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Effect of Dew and Fog Water on Swiss Grassland with Stable Water Isotopes

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Our research investigates how fog and dew affect the water use of representative species at three Swiss grasslands (CH-CHA, CH-FRU, and CH-AWS) along an elevated gradient where long-term half-hourly H_2O flux measurements and meteorological data are available. Dew or fog water has been approved to be essential moisture sources for plants in arid and semi-arid areas (Wen et al., 2012; He & Richards, 2015; Beysens, 2016). However, research so far has rarely focused on the dew or fog water used by plants in temperate ecosystems, although summer drought conditions (e.g. summer 2018 in Europe) may also impose water stress on plants like in semi-arid regions (MeteoSwiss, 2018). Moreover, a very tiny dew yield will have a stronger impact on smaller grasses than trees for which dew contribution is tiny compared to tree's internal water.

To verify the effect of dew or fog formation on plants, stable water isotopes (δ^2H and δ^{18}O) are visited to trace the variability and exchange of H_2O in the Soil-Plant-Atmosphere Continuum (SPAC). The measurements of gaseous and liquid water isotopes (δ^2H and δ^{18}O) at the site CH-CHA were carried out during intensive observation periods of dew and/or fog events in summer 2018. The deuterium excess was calculated as $d\text{-}excess = \delta^2H - 8*\delta^{18}O$ to help analyze the variability and exchange of H_2O in the process of dew and/or fog formation. A substantially depleted water tracer was manually sprayed on the leaf surface of selected plants in a dedicated tracer experiment to quantify the share of dew and/or fog water taken up by typical grassland plants. Moreover, leaf water potential and relative water content were measured to verify the effect of fog and dew on grassland plant performance. In 2019 and 2020, the experiment will be carried out at all the three sites (CH-CHA, CH-FRU, and CH-AWS) to investigate the variability of the influence of dew and/or fog formation on plants along an elevated gradient.

With the research in 2018, we test the hypothesis that during summer fair weather and drought periods, downward H_2O flux and d-excess indicated strong dew/ fog deposition that had a measurable and non-negligible quantitative effect on the plant water status of representative Swiss grassland species through foliar water uptake. This caused higher relative water content and leaf water potential of plants before sunrise than that after sunset, but had a more significant effect on *Lolium perenne* than on the other two species (*Taraxacum officinale*, and *Trifolium pratense*) that were investigated.

Our research highlights the importance of dew and fog as a water source in temperate ecosystems during dry summer periods, which are expected to become more frequent with global warming.