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Measurement of soil water vapor isotopes for evapotranspiration partitioning

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Evapotranspiration is routinely measured and modeled towards understanding the hydrology and functioning of ecosystems. Partitioning evapotranspiration into evaporation from soil and transpiration from leaves remains a challenge, and is particularly important for modeling the soil moisture in highly seasonal ecosystems. Here we present initial results from the combination of continuous atmospheric water vapor isotope measurements (δ^{18}O, δ^{2}H) and new techniques for directly quantifying the isotopic composition of soil water vapor using portable laser-based isotope analyzers in an open system arrangement. The study is performed at an eddy covariance flux tower in semi-arid savanna of central Kenya. The field method is complimented and refined by laboratory experiments using a soil chamber. The laboratory experiments are based on the mass balance of both bulk water vapor and water vapor isotopes inside the soil chamber. The water vapor in the chamber is a mixture of ambient vapor, which is measured before chamber closing, and evaporated water, which mixes into the ambient vapor once chamber closes. The air temperature, relative humidity and the isotopic composition of liquid soil water are also monitored and used in the traditional Craig-Gordon calculation for comparison with the measured water vapor isotope composition. Still under improvement, these methods provide a new window into quantifying the heterogeneity of the soil evaporation isotopic signal at the landscape scale.