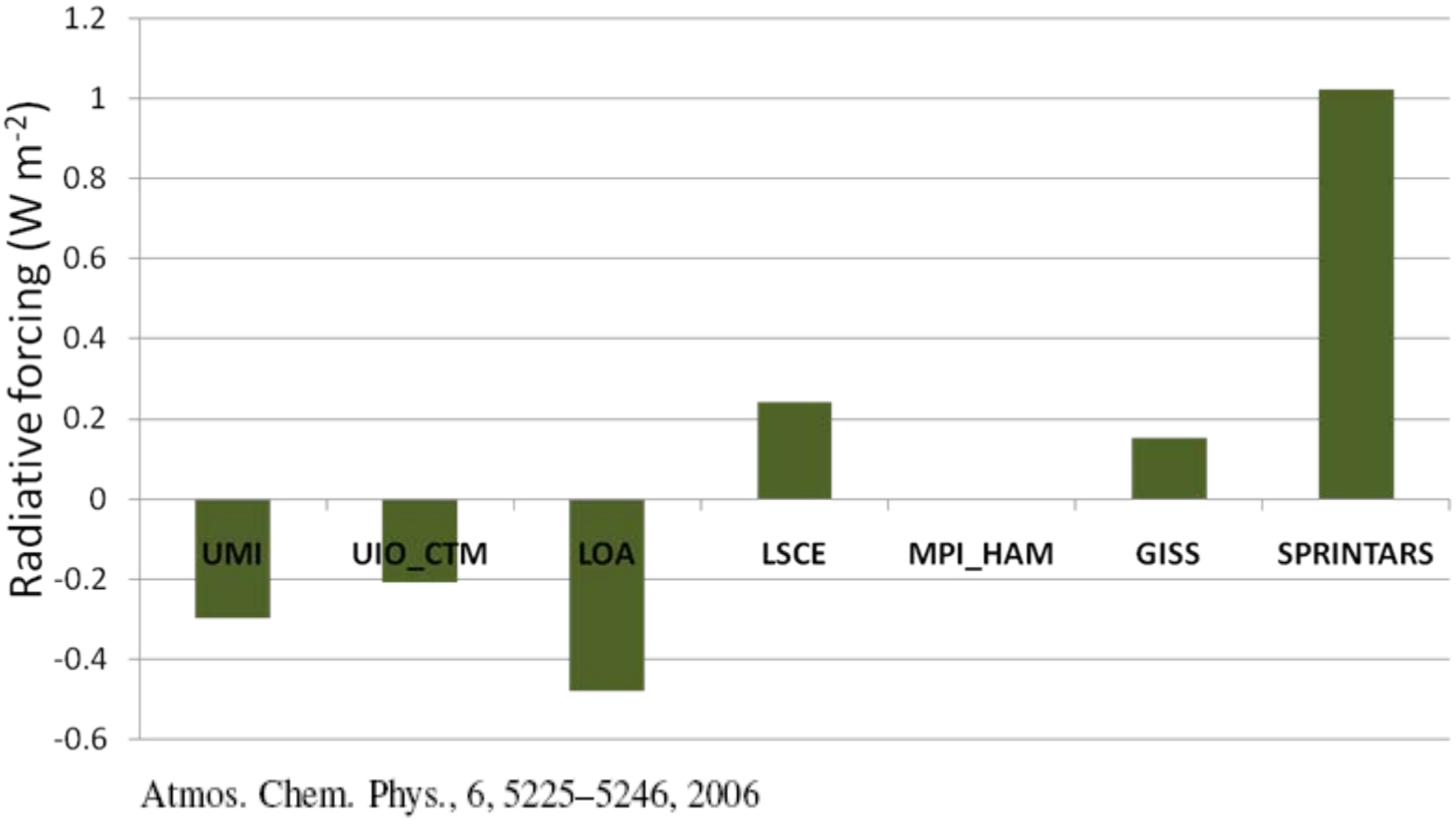
Normalized RF with AOT (RF/Burden) (W g^{-1})

Mass extinction coefficient (m^2 g^{-1})

