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Soil Water Balance and Vegetation Dynamics in two Contrasting Water-limited Mediterranean Ecosystems on Sardinia, Italy

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Water limited conditions strongly impacts soil and vegetation dynamics in Mediterranean regions, which are commonly heterogeneous ecosystems, characterized by inter-annual rainfall variability, topography variability and contrasting plant functional types (PFTs) competing for water use. Historical human influences (e.g., deforestation, urbanization) further altered these ecosystems. Often deforestation activities have been more intensive along the plan and alluvial river valleys, where deep soils are well suited for agricultural and grass became the primary PFT, while more natural woody vegetations (trees and shrubs) survived in the steep hillslopes and mountain areas, where soil thickness is low, i.e. less attractive for agricultural.
Hence, Mediterranean regions are characterized by two main ecosystems, grassland and woodland, which for both natural and anthropogenic causes can grow in soils with different characteristics (texture, hydraulic properties, depth), highly impacting water resources.
Water resources and forestal planning need a deep understanding of the dynamics between PFTs, soil and atmosphere and their impacts on water and CO2 distributions of these two main ecosystems. The first step is the monitoring of land surface fluxes, soil moisture, and vegetation dynamics of the two contrasting ecosystems. Moreover, due to the large percentage of soils with low depth (< 50 cm), and due to the quick hydrologic answer to atmospheric forcing in these soils, there is also the need to understand the impact of the soil depth in the vegetation dynamics, and make measurements in these types of soils.
Sardinia island is a very interesting and representative region of Mediterranean ecosystems. It is low urbanized, and is not irrigated, except some plan areas close to the main cities where main agricultural activities are concentrated. The case study sites are within the Flumendosa river basin (are of about 1700 km2) on Sardinia. Two sites, both in the Flumendosa river and with similar height a.s.l., are investigated. The distance between the sites is around 4 km but the first is a typically grass site located on an alluvial plan valley with a soil depth more than 2m, while the second site is a patchy mixture of Mediterranean vegetation types Oaks, creepers of the wild olive trees and C3 herbaceous (grass) species and the soil thickness varies from 15-40 cm, bounded from below by a rocky layer of basalt, partially fractured. In both sites land-surface fluxes and CO2 fluxes are estimated by eddy correlation technique based micrometeorological towers. Soil moisture profiles were also continuously estimated using water content reflectometers and gravimetric method, and periodically leaf area index (LAI) PFTs are estimated during the Spring-Summer 2005.
The following objectives are addressed:1) pointing out the dynamics of land surface fluxes, soil moisture, CO2 and vegetation cover for two contrasting water-limited ecosystems; 2) assess the impact of the soil depth and type on the CO2 and water balance dynamics. For reaching the objectives an ecohydrologic model is also successfully used and applied to the case studies. It couples a vegetation dynamic model, which computes the change in biomass over time for the PFTs, and a 3-component (bare soil, grass and woody vegetation) land surface model.