



This discussion paper is/has been under review for the journal Atmospheric Chemistry and Physics (ACP). Please refer to the corresponding final paper in ACP if available.

Radiative forcing of the direct aerosol effect from AeroCom Phase II simulations

G. Myhre¹, B. H. Samset¹, M. Schulz², Y. Balkanski³, S. Bauer⁴, T. K. Berntsen¹, H. Bian⁵, N. Bellouin⁶, M. Chin⁷, T. Diehl^{7,8}, R. C. Easter⁹, J. Feichter¹⁰, S. J. Ghan⁹, D. Hauglustaine³, T. Iversen^{2,11}, S. Kinne¹⁰, A. Kirkevåg², J.-F. Lamarque¹², G. Lin¹³, X. Liu⁹, G. Luo¹⁴, X. Ma¹⁴, J. E. Penner¹³, P. J. Rasch⁹, Ø. Seland², R. B. Skeie¹, P. Stier¹⁵, T. Takemura¹⁶, K. Tsigaridis⁴, Z. Wang¹⁷, L. Xu^{13,18}, H. Yu⁵, F. Yu¹⁴, J.-H. Yoon⁹, K. Zhang⁹, H. Zhang¹⁹, and C. Zhou¹³

11th AeroCom
WORKSHOP 2012

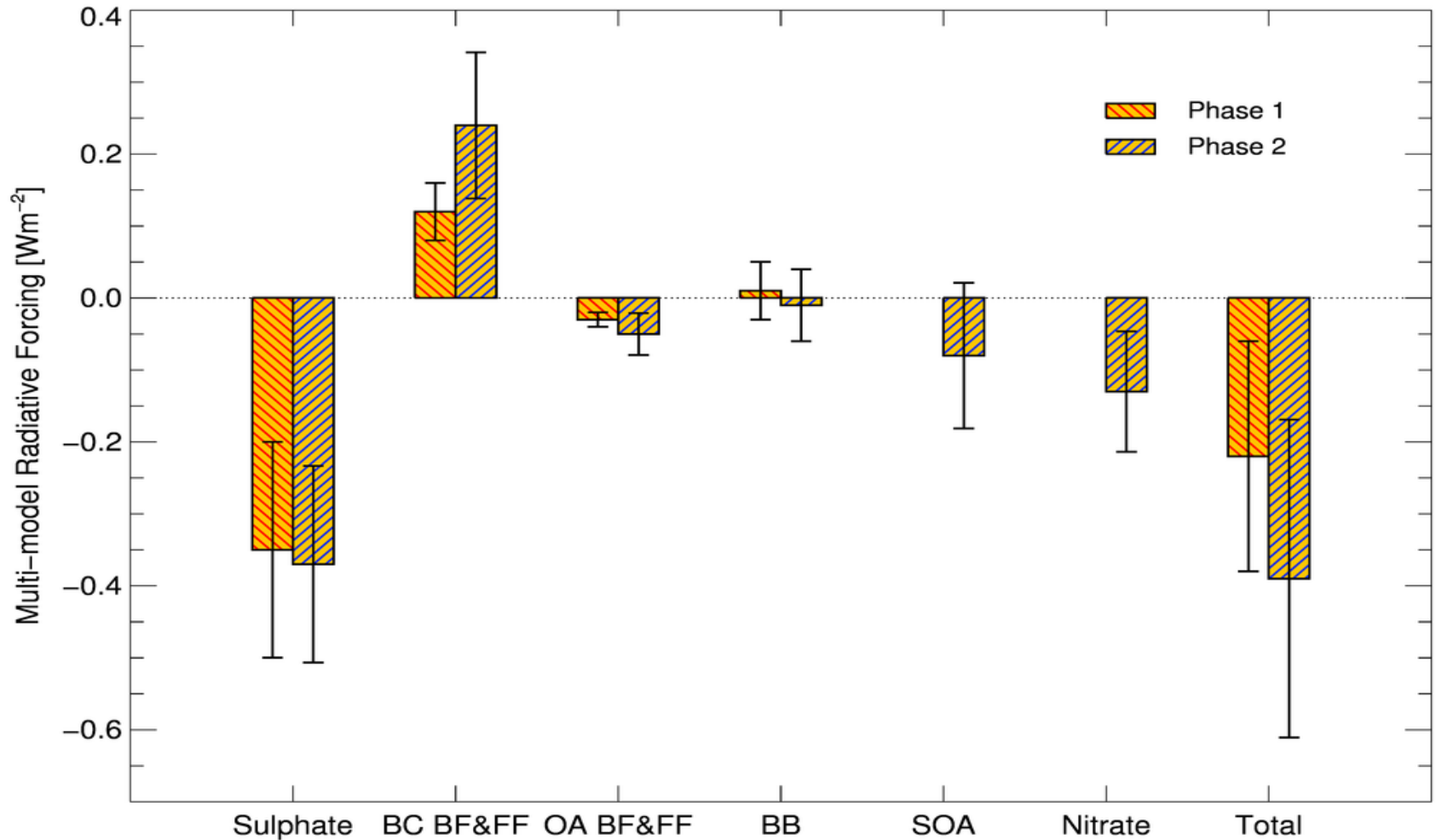


RF in AeroCom Phase II simulations



- Main results from the 15 models
- Main causes for the differences
- Show main results for the various aerosol components
- Point to other activities and new AeroCom activities that should be initiated

