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The Arctic cloud-atmospheric boundary layer-surface (CAS) system: A system of closely linked processes

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The Arctic lower troposphere represents a sensitive balance between surface, Arctic boundary layer, and cloud processes, forming a cloud-ABL-surface (CAS) system. The CAS system must be considered as a coupled system, since clouds, boundary layer, and surface processes are closely linked. For example, cloud fraction, height, phase, and other properties determine the cloud radiative properties. Cloud radiation has an enormous impact on the surface radiative fluxes as well as on atmospheric stability at cloud top, within the cloud, and below cloud base. Surface energy fluxes, which include turbulent fluxes as well as radiative fluxes, are strongly influenced by surface properties and impact the stability of the near-surface Arctic boundary layer. Boundary-layer stability in turn affects moisture and heat transport from the surface upward and from above the cloud top downward. This heat and moisture transport affects the cloud formation processes, completing the cycle. Changes and interactions within this CAS system produce climatologically significant impacts on, for instance, sea-ice extent.

Using both observations and model results from the Polar Research Group at ESRL/PSD, this presentation will quantitatively illustrate some of the interactions in the CAS system, including the effects of changing microphysics on the surface fluxes and the boundary-layer structure, and the advantages of CAS process relationships for validating models and reanalysis data.