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SHORTWAVE SURFACE SPECTRAL IRRADIANCE MEASURED AT NSA DURING ISDAC

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ABSTRACT

The Indirect and Semi-Direct Aerosol Campaign (ISDAC) will likely play a major role in improving our understanding of mixed-phase cloud microphysics and its response to natural and anthropogenic aerosol forcing. This improved physical understanding is critical for enabling global climate models to more accurately simulate present-day arctic climate and to predict climatic responses of global concern such as sea ice loss. Two key components in realizing ISDAC's scientific objectives are (1) assessment of how cloud microphysical properties measured in the field impact the surface radiation budget, and (2) ability to validate new cloud microphysical models in terms of their realism in simulating the surface radiation budget. These components were addressed by a shortwave spectroradiometer (Analytical Spectral Devices, Inc.) deployed at the North Slope of Alaska (NSA) from 01 April through 01 June, 2008. The instrument measured downwelling spectral irradiance with 3-nm resolution between 350-1000 nm, and 10-nm resolution between 1000-2200 nm, thus revealing how solar radiation is transmitted to the arctic surface through cloud in all the major shortwave atmospheric windows. Spectra were recorded as one-minute averages during nearly all daylight hours throughout ISDAC, and hence there are useful data under every aircraft overflight covering the Barrow, Alaska, region. We have developed a radiative transfer algorithm to analyze this spectral irradiance data set. We find that the 1.0 and 1.2 micron windows are more useful than the visible for inferring cloud optical depth, due to lower surface albedo at these longer wavelengths. The surface irradiance in the 1.6 and 2.2 micron windows are very sensitive to predominant cloud phase and effective particle size, with the spectral irradiance proving potentially more cloud phase discrimination information than band-integrated irradiance. Specific examples under the ISDAC "golden days" of 08 and 26 April will be discussed. Also discussed will be the relative fractions of this late-spring season under which surface shortwave radiation was influenced mainly by the ice phase relative to liquid water in arctic stratiform clouds.