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Water dynamics and groundwater contributions in a young mountain soil under different meteorological conditions

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Groundwater contribution to the soil–water content and to the evapotranspiration is a major uncertainty to assess the water balance. Particularly in mountain environments, where the soil and the depth of the water table are shallow, both percolation and water rise from the water table can happen.

Aiming at better understanding these processes at the local scale, a micrometeorological station, equipped with both traditional sensors, an eddy covariance (EC) apparatus with a $20\,\mathrm{Hz}$ sonic anemometer and infrared CO_2 and H_2O gas analyser, and four multiplexed TDR probes, was installed at Cividate Camuno (Oglio river basin, Central Italian Alps, Italy, $274\,\mathrm{m\,a.s.l.}$), in a mountain environment with complex topography and Alpine sublitoranean climate. The young, anthropised, soil upper layers are about $40\,\mathrm{cm}$ deep and mainly covered by alfalfa (*Medicago sativa*), wild carrot (*Daucus carota*) and yarrow (*Achillea millefolium*). Field and laboratory tests were performed to characterise the soil hydraulic properties. Particularly the soil–water retention relationships were measured by means of a low– and a high–pressure Richards' apparatus, and the hydraulic conductivity at saturation of each soil layer was estimated by 2–dimensional, axis–symmetrical, inverse modelling of field infiltration tests from single ring infiltrometer.

The measurements were performed during Summer 2012 and Summer 2013. The groundwater exchange was numerically estimated both in wet (Summer 2012) and in dry meteorlogical conditions (Summer 2013). Evapotranspiration was assessed by means of Penman–Monteith method, which was found to be in the range between EC–estimated fluxes and an indirect estimate based on the Bowen ratio correction for Summer 2012.

The two seasons are meteorologically very different and it results also in the soil–water regime. During Summer 2012, the weather was relatively wet, the soil did not reach very small water contents, so that precipitation was able to percolate towards the groundwater table and the groundwater table to meaningfully contribute to the evapotranspirative fluxes. Summer 2013 was instead much drier, precipitation was not able to meaningfully change the water content of the lowest soil layer and to percolate toward the water table. As a consequence of the very small water contents of the soil, also a very small water rise had place.