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On the estimate of the transpiration in Mediterranean heterogeneous ecosystems with the coupled use of eddy covariance and sap flow techniques.

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Mediterranean ecosystems are commonly heterogeneous savanna-like ecosystems, with contrasting plant functional types (PFT) competing for the water use. Mediterranean regions suffer water scarcity due to the dry climate conditions. In semi-arid regions evapotranspiration (ET) is the leading loss term of the root-zone water budget with a yearly magnitude that may be roughly equal to the precipitation. Despite the attention these ecosystems are receiving, a general lack of knowledge persists about the estimate of ET and the relationship between ET and the plant survival strategies for the different PFTs under water stress. During the dry summers these water-limited heterogeneous ecosystems are mainly characterized by a simple dual PFT-landscapes with strong-resistant woody vegetation and bare soil since grass died. In these conditions due to the low signal of the land surface fluxes captured by the sonic anemometer and gas analyzer the widely used eddy covariance may fail and its ET estimate is not robust enough. In these conditions the use of the sap flow technique may have a key role, because theoretically it provides a direct estimate of the woody vegetation transpiration. Through the coupled use of the sap flow sensor observations, a 2D foot print model of the eddy covariance tower and high resolution satellite images for the estimate of the foot print land cover map, the eddy covariance measurements can be correctly interpreted, and ET components (bare soil evaporation and woody vegetation transpiration) can be separated. The case study is at the Orroli site in Sardinia (Italy). The site landscape is a mixture of Mediterranean patchy vegetation types: trees, including wild olives and cork oaks, different shrubs and herbaceous species. An extensive field campaign started in 2004. Land-surface fluxes and CO_2 fluxes are estimated by an eddy covariance technique based micrometeorological tower. Soil moisture profiles were also continuously estimated using water content reflectometers and gravimetric method, and periodically leaf area index (LAI) PFTs are estimated. From 2012 sap flow sensors based on the thermal Dissipation Method are installed on numerous trees around the tower. Preliminary results show first the need of careful use sap flow sensors outputs which are affected by errors in the estimates of their main parameters, mainly allometric relationships between, for instance, sapwood area, diameter, canopy cover area, which affect the upscale of the local tree measurements to the site plot larger scale. Finally we demonstrate that the sap flow sensors are essential for the estimate of ET in such dry conditions, typical of Mediterranean ecosystems.