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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global response of parameterised convective cloud fields to anthropogenic aerosol forcing" *by* Zak Kipling et al.

Anonymous Referee #1

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This paper addresses a neglected topic, the global impact of aerosols on the full range of convective clouds. While many climate models consider aerosol effects on clouds, they mostly consider this only on clouds formed by large-scale condensation in the model, and generally neglect the impact on convective (for example mixed-phase) clouds. This could be important not only by contributing to cloud radiative effects, but also by altering rainfall. Thus the current contribution is useful. The results do rely heavily on a convection scheme that may not represent the convective-scale dynamics very well, but the authors explain how this scheme works and how its assumptions play into the results obtained; the study is a useful advance even though conditional on the scheme. The results qualitatively support previous suggestions based on more

localised modelling approaches.

My chief concern with this paper is that I am not sure 10 years is long enough to see the impact of aerosols on rainfall, due to its high internal variability. This impact is subtle compared to the large dynamical influences on convection, as acknowledged by the authors, and the results are not straightforward, with opposite-signed changes in different regions that defy any simple explanation as an aerosol impact and look noisy. I don't see any significance testing applied to the claimed impacts, but the authors need to do this– for example by considering each year as an independent sample and computing a t-statistic on the differences in mean rainfall or cloud property, either at the pixel or region level or aggregated in some other way to improve the statistics.

Detailed comments.

86: Please clarify whether new particle formation is included in this model. Here it says the gas-phase chemistry model is not active for this study, but later (l174) the manuscript speaks of precursor emissions, which would seem to be irrelevant if there is no gas-phase chemistry or new particle formation predicted.

175-ish: please specify what SSTs were used (are they the same each year for the 10 years?)

212-214: It is a common misconception that precipitation generated by the convective scheme is "convective" and that generated by the grid-scale scheme is "stratiform." The convective scheme simply represents the net effect of all air motions below the grid scale. For example as the model resolution increases, the fraction of total P produced by the convective scheme should steadily decrease, but the model is not predicting that rain is physically becoming more stratiform. Since convective motions in nature mathematically project onto the grid scale circulation, some of the grid-scale condensation will be attributable to convection, no matter what the resolution.

Fig 1. caption: might be helpful to (re)define PD and PI in the caption.

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