Geophysical Research Abstracts
Vol. 16, EGU2014-7511, 2014
EGU General Assembly 2014

Airborne observations of new particle formation events in the boundary layer using a Zeppelin

Janne Lampilahti (1), Hanna E. Manninen (1,2), Tuomo Nieminen (1,3), Sander Mirme (2), Iida Pullinen (4), Taina Yli-Juuti (1), Siegfried Schobesberger (1), Juha Kangasluoma (1), Jenni Kontkanen (1), Katrianne Lehtipalo (1,5), Mikael Ehn (1,4), Thomas F. Mentel (6), Tuukka Petäjä (1), and Markku Kulmala (1)

(1) Department of Physics, University of Helsinki, P.O. Box 64, 00014, Helsinki, Finland, (2) Institute of Physics, University of Tartu, Ülikooli 18, 50090, Tartu, Estonia, (3) Helsinki Institute of Physics, P.O. Box 64, 00014 University of Helsinki, Finland, (4) Institute of Bio- and Geosciences (IBG-2), Forschungszentrum Jülich, 52425 Jülich, Germany, (5) AirModus Oy, Gustaf Hällströmin katu 2 A, 00560 Helsinki, Finland, (6) Institute for Energy and Climate Research (IEK-8), Forschungszentrum Jülich, 52425 Jülich, Germany

Atmospheric new particle formation (NPF) is a frequent and ubiquitous process in the atmosphere and a major source of newly formed aerosol particles [1]. However, it is still unclear how the aerosol particle distribution evolves in space and time during an NPF. We investigated where in the planetary boundary layer does NPF begin and how does the aerosol number size distribution develop in space and time during it. We measured in Hyytiälä, southern Finland using ground based and airborne measurements. The measurements were part of the PEGASOS project.

NPF was studied on six scientific flights during spring 2013 using a Zeppelin NT class airship. Ground based measurements were simultaneously conducted at SMEAR II station located in Hyytiälä. The flight profiles over Hyytiälä were flown between sunrise and noon during the growth of the boundary layer. The profiles over Hyytiälä covered vertically a distance of 100-1000 meters reaching the mixed layer, stable (nocturnal) boundary layer and the residual layer. Horizontally the profiles covered approximately a circular area of four kilometers in diameter. The measurements include particle number size distribution by Neutral cluster and Air Ion Spectrometer (NAIS), Differential Mobility Particle Sizer (DMPS) and Particle Size Magnifier (PSM) [2], meteorological parameters and position (latitude, longitude and altitude) of the Zeppelin.

Beginning of NPF was determined from an increase in 1.7-3 nm ion concentration. Height of the mixed layer was estimated from relative humidity measured on-board the Zeppelin. Particle growth rate during NPF was calculated. Spatial inhomogeneities in particle number size distribution during NPF were located and the birthplace of the particles was estimated using the growth rate and trajectories.

We observed a regional NPF event that began simultaneously and evolved uniformly inside the mixed layer. In the horizontal direction we observed a long and narrow high concentration plume of growing particles that moved over the measurement site. The particles of the regional event as well as the particles of the plume were uniformly distributed in the vertical direction and showed a similar growth rate of approximately 2 nm/h. The plume caused sharp discontinuities in the number size distribution of the growing particle mode. These kinds of discontinuities are seen quite often on SMEAR II data during NPF events and it is likely that they are caused by inhomogeneous NPF in the horizontal direction (possibly narrow long plumes).

This work is supported by European Commission under the Framework Programme 7 (FP7-ENV-2010-265148) and by the Academy of Finland Centre of Excellence program (project no. 1118615). The Zeppelin is accompanied by an international team of scientists and technicians. They are all warmly acknowledged.

References

[1] Kulmala, M., *et al.*, (2013), Direct Observations of Atmospheric Aerosol Nucleation, *Science*, 339, 943-946

[2] Kulmala, M., *et al.*, (2012), Measurement of the nucleation of atmospheric aerosol particles, *Nature Protocols*, 7, 1651-1667