Aerosol-cloud interaction in the Arctic: The annual cycle of cloud residuals measured at Zeppelin Observatory on Svalbard

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Aerosols and their interaction with clouds remain to contribute to the large uncertainty in aerosol radiative forcing. The uncertainties are especially large for the Arctic, where climate change manifests most and observations are very sparse.

Within this work, we have analyzed the first continuous measurement of cloud residuals from low-level Arctic clouds using a ground-based counterflow virtual impactor inlet. This inlet separates cloud droplets or ice crystals from non-activated aerosol and allows a detailed study of their microphysical properties such as their size distribution and number concentration. We find that the seasonal behavior of cloud residuals and ambient aerosols follows a similar annual cycle, although the springtime peak concentration is shifted by around one month. This highlights the importance of meteorological conditions and water vapor needed for cloud activation. We also find frequently ultrafine particles as small as 15 to 30 nm (in particle diameter) within the cloud residuals size distribution. In relative terms, these ultrafine particles are more important in winter months and are possibly linked to ice particles within clouds. These findings have potentially important implications for climate modelling and for the understanding of low-level clouds in the Arctic.