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Geoscientific Model Development Discussions

Interactive comment on "A production-tagged aerosol module for earth system models, OsloAero5.3 – extensions and updates for CAM5.3-Oslo" *by* Alf Kirkevåg et al.

Anonymous Referee #1

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The article untitled "A production-tagged aerosol module for earth system models, OsloAero5.3 – extensions and updates for CAM5.3-Oslo" by A. Kirkevag et al. presents in a very detailed way updates in the modelisation of aerosols that is used in the atmospheric component of the Norwegian Earth System Model (NorESM). This updated version called OsloAero5.3 is here tested in the CAMS5.3 atmospheric model which is part of the Community Earth System Model 1.2 (CESM). With regards to the CMIP6 project, OsloAero5.3 is planned to be integrated/merged with CEMS2 to form the NorESM2 model, but the version presented in this article could be used for the early phase of CMIP6. Therefore, in addition to being of value to the aerosol modelling community, the discussions in the article are fully relevant to the CMIP6 exercise.

The article is very well written, and provides a thorough review of changes from a previous version documented in Kirkevag et al. 2013, together with an analysis of several aerosol diagnostics. Several changes have been mode, including ones to the aerosol sources, aerosol nucleation, soa production, and aerosol-cloud interactions. The analysis presents comparisons not only with results from the previous version of the aerosol model, but also with observations, with results from other aerosols models, in particular those of the AeroCom community, and with other aerosol studies. The analysis attempts to document in details the advances and setbacks of this new version. Although the article is very long, in particular in the aerosol model description part, I would recommend it for publication in GMD as it is, as details in any part can be of interest to some scientists in the aerosol community. I include below a few comments that will require only minor corrections in the document.

- it would be interesting to include information of the added computational cost required to use this aerosol model, possibly in comparison to the other aerosol models of CESM (MAM3 and MAM7). In particular, which/now many of the tracers listed in Table 1 are transported by the model? Also, please add some details on the chemical mechanism used in conjunction to this aerosol model (line 6 page 8)
- page 2 line 2: "while it...": please clarify this part of the sentence
- page 2 line 4: "overestimated" shouldn't it be changed to "underestimated"
- page 13 line 19: is the proportional coefficient you use that of the references?
- page 15 line 8: please provide details on the vertical resolution (extension, distribution of levels)
- page 17 line 26: please comment on the fact that in Figure 5 the Nudge and Amip lines are quasi identical in the troposphere

- page 19 line 28: comment on the interest of self nudging
- page 21 line 3 change “better than” to “better”
- page 29 line 7: please clarify “as the source of the largest negative biases” where do you see that in Figure 7?
- page 30 line 1: please add a few details about this dataset
- page 34 line 13: is this excess of BC in the upper troposphere common/uncommon in other models?
- page 56: Table 6 legend: I suggest to change “monthly European and Global data” to “monthly data”. Please explain “(or world oceans in the case of dust)”.

  Please indicate for how many models you have clear-sky information.
- page 58 in Table 7 legend, change “Table 9” into “Table 6”
- page 59 : please add “and column integrated optical properties” in the legend
- page 62: indicate meaning of AWNC, FREQL, AREL. CDNUMC non needed in legend.
- page 66: meaning of etax1000? please add a couple of levels in the stratosphere
- page 71: I believe ERF ari are shown; it would be clearer to indicate this on top of the figures and in the legend
- finally, in general zooming in the figures degrades their quality; this needs to be corrected

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