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Linking water balance of mountain grasslands along altitudinal transects to climate and land-use change

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Changes of the water balance of mountain grasslands with regard to climate and land-use changes are a popular research field since years. Measuring evapotranspiration (EVT) for different land-use types and plant communities at varying sea level helps us to understand the change of water availability in a future environment. Linked with transplantation experiments, this method is promising to cover most forecasted scenarios. Although the mentioned approach is well established, our study is innovative in so far as the field work as well as data analyses was supported by more than 50 pupils from a secondary school for agriculture and food industry. Hence, a huge number of field measurements could be conducted at the same time distributed over a whole alpine valley.
In our study site Stubai Valley (300km^2), Tyrol, Austria, 13 sites on 4 different altitudinal transects (valley bottom, hillside, and sub-alpine/alpine) ranging from 900m a.s.l. up to 2400m a.s.l. were selected and equipped with weather stations recording air temperature, air humidity, precipitation, solar radiation, and soil water content in different soil depths at 15-minute interval. Additionally, more than 300 small lysimeters have been installed and data on EVT, infiltration, leaf conductivity, and soil wetness was collected on 7 measuring days. The measurements spanned an entire daylight period from sunrise to sunset. Moreover, soil and vegetation analyses on all selected plots complete the enormous data pool.
The lysimeters on each plot contained samples of long-stemmed local vegetation (1 cut / 1 uncut), short-stemmed local vegetation (1 cut / 1 uncut), alpine standard vegetation (1), intensive standard vegetation (1 cut / 1 uncut), and water for potential transpiration (1). Each type was replicated three times resulting in a total number of 24 lysimeters per study plot.
Results revealed a little increase in EVT rates for the Alpine Standard Vegetation transplanted to lower altitudes and slight decrease for the Intensive Standard Vegetation when transplanted to higher altitudes. However, the effect of temperature increase / decrease was lower than expected which implies a long-time endangerment of alpine plant communities in a warmer climate due to lower competitive power. However, cutting has a more severe effect on EVT and linked soil wetness as well as deep seepage in all altitudes. Hence, even if plant communities change, land management will influence soil wetness, water storage capacities and finally catchment yield.