

Interactive comment on “Aerosol-climate interactions in the Norwegian Earth System Model – NorESM” by A. Kirkevåg et al.

Anonymous Referee #1

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The manuscript provide a detailed description of the recent changes implemented in the aerosol treatment within the CAM4-Oslo model, which is the atmospheric component of the NorESM climate model. The new model is evaluated against observations and other models. Furthermore, the authors investigate the effects of each change on the radiative forcing against the old model version.

This is an excellent work, suitable for publication in GMD. The detailed description makes the changes reproducible, and the evaluation of the model is thorough and robust. The investigation on the importance of each change is an important and interesting section of the work. This manuscript represent a great reference for future studies with CAM4-Oslo and for other model that want to implement similar changes.

I do not have any major comment about the manuscript. I add a list of minor comments
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and some questions that arose during the reading of the manuscript.

- Page 2608, line 1: Is each aerosol species present in each mode (5 species \times 4 modes = 20)? In figure 1 it appears to be more than 20 components.
- Page 2608, line 10: What does "size-bins with equal width with respect to the logarithm of the particle radius" mean?
- Page 2608, line 21: Do you mean that the Köhler theory (line 13) is used for calculating the lookup tables?
- Page 2608, line 28 and everywhere in the manuscript: I am not sure whether it is correct to use a period before *i.e.*
- page 2610, line 1: there is a typo in "exercise".
- page 2612, line 1: I am confused by the notation: do the authors want to say that the ratio of MSA to S is 3 to 1? If so, I think writing "MSA to S (3:1)" is clearer.
- page 2612, line 15: Is *W* the white cap fraction? I think it should be directly stated.
- page 2614, line 9: I understand that CAM4-Oslo does not actually have an oxidant chemistry. The oxidant chemistry is calculated with Oslo-CTM2, and then read in by CAM4-Oslo. If so, the title is confusing. I would rather call this section "Oxidant fields" or anything that does not imply the presence of a chemistry module.
- page 2614, line 15: the new H₂O₂ values are smaller than Seland et al. (2008) in the UT and in the stratosphere; is this a problem? Is CAM4-Oslo suitable for studies in the UTLS and stratosphere?

- page 2615, line 4: Is dust emitted only offline, or is it possible to have it emitted online depending on the simulated winds?
- page 2615, line 12: is there a reference for the 0.25 value of the scavenging coefficient, or was it assessed through sensitivity tests?
- page 2620, line 19: the sea salt lifetime is slightly longer in this work than in Seland et al. (2008), in spite of the fact that the wet and dry deposition are higher. Is it consistent?
- page 2622, line 20: could it also be a sign of too high deposition, which limits long range transport?
- page 2628, line 15: the simulated AOD is much smaller than observed over India. Do you know why that happens?
- page 2631, line 5: "possible" or "possibly"?
- page 2631, line 26: "it is overestimated...". What is "it"?
- page 2633, line 26 and ff: in this section the units of RF should be $W m^{-2}$.
- page 2634, line 18: How does exactly internal mixing affect AOD? Couldn't also increase it? For instance, the presence of a coating increases the absorption by BC (Bond and Bergstrom, Aerosol Sci Tech, 2006, vol 4(1) pp27-67).
- page 2635, line 8: when you say "internally mixed OM/BC", do you mean that OM and BC are internally mixed with soluble material, or that they are internally mixed together? How hygroscopic do you consider them?
- page 2643, line 1: yields

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- page 2647, line 12: the presence or absence of a hydrophilic coating should affect the scavenging, too. Is this feedback not included in CAM4-Oslo? If it is, it should affect the life cycle.
- page 2650, line 13: fluffy BC particles?
- page 2669, table 3: I am not sure about the difference between emission and sources. Is "sources" the production of secondary particles? If so, why SS and dust have different numbers for emission and sources? SS and dust should be only primary particles.
- page 2675 and ff: The fonts in all figures is much too small, hardly readable.

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