SHORTWAVE SURFACE SPECTRAL IRRADIANCE MEASURED AT NORTH SLOPE OF ALASKA DURING THE INDIRECT AND SEMI-DIRECT AEROSOL CAMPAIGN (ISDAC)

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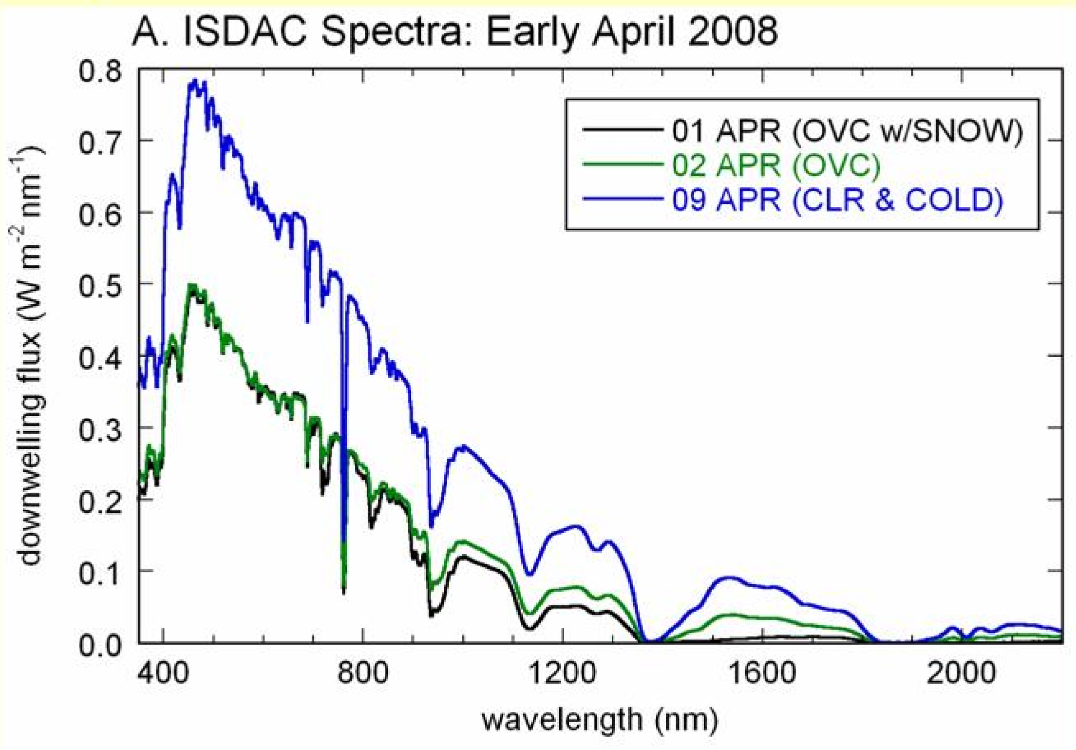
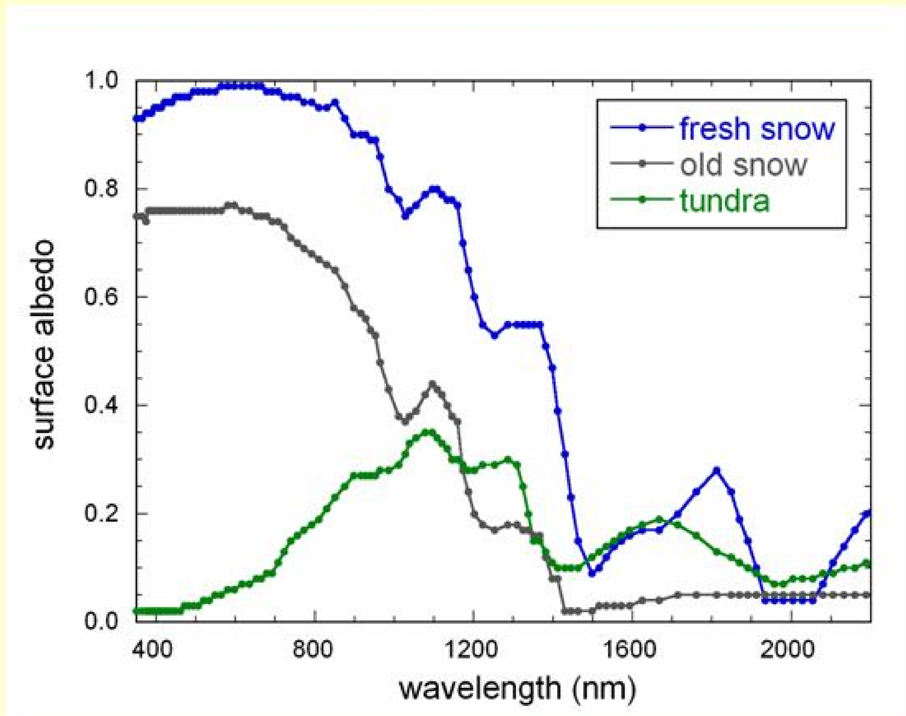
BACKGROUND

