Water balance of an extensive alpine catchment area under the effect of climate change

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The recognized evidence of global warming demands assessment of the present and future water cycle in Europe and worldwide. Recently, evidence of modified hydrological regime in the Alps under climate change has been documented. In particular, several studies (e.g. Bocchiola, 2014; Soncini et al. 2016) indicated an increase in hydrological flows in autumn and winter in response to snowfall trading with intense rainfall, shorter snow cover during winter, as well as decreased flows during dry spring and summer and large shrinking of glaciers at high altitude. However, according to the IPCC Fifth Assessment Report, it is still necessary to deepen our understanding of the impact of climate change and land use on groundwater recharge and levels in the alpine catchment areas (Cochand et al. 2019).

For this purpose, a water balance of the last three hydrogeological years (March 2017 - March 2020) was carried out on the Valtellina catchment (northern Italy, Central Italian Alps). This basin is a perfect case study for its wide unconfined aquifer in the floodplain, which makes it highly sensitive to this type of change. Moreover, the management of the water resource is of considerable importance, being crucial in a wide range of sectors (tourism, irrigation, domestic use, energy and industry).

Due to the extensive and diversified study area (26,000 km²) and the low ground data density (7 meteorological stations, 4 surface-water monitoring points, and 9 groundwater monitoring points), the water balance terms were estimated by exploiting and combining Earth Observation data products with ground data, also taking into account the geological and geomorphological characteristics of the basin. In particular, the evapotranspiration and the snow cover were provided, by MOD16A2 (MODIS/Terra Evapotranspiration 8-Day Level-4 Global 500m SIN Grid) and MOD10A2 (MODIS/Terra Snow Cover 8-Day L3 Global 500m SIN Grid, Version 6) satellite data, respectively.

As a result, the groundwater storage of a wet hydrogeological year compared with the groundwater storage of a dry hydrogeological year allowed analysing the sensitivity of groundwater resources to climate change.
