Vertical profiling of aerosol and cloud properties during Pallas Cloud Experiment 2015

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Clouds are a major component in the global hydrological cycle, since they store, transport and redistribute water. They also contribute to global energy balance through reflecting, transmitting and reradiating solar energy. Cloud properties (e.g. albedo, precipitation rate and lifetime) depend, amongst other factors, on the number concentration of aerosol particles and on their chemical composition (e.g. Lohmann and Feichter, 2005). Clouds, and their interaction with the environment, are in general investigated through two types of measurements: a) in-situ, airborne or ground-based campaigns or b) ground-based remote-sensing techniques (i.e. lidar, ceilometer and radar) and satellite.

During the Pallas Cloud Experiment (PaCE 2015) campaign conducted at the Pallas-Sodankylä (GAW; Hatakka et al., 2003) in Finnish sub-Arctic region we applied both above mentioned approaches for cloud measurements. We made vertical flight profiles using a FMI-owned Remotely Piloted Aircraft System (RPAS, Jonassen *et al.*, 2015) in vicinity of the Sammaltunturi fjeld at three locations with different above sea level altitudes: next to Pallasjarvi (300 m a. s. l.), Sammaltunturi foothills (440 m a. s. l.) and Kenttärova station (345 m a. s. l.).

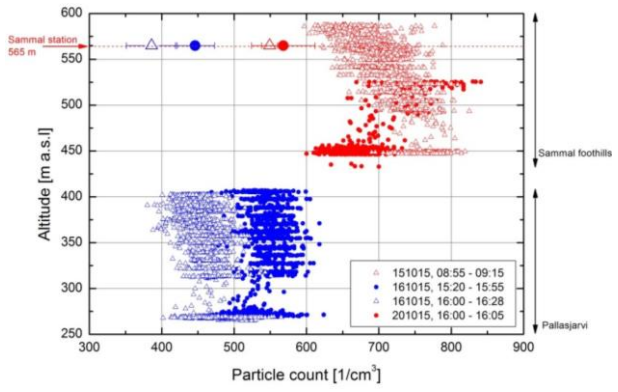

Figure 1. Example of vertical profiles of particle number concentration measured with CPC model 3007 on board of FMI-RPAS. Figure shows four profiles conducted at two different places, one in vicinity of Pallasjarvi and second at foothills of Sammaltunturi. The profiles are compared to ground-based measurements obtained at Sammaltunturi station (565 m a.s.l).

FMI-owned RPAS quadcopter platform carried on following set instruments: a CPC model 3007 (TSI Inc., USA), an OPS model 3330 (TSI Inc., USA), a micro-Aethalometer model AE51 (AethLabs, USA).

The vertical profiles were mutually compared to ground-based measurements conducted at the Sammaltunturi station which resides on the top of Sammaltunturi fjeld (565 m a. s. l.) and also data obtained from Kenttärova station, where the remote-sensing instruments (Lidar – Polly^{XT}, HALO- Lidar and cloud radar; O'Connor et al., 2005) were located.

Figure 1 shows an example of flights where we used a CPC model 3007 to measure particle number concentration. Two flights were done at Pallasjarvi and two flights at Sammaltunturi foothills. In three flights you can see the decreasing trend in particle number concentration with height, but one flight (solid red circles, Fig. 1.) has trend increasing, this is due to presence of cloud at foothills. The airborne data compare quite reasonably to data measured at the station, the station number concentration data were averaged over the flight duration. Unfortunately, there is no data available from a micro-Aethalometer, since the Arctic air is very clean and BC concentrations were below detection limits of the instrument.

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