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Comparison of actual evapotranspiration based on lysimeter, scintillometer and bowen ratio energy balance method

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Evapotranspiration is an important parameter for grassland ecosystems because the (actual) evapotranspiration explains the exchange of water and energy between soil, land surface and atmosphere. Understanding the effects of changing grassland yields on evapotranspiration rates is essential for the assessment of the water- and plant water balance of grassland sites under climate change. However, evapotranspiration is difficult to measure, and the suitability of the various methods strongly depends on the time and spatial scale considered. Thus, the aim of this work is to compare different measurements of actual evapotranspiration (ETa) at a managed alpine grassland site. The study area is located in the northern alps of Austria, at the Agricultural Research and Education Centre Raumberg-Gumpenstein (Styria). Here, the ETa data of a high resolution weighable lysimeters, are compared with ETa data measured by a scintillometer system BLS900 (Scintec, Germany). The system measures sensible heat flux integrated along the near-infrared beam of 880 nm, length of 356 m and height of 6.3 m above grassy surface. The ETa is calculated as a residual from the energy balance equation. Another independent source of ETa data is the Bowen ratio energy balance system (BREB), which is placed roughly in the middle of the scintillometer path and adjacently (few meters) to the lysimeter.

During the observation period (vegetation period 2018; March-November), ETa calculated from the weighable lysimeter was 573 mm in total and showed the highest absolute value compared to the other measurements. The calculated ETa from the BREB system is 505 mm (including condensation) and 526 mm (excluding condensation).

At the beginning of the vegetation growth, the scintillometer system measured lower values of ETa than the lysimeter, but higher values than the BREB system. Contrary, at the end of May, the lysimeter ETa showed the lowest values compared to the other two systems. This can be related to the fact that the grass on the lysimeter was cut three times per year, whereas the management of other areas on the experimental site was different. The same effects were observed at the second and third cut, always with the fact that the scintillometer system showed higher values than the BREB system. After two weeks of the first and second cut, the vegetation on the lysimeters was established faster than on the surrounding grassland. As a consequence, the lysimeter ETa

showed again the highest values. Only after the third cut at the end of September, the vegetation was slowly growing and the scintillometer as well the BREB system showed higher ETa values till the end of the observation month in November. These results suggest that the evapotranspiration rates are strongly dependent on the management of the grassland, which needs to be considered in the selection and design of evapotranspiration measurements.