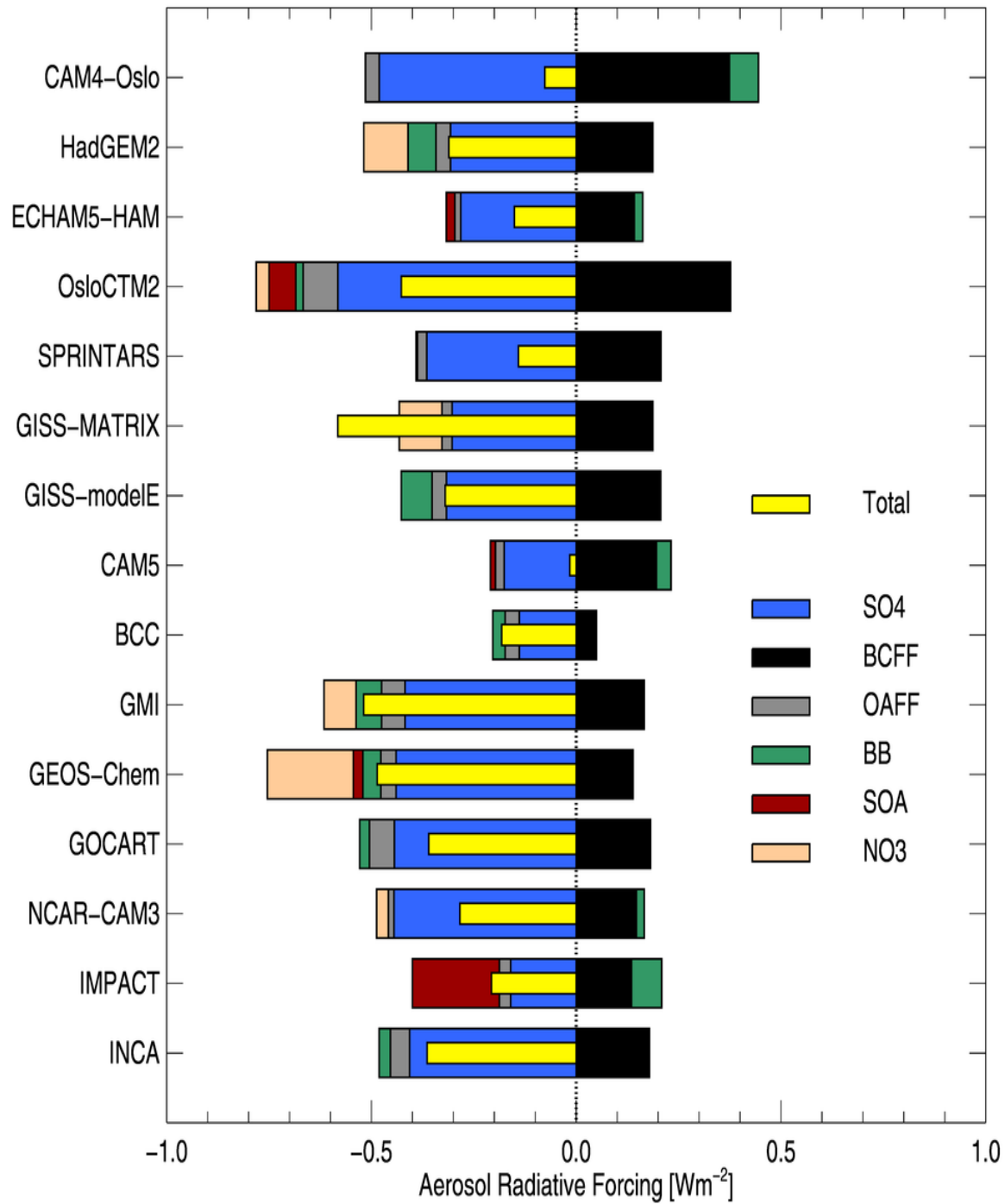
AeroCom RF of direct aerosol effect



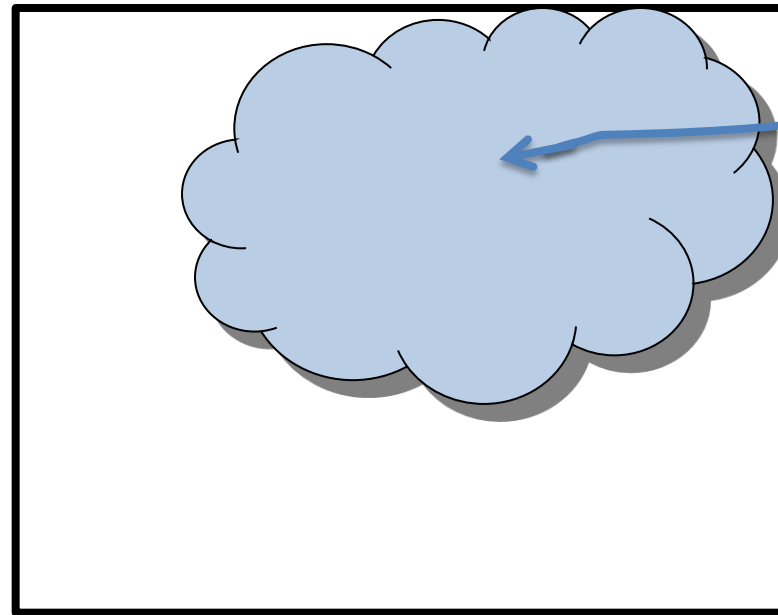
Phase I, Schulz et al., ACP (2006)

