Airborne Dual-Frequency Radar Observations of Arctic Clouds during COMPEX

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Airborne cloud radar observations provide vertically resolved measurements of clouds and precipitation in the Arctic, where shallow mixed-phase clouds and low-level precipitation remain difficult to observe and represent in models. The airborne campaign COMPEX (Clouds over cOMPlEX environment) was conducted in March and April 2026 from Longyearbyen, Svalbard, to investigate cloud and precipitation structures over open ocean, the marginal sea ice zone, and closed sea ice. In total, 15 research flights were performed, covering a range of meteorological conditions and surface types. The measurements target regimes relevant for radar remote sensing, including weak reflectivity signals from shallow clouds, snowfall, and vertical structures within the lowest kilometer of the atmosphere.

The Polar 5 research aircraft was equipped with a dual-frequency cloud radar system combining G- and W-band measurements. This configuration provides reflectivity at two frequencies, enabling increased sensitivity to small hydrometeors and the analysis of dual-frequency signatures for cloud phase and microphysical characterization. The differential absorption radar technique at G-band further constrains water vapor attenuation and enables retrievals of in-cloud and sub-cloud humidity profiles. The radar observations are complemented by additional active and passive sensors and a dropsonde system, allowing multi-sensor analyses of cloud and precipitation processes.

Coordinated flights with EarthCARE overpasses were achieved, providing collocated observations for evaluating spaceborne radar measurements. The dataset allows assessment of radar sensitivity, attenuation effects, and sampling limitations, including blind-zone impacts on shallow cloud and precipitation detection. This presentation provides an overview of the campaign and first analyses of airborne radar reflectivity and dual-frequency signatures, with a focus on their relevance for interpreting spaceborne radar observations in complex Arctic environments and for cloud microphysical studies.