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Arbuscular mycorrhiza fungi mediate soil respiration response to climate change in California grasslands

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California grasslands store ca. 100 Tg of soil organic carbon (SOC) and almost 40% of those ecosystems are prone to land use changes. The fate of these carbon pools will largely depend on how the main components of soil respiration – i.e. roots, mycorrhiza, and 'bulk soil' communities– respond to such changes. In order to determine the sensitivity to environmental drivers we set up an experiment to address the effect of plant community composition, soil age and warming on soil respiration rate during the 2014-2015 winter. We tested differences among microbial, fungal and root respiration using an exclusion technique to assess the effect of plant community (open grasslands vs oak woodland) in two field sites differing in soil properties as nutrient content, related to geologic soil age (92 and 137 kyr). We also used open top chambers (OTC) to simulate global change effects on grasslands. Our results showed that arbuscular mycorrhizal fungi were the main drivers of differences recorded between soils of different age, and that those differences were linked to nutrient availability. Bulk soil respiration was more sensitive to environmental variation than mycorrhizal or root respiration, indicating that the presence of mycorrhizae and roots can regulate the capacity of CO_2 emission to the atmosphere. Soil age affected CO_2 flux from grasslands but not under oak canopies, likely due to the high concentration of SOM in oak canopies which moderated any affect of soil mineralogy on nutrient availability. Overall our study shows that the ability of grasslands to mitigate CO_2 emissions depends on interactions between vegetation and their rhizosphere on soil microbial communities.