Leaf-wax n-alkane δD values of temperate grasses record leaf water enrichment over a growing season

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Here we explore how changes in environmental parameters and plant physiological processes over a growing season are recorded in compound-specific hydrogen isotope ratios of individual leaf-wax lipids from barley grass. We sampled soil water, leaf water at dawn and midday, water vapor for hydrogen isotopic analysis, leaves for lipid analysis and recorded a number of environmental parameters (temperature, relative humidity, vapor pressure deficit among others) and plant physiological data (stomatal conductance, transpiration, photosynthetic rate) weekly over the two month growing season of wheat grass. We analyze the relative importance of plant physiological processes and environmental factors in determining leaf water enrichment and the leaf wax lipid isotopic composition.

Grass derived *n*-alkanes exhibit changes in δD values on the order of 20‰ over a growing season, while source water (soil water) varies by 40‰. Surprisingly, δD values of grass-derived *n*-alkanes correlate best with the δD values of leaf water at midday of the sampling day, constituting the assumed maximal isotopic enrichment in leaf water during the day. These results indicate an extremely rapid turnover of leaf-wax *n*-alkanes on the order of a few days – likely due to the fast growth of these grasses. Since the slope of the relationship between leaf water δD and *n*-alkane δD is less than 0.5 we argue that additional processes such as leaf aging and/or additional hydrogen sources are influencing the *n*-alkane δD signal. For the paleoclimatic record this suggests, that the grass studied here, does not record the full magnitude of the climatic (source water δD) signal.