



In-situ Measurements of Microphysical & Optical properties of Cirrus Clouds during BATAL Campaign

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Clouds significantly impact Earth's radiation budget and hence its climate. Radiative effects of clouds depend on their macrophysical (altitude, coverage and thickness) and microphysical properties (number concentration, size and shape-distributions of cloud droplets/ice-crystals). However, the microphysical representation of clouds, especially the extremely cold and thin cirrus clouds in the global climate model is poor owing to the uncertainties involved in the size distribution and number concentration of ice-crystals having size less than 100 μm . The mechanisms involved in their formation, maintenance and decay are also not well understood.

Under the framework of Balloon measurement campaigns of Asian Tropopause Aerosol Layer (BATAL), size distribution of cloud droplets and ice-crystals inside cloud layers were measured over TIFR Balloon Facility at Hyderabad in India during August 2017 by using an optical particle counter called Boulder Counter. Boulder counter can count particles at six different size bins (5, 10, 25, 40, 50 and 100 μm) at a flow rate of 28.3 Litres per minute. Simultaneous measurements from Boulder counter and a backscatter sonde called COBALD reveal the presence of multi-layered clouds with a 2 km thick cirrus cloud layer located at extremely cold conditions (-86 °C) of tropopause. The top of this cloud layer is found to cross the cold point tropopause (at 17.8 km). Majority of ice-crystals in this cloud are having size between 5 and 10 μm . However, a small concentration of particles with size between 25 and 40 μm are also present near the bottom of the cloud exhibiting the effect of aggregation and subsequent sedimentation. This study also investigates the formation mechanism of this cloud layer using back-trajectory analyses and their intersection with convection. Significance of such measurements during Asian Summer Monsoon in the context of cross tropopause transport of water vapour will also be presented.