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When is an INP not an INP?

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Processes such as precipitation and radiation depend on the concentration and size of different hydrometeors within clouds therefore it is important to accurately predict them in weather and climate models. A large fraction of clouds present in our atmosphere are mixed phase; contain both liquid and ice particles. The number of drops and ice crystals present in mixed phase clouds strongly depends on the size distribution of aerosols. Cloud condensation nuclei (CCN), a subset of atmospheric aerosol particles, are required for liquid drops to form in the atmosphere. These particles are ubiquitous in the atmosphere. To nucleate ice particles in mixed phase clouds ice nucleating particles (INP) are required. These particles are rarer than CCN. Here we investigate the case where CCN and INPs are in direct competition with each other for water vapour within a cloud. Focusing on the immersion and condensation modes of freezing (where an INP must be immersed within a liquid drop before it can freeze) we show that the presence of CCN can suppress the formation of ice. CCN are more hydrophilic than IN and as such are better able to compete for water vapour than, typically insoluble, INPs. Therefore water is more likely to condense onto a CCN than INP, leaving the INP without enough condensed water on it to be able to freeze in the immersion or condensation mode. The magnitude of this suppression effect strongly depends on a currently unconstrained quantity. Here we refer to this quantity as the critical mass of condensed water required for freezing, Mwc. Mwc is the threshold amount of water that must be condensed onto a INP before it can freeze in the immersion or condensation mode. Using the detailed cloud parcel model, Aerosol-Cloud-Precipiation-Interaction Model (ACPIM), developed at the University of Manchester we show that if only a small amount of water is required for freezing there is little suppression effect and if a large amount of water is required there is a large suppression effect. In this poster possible ways to constrain Mwc are discussed as well as conditions where the suppression effect is likely to be greatest.

Key Words: Clouds, aerosol, CCN, IN, modelling