Phase II, Myhre et al. ACP, submitted

Direct aerosol effect by component



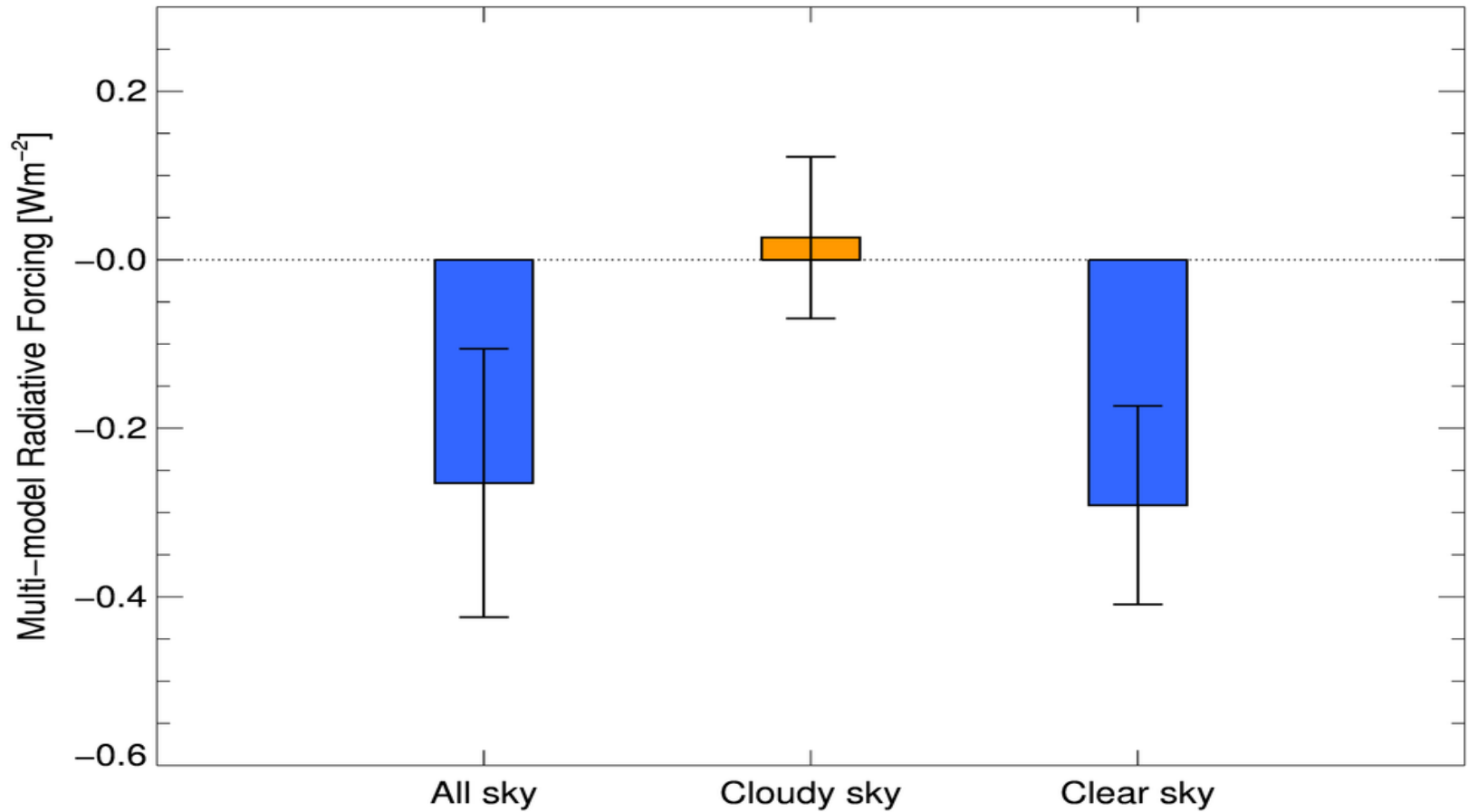
Radiative forcing in cloudy sky regions



AC – Cloud fraction

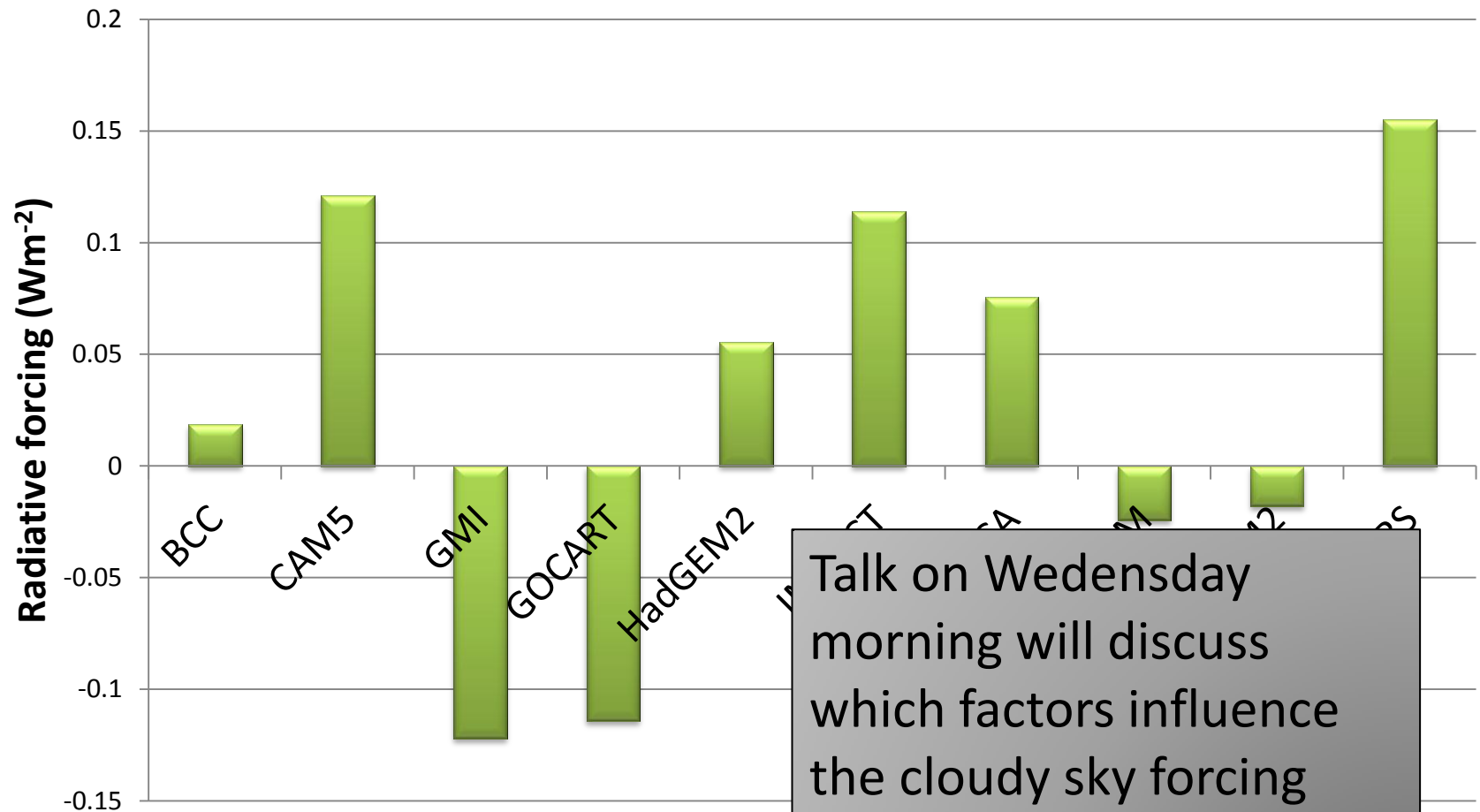
$$RF_{\text{all sky}} = (1 - AC) * RF_{\text{clear}} + AC * RF_{\text{cloud}}$$

Radiative forcing in cloudy sky regions



Ranges given as one standard deviation

Radiative forcing in cloudy sky regions



Talk on Wednesday morning will discuss which factors influence the cloudy sky forcing based on various AeroCom activities

