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Fire and drought affect plant communities and the greenhouse gas balance in a Mediterranean shrubland

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Predicted changes in the seasonality and amount of rainfall under a changing climate have the potential to dramatically alter ecosystem function and species composition. Moreover, in fire-prone ecosystems, the joint effects of fire and increasing aridity may create irreversible changes to the services these ecosystems provide. To understand the effects of increasing drought and fire in a Mediterranean shrubland, we implemented an automated rainfall manipulation system, with rain-out shelters which automatically fold and unfold when conditions are rainy and dry, respectively. In January 2009, we implemented five different treatments, where annual precipitation was reduced by diminishing summer rainfall from the long-term historical average, up to a 40% reduction, following IPCC scenarios. In September 2009, we uninstalled all the shelters to burn the different plots, and reinstalled the shelters immediately afterwards.

In this talk, we will present the preliminary results of an integrated experiment which aims at understanding the concomitant effects of fire and different drought intensities on the species composition and greenhouse gas balance (CO2, N2O and CH4) of a Mediterranean shrubland. We observed that plant growth was more severely affected by drought in the more shallow-rooted, malacophyllous shrub (from 116 to -7.2 mg/g/d in Cistus ladanifer), than in a deeper-rooted heather (from 5.5 to 66.9 mg/g/day in Erica arborea). This growth response was mediated by species-specific differences in hydraulics, leaf morphology and photosynthetic gas exchange of each species. Analyses of changes in species composition after fire are currently undergoing. The precipitation reduction treatments exerted drought stress on CH4 oxidizing microorganisms and thus reduced the CH4 sink strength of the ecosystem during the pre-fire period. Furthermore, the net CH4 uptake at the soil-atmosphere interface was reduced by the fire for a period of at least one month. Pedosphere-atmosphere N2O fluxes were mostly close to zero from May 2009 until one month after fire and affected neither by the precipitation manipulation nor by the fire.