The effect of biogenic emissions to sub-micron aerosol in hemiboreal zone – an approach based on atmospheric transport modelling

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Biogenic VOC-s are known as precursors of primary aerosol in the atmosphere, however, their exact roles are not well known yet. This study is aimed to (1) clarify the possible contribution of boreal and hemi-boreal forest VOC emissions to the aerosol formation (see also Tunved *et al*., 2006) and (2) testing the performance of regional atmospheric modelling tools in respect of dispersion of biogenic emissions.

The SILAM model with built-in isoprene and monoterpene emission module (CAMx based on Guenther scheme, Poupkou *et al*., 2010) was run for May – August 2006 in Baltic Sea region. Currently these VOC-s are included into the CB4 chemistry module only as ozone precursors. In this study they are advected as passive tracers. Modelled VOC-tracer concentrations were compared with sub-half-micrometre aerosol concentrations, simultaneously measured in Preila (western coast of Lithuania), Tahkuse (south-western Estonia), Hyytiälä (southern Finland) and Värriö (nothern Finland) during summer 2006, over 7000 hourly values in total.

Linear correlation coefficients between measured and modelled concentrations were found 0.45 for both Preila and Tahkuse, 0.56 for Hyytiälä and 0.72 for Värriö. Bilinear regression result, based on summary monoterpenes and sulphate (AQME II model run, FMI), is even better correlated with aerosol: 0.60 for Preila, 0.58 for Tahkuse, 0.83 for Hyytiälä and 0.76 for Värriö. Thus, biogenic VOC-s and sulphates are likely two major contributors to the sub-half-micron aerosol in the Nordic-Baltic region and their importance is growing from south to north. According to the regression lines, about 5 – 20% of emitted biogenic VOC-s are converted into aerosol – this is in fair agreement with results of earlier studies based on backward trajectories of air mass. Contribution of sulphate ion is roughly by order of magnitude larger – evidently, the sulphates constitute typically most of sub-half-micron aerosol mass. Selection of "clean" air mass directions, based on adjoint modelling with SILAM, improves the correlations of measured aerosol modelled concentrations with biogenic VOC slightly.

This study demonstrates that a state-of-art advection-diffusion model with proper emission database is capable to predict the accumulation mode aerosol concentrations in the atmosphere. More research in aerosol dynamics is needed to refine the results.

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