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Aircraft observations of ultrafine particles and CCN from the boundary layer to the free troposphere in the Arctic summertime

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The Arctic is one of the regions most sensitive to climate change. The shrinking extent of sea ice during the Arctic summertime increases the area covered by open ocean, which likely impacts Arctic aerosol, cloud properties, and thus climate. In this context extensive aerosol measurements (aerosol composition, particle number and size, cloud condensation nuclei, and trace gases) have been made during the NETCARE 2014 summer campaign from the Polar 6 aircraft. The Polar 6 is an adopted DC-3 aircraft owned by the Alfred Wegener Institute in Bremerhaven, Germany. In July 2014 eleven flights were conducted out of Resolute Bay. Flights included vertical profiles from as low as 60 m up to 3 km, as well as several low-level flights covering diverse terrains such as open ocean, fast ice, melt ponds, and polynyas. Here we discuss the vertical distribution of ultrafine particles (UFP, dp: 5 – 20 nm), size distributions of larger particles (dp: 20 nm to 1 μm), and cloud condensation nuclei (CCN) in relation to different meteorological conditions and terrains. UFPs have been observed predominantly within the boundary layer, where concentrations reached several hundreds and occasionally even a few thousand particles per cubic centimeter. Highest concentrations were observed above open ocean and at the top of low-level clouds. During such events, the dominant mode of the size distribution was below 20 nm. However, in a few cases this ultrafine mode extended to sizes larger than 40 nm, suggesting that these UFP can grow into the CCN size range and thereby impact cloud properties and become climatically relevant.