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Tethered balloon measurements of biogenic volatile organic compounds at a Boreal forest site

C. Spirig[1,2], A. Guenther[2], J. P. Greenberg[2], P. Calanca[1], and V. Tarvainen[3]

[1]Swiss Federal Research Station for Agroecology and Agriculture, Zürich, Switzerland

[2]National Center for Atmospheric Research, Boulder, USA

[3]Finnish Meteorological Institute, Helsinki, Finland

Abstract. Measurements of biogenic volatile organic compounds (VOCs) were performed at Hyytiälä, a Boreal forest site in Southern Finland as part of the OSOA (origin and formation of secondary organic aerosol) project in August 2001. At this site, frequent formation of new particles has been observed and the role of biogenic VOCs in this process is still unclear. Tethered balloons served as platforms to collect VOC samples within the planetary boundary layer at heights up to 1.2 km above ground during daytime. Mean mixed layer concentrations of total monoterpenes varied between 10 and 170 pptv, with α-pinene, limonene and Δ^3-carene as major compounds, isoprene was detected at levels of 2-35 pptv. A mixed layer gradient technique and a budget approach are applied to derive surface fluxes representative for areas of tens to hundreds of square kilometres. Effects of spatial heterogeneity in surface emissions are examined with a footprint analysis. Depending on the source area considered, mean afternoon emissions of the sum of terpenes range between 180 and 300 $\mu g\ m^{-2}\ h^{-1}$ for the period of 2-12 August 2001. Surface fluxes close to Hyytiälä were higher than the regional average, and agree well with mean emissions predicted by a biogenic VOC emission model. Total rates of monoterpene oxidation were calculated with a photochemical model. The rates did not correlate with the occurrence of new particle formation, but the ozone pathway was of more importance on days with particle formation. Condensable vapour production from the oxidation of monoterpenes throughout the mixed layer can only account for a fraction of the increase in aerosol mass observed at the surface.

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