Arctic High Spectral Resolution Lidar Measurements of Aerosols and Clouds

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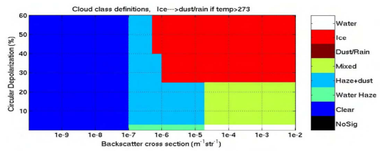
Introduction

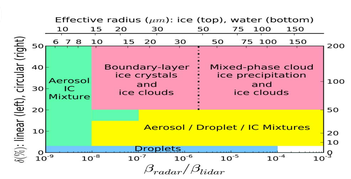
As part of the American Recovery and Reinvestment Act (ARRA) of 2009, the DOE ARM program deployed a new ground-based Arctic High Spectral Resolution Lidar (AHSRL) at the North Slope of Alaska (NSA) site. This lidar, which is based on the AHSRL that was part of the NOAA's SEARCH (Study of Environmental Arctic Change) contribution to the Canadian Network for the Detection of Atmospheric Change (CANDAC) facility at Eureka, Nunavut Territory, is an autonomous lidar that provides calibrated profiles of particulate (i.e. aerosol and cloud) backscatter cross section, optical thickness and circular depolarization at 532 nm. The AHSRL provides measurements of both intensive and extensive particulate properties. The intensive parameters depend only on the nature of the particles (size, composition, shape), not on the quantity or concentration. Here we show examples of the AHSRL data during both clear and cloudy conditions to show how these measurements can be used to depict aerosols and clouds over the NSA.

AHSRL Analysis

The AHSRL measurements of particulate backscatter and depolarization were used to discriminate and identify ice, liquid water, and aerosol (e.g. dust, pollution) with a simple classification scheme developed at the Univ. of Wisconsin. High values of depolarization correspond to nonspherical particles such as dust and ice while low values correspond to spherical particles (e.g. haze, liquid water). High values of backscatter correspond to clouds. Some examples of these classifications are shown below.



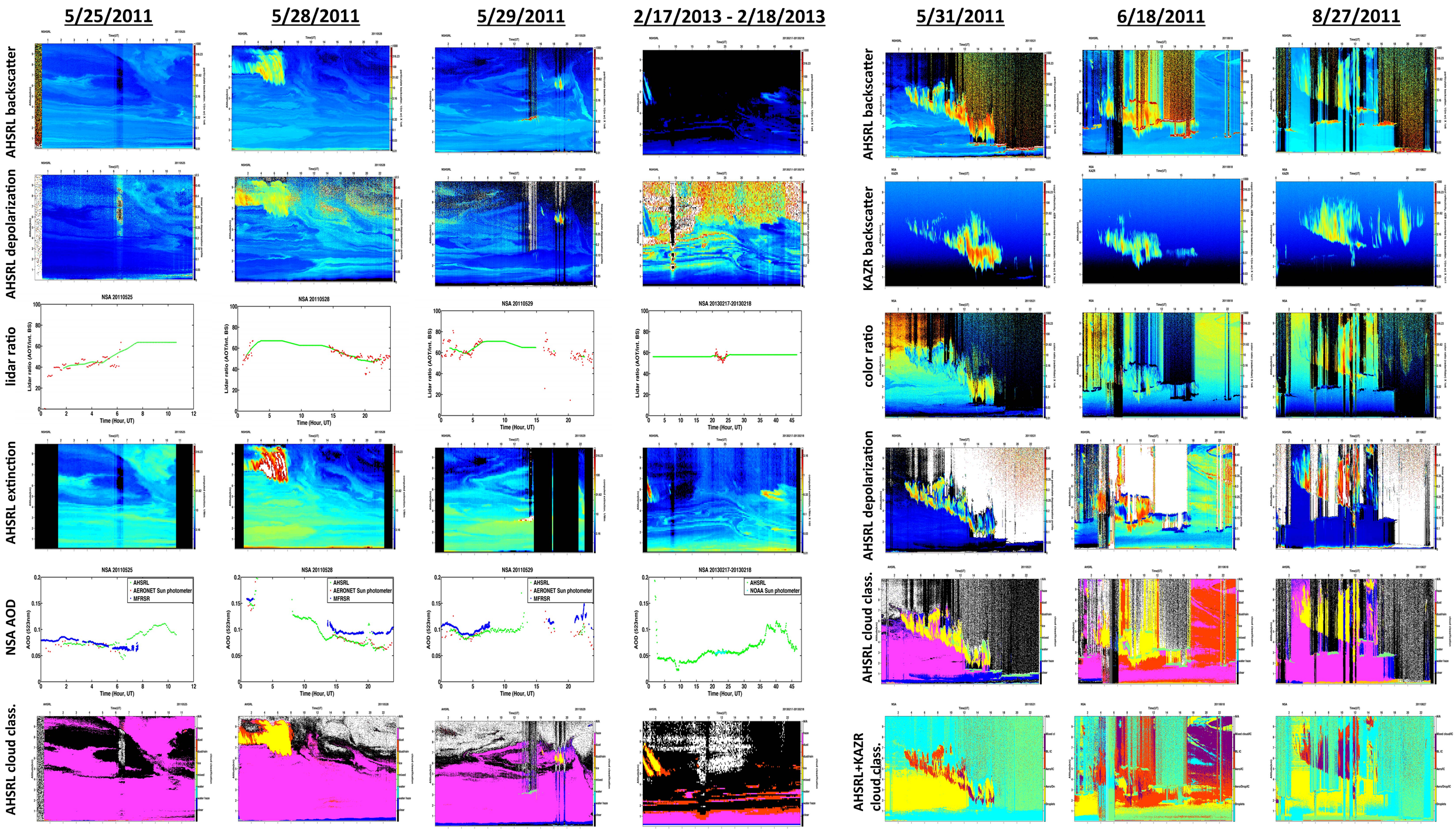
The AHSRL measurements were also combined with data from the Ka-band ARM zenith radar (KAZR) to help study the distributions and properties of clouds over the NSA. KAZR reflectivity measurements were combined with the AHSRL backscatter measurements to compute backscatter color ratios which were then used with the AHSRL depolarization measurements to classify the aerosols and clouds over the NSA. This classification scheme is described by Bourdages et al. (2009)



Aerosol extinction/ backscatter ratios were computed using the AHSRL integrated backscatter profiles and column aerosol optical thicknesses provided by the ARM Sun photometer and MFRSR instruments as well as by NOAA Carter-Scott Sun photometers. These lidar ratios were used to compute aerosol extinction profiles and optical thickness.

Summary

- ASHRL measurements are being used to study aerosol and cloud distributions over the NSA site.
- AHSRL and KAZR measurements are used to help classify aerosols and clouds
- AHSRL measurements are combined with Sun photometer measurements to derive aerosol optical thickness and aerosol extinction profiles

Acknowledgements

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