	CAM4-Oslo			HadGEM2-ES			Oslo CTM2			Sprintars		
	NRF (W m^{-2})	NRF (W g^{-1})	MEC (m^2 g^{-1})	NRF (W m^{-2})	NRF (W g^{-1})	MEC (m^2 g^{-1})	NRF (W m^{-2})	NRF (W g^{-1})	MEC (m^2 g^{-1})	NRF (W m^{-2})	NRF (W g^{-1})	MEC (m^2 g^{-1})
SO4	-25	-236	9.6	-22	-193	8.9	-20	-224	11.2	-17	-172	10.3
BC FF	239	2556	10.7				169	2216	13.2			
POM FF	-19	-190	10.2									
BB	5	44	8.6				-5	-101	20.8			
SOA							-27	-181	6.8			
NO3				-18	-143	8.0	-17	-190	11.1			



RF i cloudy regions



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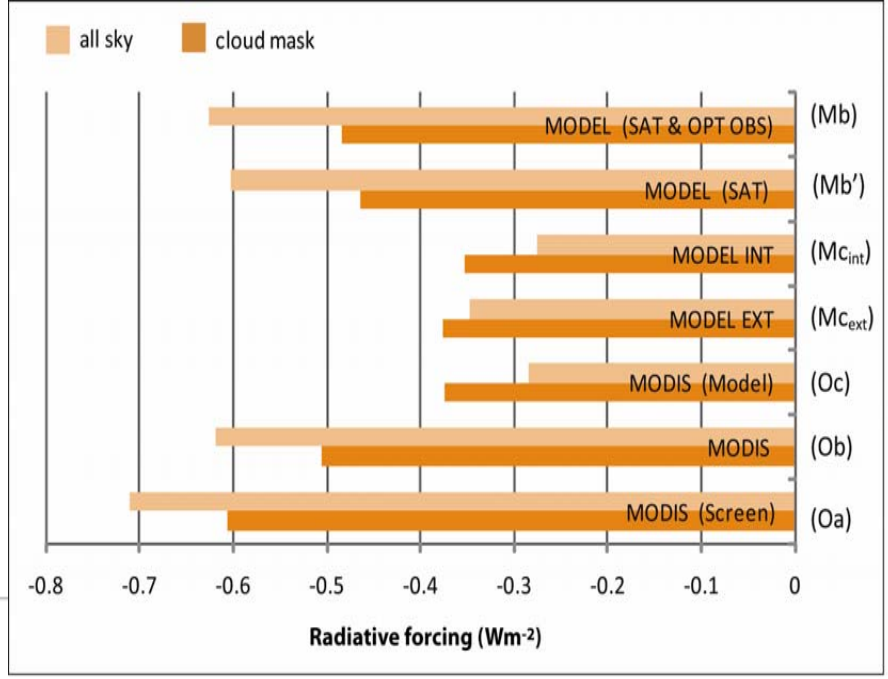
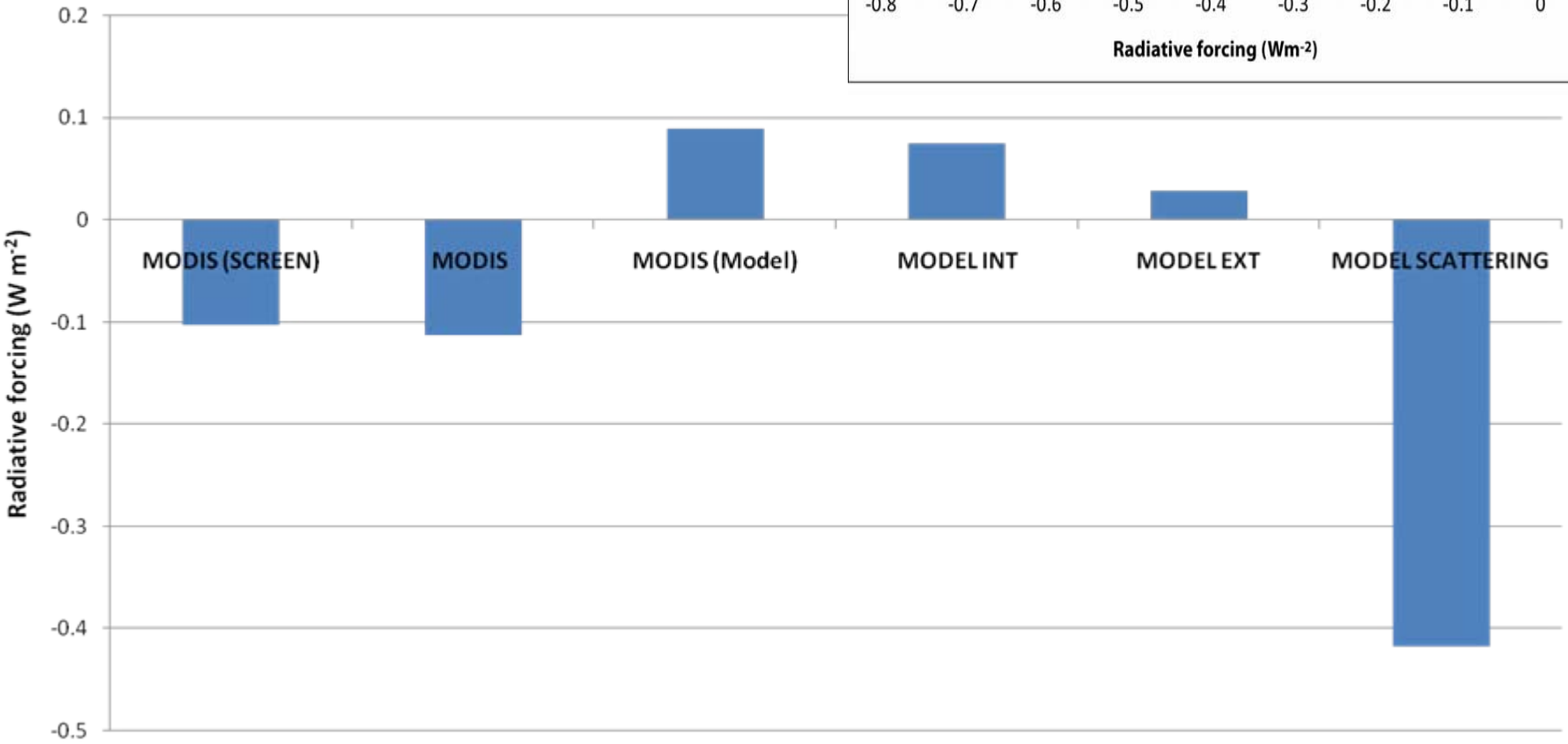
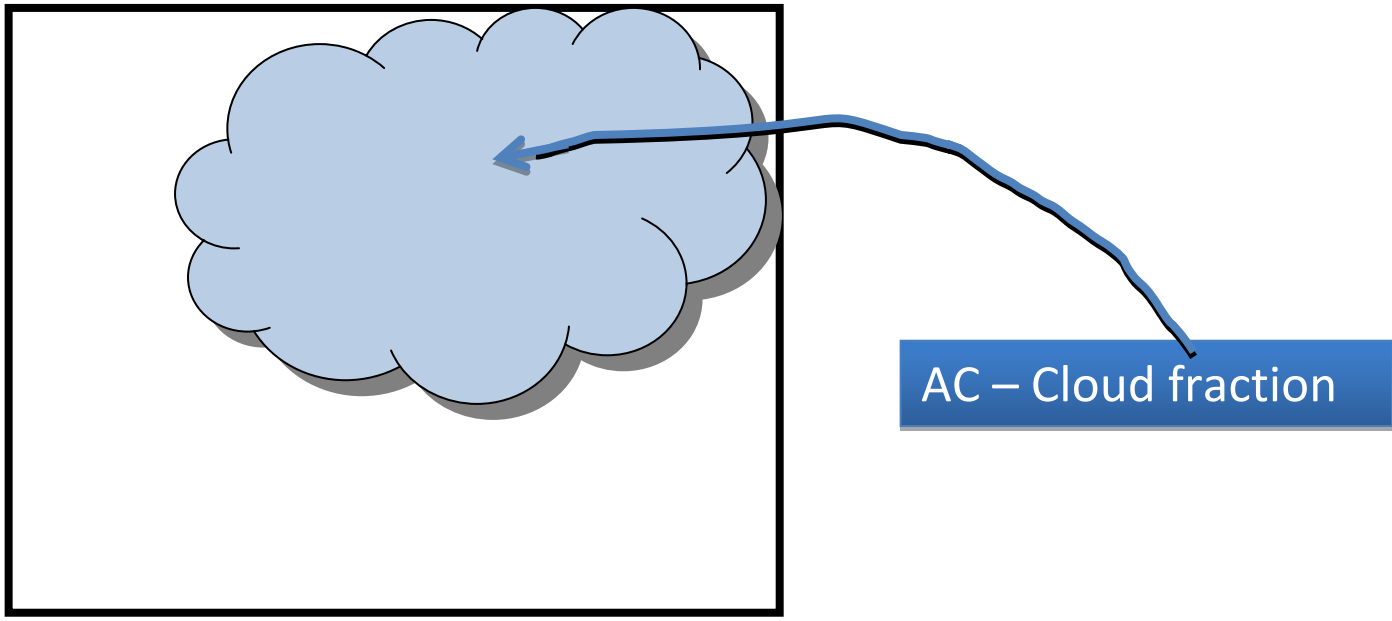
AeroCom