Atmospheric absorption by aerosols

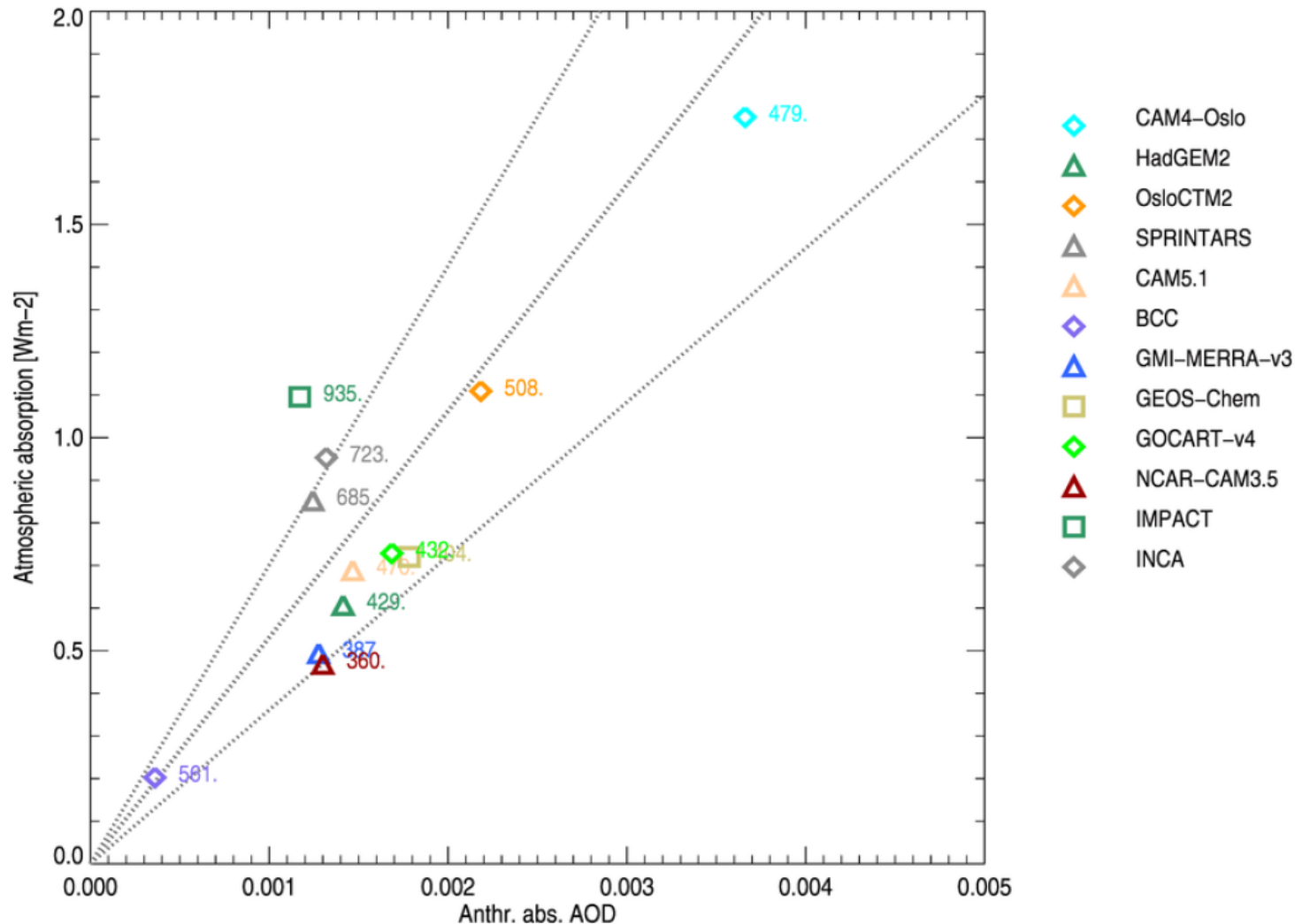
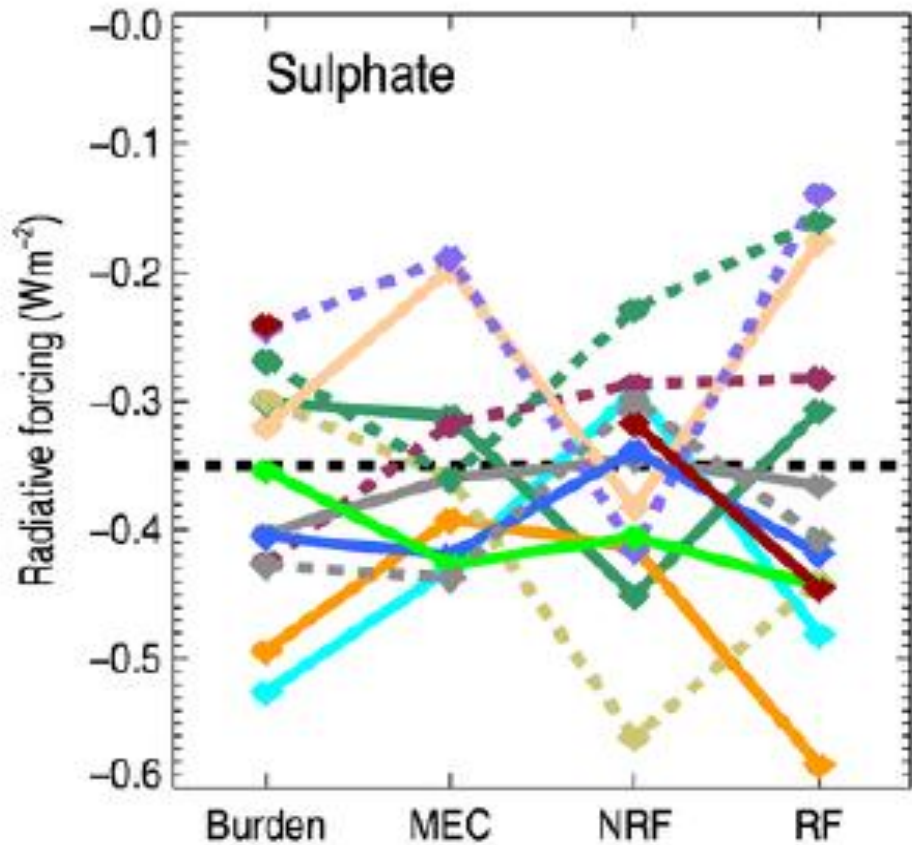


Fig. 6. Correlation between anthropogenic absorption AOD and atmospheric absorption. Numbers show ratio $\text{AtmAbs}/\text{AAOD}$, the lines indicate the mean and one standard deviation of this ratio. $R^2 = 0.73$.

Sulphate

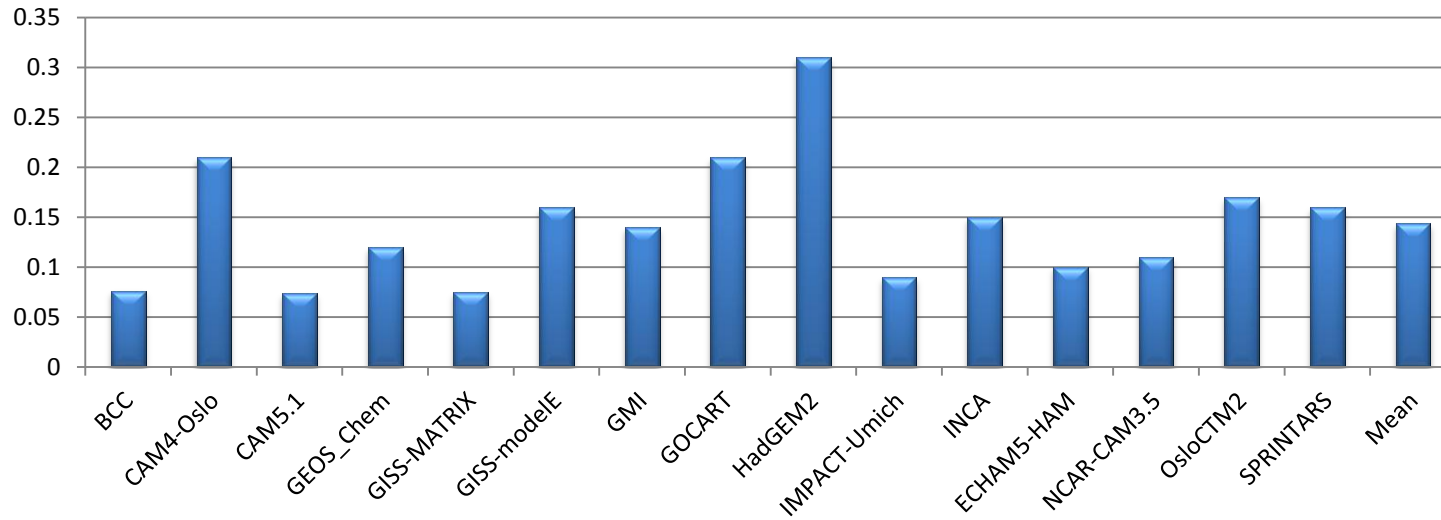


- Burden differences are large
- However, MEC and NRF contribute almost equally to range in RF
- See presentation later this week of importance of spatial distribution and RH.

