Dataset name: **iCUPE Dataset (DS) from Deliverable 4.3.1:**

Datasets of validated aerosol vertical profiles from ground-based and satellite observations above selected sites in Finland and Siberia

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In the iCUPE task 4.3, poorly known sources and sinks of key atmospheric species are investigated via the combined analysis of satellite and in situ data as well as regional modeling. We focus on improved quantification of sources and origins of pollution in the Eurasian Arctic, and in particular Siberia, where sources of trace gases and aerosols are very poorly known. The main results of this work are published in Ancellet et al. 2019 and Nikandrova et al. 2018.

Russia: Tomsk data

An eye safe CIMEL CE372 lidar was installed in Tomsk in April 2015 to obtain continuous measurements of cloud and aerosol backscatter vertical profiles. The lidar was first installed on the roof of the Institute of Atmospheric Optics (IAO) for four months (April–August 2015) before being moved to a thermostatically controlled box at Fonovaya Observatory, 50km west of Tomsk (September 2015 to August 2016). It was then re-installed on the IAO roof for one month in September 2016 before being shut down for several months of maintenance. The lidar was installed near the local AERONET sun photometer to obtain an independent measurement of the total AOD.

Figure 1. Description of the Fonovaya station taken from Antonovich et al., 2018.

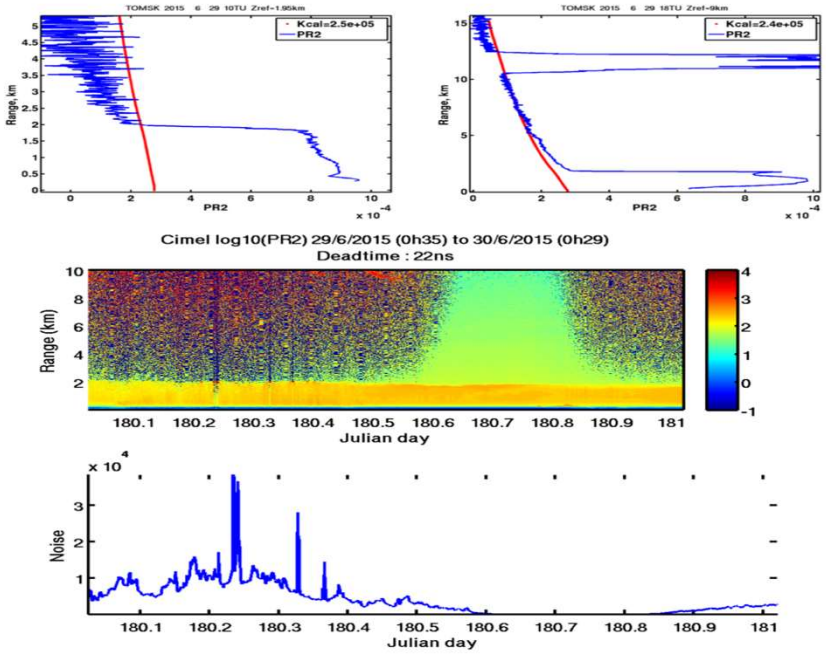

Figure 2. Example of daily lidar time/altitude cross section of the total attenuated backscatter (bottom) and example of daytime and nighttime 30 min vertical profiles compared to the molecular backscatter in red.

The CIMEL lidar 372 processed data (AOD, backscatter ratio) are available on the LATMOS data server and can be provided on request. The 18-month calibrated lidar data for Tomsk are available at the following ftp address (see below for Data access and registration): ftp://ftp.icare.univ-lille1.fr/GROUND-BASED/Tomsk/

Finland: SMEAR II data

Ground-based HSRL (High Spectral Resolution Lidar) was deployed at the SMEAR II station as a part of BAECC (Biogenic Aerosols – Effects on Clouds and Climate) campaign that took place from January to September 2014 (Petäjä et al. 2016). HSRL is an autonomous eye safe lidar system designed to retrieve vertical profiles of the backscatter coefficient, extinction coefficient and depolarisation. Continuous profiles can be detected from around 50 m up to

