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Analysis of Sources and Sinks of Biogenic Volatile Organic Compound (BVOC) emissions in a mixed temperate forest

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The aim of this analysis is (i) to determine the BVOC sources and sinks within the canopy of a mixed temperate forest (ii) to identify their relative importance and their daily and seasonal evolution patterns (ii) and their response to driving meteorological variables.

To this end, we used a combination of (i) above-canopy BVOC eddy flux measurements (ii) trunk-space (below canopy) BVOC eddy flux measurements (iii) BVOCs concentration measurements at several heights from near ground to above canopy (3, 12, 20, 30, 40 and 53 m) obtained concurrently with standard meteorological and biotic potential driving variables.

The measurements were carried out in a mixed forest (Fagus sylvatica, Pseudotsuga menziesii, Abies alba, Picea abies) at the Belgian Vielsalm Terrestrial Observatory (50°18'18.20" N, 5°59"53.15" , altitude 450 m) from April 2011 to November 2011 and therefore covered the whole vegetation season and a part of the leafless period for deciduous. A proton transfer reaction mass spectrometer (PTR-MS) was used to measure BVOC mixing ratios and fluxes were computed by the disjunct eddy covariance by mass scanning technique using standard quality and correction procedures. Compounds investigated were methanol, acetone, acetaldehyde, isoprene, and monoterpenes. The measurement system was completed by a micrometeorological station that collected below and above canopy meteorological standard measurements.

A first analysis of vertical mixing ratios profiles showed different behaviors depending on the BVOC of interest. During the days hours (10h to 18h), the following observations were done.

The methanol profile was linear, mixing ratios increasing from soil level to top of the canopy. This behavior was observed from spring to summer, with the profile becoming flat in autumn.
The isoprene profile showed a "D" shape with maximum mixing ratios being reached inside the canopy layer. This behavior was observed from spring to summer, the maximum reached being more important during summer. At end of the season (September, October) the profile evolved to a flat profile.
The monterpenes showed a linear profile, mixing ratios decreasing with canopy height. The same behavior was observed during all the season.

Concerning trunk-space BVOC fluxes, the only detectable fluxes were those of monoterpenes and were two order of magnitudes lower than those observed above the canopy. Methanol and isoprene fluxes were almost null. The reliability of BVOC trunk-space fluxes will be investigated through spectral analysis on high-frequency data and spectral comparison with the data obtained above the canopy and with a co-located trunk-space conventional eddy-covariance system for CO_2 and H_2O.

Fluxes data, below and above canopy, and profile data is being gathered in order to explain the observed profiles.