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Eddy covariance flux measurements of biogenic VOCs during ECHO 2003 using proton transfer reaction mass spectrometry

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Abstract. Within the framework of the AFO 2000 project ECHO, two PTR-MS instruments were operated in combination with sonic anemometers to determine biogenic VOC fluxes from a mixed deciduous forest site in North-Western Germany. The measurement site was characterised by a forest of inhomogeneous composition, complex canopy structure, limited extension in certain wind directions and frequent calm wind conditions during night time. The eddy covariance (EC) technique was applied since it represents the most direct flux measurement approach on the canopy scale and is, therefore, least susceptible to these non-ideal conditions. A specific flux calculation method was used to account for the sequential multi-component PTR-MS measurements and allowing an individual delay time adjustment as well as a rigorous quality control based on cospectral analysis. The validated flux results are consistent with light and temperature dependent emissions of isoprene and monoterpenes from this forest, with average daytime emissions of 0.94 and $0.3\mu\text{g m}^{-2}\text{s}^{-1}$, respectively. Emissions of methanol reached on average $0.087\mu\text{g m}^{-2}\text{s}^{-1}$ during daytime, but fluxes were too small to be detected during night time. Upward fluxes of the isoprene oxidation products methyl vinyl ketone (MVK) and methacrolein (MACR) were also found, being two orders of magnitude lower than those of isoprene. Calculations with an analytical footprint model indicate that the observed isoprene fluxes correlate with the fraction of oaks within the footprints of the flux measurement.

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