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Ice nucleating particle concentrations in Dust Regional Atmospheric Model (DREAM) – going one step further

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Mineral dust particles in the atmosphere have a large influence on the physical properties of clouds and their lifecycle. Findings from field experiments, modeling, and laboratory studies suggest that mineral dust particles are very efficient ice-nucleating particles (INPs) even in regions distant from the desert sources. The major sources of mineral dust present in the Mediterranean basin are located in the Sahara Desert. Understanding the significance of mineral dust in ice initiation led to the development of INPC parameterizations in presence of dust for immersion freezing and deposition nucleation processes. These parameterizations were mineralogically indifferent, estimating the dust ice nucleating particle concentrations (INPCs) based on dust concentration and thermodynamic parameters. In recent studies, feldspar and quartz minerals have shown to be significantly more efficient INPs than other minerals found in dust. These findings led to the development of mineralogy-sensitive immersion freezing parameterizations. In this study, we implement mineralogy-sensitive and mineralogically-indifferent INPC parameterizations into a regional coupled atmosphere-dust numerical model. We use the Dust Regional Atmospheric Model (DREAM) to perform one month of simulations of the atmospheric cycle of dust and its feldspar and quartz fractions during Saharan dust intrusion events in the Mediterranean. EARLINET (European Aerosol Lidar Network) and AERONET (AErosol RObotic NETwork) measurements are used with POLIPHON algorithm (Polarization Lidar Photometer Networking) to derive cloud-relevant dust concentration profiles. We compare DREAM results with lidar-based vertical profiles of dust mass concentration, surface area concentration, number concentration, and INPCs. This analysis is a step towards the systematic analysis of dust concentration and INPC parameterizations performance when compared to lidar derived vertical profiles.