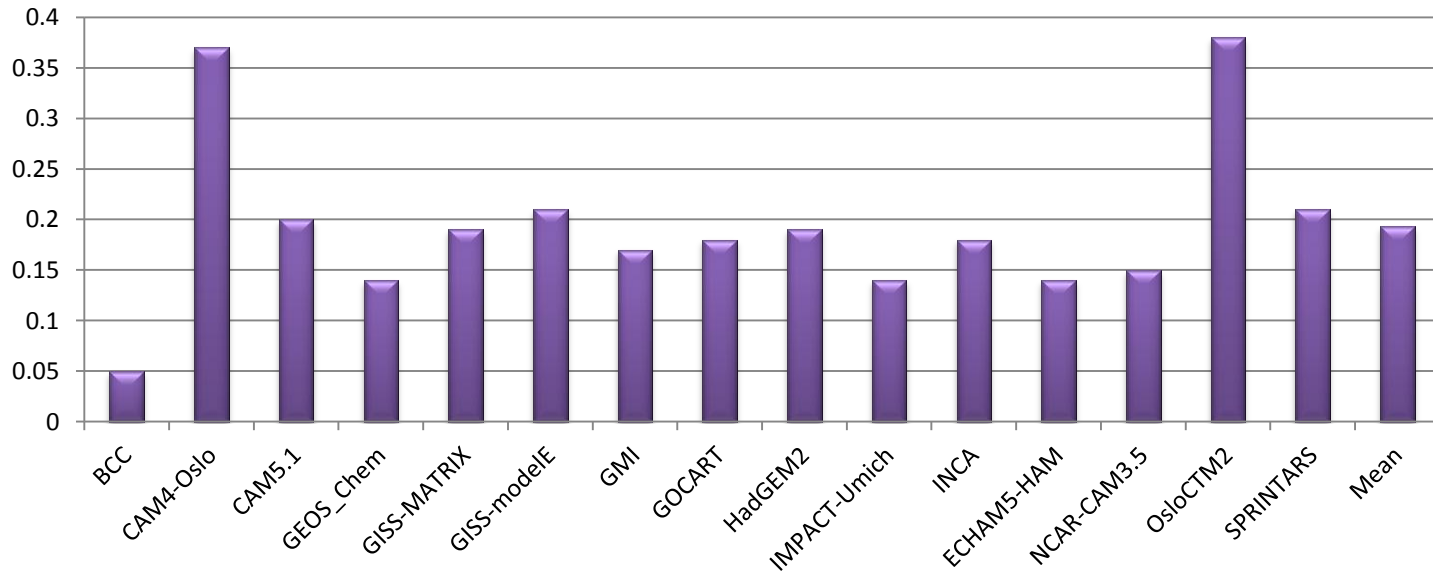
Fig. 14. Aerosol forcing partial sensitivities for the AeroCom models. The partial sensitivities are calculated as $P_{x,n} = x_n / \langle x \rangle \cdot \langle \text{RF} \rangle$, where n is model, x is either burden, MEC, NRF (with respect to AOD) or RF, $\langle \rangle$ denote mean values.

Black carbon from fossil fuel & biofuel

Load [mg/m²]

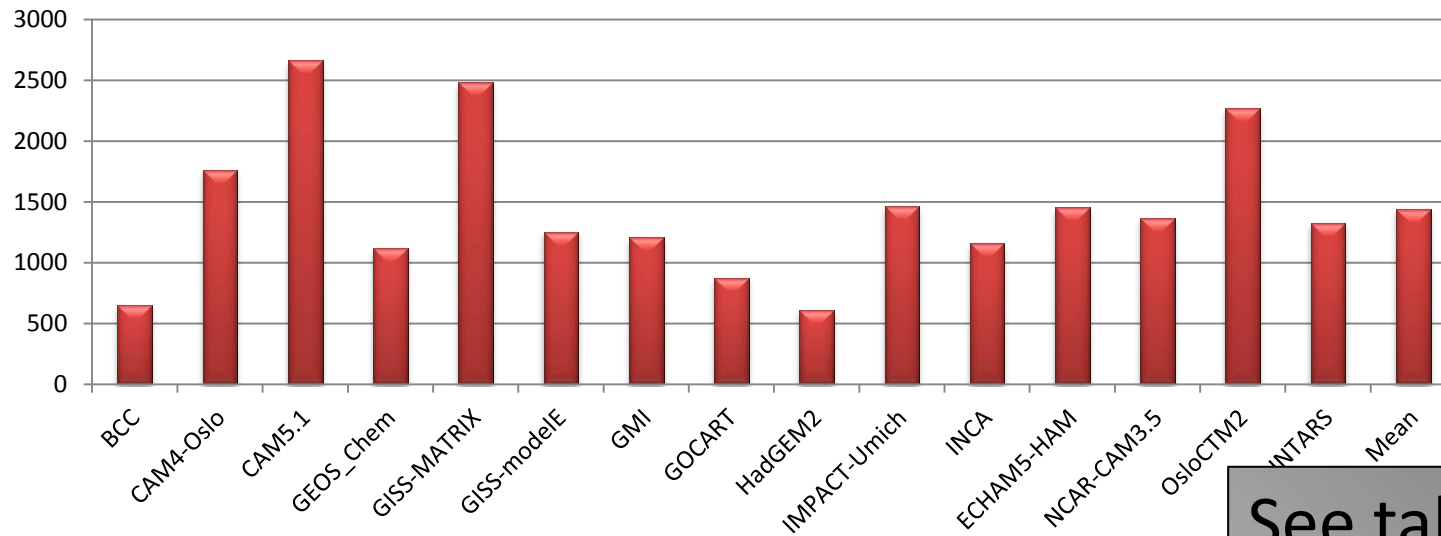


RF [W/m²]

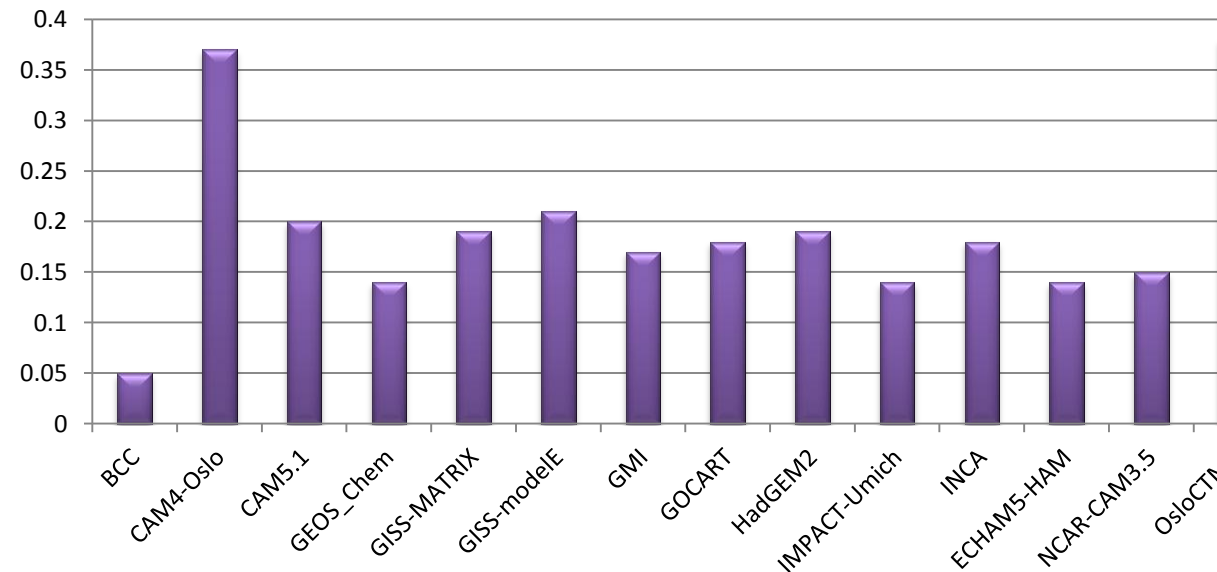


Black carbon from fossil fuel & biofuel

NRFB [W/g]



