Geoscientific

Model Development

Discussions

**[GMDD]**

Interactive

comment

# *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 #2**

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This manuscript describes the latest version of the OsloAero module used for modelling atmospheric aerosol in the aerosol-climate model CAM5.3-Oslo and earth-system model NorESM 1.2. OsloAero has a quite different formulation to most aerosol schemes, using a set of "background aerosol" tracers, whose prescribed size distributions and composition are then modified according to a second set of tracers which are tagged according to aerosol production processes. The resulting variations in size and composition, which are not restricted to e.g. a log-normal form, are then looked up in tables computed offline to determine the relevant optical and other properties of these mixtures. This is a novel approach to aerosol modelling which the authors have developed over a number of previous papers, adding distinct capabilities com-

pared to the more widespread modal and sectional schemes. The present manuscript describes new developments for nucleation and secondary organic aerosol, as well as new online emission schemes for sea-salt, mineral dust and oceanic DMS and organics. There has also been an effort to ensure better consistency of parameters between the different components of the scheme, which is always welcome from a physical point of view. These are important additions, both in terms of updating this modelling framework with the latest understanding of physical processes, and for tighter coupling in the earth system context. A good basic set of evaluation plots and metrics are included, though the overall results compared to the previous CAM4-Oslo are somewhat mixed, with some biases and errors improved but others becoming larger; nevertheless this is a well-presented paper documenting a significant advance in the physical and chemical capabilities of the model and I would recommend it for publication in GMD subject to the minor comments below:

**p.3, line 28 – p.4, line 10** This section is quite programmatic in terms of discussing the evolution of the projects to which OsloAero is related; I would consider whether all of this is relevant to a model description paper.

**p.4, line 27** "same method of aerosol activation as Liu et al. (2012)": is this the primary reference for the parameterisation in use, or does it describe a particular implementation of a well-known parameterisation (e.g. Abdul-Razzak and Ghan, 2000) which should also be cited here.

**p.6, line 4** It's not clear either *why* a portion of the modifying tracer is redistributed to the background ones, or the basis on which the amount redistributed is calculated; some explanation here is needed.

**p.6, lines 12–13** In what way are these sized "augmented to take into account atmospheric growth"? This is a rather vague description.

**p.6, lines 13–16** A little more explanation of what is meant by lumping the size-modifying tracers would be good, as well as the meaning of the modal size parameters of these modifying tracers, if these are not particles in their own right, but act to adjust the sizes of the background modes. (This may be explained further in earlier papers e.g. that labelled K13, but should ideally be self-explanatory in this manuscript.)

**p.27–29** I assume "lost from the model" means that monoterpene and isoprene do not exist as tracers in the model, but only as "transient" species near the surface within a given model time step?

**p.11, line 19** This should be "...scheme is different from that..." or "...schemes are different from those..." for singular/plural consistency.

**p.14, line 8** It would be good to recap the emission sources here, even if they haven't changed from the previous paper.

**p.15, line 8** What is the height of the model top with 30 levels?

**p.15, line 9** Clarify that "microphysical schemes" here refers to cloud and precipitation rather than aerosol, if that is the case. Also, a brief description of the nature of these schemes (single/double-moment, what is prognostic etc.) would be welcome to provide context for aerosol-cloud interactions in this model.

**p.15, line 24** A reference for the nudging technique would be welcome (e.g. Jeuken et al., 1996, 10.1029/96JD01218 or equivalents in other models).

**p.16, line 18** Is there a reason why CAM4-Oslo couldn't be tested at the higher resolution, or CAM5.3-Oslo at the lower one, in order to assess the impact of the resolution change separately from the actual model updates?

**p.16, line 25** If the DMS burden is doubled compared to the earlier version, are there some observations which could be cited here to indicate which is more realistic, or is the uncertainty even larger than this?

**p.17, line 29–30** The attribution of upper-tropospheric excess to the treatment of convective processes based on comparisons to HIPPO was also made by Kipling et al. (2013, 10.5194/acp-13-59690-2013 in the context of another model.

**p.27, lines 8–12** The rationale for using the grid-box-mean RH and weighting by clear-sky fraction, rather than the more common approach is not clear.

**p.37, line 30** NUDGE_PI appears twice; one should be NUDGE_PD.

**p.38, line 9** Who should be contacted to obtain a user agreement for access to the code and data?

**Tables** Many of the tables contain a large number of numerical values, either mass budget terms or statistics. While the actual numbers may be useful for reference, summarising these in charts would probably be much easier for the reader to understand at a glance.

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