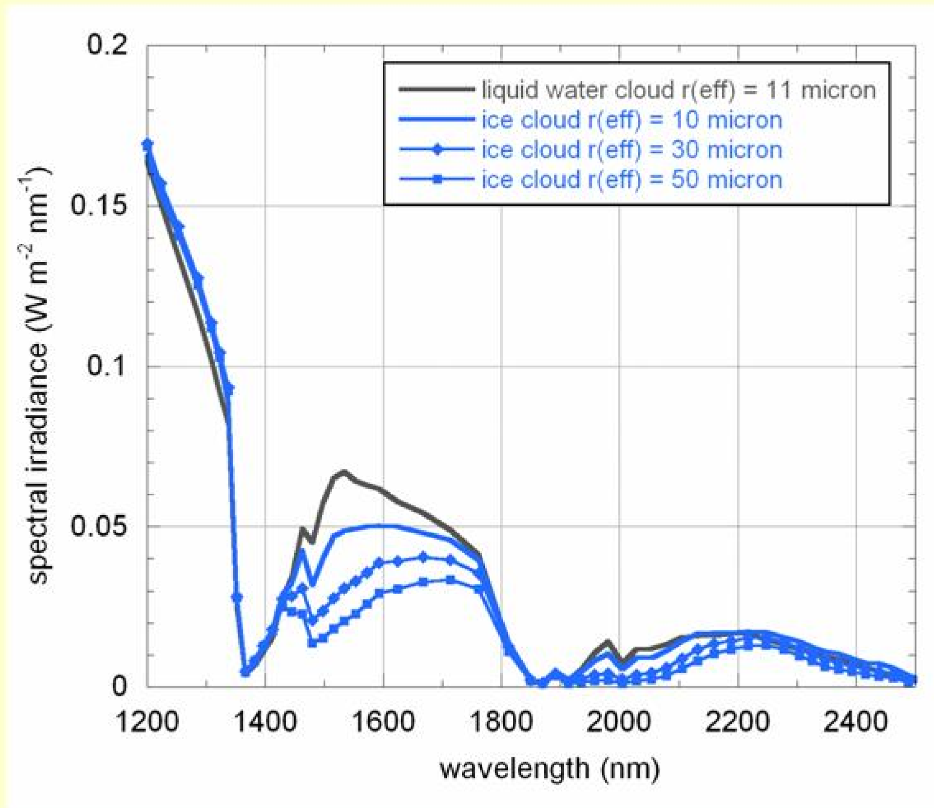
- During April 2008 the US Department of Energy Atmospheric Radiation Measurement (ARM) program conducted a field program called the Indirect and Semi-Direct Aerosol Campaign (ISDAC). ISDAC's objectives involved detailed observations of cloud nucleation and modification by "Arctic haze," using research aircraft and supplemental microphysical and radiometric instrumentation at the ARM North Slope of Alaska (NSA) site at Barrow.

- We deployed an Analytical Spectral Devices (ASD, Inc.) spectroradiometer at NSA from 01 April – 01 June, 2008. This instrument measured downwelling surface irradiance in the spectral interval 350-2200 nm, recording spectra every minute throughout the campaign.