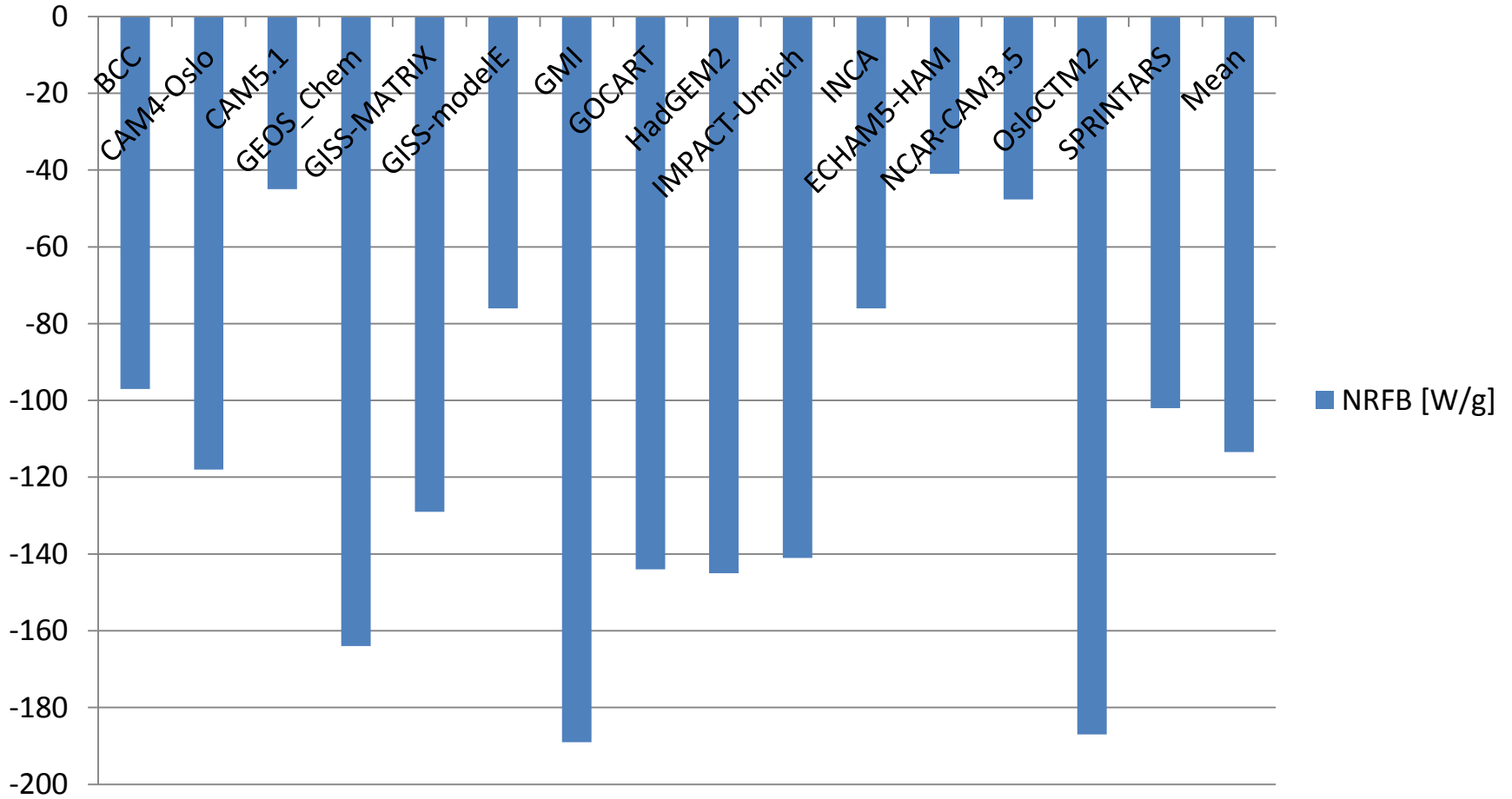
RF [W/m²]



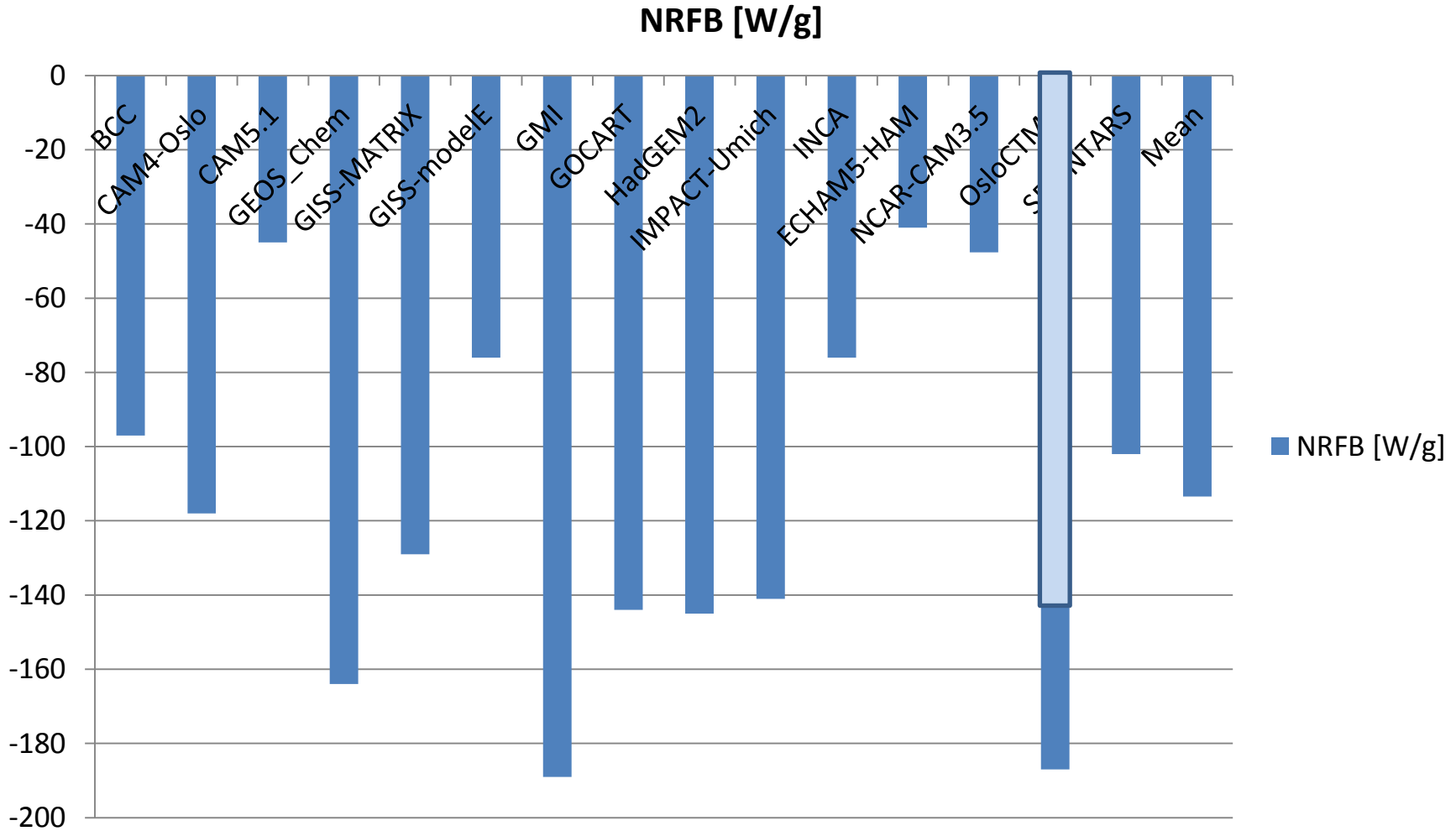
See talk on Wednesday morning by Bjørn Samset on importance of differences in vertical profile of BC

OA

NRFB [W/g]



