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Difficulties in Determining Surface Fluxes in the Polar Regions

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Determination of surface fluxes of energy and water requires accurate information about the surface (albedo, emissivity, temperature, “wetness”, “roughness”), the near-surface atmosphere (temperature, humidity, windspeed) and other meteorological factors (cloud properties, precipitation), regardless of whether the source of this information is from satellites. Moreover, to avoid systematic errors in flux estimates, the diurnal and weather-scale variations of these properties **and** their correlations must be known. Determination of surface fluxes in the polar regions is more challenging than for most other regions because most of the instrumentation used to measure these quantities is working near its sensitivity limits, because the fluxes themselves are relatively small, though important, and because the contrasts between the atmosphere and surface are either small in magnitude and/or reversed in sign from the usual situation. Adding to all of these challenges is the fact that the surface temperature and fluxes can be much more sensitive to changes in cloudiness, even in the dark, and change rapidly, requiring high time resolution to resolve them properly. At other times, the energy of water phase changes mediates time variations of the surface temperature but alters the fluxes significantly. Some of these difficulties will be illustrated using current satellite products but the emphasis will be on the latter two points that will be illustrated using field measurements from SHEBA.