Geophysical Research Abstracts
Vol. 16, EGU2014-16615, 2014
EGU General Assembly 2014

Long-term aerosol and trace gas measurements in Eastern Lapland, Finland: the impact of Kola air pollution to new particle formation and potential CCN

Ella-Maria Kyrö (1), Riikka Väänänen (1), Veli-Matti Kerminen (1), Aki Virkkula (2), Ari Asmi (1), Tuomo Nieminen (1), Miikka Dal Maso (3), Tuukka Petäjä (1), Petri Keronen (1), Pasi Aalto (1), Ilona Riipinen (4), Katrianne Lehtipalo (1), Pertti Hari (5), and Markku Kulmala (1)

(1) Department of Physics, University of Helsinki, Helsinki, Finland, (2) Finnish Meteorological Institute, Helsinki, Finland, (3) Department of Physics, Tampere University of Technology, Tampere, Finland, (4) Department of Applied Environmental Science and Bert Bolin Centre for Climate research, Stockholm University, Stockholm, Sweden, (5) Department of Forest Sciences, University of Helsinki, Helsinki, Finland

Sulphur and primary emissions have been decreasing largely all over Europe, resulting in improved air quality and decreased direct radiation forcing by aerosols. The smelter industry in Kola Peninsula is one of largest sources of anthropogenic SO_2 within the Arctic domain and since late 1990s the sulphur emissions have been decreasing rapidly (Paatero et al., 2008; Prank et al., 2010). New particle formation (NPF) is tightly linked with the oxidizing product of SO_2, namely sulphuric acid (H2SO4), since it is known to be the key component in atmospheric nucleation (Sipilä et al., 2010). Thus, decreasing sulphur pollution may lead to less NPF. However, low values of condensation sink (CS), which is determined by the amount of pre-existing particles, favours NPF. We used 14 years (1998-2011) of aerosol number size distribution and trace gas data from SMEAR I station in Eastern Lapland, Finland, to investigate these relationships between SO_2, NPF and CS. The station is a clean background station with occasional sulphur pollution episodes when the air masses arrive over Kola Peninsula. We found that while SO_2 decreased by 11.3 % / year, the number of clear NPF event days was also decreasing by 9.9 % / year. At the same time, CS was decreasing also (-8.0 % / year) leading to formation of more particles per single NPF event (J3 increased by 29.7 % / year in 2006-2011) but the low vapour concentrations of H2SO4 (proxy decreased by 6.2 % / year) did not allow them to grow into climatically relevant sizes. Over the time, concentrations of potential CCN (cloud condensing nuclei) were also decreasing with more moderate pace, -4.0 % / year. The events started on average earlier after sunrise when the SO_2 concentration during the start of the event was higher and NPF occurred more frequently in air masses which were travelling over Kola. Despite the total decrease in sulphur pollution originating from Kola there is currently no evidence of cleaning of the emissions, rather the decrease is a result of socio-economic changes in the area. It is very likely that in areas with low background aerosol concentrations but close to large sources of anthropogenic sulphur emissions the trends in NPF depend on the overall human activity, general cleaning of the emissions and changes in natural biogenic emissions. This should be taken into account when estimating e.g. the effect of Arctic shipping routes to the future climate.

Paatero, J., et al. (2008). Effects of Kola air pollution on the environment in the Western part of the Kola peninsula and Finnish Lapland - Final report. Finnish Meteorological Institute Reports, 6, 1-26.

Prank, M., M. et al. (2010). A refinement of the emission data for Kola Peninsula based on inverse dispersion modelling. Atmos. Chem. Phys., 10, 10849-10865.

Sipilä, M., et al. (2010). The role of sulfuric acid in atmospheric nucleation. Science, 327, 1243-1246.