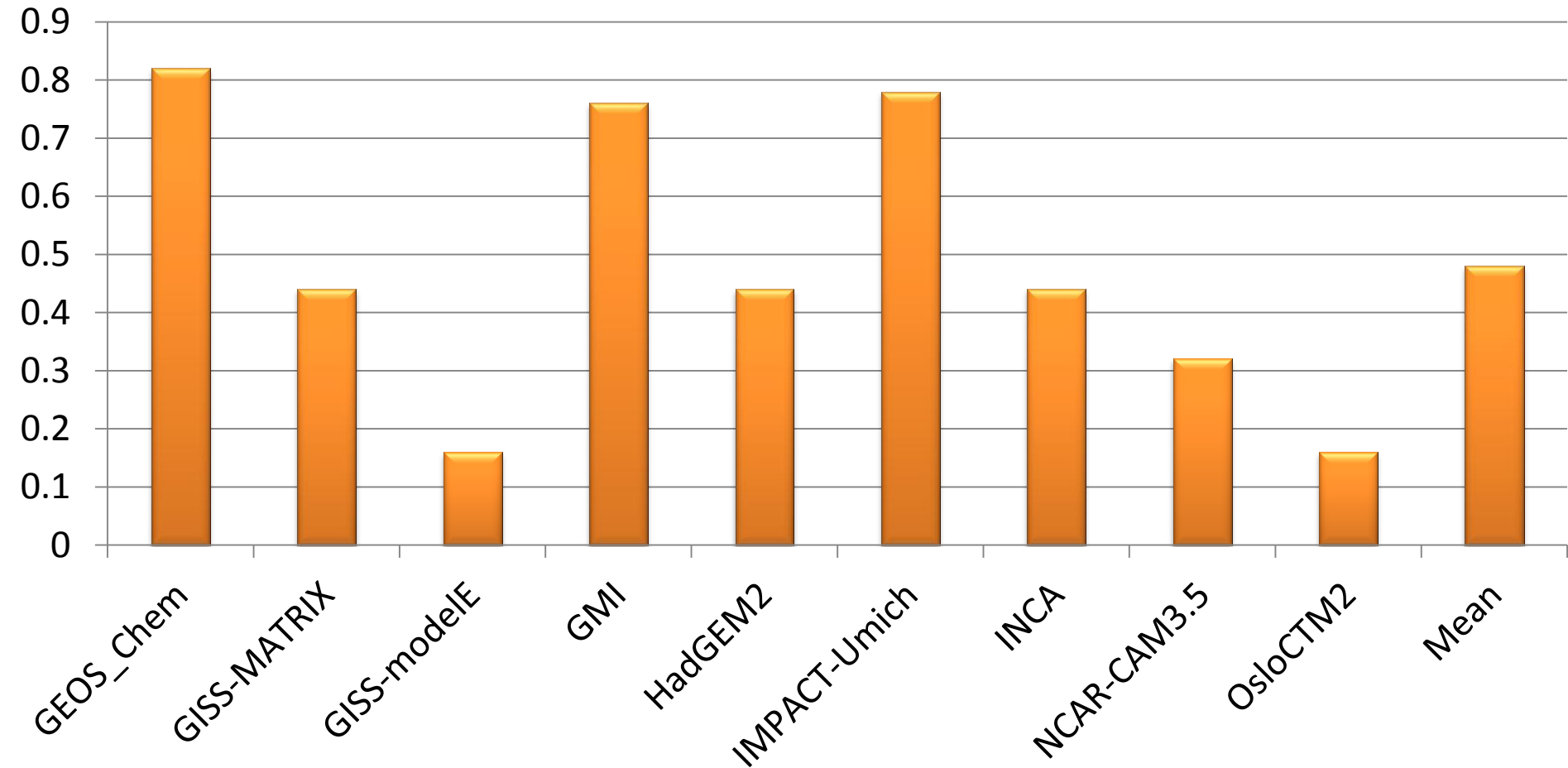
OA



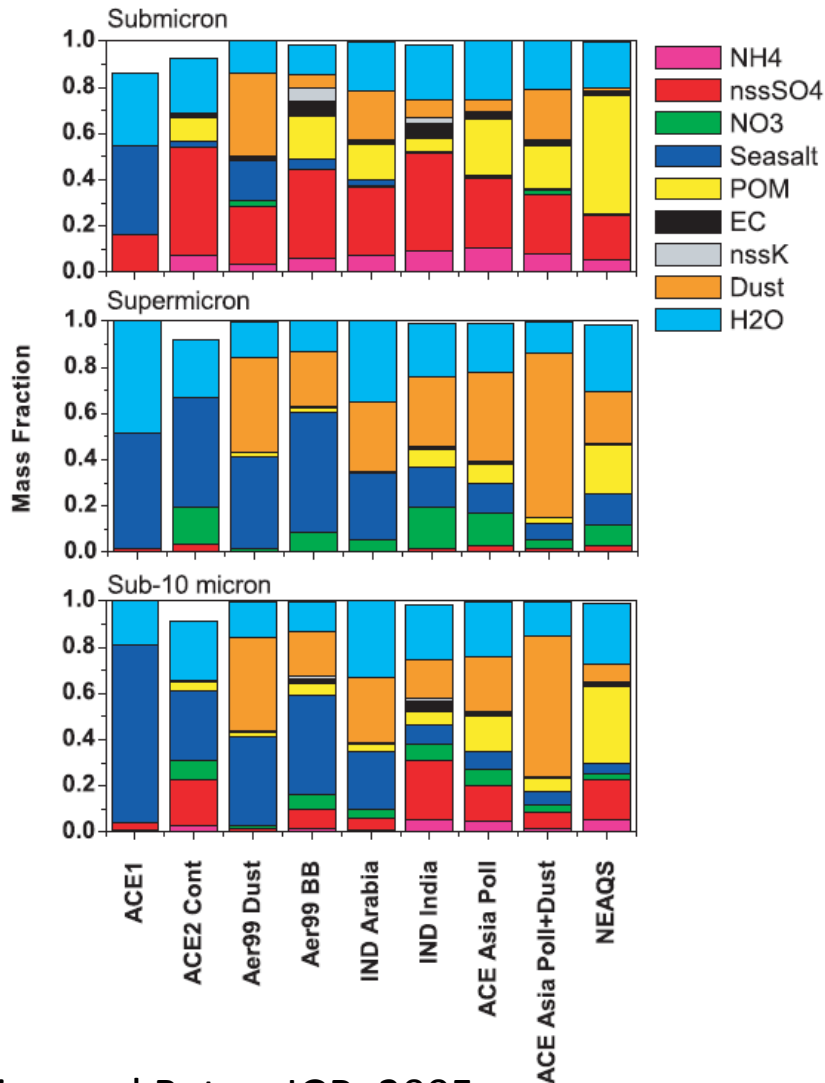
Optical properties quite important – recommendation for treatment

Nitrate

Load [mg/m²]



