

Interactive comment on “No statistically significant effect of a short-term decrease in the nucleation rate on atmospheric aerosols” by E. M. Dunne et al.

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We thank Anonymous Reviewer #2 for their helpful feedback and comments. We have addressed their comments below. Text in italics is quoted from the referee's comments, while bold text has been added to the manuscript.

First the introduction presents a very interesting discussion on this topic but at the end I'm missing a paragraph about the aim of this manuscript. The authors have moved this to section 2 but there should be a couple of sentences at this place like it is supposed to be.

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The Introduction now includes the line: **“The aim of this manuscript is to test the hypothesis that changes in the nucleation rate can account for observed correlations between GCRs and cloud and aerosol properties, and to evaluate the response in aerosol in a way that is transferable to atmospheric observations, taking into account the detectability of the response above global aerosol variability.”** A similar phrase still appears in the Methods section.

Page 15382, line 11: I believe that this paragraph relates to the binary nucleation mechanism but should be also mentioned. There should be also a statement at the end of this chapter that no ion-induced nucleation mechanism has been implemented in GLOMAP until now if this is the case otherwise the readers will not easily understand why this reduction of the nucleation rate was used.

The paragraph now reads: **“Previous nucleation studies in GLOMAP have used the neutral binary homogeneous nucleation parametrisation of Kulmala et al. (1998), but this study uses the improved parametrisation of Vehkamäki et al. (2002). The latter is more physically accurate, as it takes the formation of sulphuric acid hydrates into account and predicts the critical cluster size. The effective change in the modelled nucleation rate is quite small, due to losses of sub-3 nm particles, so the model validation carried out with the parametrisation of Kulmala et al. (1998) remains valid (J. Merikanto, personal communication). No ion-induced nucleation parametrisation has been implemented in GLOMAP at this time, hence the use of of a neutral nucleation mechanism in this study.”**

One possible way of influencing the climate by GCR which was not mentioned in detail is the enhanced growth of new formed charged particles. I assume that no

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parameterisation for this effect was included in GLOMAP and should be at least mentioned in the discussion for a possible factor GCR could have on the aerosol parameters.

The following sentence has now been included in the introduction: “**The enhancement of growth rates of freshly nucleated charged particles compared to corresponding neutral particles is another possible mechanism by which ions could increase the influence of nucleation on the climate, which has not been accounted for in this study.**” No parameterisation on the increased growth rate of charged particles has been included in the simulations described in this paper; however, based on unpublished sensitivity studies using GLOMAP, we would not expect the increased growth rate to have much of an effect on aerosol concentrations. We feel that based on these studies, the new sentence in the Introduction is sufficient discussion.

References

- Kulmala, M., Laaksonen, A. and Pirjola, L. (1998), “Parameterizations for sulfuric acid/water nucleation rates”, *J. Geophys. Res.*, Vol. 103. 10.1029/97JD03718.
- Vehkamäki, H., Kulmala, M., Napari, I., Lehtinen, K. E. J., Timmreck, C., Noppel, M. and Laaksonen, A. (2002), “An improved parameterization for sulfuric acid–water nucleation rates for tropospheric and stratospheric conditions”, *Journal of Geophysical Research*, Vol. 107, p. 4622.