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On the coupled use of sapflow and eddy covariance measurements: environmental impacts on the evapotranspiration of an heterogeneous - wild olives based - Sardinian ecosystem.

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Sapflow and eddy covariance techniques are attractive methods for evapotranspiration (ET) estimates. We demonstrated that in Mediterranean ecosystems, characterized by an heterogeneous spatial distribution of different plant functional types (PFT) such as grass and trees, the combined use of these techniques becomes essential for the actual ET estimates. Indeed, during the dry summers these water-limited heterogeneous ecosystems are typically characterized by a simple dual PFT system with strong-resistant woody vegetation and bare soil, since grass died. An eddy covariance – micrometeorological tower has been installed over an heterogeneous ecosystem at the Orroli site in Sardinia (Italy) from 2003. The site landscape is a mixture of Mediterranean patchy vegetation types: wild olives, different shrubs and herbaceous species, which died during the summer. Where patchy land cover leads and the surface fluxes from different cover are largely different, ET evaluation may be not robust enough and eddy covariance method hypothesis are not anymore preserved.
In these conditions the sapflow measurements, performed by thermodissipation probes, provide robust estimates of the transpiration from woody vegetation. Through the coupled use of the sapflow sensor observations, a 2D footprint 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.
Based on the Granier technique, 33 thermo-dissipation probes have been built and 6 power regulators have been assembled to provide a constant current of 3V to the sensors.
The sensors have been installed at the Orroli site into 15 wild olives clumps with different characteristics in terms of tree size, exposition to wind and solar radiation and soil depth. The sap flow sensors outputs are analyzed to estimate innovative allometric relationships between sapwood area, diameter, canopy cover area, which are needed for the correct upscale of the local tree measurements to the site plot larger scale. Results show the response of wild olives stomatal conductance to vapor pressure deficit that follow an exponential decrease. Interestingly the tree exposure impacts transpiration significantly, showing double rates for the trees in the south part of the wild olive clumps. The soil depth also affects ET dynamics due to the influence on water absorption of the root tree system.
Finally using an innovative scaling procedure, the sap-flow transpiration at field scale have been compared to the eddy covariance ET, showing the impact of climate dynamics on the ET estimates with the two tecniques.