

Interactive comment on “Aerosols at the Poles: An AeroCom Phase II multi-model evaluation” by Maria Sand et al.

Anonymous Referee #1

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The paper describe a important topic related to the behaviour of aerosol modelling at Poles. A comparison between models and most important with observations is reported. This add value to the manuscript. However, prior the publication a deeper description related not only to the observed behaviour of the models, but also to the underlying mechanisms (i.e. reasons) is required throughout the whole paper. Here below some suggestion to improve the paper.

MAJOR POINTS

Page 5, lines 4-5. Even the “Model descriptions including model resolution, dynamics, and microphysics schemes used are given in Table 1 and 2 in Myhre et al. (2013)”, it should be useful for the reader to have at disposal the main model features in the present paper. I suggest to resume them in the supplemental material

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Page 5, lines 6-7. “Each model has provided climate and aerosol simulations using year 2006 meteorology. For present-day simulations emissions for year 2000 have been used, and for preindustrial runs year 1850 emissions have been used (Lamarque et al., 2010).” If the assumption on the used datasets for emissions appears reliable, it is not so intuitive for the reader to understand the choice of the year 2006 as a reference for meteorology. Please, demonstrate that 2006 year does not present any anomaly for what concern meteorology and general atmospheric circulation compared at least to the 2000-2015 period (the period of experimental data used for the comparison) using both modelling and experimental data i.e. GAW-WMO data. It seems that the 2006 assumption represents a big limitation when compared the simulated AOD with AERONET data (Figure 2). A big effort has to be done to overcome this limitation or to details its implication in term of uncertainty on the simulated aerosol properties when compared to other dataset based on multi-annual data. For example Figure 5 seems to overcome this limitation due to the fact that only 2006-2007 CALIPSO data were used.

Page 5, lines 17-18: “The models have estimated AOD as a combination of aerosol abundancies and optical properties, which is why AOD can be reported in the months where there is no actual sunlight”. Please details (at least in supplemental material) how each model calculates the aerosol optical properties and the underlying assumptions (i.e. mixing state, hygroscopic growth etc.).

Page 7, line 28 – page 8, lines 1-3: “For GEOS-Chem and GOCART this maximum is dominated by natural aerosols (sea-salt and dust, respectively, as shown in Fig. 8). Note that modeled AOD is calculated from simulated aerosol distributions, and can therefore be reported even for months where there is no actual sunlight.” This sentence is limited just to observe that the behaviour of GEOS-Chem and GOCART is related to wrong simulation of sea-salt and dust. But it should be important to describe the inner reason for the overestimation of sea-salt and dust. Could you describe them?

Figure 1b: which is the reason for the overestimation of CAM4-Oslo in the Antarctic? Please add to the text an explanation.

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Figure 5 is very promising. May I suggest also to add a comparison concerning the vertical behaviour of aerosol extinction coefficient? As the simulated radiative forcing strongly depends from the aerosol vertical profiles, this comparison could be very useful.

Figure 10 and related description at page 10 lines 5-7: the description is too short to capture the complexity of Figure 10. Please improve it. For example: why GISS-MATRIX forecast a such big contribution of SOA compared to other models? Why GMI-MERRA-v3 did the same for Nitrate? What about the SPRINTARS behaviour for sulphate which is opposed to the other models? A deeper description related not only to the observed behaviour but also the underlying mechanisms (i.e. reasons) is required here and throughout the whole paper.

Section 3.2: is the calculated radiative forcing in clear sky approximation or in all sky conditions?

MINOR POINT

Page 10, line 13: "although the Arctic AOD of BC sis". Change "sis" with "is".

Interactive comment on *Atmos. Chem. Phys. Discuss.*, doi:10.5194/acp-2016-1120, 2017.

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