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Characterization of mixed-phase clouds using remote sensing and vertical soundings

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Mixed-phase clouds (MPC) consist of both liquid droplets and ice crystals at temperatures below 0 deg C. Observations show that such clouds are present in many regions of the world, have seasonal variations, and account for a significant fraction of the global cloud coverage. They can impact cloud electrification and aircraft icing. The mix consisting of ice particles, liquid droplets, and water vapor, is unstable, and such clouds tend to have a relatively short lifetime in most situations at mid-latitudes. In contrast, observations of low-level stratiform MPC in Arctic regions revealed remarkable persistence, with significant potential impact on radiative fluxes. The phase composition of MPC is essential for cloud parameters retrievals by radar and lidar and is particularly relevant for climate modeling. It is influenced by cloud condensation nuclei (CCN), ice nuclei (IN) particles, cloud dynamics, and has implications for the cloud life cycle. The complexity of dynamics and microphysics involved in MPC is addressed with new observational and modeling tools. Among these techniques, the remote sensing methods provide an increasing set of parameters, covering large regions of the world. Satellite data and aircraft in situ measurements in deep convective clouds suggest that highly supercooled water droplets can exist in strong continental convective storms. In this study, we show cases of convective clouds and discuss the possibility of MPC characterization using ground based radar and satellite remote sensing data, aided by vertical sounding analysis.