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Tracing plant water fluxes in ecosystems by stable isotopes along the soil-plant and plant-atmosphere interfaces

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Terrestrial vegetation is a main driver of ecosystem water fluxes, as plants mediate the water fluxes within the soil-vegetation-atmosphere continuum. Stable isotopologues of water are efficient tracer to follow the water transfer in soils, uptake by plants, transport in stems and release into the atmosphere through stomata. The development of in-situ methods coupled to isotope spectroscopy does now enable real-time in-situ water vapour isotopologue measurements revealing high spatial and temporal dynamics, such as adaptations in root water uptake depths (within hours to days) or the impact of transpirational fluxes on atmospheric moisture.

Examples will be given how isotopes can be used to inform the complex interplay between plant ecophysiological adaptations and hydrological processes. For example, root water uptake is not solely driven by soil water availability but has to be understood in the context of species-specific regulation of active zones in their rooting system determining the conductivity between soil and roots regulating uptake depths. The latter has also to be evaluated in context of the nutrient demand and the spatial nutrient availability. Similarly, plant water transport and losses are a fined tuned interplay between species-specific structural and functional adaptations and atmospheric processes.

Finally, first data of a large-scale ecosystem labelling experiment at the Biosphere 2 tropical rainforest of the B2 Wald, Atmosphere, and Live Dynamics (B2WALD) will be presented.