Emission and CHemical Transformation of biogenic volatile Organic Compounds – Investigations in and above a Mixed Forest Stand (ECHO)

Simultaneous measurements of primary emission rates and fluxes of Volatile Organic Compounds (VOC) and nitrogen oxides (NOx) within and above canopy stands.

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Sampling and analytical techniques for volatile organic compounds (VOC) were improved and first measurements of the biogenic exchange were performed. All applied techniques were tested. The automatically operating sampling system with freely programmable magnetic valves was found to be universally applicable, only depending on the adsorber cartridges needed for different compound classes. Different groups of VOCs could be sampled automatically over hours or days simultaneously. Tests with new separating columns completed our analytical preparatory work. Adapting the GC columns to our needs resulted in a significant improvement of the simultaneous analysis of isoprenoids an their oxidation products. Intercomparisons with the CNR laboratory (P. Cicciolo, Rome) showed good agreements with our analyses. Investigations on the exchange of short chain carboxyls and organic acids confirmed the more and more understood bi-directional exchange of these compounds. This bi-directional exchange is significantly triggered by the ambient mixing ratios and exhibits a compensation point. An intercomparison exercise at the Research Center Jülich to measure several VOC species, showed quite significant errors in the measurements of some VOC species by the MPIC. Among these species was isoprene. We assume the ozone scrubbers – used to prevent ozone from attacking sensitive VOC species during sampling – to be of critical relevance. Investigations are on the way. The use of the "Chemical Ionisation Mass Spectrometer, (CIMS)" during the intercomparison proved the general suitability of the instrument. Detection and sensitivity were depending on the VOC species and the air humidity.

A first estimate of biogenic NO-emissions from the uppermost soil layer of the Jülich forest was facilitated by laboratory investigations. Soil samples (mixed samples of 1 kg (6–8 individual samples à 100 ml) from the 0–5 cm soil layer have been taken on 11 October 2001, transported to Mainz (at +5°C), where bulk soil density (approx. 1.5×10³ kg m⁻³) and soil moisture have been determined. Sub-samples have been sent to FH Geisenheim for analysis of the N-nutrient content (NO₂⁻, NO₃⁻, NH₄⁺). Still in November and December 2001, homogenized (sieved, 2 mm) aliquots of the soil samples (still stored at +5°C) have been exposed in thermostatted dynamic soil chambers to variable NO mixing ratios (0–180 ppb), soil temperatures (4, 10, 20, 30°C) and soil moistures (10–60% vol.). At the in- and outlets of the soil chambers NO mixing ratios have been measured for determination of the corresponding NO release. The microbial NO-production rates (in terms of mass of nitrogen per unit mass of dry soil per unit of time) and first order NO consumption constants (m³ kg⁻¹ s⁻¹) have been calculated. Maximum production rates (20 ng kg⁻¹ s⁻¹) have been observed at 30°C, while NO consumption constants ranged between 10⁻⁴ and 10⁻⁵ m³ kg⁻¹ s⁻¹. From these data NO production and consumption will be parameterized in terms of soil moisture and soil temperature. Using an operational algorithm, the NO release rate and NO emission from the Jülich forest soil could be estimated for available data sets of soil moisture and soil temperature.