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Contact freezing for external Mixtures of different Ice Nuclei

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Most of the precipitation over the continents is formed via the ice phase. One of the most critical issues is the initiation of the ice phase. An important process is contact freezing which means that an ice nucleus (IN) collides with a supercooled drop leading to the formation of a frozen drop which can grow further by water vapor deposition and riming. Potential IN for contact freezing are insoluble particles with a relatively dry surface.

The freezing behaviour for single IN types (biological and mineral particles, soot) is described using spectral microphysics in the frame of a parcel model. External mixtures of aerosol particles (AP) with a significant soluble fraction (potentially acting as cloud condensation nuclei, CCN) and different insoluble AP (potentially acting as contact freezing IN) with variable number size distributions are implemented.

Sensitivity studies are shown for different mixtures of IN types and varying AP number size distributions. From the results it can be deduced i) what are the main microphysical factors ruling the ice formation (e.g., particle and drop size distribution, composition, ...) and ii) which size regime of the IN leads most efficiently to the formation of frozen drops by contact freezing.

Furthermore, the above mentioned IN types act at different temperatures. Therefore, the question arises whether for a mixed IN population only the IN, which act at the highest freezing temperatures, will rule the ice formation or if the other potential IN will become more important with decreasing temperature in the cloud. This question will be addressed.

From the explicit description a parameterization of the contact freezing for a given AP mixture is deduced which can be implemented in higher dimensional cloud resolving models.