RF in cloudy regions





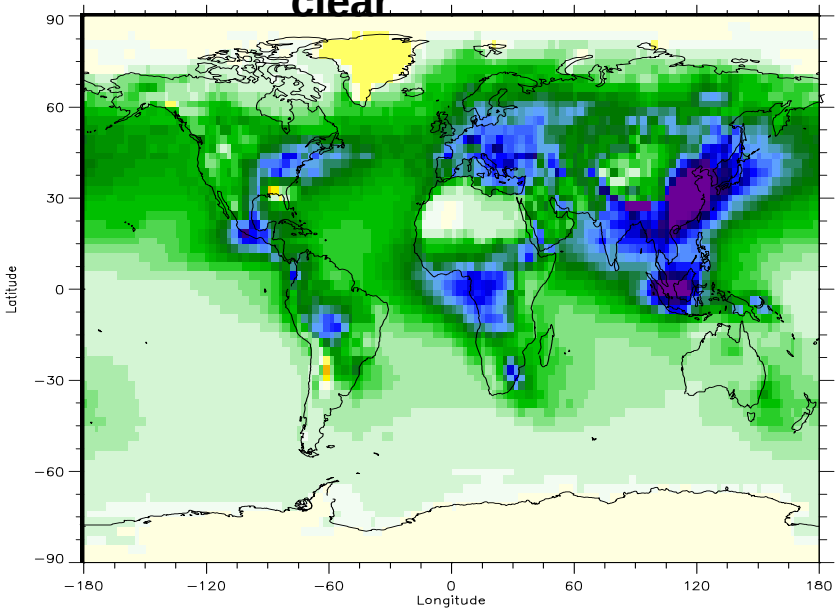
Radiative forcing in cloudy regions



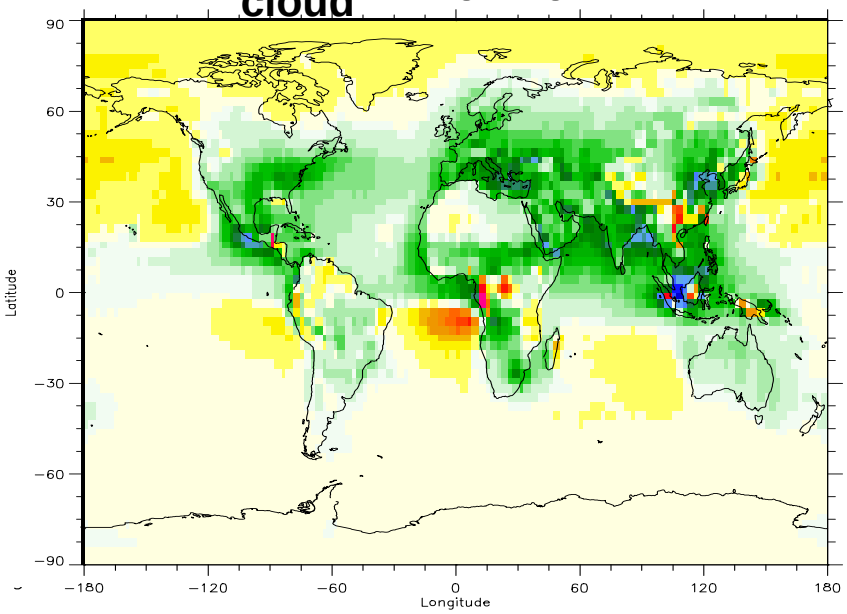
$$RF = (1 - AC) * RF_{clear} + AC * RF_{cloud}$$

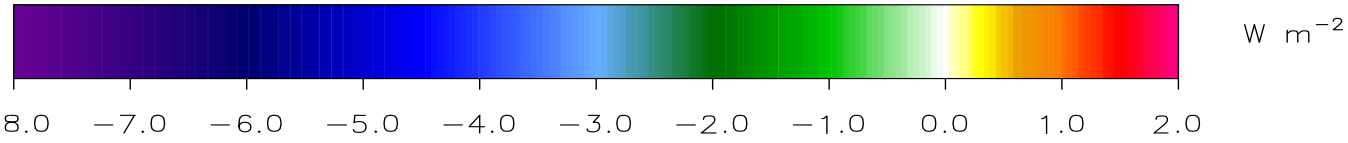
Contribution from clear and cloudy regions