1) RADIATIVE TRANSFER INTERPRETATION OF ASD DATA

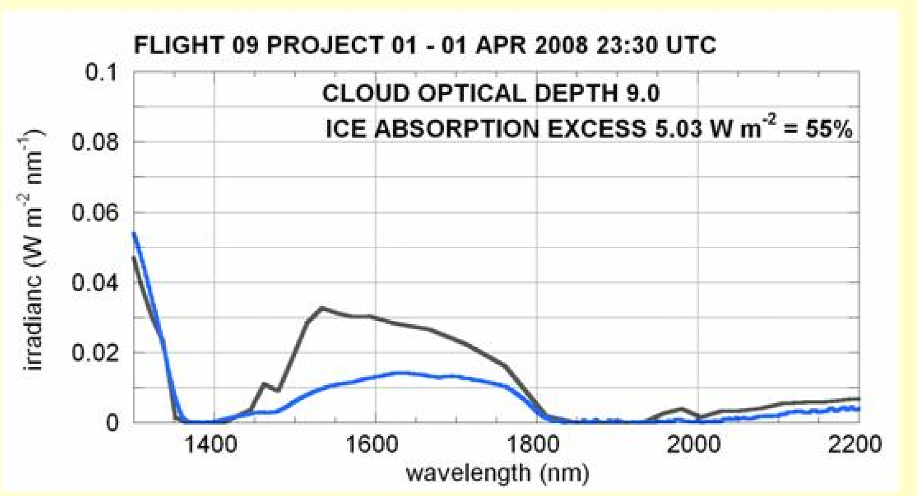


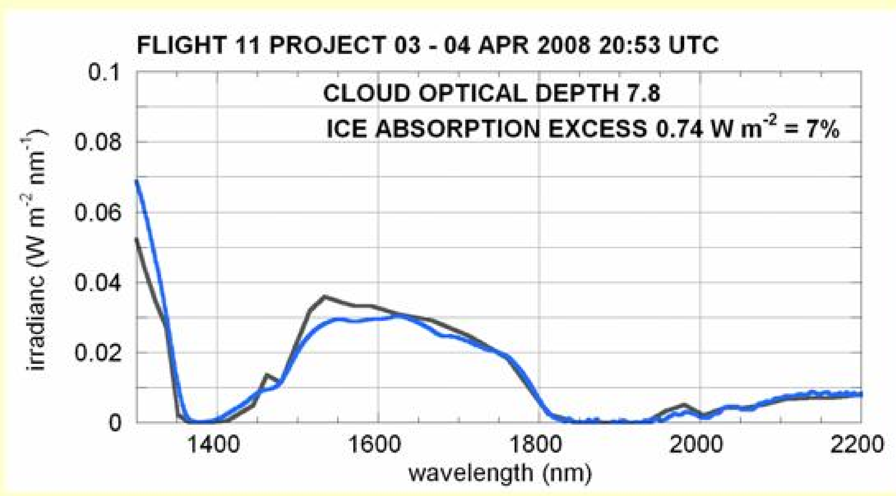


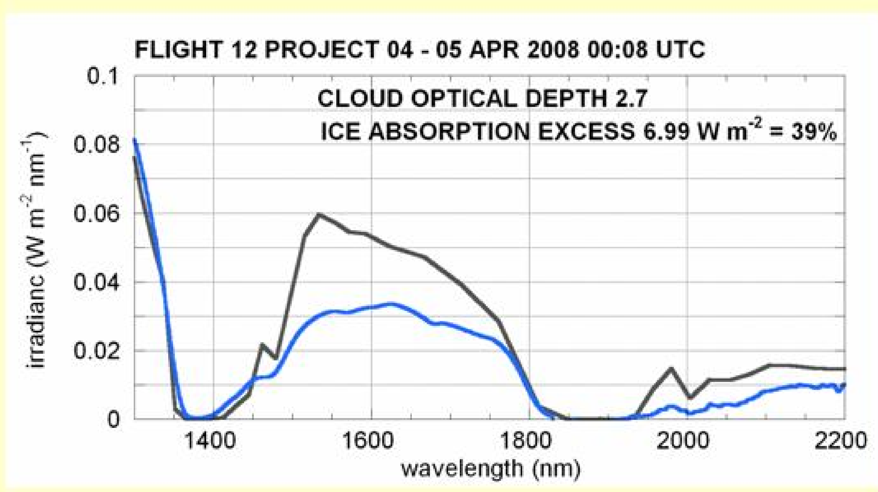


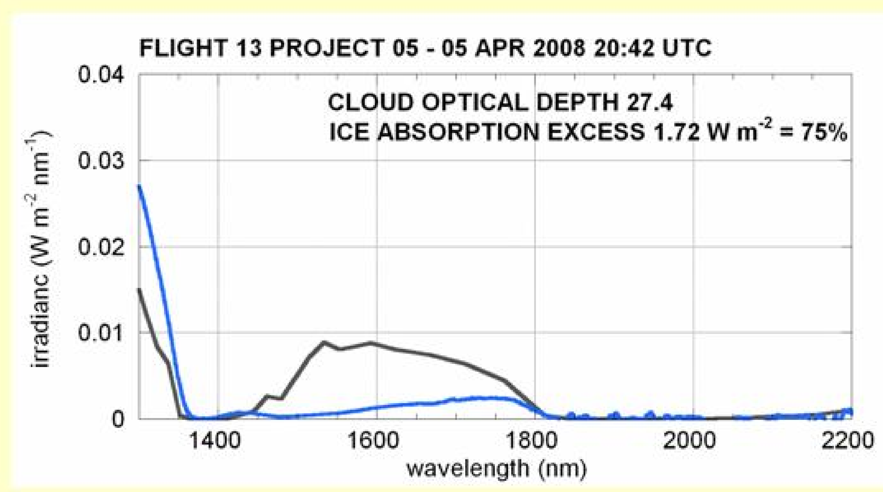
- To survey the ASD data (above are three examples from thousands of spectra), we use a discrete-ordinates based radiative transfer model (Stamnes *et al.* 1988; Lubin and Vogelmann, 2007) to solve for the conservative scattering cloud optical depth at 1000 nm, where the decreasing albedo of the snow surface (Perovich *et al.