Geophysical Research Abstracts
Vol. 19, EGU2017-19388, 2017
EGU General Assembly 2017

Eddy Covariance measurements of stable isotopes (δD and δ18O) in water vapor

Jelka Braden-Behrens and Alexander Knohl
Bioclimatology, Georg-August-Universität Göttingen, Germany (aknohl@uni-goettingen.de)

Stable isotopes are a promising tool to enhance our understanding of ecosystem gas exchanges. Studying 18O and 2H in water vapour (H_2Ov) can e.g. help partitioning evapotranspiration into its components. With recent developments in laser spectroscopy direct Eddy Covariance (EC) measurements for investigating fluxes of stable isotopologues became feasible. So far very few case studies have applied the EC method to measure stable isotopes in water vapor.

We continuously measure fluxes of water vapor isotopologues with the EC method in a managed beech forest in Thuringia, Germany, since autumn 2015 using the following setup: An off-axis integrated cavity output water vapor isotope analyzer (WVIA, Los Gatos Research. Inc, USA) measures the water vapour concentration and its isotopic composition (δD and δ18O). The instrument, that was optimized for high flow rates (app. 4slpm) to generate high frequency (2Hz) measurements, showed sufficient precision with Allan Deviations of app. 0.12 ‰ for δD and 0.06 ‰ for δ18O for averaging periods of 100s. The instrument was calibrated hourly using a high-flow optimized version of the water vapor isotope standard source (WVISS, Los Gatos Research. Inc, USA) that provides water vapor with known isotopic composition for a large range of different concentrations. Our calibration scheme includes a near continuous concentration range calibration instead of a simple 2 or 3-point calibration to face the analyzers strong concentration dependency within a range of app. 6 000 to 16 000 ppm in winter and app. 8 000 to 23 000 ppm in summer.

In the used setup, the high-flow and high-frequency optimized water vapor isotope analyzer (WVIA) showed suitable characteristics (Allan deviation and spectral energy distribution) to perform Eddy covariance measurements of stable isotopes in H_2Ov. Thus, this novel instrument for EC measurements of water vapor isotopologues provides a new opportunity for studying the hydrological cycle in long-term observation networks like Fluxnet and ICOS.