Analysis of aerosol properties dynamics in relation to the air mass transport during BAECC campaign

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Biogenic secondary organic aerosols (BSOA) grow to the sizes sufficient to act as cloud condensation nuclei (CCN) and can influence cloud properties. Biogenic Aerosols – Effects on Clouds and Climate (BAECC) campaign, Petäjä *et al* (2016), aimed to link biogenic aerosols and clouds took place at the SMEAR II station in Hyytiälä, Finland, from February to September 2014. In this study we investigate properties of aerosols measured at the surface level during BAECC campaign. We concentrate on the dynamics of properties I usein relation to the air mass history, namely the time that air mass spent over land (TOL).

HYSPLIT model four-day (96 h) ensemble mean backtrajectories arriving to the SMEAR II were used for air mass history analysis. Only trajectories originating from the clean marine environment and travelling over the boreal forest were considered. Observed aerosol number size distributions (Fig. 1, top) show that during campaign period shorter TOL is characterized by high number concentration in the nucleation mode with concentration reaching 4000 cm^{-3}, peaking at the 20 nm. As time of travel increases, distribution mode shifts toward larger particles – Aitken and accumulation modes. Event days classification showed that clean air masses arriving to the station favor new particle formation events (NPF). Low aerosol loading in marine air masses that had moved over boreal forest results in a smaller condensation sink – a parameter that describes loss of condensable vapor molecules onto existing particles. CCN concentrations (Fig.1, bottom) increase by the number of 2.6 h^{-1} and 6.6 h^{-1} for the supersaturation levels Sc of 0.1% and 0.3% correspondingly. CCN concentrations at these two Sc increase for about 72 hours of travel time, and after that numbers start to drop.

Our analysis shows that air mass history had strong influence on the observed aerosol properties during BAECC campaign period. We found that clean air arriving from the marine environment favors NPF. Median aerosol size grows and size distribution shifts from nucleation to the Aitken and accumulation modes. More and more aerosols can be activated to CCN and influence formation and life of clouds. The campaign period represents well average conditions at SMEAR II station and can be used for the further studies of aerosol-cloud interaction in the boreal forest environment.

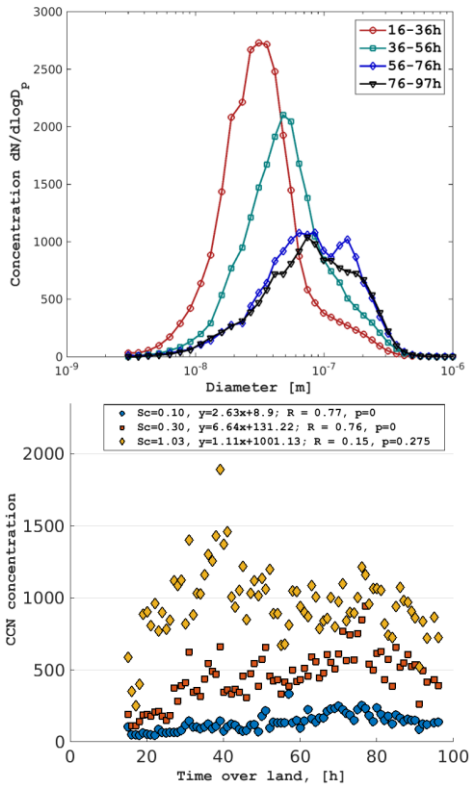

Figure 1. Top: Median number size distribution for different times air mass spent over land. Bottom: Cloud condensation nuclei concertation [cm^{-3}] as a function of time air mass spent over land.

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Petäjä, T., O'Connor, E. J., Moisseev, D., Sinclair, V. A., Manninen, A. J., Väänänen, R., Lerber, A. v., Thornton, J. A., Nicoll, K., Petersen, W., Chandrasekar, V., Smith, J. N., Winkler, P. M., Krüger, O., Hakola, H., Timonen, H., Brus, D., Laurila, T., Asmi, E., Riekkola, M.-L., Mona, L., Massoli, P., Engelmann, R., Komppula, M., Wang, J., Kuang, C., Bäck, J., Virtanen, A., Levula, J., Ritsche, M., and Hickmon, N. (2016) *Bull. Am. Met. Soc*, accepted