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^{18}O isotope fluxes in water vapor and carbon dioxide: measurements, modeling, and potential application

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The stable isotope ^{18}O in water is a powerful tracer to investigate the hydrological cycle, ecological processes or paleoclimatic archives. Recently, laser spectroscopic techniques for isotope measurements have been developed which allow for field deployable, high accuracy and high frequency measurements of isotopic gas-exchange with the atmosphere.
Here we present a unique dataset of δ ^{18}O in water vapor and δ ^{18}O in carbon dioxide measured simultaneously by two laser spectrometers (Los Gatos Research and Aerodyne Research, respectively). The study was conducted on beech trees in a mixed forest in Switzerland in two campaigns in 2009 and 2010. By using this technique in combination with steady-state through-flow chambers, leaf water samples, sophisticated data screening and a modeling approach we (i) were able to provide continuous time series of leaf water ^{18}O signals for the two campaigns and (ii) determined the ability to predict ^{18}O of carbon dioxide from these leaf water ^{18}O data. Modeling of leaf water enrichment in ^{18}O was based on the Peclet-modified Craig-Gordon model and parameter optimization was done via a Bayesian approach, providing additional information on parameter and model uncertainty compared to commonly used least squares fitting approaches.