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Influence of water availability on carbon uptake of two Mediterranean Holm oak forests

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In the last decades changes in precipitation pattern were registered at global level as a consequence of temperature rise, with an increase in the intensity of precipitation events in many regions of the world. but also more intense and longer drought in others, and in particular in the Mediterranean basin. Climate changes can have direct influence on biological phenomena, like the earlier onset of spring and the lengthening of the growing season, playing a key role for the carbon fixation and for the amount of CO2 exchanged by the biosphere with the atmosphere.
The impact of water availability variation on ecosystem functioning and carbon fluxes differs from species to species and depends on the period of occurrence. Mediterranean-type ecosystems (MTEs), which are mostly water and temperature-limited biomes and suffered prolonged and exacerbated human pressure, are particularly sensitive to changes in climate, as suggested by the observed decrease in plant productivity following recent heat waves and droughts events.
Water availability for this region seems to be a crucial constraint for the net carbon assimilation, and biomes evolving in particularly negative soil and climatic conditions could be the most affected by changes in rainfall pattern.
In this view a comparison between carbon uptake of two Holm oak (Quercus ilex L.) forests of Central Italy (Castelporziano-Rome and Lecceto-Siena), measured by eddy covariance technique, was done to analyze the possible adaptation to rainfall decrease.
The two ecosystems are characterized by different soil water content of the upper soil layers, by the occurrence of a shallow water table in Castelporziano forest and by a strongly different net ecosystem exchange rate (NEE), with -360 gCm-2year-1 for Lecceto and -875 gCm-2year-1 for Castelporziano.
The water supply of Lecceto was mostly driven by rainfall, reaching minimum values under 5% in particularly dry periods and increasing the carbon sink of the ecosystem after sufficiently prolonged or high precipitation events; on the contrary in Castelporziano the presence of the underground water allowed to keep lower level of soil water content around 10%, guaranteeing a more regular photosynthetic activity and favouring, at the end of the year, a greater carbon uptake.
The comparison of the net carbon exchange for medium and high values of photosynthetically active radiation shown a correlation with the soil water content and indicated that, keeping constant soil moisture classes, Lecceto ecosystem resulted more efficient than Castelporziano, but became a source of CO2 in drought conditions, confirming the importance of water in favouring plant functions and indicates an influence on carbon exchange in terms of water stress.