RF_{clear} = -1.17 Wm-2



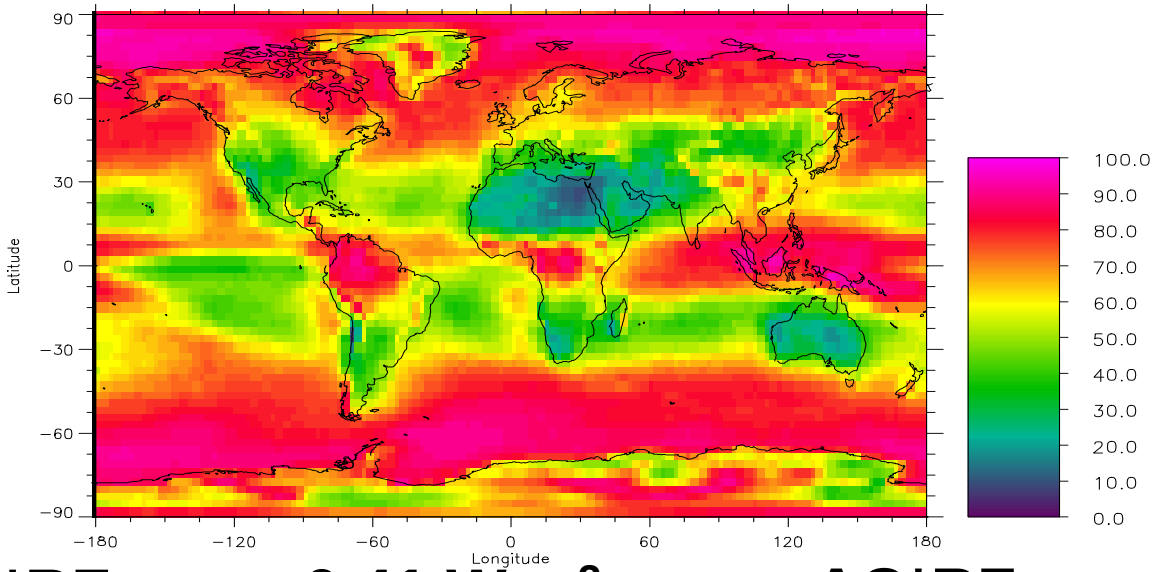
RF_{cloud} = -0.20 Wm-2



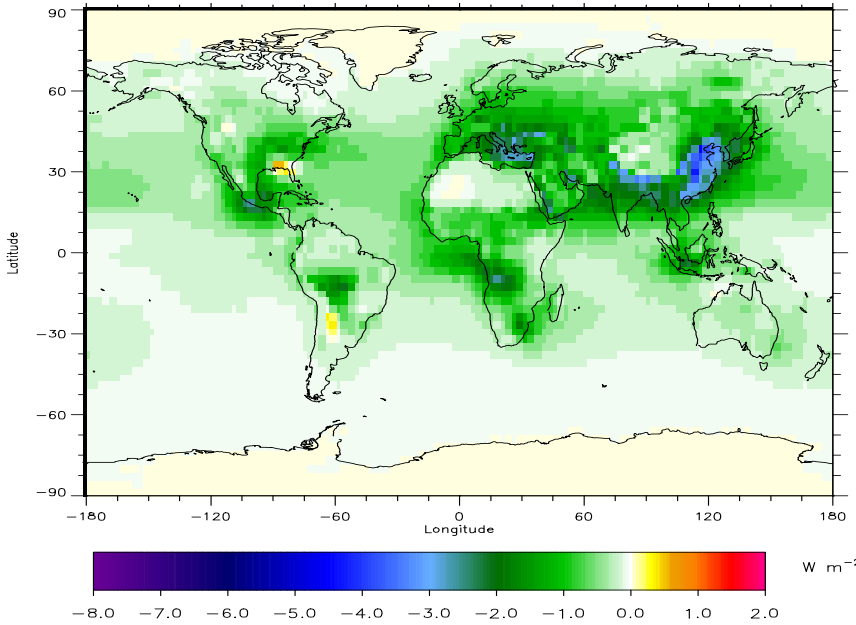


