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Development and application of an analytical method for the determination of total atmospheric biogenic non-methane organic carbon

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Most of the organic carbon which is present in the atmosphere is found as volatile organic compounds (VOCs) dominantly emitted by the biosphere. This biogenic emission has a major impact on the chemical and physical properties of the atmosphere by contributing to the formation of tropospheric ozone and secondary organic aerosol (SOA). One major limitation in advancing the understanding of this ozone and aerosol generation is the technical ability to accurately measure the sum of these volatile organics. Frequently used methods focus on the detection of a defined set of non-methane organic compounds (NMOC). However, adding these single compound concentrations might only represent a lower limit of atmospheric carbon concentrations, since no available method is able to analyze all organic compounds present in the atmosphere. A few studies are known that report on total NMOC concentration measurements in ambient air but measurements of the total NMOC exchange between vegetation and the atmosphere are missing. Therefore, we investigated the analysis of the total NMOC concentration by collecting these compounds on a solid adsorbent material for subsequent total carbon analysis. This first step is necessary to separate the stable gases CO, CO_2 and CH4 from the volatile NMOC fraction. NMOC was desorbed and converted to CO_2 by passing an oxidation unit. The CO_2 is collected on a second preconcentration unit followed by thermal desorption and detection by an infrared gas analyzer. As major difficulties we identified the separation of CO_2 from the NMOC compounds on the solid adsorbent unit and the choice of the catalytic material. The measurements were accompanied by GC analysis of single calibrated VOC species from permeation devices and measurements by a PTR-MS. Plant chamber measurements with Quercus ilex showed an expected diurnal course which was confirmed by the NMOC analyzer though with a discrepancy during the day of up to 40 %.