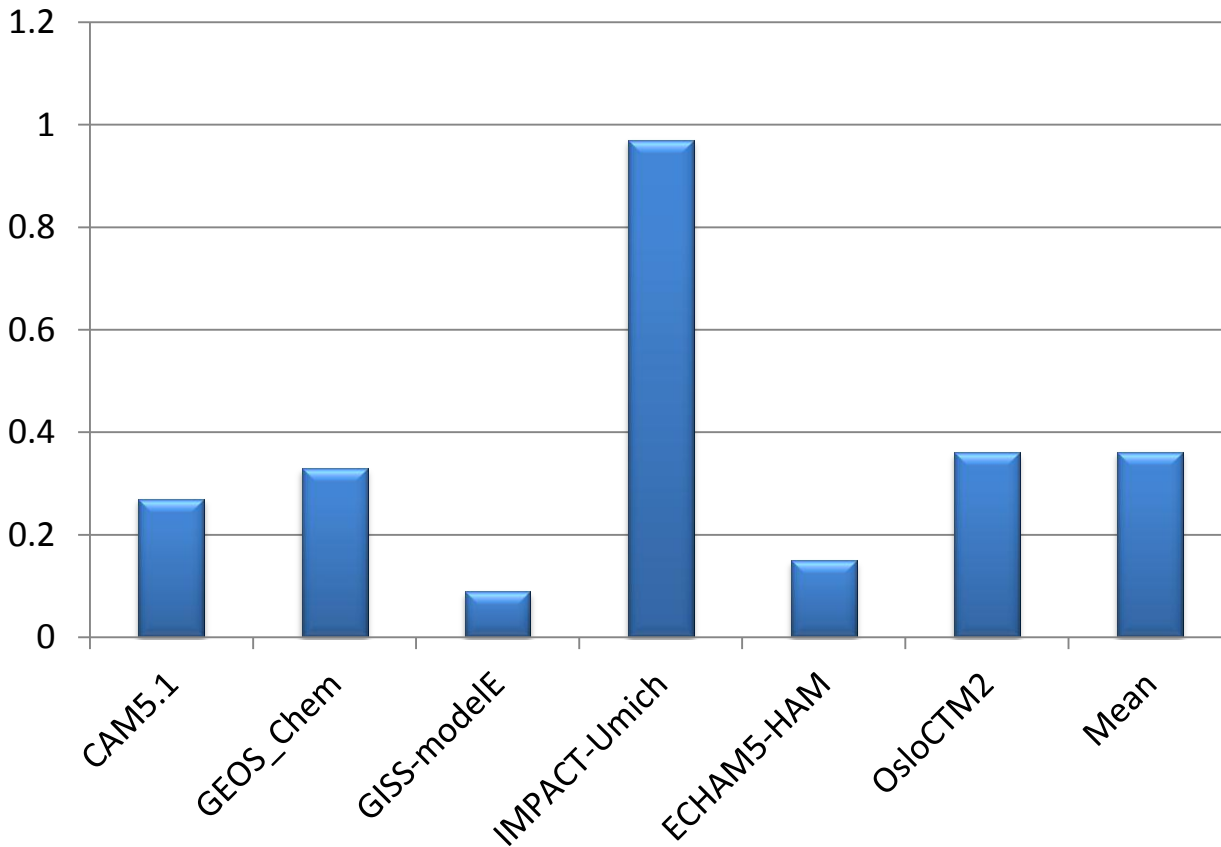
Nitrate over ocean



- Are models able to reproduce coarse mode nitrate over ocean?
- Are models able to reproduce the high fraction of fine mode nitrate over land (at surface and lower troposphere) as measured in Europe?

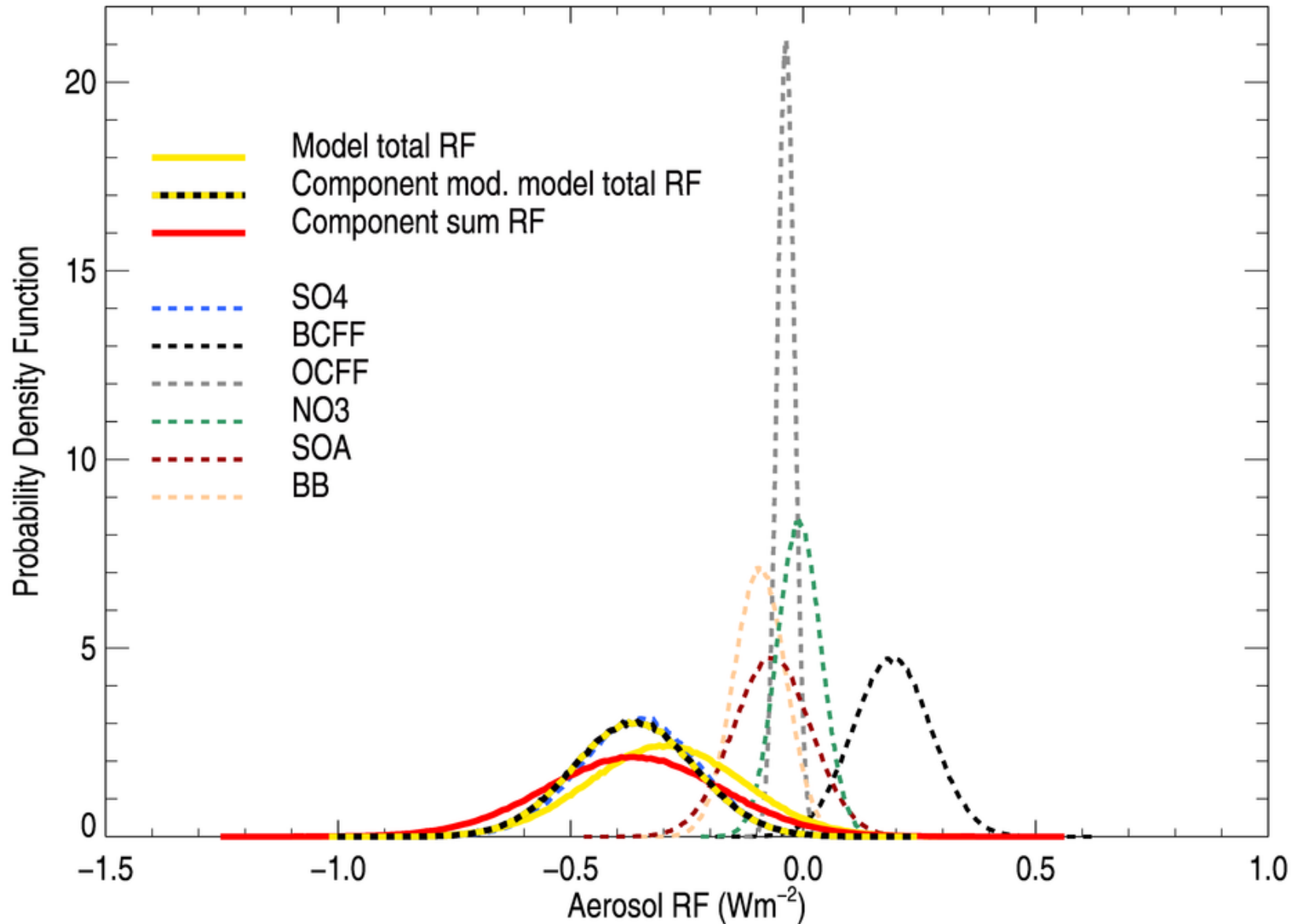
Secondary organic aerosols

Load [mg/m²]



- Various modules for SOA should be tested in AeroCom models.
- Absorption at short wavelength also important for SOA

Uncertainties in the direct aerosol effect



Summary

- Uncertainties are similar in Phase I and Phase II
- Additional AeroCom activities are needed to evaluate model performances
- On-going AeroCom activities are important for the understanding of model differences
- Still possible with updates and new submissions for the full direct aerosol effect experiment. Final deadline is 1. November

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