30 km in altitude at 0.5 s and 7.5 m resolution. An example of HSRL measurements can be seen on fig. 3 and data are available at: http://hsrl.ssec.wisc.edu/by_site/18/custom_rti/

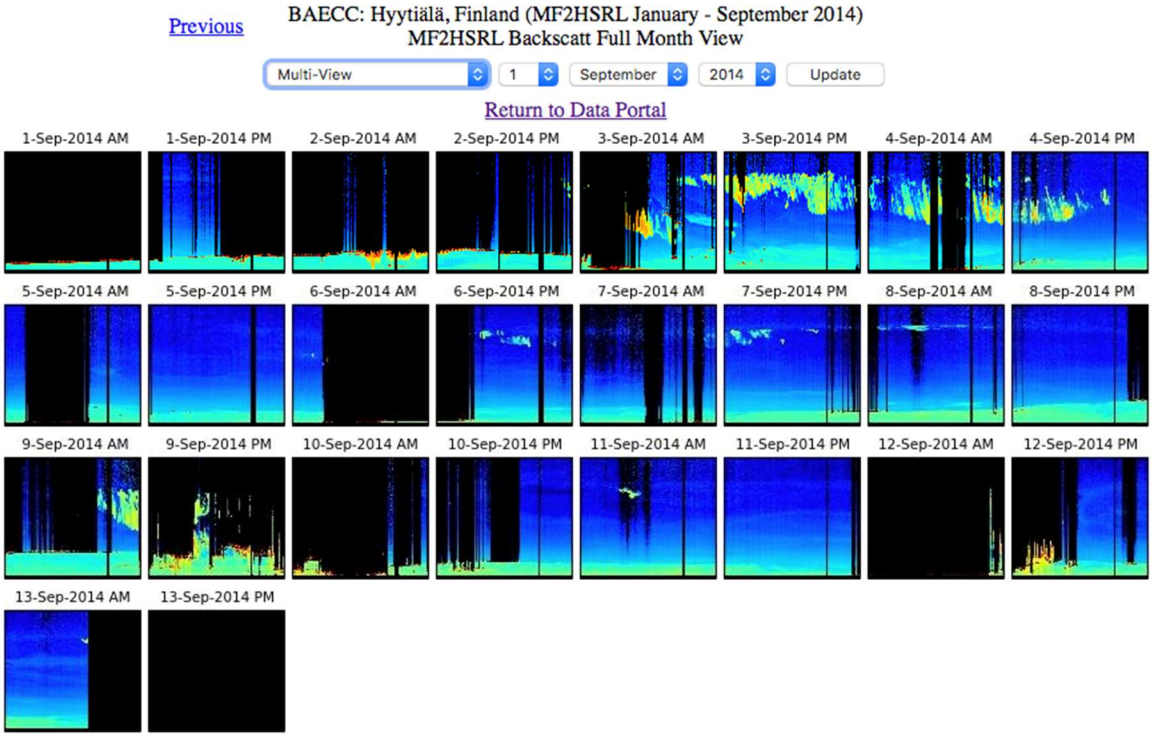

Figure 3. A screenshot from the BAECC data portal.

HSRL measurements were combined with aircraft aerosol in situ measurements in order to analyze aerosol layers properties and their origins (Nikandrova et al. 2018). Lagrangian model HYSPLIT was used to calculate backward trajectories every 50 m up to 3500m and arriving heights of these trajectories were compared with aerosol layers recognized by HSRL (Fig.4).