*, 2002) allows for sensitivity in surface flux to varying cloud optical depth.

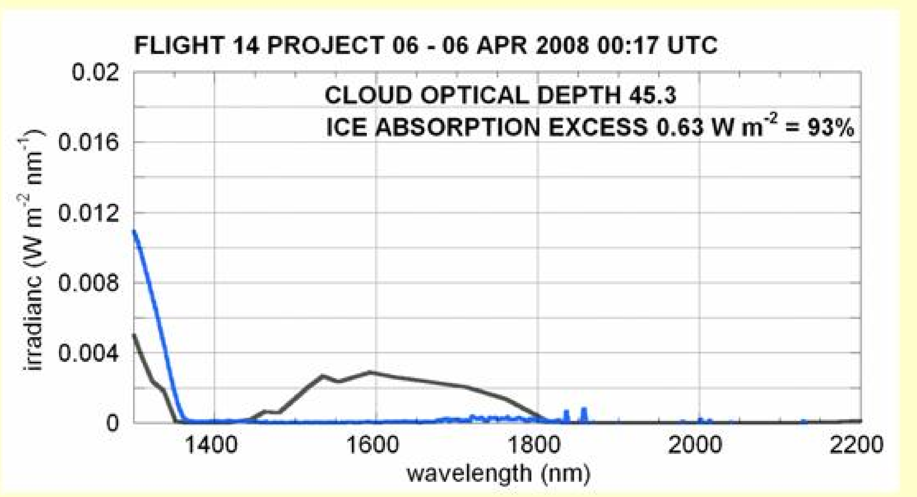
- We then note that, for a fixed conservative scattering cloud optical depth (5 in the above example, with solar zenith angle 60°), the presence of ice in the cloud yields more shortwave absorption in the near-infrared windows than would prevail under a liquid water cloud alone. The size of the ice particles affects the total additional NIR absorption and the spectral dependence in the surface irradiance (flux).

