Geophysical Research Abstracts
Vol. 19, EGU2017-2257, 2017
EGU General Assembly 2017

Impacts of Aerosol, Surface and Meteorological Conditions on Polar Cloud Properties: Use of In-Situ Cloud Probe Data

Greg McFarquhar (1), Wei Wu (1,2), Maximilian Maahn (3,4)

(1) University of Illinois, Dept. Atmospheric Sciences, Urbana, United States (mcfarq@atmos.uiuc.edu), (2) National Center for Atmospheric Research, Boulder, CO, (3) University of Colorado at Boulder, Boulder, CO, (4) NOAA Earth System Research Laboratory, Boulder, CO

Over the Southern Oceans, models from the Coupled Model Intercomparison Project 5 (CMIP5) almost universally underestimate sunlight reflected by near surface cloud in the Austral summer compared to Clouds and the Earth's Radiant Energy System (CERES) data. These and other biases in radiative fluxes over the Arctic are believed to be associated with the poorly modeled properties of low-level clouds that are frequently composed of supercooled water. Because changes in cloud macrophysical (heights, coverage) and microphysical (sizes, shapes and phases of particles) can alter the radiative impact of clouds, it is important to understand the processes that control cloud properties.

In this presentation, in-situ microphysical observations obtained in prior arctic field campaigns (e.g., the Indirect and Semi-Direct Aerosol Campaign ISDAC, the Mixed-Phase Arctic Cloud Experiment M-PACE, and the Atmospheric Radiation Measurement Carbon Measurements Program-V ACME-V) are discussed. Strategies for comparing data collected in campaigns with different probes and processed with varying algorithms are introduced, along with procedures for using cloud probe data to refine assumptions about cloud properties in model schemes (e.g., size distributions, mass-dimension, and velocity-dimension relations) that affect rates at which mass and number are transferred between hydrometeor categories and hence estimates of latent and radiative heating, which feeds back on dynamics and hence cloud properties.

Such observations from past arctic field experiments have enhanced our understanding of aerosol-cloud interactions acting in single-layer mixed phase clouds that are ubiquitous in the Arctic. But, it is still unknown what controls the amount of supercooled water in polar clouds (especially in frequently occurring complex multi-layer clouds), how probability distributions of cloud properties vary with aerosol loading and composition in different surface and meteorological conditions, and how the composition and concentration of arctic aerosols and cloud microphysical properties vary annually and interannually). Finally, it is shown that upcoming observational campaigns (the Measurements of Aerosols Radiation and Clouds over the Southern Oceans MARCUS and the Southern Oceans Cloud Radiation Transport Experimental Study SOCRATES) will provide cloud, aerosol, radiative and precipitation observations over the pristine and continually cloudy Southern Oceans remote from natural and continental anthropogenic aerosol sources in order to help populate the phase space of how varying aerosols, surface and meteorological conditions affect cloud properties.