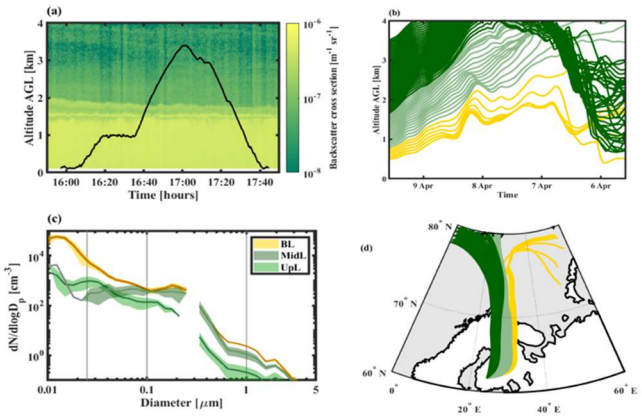

Figure 4. An example of the case study during 9 April 2014 at SMEAR II station, Finland: **(a)** HSRL backscatter coefficient with Cessna flight altitudes superimposed in black; **(b)** 96h backward trajectories calculated every 50 m and combined into layers according to similarities in the travelling path; **(c)** aerosol size distribution measured onboard during the flight and

combined into layers, shown with one standard deviation; **(d)** spatial coverage of backward trajectories combined in layers (taken from Nikandrova et al., 2018)

Furthermore, measurements from the ground-based HSRL were compared with observations by CALIOP (Cloud-Aerosol Lidar with Orthogonal Polarization) on-board Calipso (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation) satellite. CALIOP provides vertical profiles of aerosols with high resolution. It provides backscatter coefficient at 532 nm and 1064 nm. CALIOP collects data only along the ground track of the satellite since it is a nadir-only lidar. Swath of the instrument is very narrow therefore data from the same location can be obtained once in several days. Level 2 products were used for the analyses with 60-m vertical and 5-km horizontal resolution.

Several case studies were chosen based on highly scattering layers visually observed in the HSRL and times of Calipso overpasses. Calipso vertical profiles were co-located with ground-based measurements. In some cases backward or forward trajectories were checked for the movement of the air masses. This dataset consists of 8 co-located measurements in 2014: 30.03, 18.05, 05.06, 07.07, 16.07, 18.07, 27.07, 01.08.

Satellite data links

Satellite data from the CALIOP have been processed for the time period corresponding to the ground-based lidar data (2015 and 2016). Two datasets have been used: the level 1 total attenuated backscatter data product for the vertical distribution of the aerosol and the aerosol level 2 data products for the optical properties of the aerosol layers. Data are available at the ICARE database http://www.icare.univ-lille1.fr (see below for Data access and registration).

The specific CALIOP dataset corresponding to iCUPE is:
http://www.icare.univ-lille1.fr/archive?dir=CALIOP/CAL_LID_L1.v4.10/2015/ - for the L1 data set (see below for Data access and registration).
http://www.icare.univ-lille1.fr/archive?dir=CALIOP/05kmAPro.v4.20/2015/ - for the L2 aerosol data product (see below for Data access and registration).

The daily MODIS and VIIRS information from the fires were provided by LANCE FIRMS operated by NASA/GSFC/EOSDIS and are available at
https://firms.modaps. eosdis.nasa.gov/download / (last access: 9 January 2019). E-mail address should be provided on the website in order to request and download data.

The level 3 gridded MODIS aerosol parameter data collection 6 were provided in hdf format by
https://ladsweb.modaps.eosdis.nasa.gov/search/order/1/MYD08_D3--61
MYD08_D3 - MODIS/ Aqua Aerosol Cloud Water Vapor Ozone Daily L3 Global 1Deg CMG
(see overview, product information, data availability at:
https://doi.org/10.5067/MODIS/MYD08_D3.061, Platnick et al., 2017)
and by
https://ladsweb.modaps. eosdis.nasa.gov/search/order/1/MOD08_D3--61
MOD08_D3 - MODIS/ Terra Aerosol Cloud Water Vapor Ozone Daily L3 Global 1Deg CMG

(see overview, product information, data availability at:
https://doi.org/10.5067/MODIS/MOD08_D3.061, Platnick et al., 2017)

Data access and registration

For data stored at ICARE a prior data registration is necessary at:
http://www.icare.univ-lille1.fr/register

References:

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