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Airborne measurements performed by a light aircraft during Pegasos spring 2013 campaign

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To fully understand the chemical and physical processes in atmosphere, measuring only on-ground is not sufficient. To extend the measurements into the lower troposphere, the University of Helsinki has performed airborne campaigns since 2009. During spring 2013, a light aircraft was used to measure the aerosol size distribution over boreal forests as a part of the Pegasos 'Norhern Mission'. The aims of the measurements were to quantify the vertical profiles of aerosols up to the altitude of 3.5 km, to study the new particle formation in the lower troposphere, to measure the planetary boundary layer evolution, and to support the measurements performed by Zeppelin NT.

We used a Cessna 172 light aircraft as a platform. An aerosol and gas inlet was mounted under the right wing and the sample air was conducted inside the cabin where most of the instruments were placed. The aerosol measurement instruments included a TSI 3776 condensation particle counter (CPC) with a cut-off size of 3 nm, a Scanning Mobility Particle Sizer (SMPS), with a size range of 10-350 nm, and a Particle Size Magnifier (PSM) connected with a TSI 3772 condensation particle counter. As the properties of the PSM measuring in airborne conditions were still under testing during the campaign, the setups of the PSM varied between the measurements. Other instruments on board included a Li-Cor Li-840 H_2O/Co2-analyzer, a temperature sensor, a relative humidity sensor, and a GPS receiver.

Total amount of 45 flights with 118 flight hours were performed between 24th April and 15th June 2013. The majority of the flights were flown around SMEAR II station located in Hyytiälä, and when possible, the flights were synchronized with the Zeppelin flights. Simultaneously, an extensive field campaign to measure aerosol and gas properties was performed on-ground at SMEAR II station.

A time series of airborne aerosol data of around 1.5 months allows us to construct statistical vertical profiles of aerosol size distribution and of the total particle concentration, and compare them to the on-ground measurements. Also, the data set offers new information about the spatial variability of the boundary layer aerosols within a scale of tens of kilometers.

Our measurements performed by the light aircraft covered spatially larger area compared to the Zeppelin flight paths, and can thus provide information of the extend of the phenomena which on the other hand can be measured more in detail with the Zeppelin's more extensive instrumentation. We, for example, observed the spatial variety of the new particle formation in-line with the Zeppelin measurements.