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Water balance modelling in two pine forests along the Túria river basin (Eastern Spain)

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This study is part of an ongoing research project aiming to enhance forecasting of extreme precipitation events in eastern Spain. Utilizing on-site measurements to estimate the soil-water balance, we opt to understand the contribution of water vapour from land cover (evapotranspiration) to the precipitable water vapor in the troposphere, along the Túria river basin. This will lead to a better understanding of the sensitivity and importance of land use changes to precipitations patterns in the region.

An eco-hydrological modelling approach was used to quantify water consumption in six pine plots (20 m x 20 m), three located 200 m a.s.l. and 30km from the coastline (coastal site) and the other three, 1200 m a.s.l. and 85 km from the coastline (inland site). Both sites are included in the diurnal seabreeze circulations during spring and summer.

Meteorological measurements include precipitation (mm), temperature (Cº), relative humidity (%) and solar radiation (MJ). Soil water content is measured to validate modelling outputs (m3/m3). In addition, sap-flow is measured in pine trees within the experimental plots to validate transpiration values (mm). The modelling program (HYDROBAL) utilizes the meteorological measurements as input data in addition to potential evapotranspiration (Eto) and vegetation- and soil characterisation data. Both field sites are composed of Pinus halepensis Mill. with Quercus coccifera L., Pistacia letiscus L., Erica multiflora L., Rhamnus lycioides L., and Rosmarinus officinalis as dominating species.

The data presented was acquired during eight months of continuous field measurements (April – December 2017). During that time we observed significantly higher precipitation rates and consequently soil water content in the inland field-site, which holds thirty percent more vegetation cover than that of the coastal field-site. During the study period both sites were highly affected by water-limited evapotranspiration, with the precipitation being extremely low (111.67 mm and 59.96 mm). At both sites relative humidity (%) showed similar values (differences lower than 25%) for 91 % of the days. Further results demonstrate that despite the inland site having more net precipitation and consequently higher levels of soil-water content (17.6 % vs. 7.9%) and Eto (406,3 mm vs. 217,3 mm), the Eta/Precipitationnet ratio was overall lower compared to that of the coastal site. This indicates that the Eta values are sensitive to other factors, like the water vapour mixing ratio, which was found to be up to 50% higher at the coastal site than that of the inland. This is a key feature to be considered in regards to quantification of apportionment of total precipitable water vapor deriving from evapotranspiration in dry regions where strong spatial heterogeneities of water vapour mixing ratio values are found, as is the case of coastal areas in the Mediterranean.