B05-O02

USE OF SURFACE-BASED REMOTE SENSORS FOR UNDERSTANDING AEROSOL-CLOUD INTERACTIONS AT HIGH LATITUDES

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Of the uncertainties surrounding our understanding of global climate, one of the largest involves the relationships between aerosols and clouds along with the resulting impacts on atmospheric radiation and precipitation. Due to very limited profiling of aerosol properties, traditionally aerosol-cloud interactions have been evaluated using surface-based aerosol measurements as a proxy for aerosol at cloud height. At low- and mid-latitudes, clouds often form atop a well-mixed atmospheric boundary layer, meaning that the use of surface-based aerosol measurements is not necessarily unreasonable. At high latitudes, however, the atmosphere is often very stratified. This stratification limits vertical mixing of aerosols, meaning aerosol properties (e.g. number, hygroscopicity, scattering, size) observed at the Earth's surface may be very different from those at cloud height. This limitation makes it challenging to interpret previous efforts[1,2] to understand the impacts of aerosols on liquid-containing Arctic clouds.

In this work, we combine a variety of measurements obtained at the US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) program's North Slope of Alaska (NSA) site to revisit the derivation of relationships between aerosol and cloud properties. Included in the mix of remote sensors are the Ka-Band zenith pointing cloud radar (KAZR), high spectral resolution lidar (HSRL) and the Atmospheric Emitted Radiance Interferometer (AERI). The KAZR provides estimates of turbulent dissipation rate and ice water content. The turbulent dissipation rate is used to segregate from long-term measurements the cases that demonstrate atmospheric mixing between the surface and cloud height and therefore allow for use of surface based aerosol measurements from the National Oceanic and Atmospheric Administration (NOAA) Global Monitoring Division (GMD) site at Barrow. Similarly, the HSRL provides profiles of aerosol backscatter, allowing us to evaluate vertical distribution of aerosol particles in clear sky conditions and the sub-cloud aerosol in non-precipitating overcast conditions. The AERI provides estimates of cloud microphysics (e.g. droplet and ice crystal effective radius and number concentration), liquid water path, and cloud emissivity. Together, these quantities are used to better characterize aerosol-cloud interactions in the Arctic. This evaluation will span a multi-year period of measurements, and will provide insight into these processes at Barrow and other Arctic observatories.

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1 Garrett, T.J. and C. Zhao (2006): Increased Arctic cloud longwave emissivity associated with pollution from mid-latitudes, *Nature*, **440**, 787-789.
2 Lubin, D., and A.M. Vogelmann (2006): A climatologically significant aerosol longwave indirect effect in the Arctic, *Nature*, **439**, 453-456.