

Atmos. Chem. Phys. Discuss., referee comment RC1
<https://doi.org/10.5194/acp-2021-151-RC1>, 2021
© Author(s) 2021. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on acp-2021-151

Anonymous Referee #1

Referee comment on "Reduced effective radiative forcing from cloud–aerosol interactions (ERF_{aci}) with improved treatment of early aerosol growth in an Earth system model" by Sara Marie Blichner et al., Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2021-151-RC1>, 2021

Blichner et al. have developed, in previous work, a more sophisticated treatment of small secondary aerosol particles that form via new particle formation (NPF) from the gas phase and numerically resolves the evolving size distribution for small particles in discrete size bins. Blichner et al. report from their previous study that the revised parameterisation is superior to the one typically used in the NorESM in comparison to observational data.

This present work is entirely a modelling study, no observational data are shown at all. It considers a range of uncoupled runs (ocean and sea ice prescribed) with nudging of atmospheric dynamics. For three different model versions (standard, revised parameterisation of small aerosols, and an intermediate version) present-day and pre-industrial simulations are conducted and compared in terms of radiative fluxes, drop number, and aerosol number.

The overall result is a small ($\sim 10\%$) reduction in the ERF due to aerosol-cloud interactions with the revised parameterisation. The bulk of the study is then dedicated to explaining how various processes lead to this net effect in the model. This analysis is very diligently performed and very well explained. It is plausible. It is a pity that nowhere observations are used to try and evaluate to which extent the modelled and hypothesized effects may reflect reality, but I acknowledge this is difficult to do since the effects are small, regionally very variable, and hard to measure (in particular of course there are no measurements for the pre-industrial atmosphere).

Nevertheless, I believe the study is interesting enough for the readership of Atmos. Chem. Phys. I do not have many recommendations.

l6 superfluous "with"? □ "contributes a large"

l10 radius or diameter?

l15 sounds to me like this is the same number

l38 "which is dependent"

l48 this concerns of course only the secondary aerosol

l55 radius or diameter?

l58 "proportional"

l59 "dependent on" rather "describing"?

l64 It does not seem obvious that one cannot implicitly take into account time-varying conditions. Do the authors perhaps mean, that current parameterisations use such an assumption?

l73 This is for *number* concentrations presumably

l108 "in that its aerosol scheme"

l111 "by Blichner et al"

l144, l147 These numbers seem potentially rather important for the conclusions of the present manuscript. Where do they stem from? How sensitive are the results to this choice?

1505 "lower than"