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Effect of sub-grid variability on aerosol processes

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Spatial scales of aerosol processes range from sub-micron for nucleation events to several hundred kilometres for cloud interactions and dynamical transport. These scales are largely unresolvable in global climate models (GCM), with typical grid spacings of 100 to 400 km. In GCMs, spatial variations of aerosol parameters are averaged over these grid cells so that the variability in the distribution and microphysical evolution of aerosols may not be properly represented. In this study, we aim to explore the impact of this averaging on key aerosol microphysical properties. Using the chemistry version of the Weather Research and Forecasting Model (WRF-Chem), we isolate the impact of model resolution by simulating aerosol concentrations at varying resolutions while maintaining a constant resolution in meteorological fields. This novel technique enables us to separate the effect of sub-grid variability on aerosol processes from the resolution dependent meteorology. In this presentation we focus on the resolution dependence of aerosol optical depth (AOD) and cloud condensation nuclei (CCN). Results show significant differences in both AOD and CCN due to changes in aerosol water content and aerosol number concentrations, respectively. We explore the processes that are affected by changes in scale and how they influence these aerosol properties. Our results shed new light on the importance of specific aerosol processes and their representation in global climate models.