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Ground based in situ measurements of arctic cloud microphysical and optical properties at Mount Zeppelin (Ny-Alesund Svalbard)

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The high sensitivity of the polar regions to climate perturbation, due to complex feedback mechanisms existing in this region, was shown by many studies (Solomon et al., 2007; Verlinde et al., 2007; IPCC, 2007). In particular, climate simulations suggest that cloud feedback plays an important role in the arctic warming (Vavrus 2004; Hassol, 2005). Moreover, the high seasonal variability of arctic aerosol properties (Engwall et al., 2008; Tunveld et al., 2013) is expected to significantly impact the cloud properties during the winter-summer transition. Field measurements are needed for improved understanding and representation of cloud-aerosol interactions in climate models.

Within the CLIMSLIP project (CLimate IMpacts of Short-LIved Pollutants and methane in the arctic), a two months (March-April 2012) ground-based cloud measurement campaign was performed at Mt Zeppelin station, Ny-Alesund, Svalbard. The experimental set-up comprised a wide variety of instruments. A CPI (Cloud Particle Imager) was used for the microphysical and morphological characterization of ice particles. Measurements of sized-resolved liquid cloud parameters were performed by the FSSP-100 (Forward Scattering Spectrometer Probe). The Nevzorov Probe measured the bulk properties (LWC and IWC) of clouds. The Polar Nephelometer (PN) was used to assess the single scattering properties of an ensemble of cloud particles. This cloud instrumentation combined with the aerosol properties (size distribution and total concentration) continuously measured at the station allowed us to study the variability of the microphysical and optical properties of low level Mixed Phase Clouds (MPC) as well as the aerosol-cloud interaction in the Arctic. Typical properties of MPC, snow precipitation and blowing snow will be presented. First results suggest that liquid water is ubiquitous in arctic low level clouds. Precipitations are characterized by large (typically 1 mm sized) stellar and pristine shape particles whereas blowing snow is typically composed of 250 μm irregular ice crystals. This dataset will be used to test physically based representations of the relationships between particle size, shape and optical properties and to investigate dominant microphysical processes occurring in MPC using detailed microphysical modeling. Moreover, carbon monoxide measurements allow us to compare polluted with clean cases. The cloud-aerosol interactions processes which take place during the transport of polluted air masses from mid-latitude to the Arctic is thus assessed.