$$RF = (1 - AC) * RF_{clear} + AC * RF_{cloud}$$

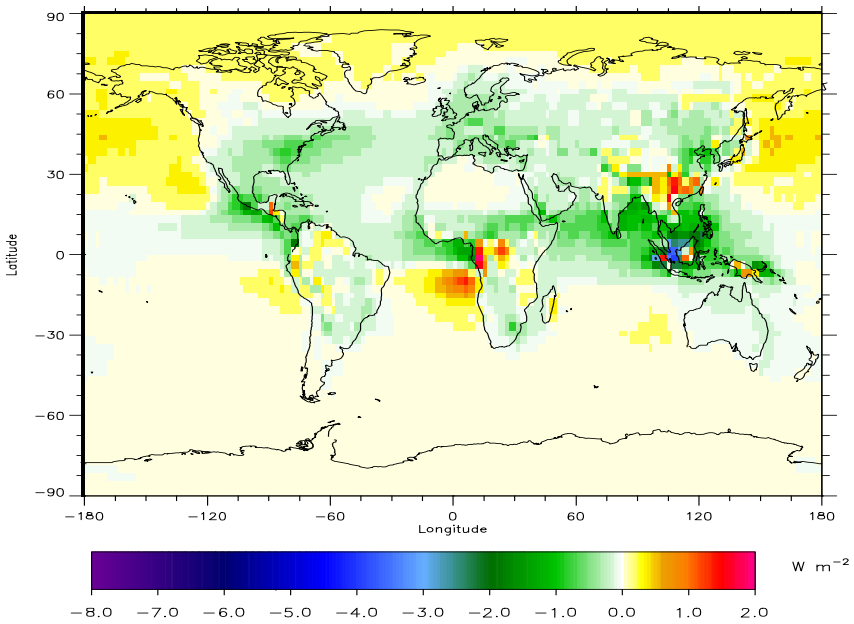
rsutcs - F ↑ (TOA) clear sky **rsutcl** - F↑(TOA) cloudy part



