Geophysical Research Abstracts
Vol. 16, EGU2014-10051, 2014
EGU General Assembly 2014

Biomass burning smoke episodes in Finland from Eastern European wildfires

Katri E. Leino (1), Laura Riuttanen (1), Tuomo Nieminen (1,2), Miikka Dal Maso (3), Riikka Väänänen (1), Toivo Pohja (1), Petri Keronen (1), Leena Järvi (1), Pasi P. Aalto (1), Aki Virkkula (1,4), Veli-Matti Kerminen (1), Tuukka Petäjä (1), and Markku Kulmala (1)

(1) University of Helsinki, Department of Physics, Helsinki, Finland (laura.riuttanen@helsinki.fi), (2) Helsinki Institute of Physics, Helsinki, Finland, (3) Tampere University of Technology, Tampere, Finland, (4) Finnish Meteorological Institute, Helsinki, Finland

Biomass burning emissions from Eastern Europe are occasionally observed in Finland. In spring of 2006 and the late summers of 2006 and 2010, smoke plumes were transported to large parts of Finland. By combining multiple methods we were able to study the horizontal and vertical properties of long-range transported smoke plume, as well as time evolution of particle number size distributions in an aged biomass burning smoke.

In this study we used trace gas and aerosol particle number size distribution measurements at three SMEAR stations (Station for Measuring Forest Ecosystem – Atmosphere Relations; Ruuskanen et al., 2003; Hari & Kulmala, 2005; Järvi et al., 2009). Vertical distribution of the smoke was studied by a small aircraft, Cessna FR172F, instrumented with Ultrafine Condensation Particle Counter and CO_2/H_2O –gas analyser. The airborne measurements were compared with vertical profiles from a polarization-sensitive, two-wavelength lidar (CALIOP; the Cloud-Aerosol Lidar with Orthogonal Polarization; Winker et al., 2009) onboard the CALIPSO satellite (the Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation).

HYSPLIT 4 (Hybrid Single Particle Lagrangian Integrated Trajectory Model; Draxler, 1999) backward trajectories as well as MODIS (Moderate Resolution Imaging Spectroradiometer) Terra thermal anomalies data (MOD14A1) were used together with synoptic analyses to study the transport and the horizontal distribution of the smoke.

In the spring 2006, there was a blocking high pressure system in Eastern Europe and smoke from the Eastern European fires was transported far to the north-west. The smoke episode in Finland lasted for two weeks. In summers of 2006 and 2010 the smoke came to Finland in a warm sector of a low-pressure system and the episodes lasted for less than two days.

Smoke plumes had elevated concentrations of aerosol particles, black carbon and CO, and varying concentrations of CO_2, SO_2, O_3 and NO_x. The difference to the background air was clear. At least one of the smoke plumes had a layered structure, and the smoke plumes were observed to be vertically and horizontally inhomogeneous. Aerosol number size distributions peaked at 100-200 nm size, median particle size being 60-250 % larger than in July-August on average. Growth of aerosol particles in the aged smoke plume was observed.

References:
Draxler R. R. (1999). HYSPLIT4 user's guide. NOAA Tech. Memo. ERL ARL-230.
Hari P. & Kulmala M. (2005). Boreal Environ. Res. 10, 315-322.
Järvi L. et al. (2009). Boreal Environ. Res. 14, 86-109.
Ruuskanen T. M. et al. (2003). Boreal. Environ. Res., 8, 335-349.
Winker D. M. et al. (2009). J. Atmos. Oceanic Technol., 26, 2310-2323.