Arctic-Winter Climatology and Radiative Effects of Clouds and Aerosols Based on Lidar and Radar Measurements at PEARL

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During the cold and dark Polar winter months, arctic regions are the site of interactions between aerosols, clouds, radiation and precipitations that are linked to intense cold anomalies and winter storms. The long-range transport and deep mixing into the arctic atmosphere of sulfur-enriched anthropogenic aerosols originating from northern regions result in the vast formation of thin ice clouds, which are characterized by fast-growing and precipitable crystals. This leads to significant enhancement of precipitation, atmospheric dehydration and infrared cooling with prominent climate feedbacks.

To study such processes, an algorithm is developed that identifies and classifies aerosol and cloud features based on data collected at the Polar Environment Atmospheric Research Laboratory (PEARL) at Eureka, Nunavut by an Automated High Spectral Resolution Lidar (AHSRL) and the Millimeter-Wave Cloud Radar (MMCR). The algorithm also provides radiative properties of clouds and aerosols, which are used to compute their radiative effects and heating rates by the Santa Barbara DISORT Atmospheric Radiative Transfer (SBDART) code. Results on the climatology and radiative effects of clouds and aerosols are presented for arctic winter months of recent years, and their implications to the study of climate change are discussed.