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Use of canopy coefficients obtained from satellite data to estimate evapotranspiration over high mountain Mediterranean watersheds

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The high mountain areas of Sierra Nevada (Southern Spain) have a great ecological value due to the presence of endemic ecosystems together with landscapes and cultural heritage, being protected by the figures of Biosphere Reserve (1986) and National Park (1999). However, a considerable increase of irrigated areas has taken place in the region over the last years producing a rise in groundwater consumption that in turns is being projected in the functioning regime of rivers and the water quality of the basins runoff. These reasons led to the river basin authority to conduct a pilot study to improve the current knowledge of the hydrological behavior of the high mountain area of Sierra Nevada. In this context, a regular monitoring of water consumed by both, irrigated horticultural crops and natural communities is crucial (1) to evaluate the current water issues related changes and (2) to assist the decision makers to guarantee a sustainable management of water resources in these watersheds.

This work is focused on monitoring, on a regular time-step and distributed basis, the dynamic of the evapotranspiration of two high mountain watersheds, part of Sierra Nevada Mountains, for the hydrological years 2013/14 and 2014/15. A vegetation index (VI)-canopy coefficient approach (called VI-ETo) has been applied by using a set of Landsat-8 and MODIS images. This model combines FAO56 methodology with the vegetation indices (VIs) provided by remote sensing to accurately determine the plant transpiration. Finally, the applied methodology was compared with both, results of the hydrological model HBV and field data observations to evaluate the water resources of the watersheds.

The results of the VI-ETo approach provided an assessment of the spatio-temporal variability of ET in both watersheds and an improved knowledge about the water consumption patterns of the main land cover types in the area. This information will help future decisions related with land use changes and sustainable management of water resources. In addition, the estimated annual runoff data were similar to those obtained by the HBV model and observed at the watershed outlet, validating the application of the VI-ETo approach over high mountain watersheds of Sierra Nevada.