(1-AC)*RF$_{clear}$ = -0.41 Wm^{-2}



AC*RF$_{cloud}$= -0.06 Wm^{-2}

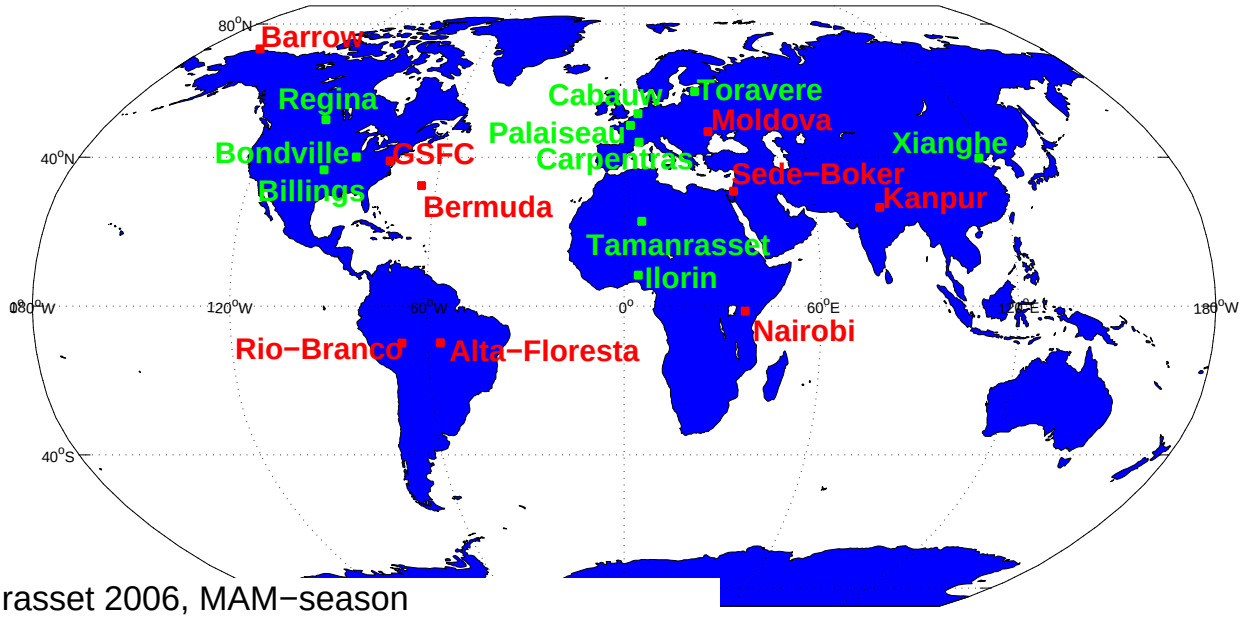


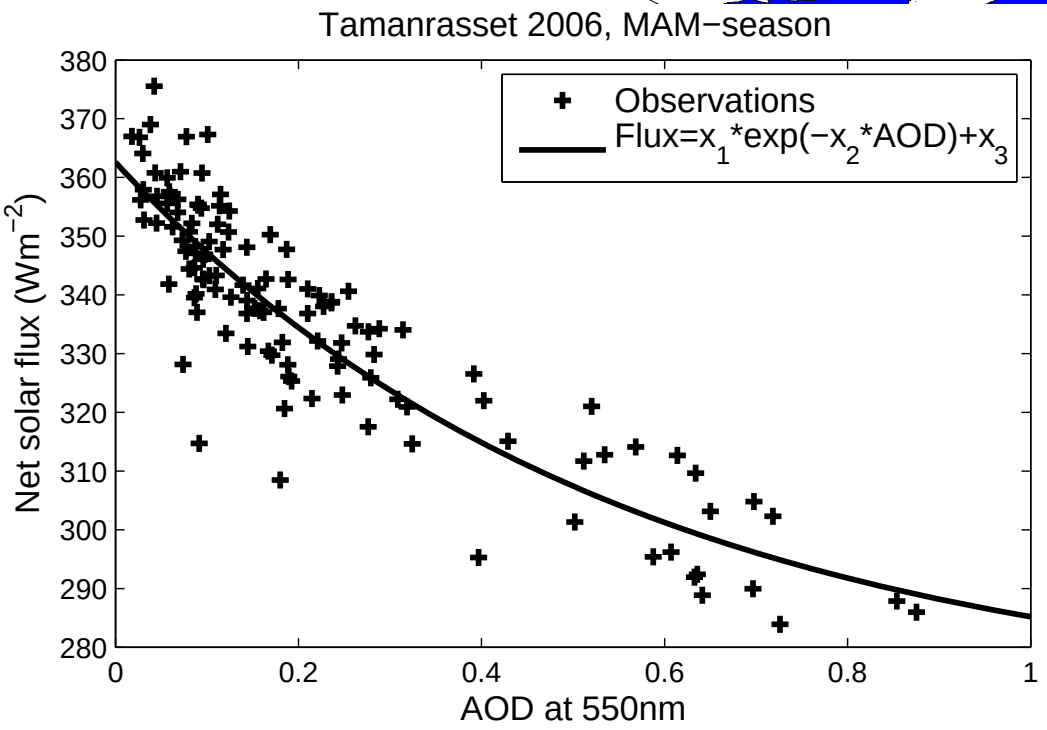
$$RF = (1 - AC) * RF_{clear} + AC * RF_{cloud}$$

Poster:
Huttunen et al.

