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Impact of climate manipulation on carbon fluxes of a Mediterranean shrubland in Sardinia

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Arid and semiarid woody shrublands make up approximately 35% of the global terrestrial surface area, 24% of the global organic carbon and 16% of the global aboveground biomass. Despite their potential impact on the global carbon balance, these ecosystems and their responses to climate change are still poorly studied. With the aim of investigating the potential effect of global environmental changes on ecosystem function, we manipulated the microclimate in a Mediterranean shrubland in the Island of Sardinia in Italy to increase soil and air night-time temperatures and to reduce water input from precipitation. Temperature and water are the main drivers for many biological and chemical processes, and could strongly affect the principal C fluxes such as NEE (Net Ecosystem Exchange), TER (Total Ecosystem respiration) and SR (Soil CO_2 efflux). The experimental site consists of nine plots (about 25 m^2) with an automatic roof that covers the vegetation during the night (Warming treatment, 3 plots) or during rainfall events (Drought treatment, 3 plots), the remaining 3 plots are used as control. A canopy-chamber was developed and tested to measure NEE and TER in the three treatments. Soil CO_2 efflux was also measured in each of the 9 plots, using a commercial Li-Cor 8100 soil chamber. All measurements were carried out during the year 2010, after nine years of manipulative experiment.

All the C fluxes examined showed a strong seasonality, with the highest rates during the spring, when the high soil water content and the mild temperatures supported both the photosynthetic and respiratory activity, and the lowest rates during the hot dry non-vegetative summer season. The warming and drought treatments did not affect significantly the C fluxes at any sampling date. The variability between plots was also high, as a consequence of the high heterogeneity in plant composition. In this Mediterranean shrubland, already adapted to extremely high temperatures and prolonged drought conditions, the increase of temperature and the reduced water availability will unlikely affect ecosystem C fluxes. In the long term, changes in plant composition could play a major role to determine the responses of this community to climate changes, and their role on the biosphere C-balance.