Session: C5 Poster: M178A

Arctic boundary-layer cloud observations from Terra MISR and CALIOP

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Clouds might play a critical role in sea ice loss in the Arctic Ocean because of their potential positive feedback in autumn and winter, but reliable observations in the Arctic basin remain lacking. Continuous observations of boundary-layer clouds are not readily obtained from in-situ techniques, especially near ice edges, and therefore satellite remote sensing has been the major data source for studying spatial distribution of cloud over the Arctic Ocean. Terra MISR stereoscopic technique is used in this study to provide very accurate cloud top height and wind measurements for these low-level clouds, while other passive satellite techniques have difficulties distinguishing between clouds and snowy/icy surfaces and have relatively poorer vertical resolution. More than a decade-long data record of MISR cloud observations shows that autumn low cloud cover has been increasing steadily at a rate of 2.18% per year over Beaufort and East Siberian Seas, partly because of more open water in the Arctic Ocean. This increase is confirmed with Cloud-Aerosol Lidar with Orthogonal Polarization (CALIOP) cloud measurements. To show that the marginal sea ice zone (MSIZ) has a significant impact on atmospheric boundary layer (ABL) and cloud development, we also examine several roll cloud cases to better understand ABL dynamics in this region. In the MSIZ, background winds, roll cloud length and height, and roll scale periodicity are derived from MISR data with high precision and spatial resolution, revealing interesting interactions among clouds, sea ice, and ABL winds.