Effects of aerosol sources and chemical compositions on cloud drop sizes and glaciation temperatures

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The effect of aerosols on cloud properties depends on their compositions and concentrations. In order to examine these effects we collected rain samples in northern Israel during five winters (2008-2011, 2013) and determined their chemical composition which was later used to identify the aerosols in the air mass and their sources. By combining the chemical data with geostationary satellite-retrieved cloud properties, we were able to link the aerosols' types, sources and concentrations with the cloud's glaciation temperature (Tg). Even though an increase of dust concentrations causes smaller cloud drop effective radius, Tg increases with higher dust load. This result is in agreement with the conventional wisdom that desert dust serves as good ice nuclei (IN). Our results determine that marine air mass also encourages freezing, but in this case, freezing is enhanced by the larger droplets of the marine air masses (caused by low aerosol concentrations) and not by IN concentrations. An increased fraction of anthropogenic aerosols in marine masses causes decrease in Tg, indicating that these aerosols serve as poor IN. In addition, anthropogenic aerosols reduce cloud droplet size which further decreases Tg. Our results document complex aerosols-cloud interactions. The effect of a given aerosol on cloud properties is not a simple function of the aerosol's type, but also a function of the background aerosols to which it was added.