

## ***Interactive comment on “Effect of aerosol sub-grid variability on aerosol optical depth and cloud condensation nuclei: Implications for global aerosol modelling” by N. Weigum et al.***

### **Anonymous Referee #1**

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The manuscript presents a topic of great interest to the global modeling community. Often it is not clear what are the impact of subgrid-scale variability of aerosol processes.

This study conducts a systematic evaluation separating resolution of aerosol processes, from changes in full model resolution that have other contributing factors e.g. resolution effects due to convection, RH etc.

The paper is well written, the concepts presented are logical and the paper is easy to understand. I recommend publication, after the authors acknowledge some caveats and future directions in their study:

1. In their study the authors hold met and dynamics at 10 km baseline for both averaged

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and high resolution runs. But in global models the met and dynamics are at 80 km. How would their results change if they had used met and dynamics at 80 km baseline?

2. Aerosol nucleation and secondary organic aerosols: Although not the focus of their study aerosol nucleation and new particle formation is significantly affected by low volatility organic vapors (see several recent papers e.g. "Trostl, J., et al. (2016), The role of low-volatility organic compounds in initial particle growth in the atmosphere, Nature, 533(7604), 527"

More future studies similar to what the authors presented are needed not just for inorganic but organic aerosol systems. 3. It should be acknowledged, that the overestimations in CCN the authors see can get affected by what processes (e.g. effects of organic aerosols, and their non-linear relations with chemistry) are included. The resolution effects, although valuable as presented in their study, are subject to change based on simulations of aerosols and aerosol processes. This caveat is very important to acknowledge in the conclusions sections.

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C2