# Analysis of particle size distribution changes between three measurement sites in Northern Scandinavia

R. Väänänen[1], E.-M. Kyrö[1], T. Nieminen[1,2], N. Kivekäs[3,4], H. Junninen[1], A. Virkkula[1,3], M. Dal Maso[1,5], H. Lihavainen[3], Y. Viisanen[3], B. Svenningsson[4], T. Holst[6], A. Arneth[7], P.P. Aalto[1], M. Kulmala[1], V.-M. Kerminen[1]

[1]University of Helsinki, Department of Physics, Helsinki, 00014 University of Helsinki, Finland
[2]Helsinki Institute of Physics, P.O. Box 64, 00014 University of Helsinki, Finland
[3]Finnish Meteorological Institute, Climate Change Unit, 00101 Helsinki, Finland
[4]Lund University, Department of Physics, Lund, 22100 Lund, Sweden
[5]Tampere University of Technology, Dept. of Physics, PO Box 692, 33101 Tampere, Finland
[6]Department of Physical Geography and Ecosystems Science, Sölvegatan 12, 223 62 Lund, Sweden
[7]Karlsruher Institute of Technology, Instute of Meteorology and Climate Research/Atmospheric Environmental Research (IMK-IFU), Kreuzeckbahnstr. 19, 82467 Garmisch-Partenkirchen, German

Keywords: Aerosol, air-mass-transport
Presenting author email: riikka.vaananen@helsinki.fi

Atmospheric particles have a complex role in the warming of the high northern latitudes: Black carbon both in air and on snow enhances the warming (Law and Stohl 2007, Flanner *et al*. 2009), whereas biogenic secondary aerosols have a cooling effect via their cloud interactions (Kulmala *et al*, 2004).

We combined the aerosol size distribution data observed at three measurements with calculated air mass trajectory data (Draxler & Hess, 1998) to deepen the understand of aerosol particle dynamics when air masses travel several hundreds of kilometres above the boreal forest zone in Northern Scandinavia.

The measurement sites are situated along a line from east to west on latitudes 67-68 °N. Two of the three measurement stations, Värriö SMEAR I station and Pallas GAW station, are situated in Finland, and the third one, Abisko, is in Sweden, near the border of Norway. The distance between Abisko and Värriö is 440 km. Abisko is located next to the Scandinavian mountains and 70 km from the Atlantic Ocean. Its surroundings is dominated by subarctic mires, birch forest and mountain tundra. Värriö and Pallas are surrounded by boreal forest. The Pallas station is situated above the tree line.

The aerosol size distribution data was measured between Aug-2005 and Dec-2007. In Abisko there was a Scanning Mobility Particle Sizer with a cut-off size of 10 nm, and in Pallas and Värriö there were Differential Mobility Particle Sizers with cut-off sizes of 7 nm and 3 nm, respectively. Abisko data was from several campaigns, and it covered c. half of the analyzed period.

We used three methods to analyze the aerosol dynamics. First, the days were classified to new particle formation (NPF) event days, non event days, and undefined days, and the NPF events were analyzed according to a schema created by Dal Maso *et al* (2005).

Secondly, we analyzed the aerosol size distributions as a function the corresponding air mass had been above the continental. This broadened the analysis made by Tunved *et al* (2006). We compared the apparent growths of particle diameters, their accumulated masses, number concentrations and condensation sinks.

Third approach was to study the changes in size distributions when the airmass analysis showed that same air mass was passed two measurement stations. To get comparable initial states, the size distributions at the upwind station were clustered. We analyzed the dynamics of each these clusters.

Our results showed (Väänänen *et al*, submitted), that during the growing season, the Aitken-mode particles grew at an apparent rate of around 1 nm/h or less when air masses travelled hundreds of kilometres. This rate was found to be several times smaller than the average growth rate during the new particle formation event. This indicates that the condensational growth has an important effect in the regional-scale air masses also when the evident nucleation is not observed.

The financial support by the Academy of Finland Centre of Excellence program (project no 1118615) and the Nordic Centre of Excellence CRAICC are gratefully acknowledged.

Dal Maso, M., Kulmala, M., Riipinen, I., Wagner, R., Hussein, T., Aalto, P.P. & Lehtinen, K.E.J. (2005) *Boreal Env. Research*, vol. 10, no. 5, pp. 323-336.

Draxler, R.R. & Hess, G. (1998) *Australian Meteorological Magazine*, vol. 47, no. 4, pp. 295.

Flanner, M., Zender, C., Hess, P., Mahowald, N., Painter, T., Ramanathan, V. & Rasch, P. (2009) *Atmos.Chem.Phys*, vol. 9, no. 7, pp. 2481-2497.

Kulmala, M., Suni, T., Lehtinen, K., Dal Maso, M., Boy, M., Reissell, A., Rannik, Ü., Aalto, P., Keronen, P. & Hakola, H. (2004) *Atmospheric Chemistry and Physics*, vol. 4, no. 2, pp. 557-562.

Law, K.S. & Stohl, A. (2007) Science, vol. 315, no. 5818, pp. 1537-1540.

Tunved, P., Hansson, H.C., Kerminen, V.M., Ström, J., Maso, M.D., Lihavainen, H., Viisanen, Y., Aalto, P., Komppula, M. & Kulmala, M. (2006), *Science,* vol. 312, no. 5771, pp. 261.

Väänänen R. et al. submitted to Atm. Chem. Phys. Discuss. 2013