Geophysical Research Abstracts
Vol. 16, EGU2014-9918, 2014
EGU General Assembly 2014

Hydrological cycling of alpine grassland along an elevation gradient in an inner dry alpine valley

Stefano Della Chiesa (1), Giacomo Bertoldi (1), Georg Niedrist (1), Nikolaus Obojes (1), Stefano Endrizzi (2), John D. Albertson (3), Lukas Hoertnagl (4), Georg Wohlfahrt (4), and Ulrike Tappeiner (4)

(1) 1Institute for Alpine Environment, EURAC research, Bolzano, Italy, (2) Department of Geography, University of Zurich, (3) Department of Civil and Environmental Engineering, Pratt School of Engineering, Duke University, North Carolina, USA, (4) Institute of Ecology, University of Innsbruck, Austria

The effects of elevation on surface water fluxes in dry alpine grassland ecosystems were investigated along an elevational transect between 1,000 and 2,000 m a.s.l. established in the Vinschgau/Venosta valley, a relatively dry region in the Italian Alps. The GEOtop-dv hydrological model was employed in point-scale mode to model the effects of the elevation gradient on snow water equivalent (SWE), soil water content (θ) evapotranspiration (ET), above ground biomass (Bag) and water use efficiency (WUE) in different climatic conditions. Results show that SWE decreased strongly with decreasing elevation, but was also affected by the interannual variability of meteorological drivers. During warmer years the magnitude of changes in SWE was mitigated at higher altitudes, while exacerbated below 1,500 m. θ dynamics indicated that water stress conditions for vegetation currently occur at 1,000 m each year, while only a warmer and drier year caused drought at 1,500 m and no water stress was found at 2,000 m.

ET, Bag and WUE did not decrease with elevation, but showed a maximum at an intermediate elevation around ca. 1,500 m, because of the contrasting trends of a shorter vegetation season at higher elevations and water stress at lower elevations, where, in fact, irrigation is needed to maintain grassland productivity. A simulation based on long-term climatic conditions in combination with a sensitivity analysis of precipitation change showed that this effect is more pronounced during drier years, while for the wettest years ET tended to decrease with increasing elevation. Taking these findings together, this study suggests that in relatively dry climatic conditions, mountain areas generally act as “water towers” above 1,500 m. Quantifying this critical threshold and its likely future variation under climate change scenarios is a challenge for water resource research in the Alpine region and can help stakeholders in planning future mitigation strategies.