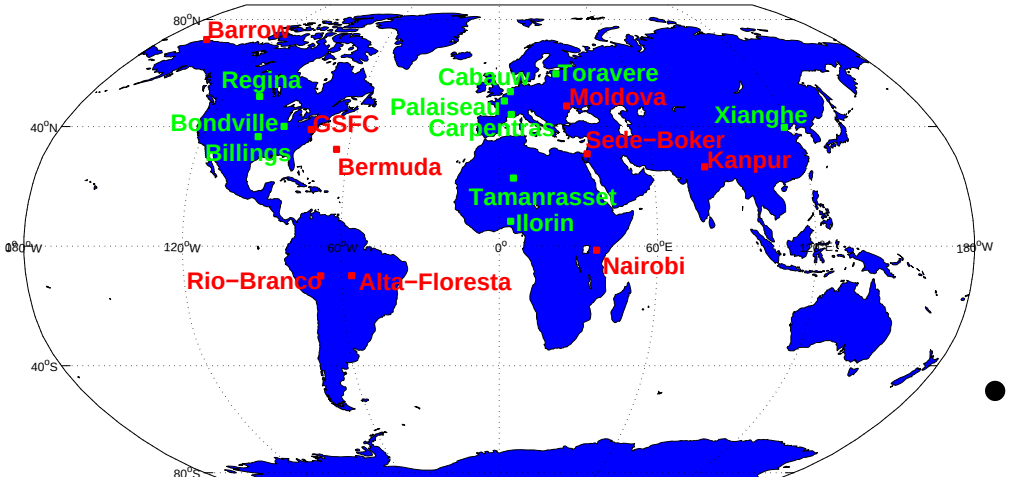
Red sites:
SolRadNet

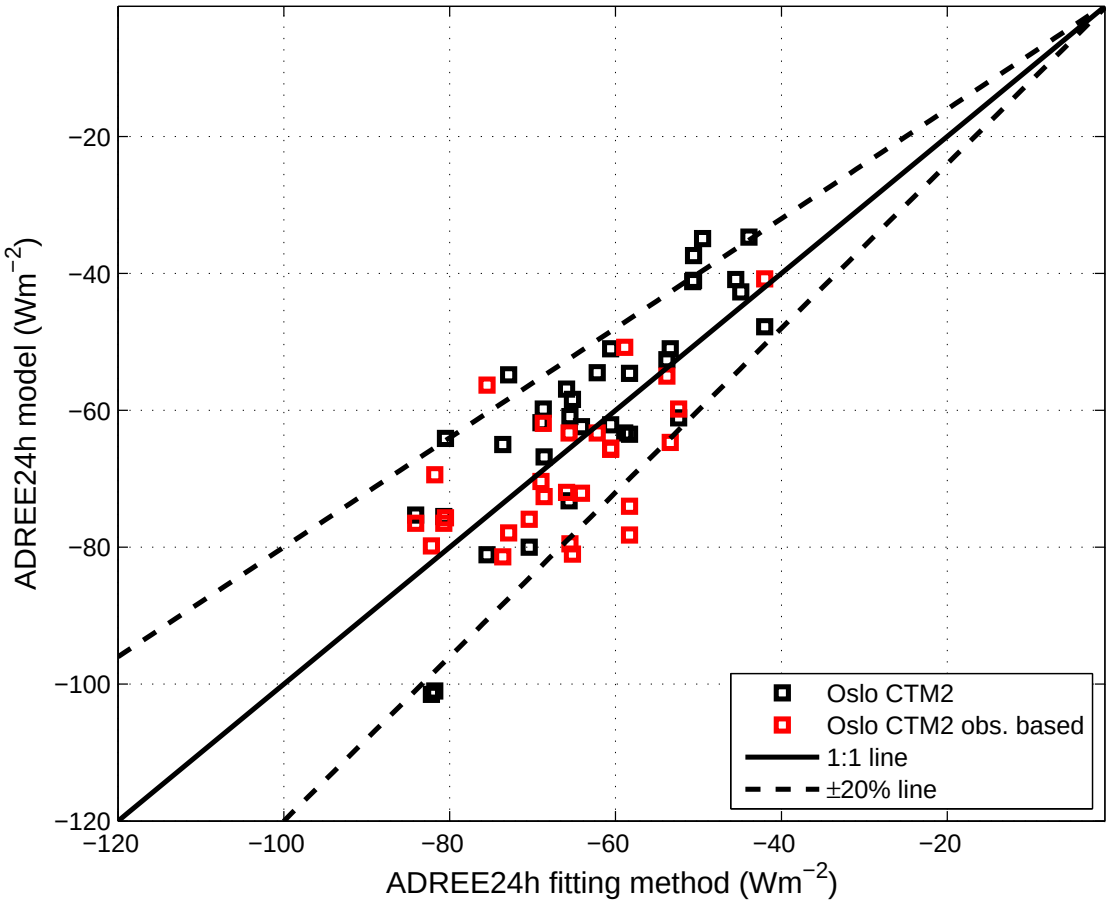
Green sites:
BSRN





ADREE – Aerosol direct radiative effect efficiency (Surface radiative effect divided by AOD)





- **To participate in this comparison**
  - Perform a ZERO simulation in addition to CTRL
  - Provide variable rsdscs
  - Provide variables rsds & rsus (for the surface albedo)

DIRECT AEROSOL EFFECT EXPERIMENT

Summary

- We need results from more models
- Look carefully at the experiment description
- Please follow the suggestions for filenames according to the protocol

Wishing list

- load bcff
- load ocff
- load soa
- Daily rsut, clt, rsutcs, rsutcl
- ZERO & CTRL simulations
  - rsds, rsus, srdscs