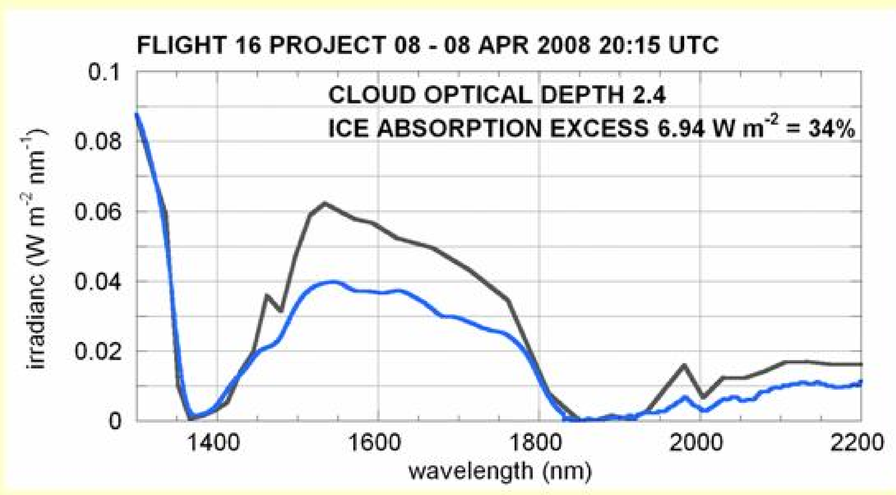


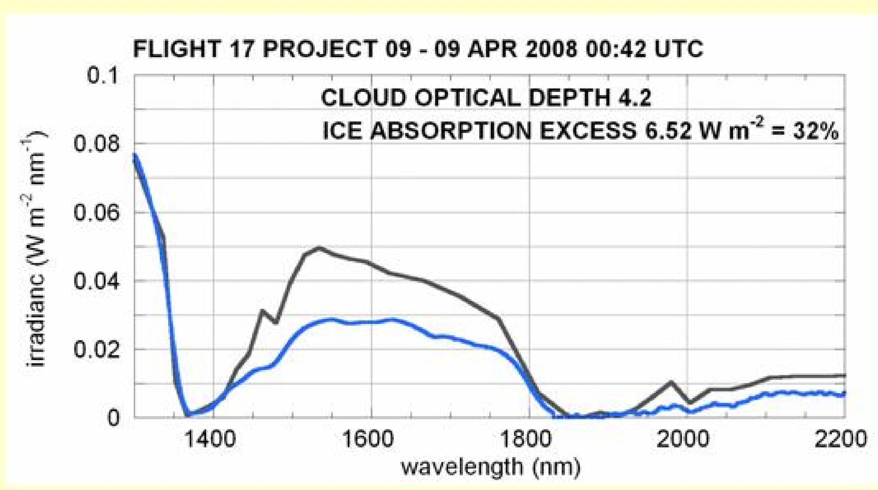


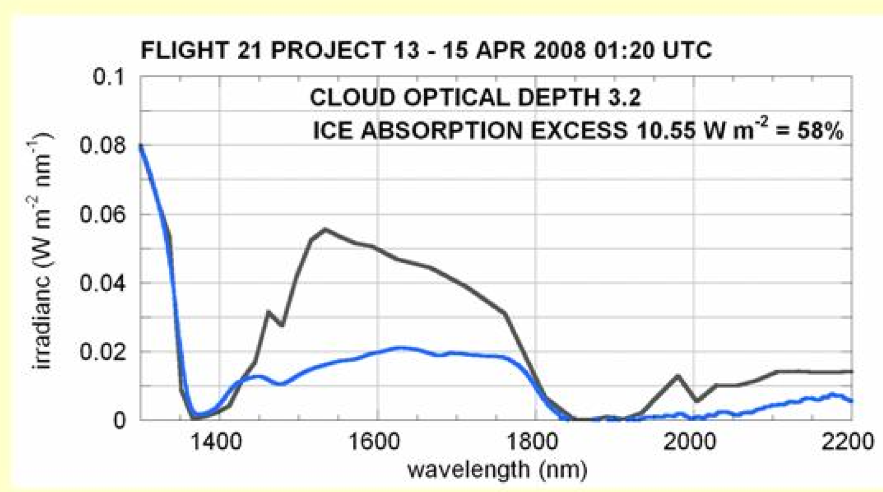


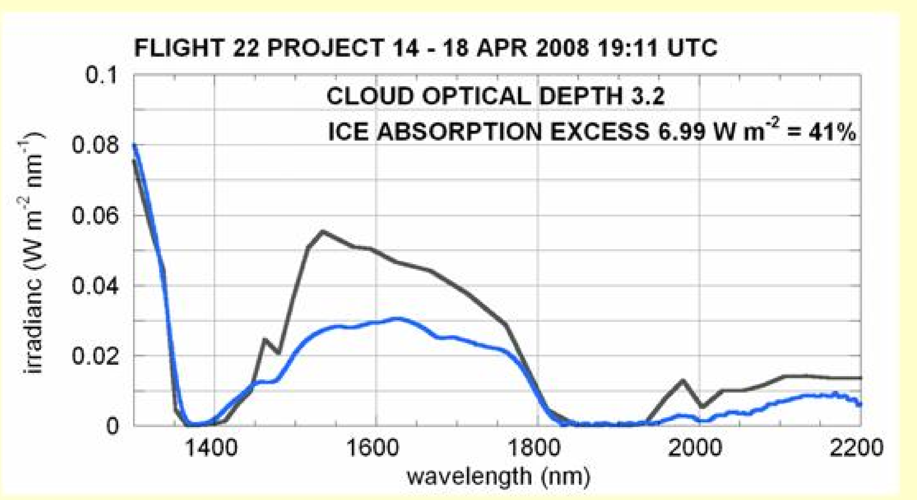


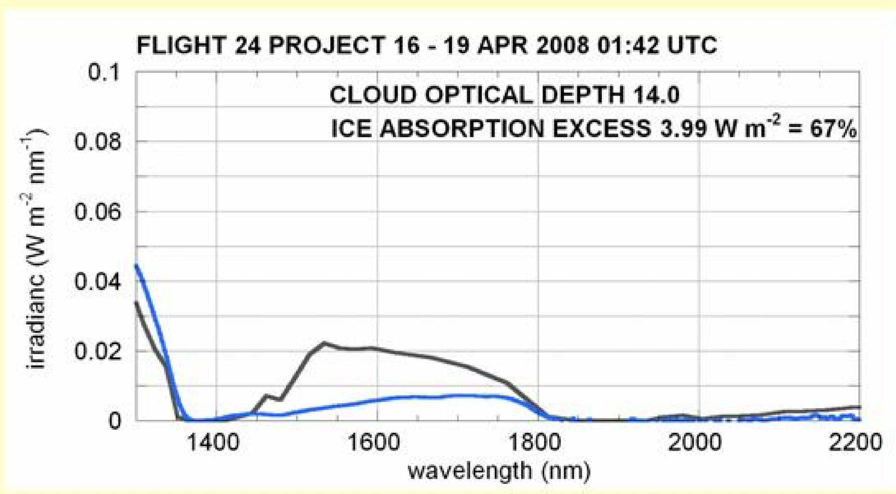


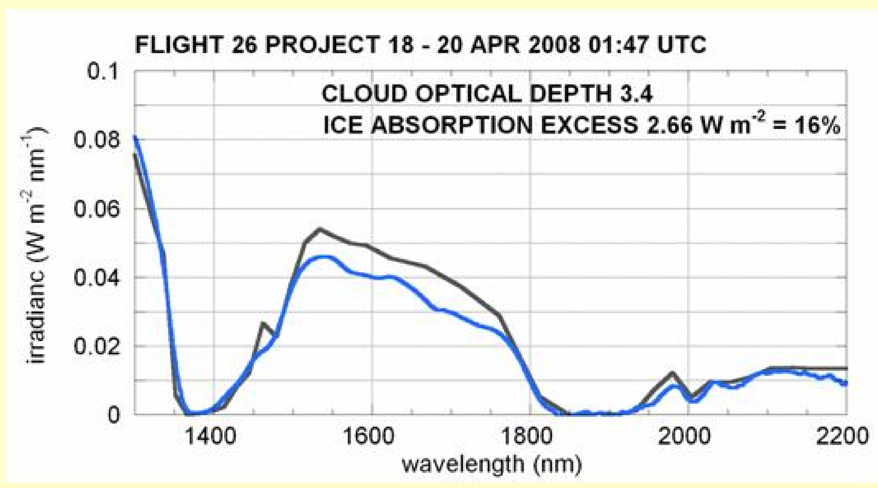


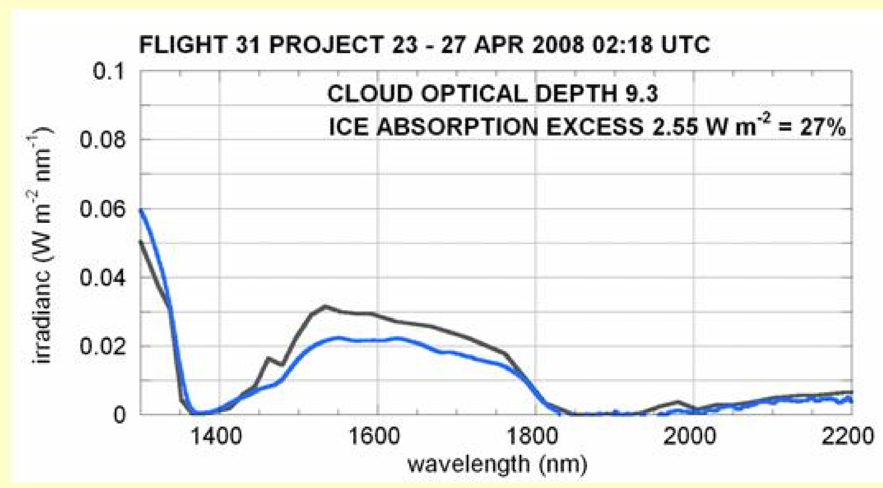


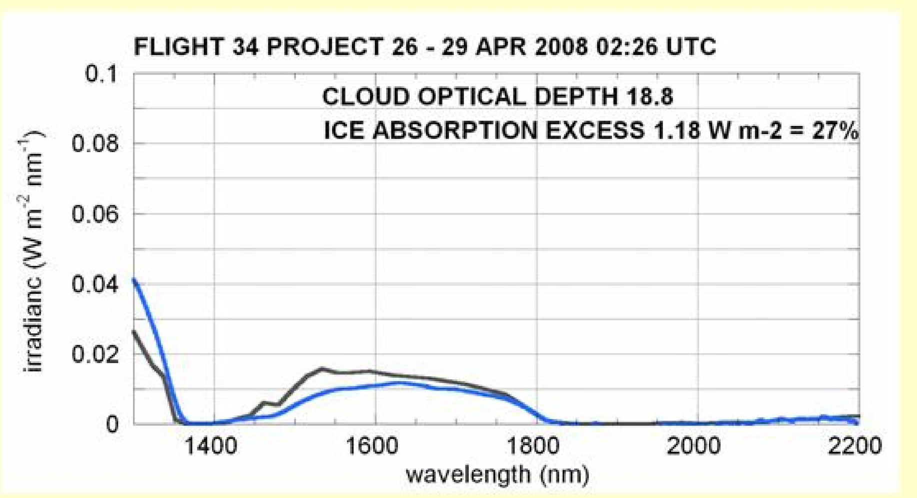


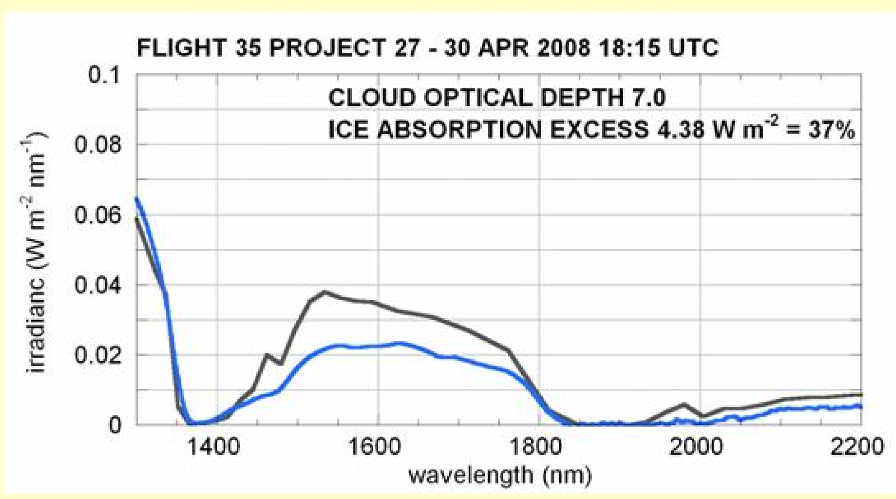












- We define the ***ice absorption excess*** as the difference between the flux that would prevail under a theoretical pure liquid water cloud having the optical depth as derived from the data at 1000 nm and the actual measured flux throughout the NIR. For wavelengths shorter than 1200 nm, this difference is negligible because cloud scattering is essentially conservative. In the NIR windows, however, we readily notice the excess cloud absorption due to ice water content in the majority of the ISDAC data obtained during April 2008. The above are examples of spectra recorded under some of the various flights. These examples all have the same solar zenith angle (67°). In some spectra (flights 11 and 26) the influence of ice is relatively small; but in most of these examples, the ice absorption excess is large enough to have climatological significance. We are interested in further comparison of this analysis with the actual aircraft cloud microphysical data from ISDAC.

MANUSCRIPT

Lubin, D., and Vogelmann, 2010: Influence of cloud microphysics on spectral shortwave surface irradiance in the Arctic. *J. Geophys. Res.*, in preparation.

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ACKNOWLEDGEMENTS

Supported by the ARM Program under ISDAC, and by the NSF Arctic Natural Sciences (ANS) Program. We thank Jeff Zirzow (Sandia National Laboratory) and Walter Brower and his NSA technical staff for their valuable assistance.

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