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Climate change mitigation capacity of a deciduous oak forest under coppice management subject to seasonal droughts

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Climate warming and increased frequency of extreme drought events, are being observed as the cause of wide spread tree mortality across the globe (Anderegg et al., 2013; Allen et al., 2010). The Mediterranean region in particular is projected to be very exposed to reduced precipitation levels and increased frequency of heat waves (Hoerling et al., 2012; IPCC, 2014), conditions that are expected to have a negative impact on the productivity of forest ecosystems and weaken their capacity of uptaking atmospheric CO_2.

Despite several studies in the last two decades have contributed to shed light on the carbon budget of European forests and their role as active carbon sinks, coppiced forests, a common forest landscape feature in southern Europe characterized by relatively short rotation periods, have received limited attention.

Here we present an analysis of 18 site/years of ecosystem scale CO_2 fluxes of a deciduous oak (*Quercus cerris* L.) coppice forest in Central Italy monitored during the years 2000-2012 over two differently aged forest stands. The resulting chronosequence covered the forest rotation period from the post-harvesting stage up to a stand age of 22 years, that is indeed longer than the minimum rotation period prescribed by law or typically applied for such forests.

The recovery of a net carbon sequestration capacity already in the second year after the harvest denoted the high resilience of this system to the disturbance induced by the silvicultural management, at least in the short term. The evaluation of biotic and biotic controls on the forest-atmosphere CO_2 exchanges highlighted that the net ecosystem exchange (NEE) scaled primarily with plot age and was mostly explained by the variability of ecosystem respiration rather than photosynthesis, the latter recovering in the first year after the forest harvest and then levelling off, although still subject to a certain degree of inter-annual variability (CV=8.3%) Seasonal droughts, in the most severe cases, were found to reduce annual photosynthetic assimilation up to -21%. After deducting the harvested biomass, the coppice management of the studied forest was still associated to a net sequestration of atmospheric carbon not smaller than 1.3 tC ha^{-1} yr^{-1} when integrated over the rotation period.