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The thermodynamic structure of summer Arctic stratocumulus and the dynamic coupling to the surface.

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The vertical structure of Arctic low-level clouds and Arctic boundary layer is studied, using observations from ASCOS (Arctic Summer Cloud Ocean Study), in the central Arctic, in late summer 2008. Two general types of cloud structures are examined: the "neutrally-stratified" and "stably-stratified" clouds. Neutrally-stratified are mixed-phase clouds where radiative-cooling near cloud top produces turbulence that creates a cloud-driven mixed layer. When this layer mixes with the surface-generated turbulence, the cloud layer is coupled to the surface, whereas when such an interaction doesn't occur, it remains decoupled; the latter state is most frequently observed. The decoupled clouds are usually higher compared to the coupled; no difference in thickness or cloud water properties between the two cases is found. In addition, the surface fluxes are very similar for both states, suggesting that the observed cloud thermodynamic state is not driven by changes in the magnitude, or sign, of the surface fluxes. It is more likely that displacements downwards (upwards) of the cloud layer could is the leading factor that produces coupling (decoupling), which would instead be related more to the mesoscale weather patterns and advected thermodynamics. Advection of additional cloud layers aloft, in the free troposphere, could also alter the cloud-top cooling and thus affect the strength of the mixing and hence the subcloud mixed-layer (SML) depth; this is also mostly tied to meso- or synoptic scale motions. Furthermore, the decoupled clouds exhibit a bimodal thermodynamic structure, depending on the depth of the SML: clouds with shallower SMLs are disconnected from the surface with weak inversions, whereas those that lay over a deeper SML are associated with stronger inversions at the decoupling height. Neutrally-stratified are generally precipitating clouds; the evaporation/sublimation of precipitation often enhance the decoupling state. Finally, stably-stratified clouds differ substantially from neutrally-stratified in both thermodynamic and microphysical structure, as well as in geometry and water properties. They are geometrically and optically thin, often single-phase liquid clouds with no or negligible precipitation falling out. Some of these cases, based on their proximity to the surface and tenuous nature, represent fog.