



## Eddy Covariance measurements of stable CO<sub>2</sub> and H<sub>2</sub>O isotopologues

Jelka Braden-Behrens and Alexander Knohl

Bioclimatology, Georg-August University of Göttingen, Göttingen, Germany

The analysis of the stable isotope composition of CO<sub>2</sub> and H<sub>2</sub>O fluxes (such as <sup>13</sup>C, <sup>18</sup>O and <sup>2</sup>H in H<sub>2</sub>O and CO<sub>2</sub>) has provided valuable insights into ecosystem gas exchange. The approach builds on differences in the isotope signature of different ecosystem components that are primarily caused by the preference for or the discrimination against respective isotope species by important processes within the ecosystem (e.g. photosynthesis or leaf water diffusion). With the ongoing development of laser spectrometric methods, fast and precise measurements of isotopologue mixing ratios became possible, hence also enabling Eddy Covariance (EC) based approaches to directly measure the isotopic composition of CO<sub>2</sub> and H<sub>2</sub>O<sub>v</sub> net fluxes on ecosystem scale.

During an eight month long measurement campaign in 2015, we plan to simultaneously measure CO<sub>2</sub> and H<sub>2</sub>O<sub>v</sub> isotopologue fluxes using an EC approach in a managed beech forest in Thuringia, Germany. For this purpose, we will use two different laser spectrometers for high frequency measurements of isotopic compositions: For H<sub>2</sub>O<sub>v</sub> measurements, we will use an off axis cavity output water vapour isotope analyser (WVIA, Los Gatos Research Inc.) with 5 Hz response; and for CO<sub>2</sub> measurements, we will use a quantum cascade laser-based system (QCLAS, Aerodyne Research Inc.) with thermoelectrically cooled detectors and up to 10 Hz measurement capability. The resulting continuous isotopologue flux measurements will be accompanied by intensive sampling campaigns on the leaf scale: Water from leaf, twig, soil and precipitation samples will be analysed in the lab using isotope ratio mass spectrometry. During data analysis we will put a focus on (i) the influence of carbon and oxygen discrimination on the isotopic signature of respective net ecosystem exchange, (ii) on the relationship between evapotranspiration and leaf water enrichment, and (iii) on the <sup>18</sup>O exchange between carbon dioxide and water. At present, we already carried out extensive instrument performance tests for both laser spectrometers that will be presented here. In addition, we will present the instrumentation, the measurement periphery as well as anticipated analysis approaches required for the planned measurement campaign.