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High accuracy measurement system for dew and fog water quantification in temperate grassland ecosystems

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Dew and fog occur rather frequently in ecosystems all over the world. Still, water from dew and fog is often not considered in ecohydrological budgets. One reason is that there is no reference standard instrument to measure those water inputs into ecosystems. Another reason is that the water input from dew and fog is, compared to the water input from precipitation, a rather small amount at most locations, which makes it difficult to be measured accurately.

We developed a custom-made measurement system for quantifying dew and fog water inputs to temperate grassland ecosystems. The system consists of three high accuracy weighing micro-lysimeters composed of a plant pot which stands on a weighing platform with additional sensors. The weighing micro-lysimeters were designed to quantify even small water gains caused by dew formation on grasses with unprecedented accuracy. Some former studies on micro-lysimeter design for dew measurements used small-size plant or bare-soil pots in combination with low capacity load cells, which allowed high accuracy measurements, but these systems were not able to mimic natural field conditions in terms of thermal behaviour and plant development. Other studies used large lysimeter systems which were better capable to simulate natural conditions, but required substantial infrastructure for installation and often showing too low accuracy, because of a trade-off between load cell accuracy vs. capacity.

Inside the micro-lysimeter plant pots, we installed soil moisture and temperature sensors to compare thermal and moisture conditions inside the plant pots with sensors installed in a control field plot at 1 m distance. A further component of the measurement system is a visibility sensor which allows to determine if water inputs originate solely from dew or from dew and fog in combination (fog: horizontal visibility < 1000 m). A leaf moisture sensor gives a redundant measurement to sense if leaves are really wet and for how long they stay wet.

We set up a measuring network with the beforementioned system at eight sites in Switzerland and an additional site in South Tyrol (Italy). The sites were selected to gain representative measurements over an extended elevational gradient (from 500 to 2000 m a.s.l), within areas prone to fog (Swiss Plateau) and rather unlikely fog occurrence (Alps), as well as with low and high precipitation amounts (from 500 up to over 1500 mm/year).

Measuring dew and fog water inputs is expected to be important, as grassland species are able to

take up water via foliar water uptake. Thus, dew and fog water can be important water inputs, especially in dry periods during fair weather summer conditions.