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Emissions of biogenic volatile organic compounds & their photochemical transformation

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Natural and anthropogenic activities emit volatile organic compounds (VOC) into the atmosphere. While it is known that land vegetation accounts for 90% of the global VOC emissions, only a few molecules' emission factors are understood. Through VOCs atmospheric oxidation intermediate products are formed. The detailed chemical mechanisms involved are insufficiently known to date and need to be understood for air quality management and climate change predictions.

In an experiment using a PTR-ToF-MS with the new-built plant chamber SAPHIR-PLUS in Forschungszentrum Juelich, biogenic emissions of volatile organic compounds (BVOC) from Quercus ilex trees were measured. The BVOC emissions were dominated by monoterpenes, minor emissions of isoprene and methanol were also observed with the overall emission pattern typical for Quercus ilex trees in the growing season. Monoterpenes and isoprene emissions showed to be triggered by light. Additionally, their emissions showed clear exponential temperature dependence under constant light condition as reported in literature. As a tracer for leaf growth, methanol emission showed an abrupt increase at the beginning of light exposure. This is explained as instantaneous release of methanol produced during the night once stomata of leaves open upon light exposure. Emission of methanol showed a near linear increase with temperature in the range of 10 to 35 °C.

BVOC were transferred from the plant chamber PLUS to the atmospheric simulation chamber SAPHIR, where their oxidation products from O_3 oxidation were measured with PTR-ToF-MS. Gas phase oxidation products such as acetone and acetaldehyde were detected. A quantitative analysis of the data will be presented, including comparison of observations to the Master Chemical Mechanism model.