

***Interactive comment on* “Strong impacts on aerosol indirect effects from historical oxidant changes” by Inger Helene Hafsahl Karset et al.**

Anonymous Referee #2

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Karset *et al.* explore the importance of using oxidants appropriate to the time period being simulated when determining the strength of the first aerosol indirect effect. Using CAM5.3-Oslo (which includes OsloAero) the authors perform a series of sensitivity simulations to enable them to determine the role of variability for each oxidant individually, and in combination. The manuscript highlights an important issue, is well written throughout, and is both clear and thorough – I would recommend publication in ACP following clarification on the below issues.

General points:

It would be useful to see a bit more discussion on the extent to which we can *know* what pre-industrial oxidant levels actually were (or the challenges in determining them). The authors point out that a number of studies have attempted to infer pre-industrial

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oxidant levels from emissions inventories (also uncertain) and limited observations, but a bit more detail here about what is known and how well would be useful context.

Relating to my previous point - since there can only be limited confidence in any simulated pre-industrial oxidant levels, one possibility would be to consider how well the full-chemistry model captures present-day oxidant concentrations in clean v. polluted regions. Without this, the paper makes an important point about the potential impact of incorrect / inappropriate oxidant concentrations when diagnosing RFs, but doesn't necessarily tell us how much we can trust this particular set of pre-industrial oxidants and therefore the size of the change in RF that is diagnosed.

Could you add more detail on the new particle formation mechanism that is used in OsloAero? This is also an important factor in determining PI particle concentrations, and therefore the PI to PD radiative forcing. For example, Gordon *et al.*, (2016) found that including pure biogenic new particle formation reduced the strength of their simulated PI to PD first aerosol indirect RF.

Minor / technical remarks:

p6, line 29: change to "low volatility"

p7, line 21: change to "describes"

p7, line 26: change to "increases"

p7, line 28: correct the spelling of "switching"

p8, line 14-15: rephrase the sentence starting "Figure 9", may require insertion of an "is" somewhere?

p8, line 17: should this just be Figure 9(a)? (since (c) and (d) do not relate to DMS?)

p8, line 18-20: I think here you are saying that reaction R2 + R3 is favoured over R4 since there is less oxidation via the NO₃ pathway – rephrase to avoid saying “..out off a DMS-“

p11, line 9: change to “gives”

Figure 8: what is meant by “aerosol size” in this Figure? Would be useful to describe in the caption

Figure 9: rephrase third sentence of the caption

Table 5: is there an error here in the description of the NOSOA simulation? (the reaction is the same as the line above)

References:

Gordon H., *et al.*, (2016) Reduced anthropogenic aerosol radiative forcing caused by biogenic new particle formation, Proceedings of the National Academy of Sciences of the United States of America, 113, pp.12053-12058. doi: 10.1073/pnas.1602360113.

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