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Testing leaf-wax lipids in aerosols as eco-hydrological monitors

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Leaf waxes of terrestrial higher plants are abraded from leaf surfaces by wind, dust or rain and can become airborne. In order to maintain the protective wax layer plants replenish the surface wax layer by synthesis of new wax.compounds. Newly formed wax lipids should reflect the environmental conditions during their synthesis in their composition and isotopic signature. Therefore, the composition and isotopic signature of airborne leaf wax lipids could serve as an integrated measure of the hydrological state of the ecosystem from which they originated. In order to investigate how and how fast changing hydrological conditions are reflected in plant and aerosol derived leaf waxes, we installed a high-volume aerosol sampler at 45 m height (10 m above canopy top) on a meteorological observation tower in the Hainich National Park in Thuringia, Germany. The Hainich is a 160 square km area of closed deciduous forest in almost original state dominated by European beech. Weekly aerosol samples were collected from July to October 2009. In parallel, weekly leaf samples of beech, maple and ash were collected for wax analyses. In order to monitor the isotopic composition of plant water sources weekly samples of rain water, soil water, xylem and leaf water were collected. Meteorological parameters were constantly monitored providing data on temperature, precipitation, relative humidity, soil moisture, etc.
Aerosol samples will be extracted with organic solvents and leaf wax lipids will be quantified and analysed for their compound-specific hydrogen isotope compositions. Leaf samples will be treated likewise for direct comparison of aerosols with plant sources. Water samples (precipitation, soil water, xylem water, leaf water) will be analysed for hydrogen and oxygen isotope compositions in order to characterize hydrologic isotope changes in the ecosystem. Aim of this study is to provide an integrated perspective how hydrological changes are incorporated and travelling through an ecosystem from precipitation to leaf water, what the timescales of these changes are and how these are ultimately recorded in leaf waxes of trees and in aerosols. We will present initial data and discuss the potential of this approach.