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Connecting in-situ measurements of Ice Nucleating Particles in air and in ocean and cloud water for the region of the Cape Verde islands

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Ice nucleating particles (INP) in the troposphere can form ice in clouds via heterogeneous ice nucleation. Number concentrations of ice in clouds significantly affect cloud lifetime, the formation of precipitation and radiative properties. Still up to date, atmospheric number concentrations of INP are not well characterized and although there is some understanding of their sources, it is not known to which extend different sources contribute, nor if all sources are known. In this work, we are examining properties of INP that are known to occur in the oceanic sea surface microlayer (SML) and in bulk seawater, as well as the contribution of sea spray aerosol (SSA) to INP in clouds.

The measurements to be presented here were carried out from 13 September to 12 October 2017 at Cape Verde. Besides for a thorough analysis of the atmospheric aerosol, samples collected for INP analysis include: bulk seawater and SML from the ocean upwind of the island; polycarbonate filter samples of atmospheric aerosol, collected on a tower installed at the island shore and on a 700 m high mountain top; cloud water collected during cloud events on the mountain top. INP concentrations were measured offline with two types of cold stages, based on well known techniques (see Chen et al., 2018), yielding results in the temperature range from roughly -5°C to -25°C.

There were two main findings. Firstly, both enrichment and depletion of INP in the SML were observed compared to the bulk seawater, with an enrichment factor (EF) of INP number concentrations at -22 °C varying from 0.58 to 3.88. Secondly, the INP concentrations of the cloud water were around one order of magnitude higher than those of the SML and bulk seawater. When accounting for measured aerosol parameters (concentrations of total particles and cloud condensation nuclei) and assuming cloud droplet sizes in a range from 5 to 20 micrometer, it can be estimated that only a low fraction of all atmospheric INP were from the SSA.

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Literature:
Chen, Jie, et al. "Ice-nucleating particle concentrations unaffected by urban air pollution in Beijing, China." Atmospheric Chemistry and Physics 18.5 (2018): 3523-3539.