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Microbial community dynamics induced by rewetting dry soil: summer precipitation matters

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The massive soil CO_2 efflux associated with rewetting dry soils after the dry summer period significantly contributes to the annual carbon budget of Mediterranean grasslands. Rapid reactivation of soil heterotrophic activity and available carbon are both required to fuel the CO_2 pulse. Better understanding of the effects of altered summer precipitation on the metabolic state of indigenous microorganisms may be important in predicting future changes in carbon cycling. We investigated the effects of a controlled rewetting event on the soil CO_2 efflux pulse and on the present (DNA-based) and potentially active (rRNA-based) soil bacterial and fungal communities in intact soil cores previously subjected to three different precipitation patterns over four months (full summer dry season, extended wet season, and absent dry season). Phylogenetic marker genes for bacteria (16S) and fungi (28S) were sequenced before and after rewetting, and the abundance of these genes and transcripts was measured. Even after having experienced markedly different antecedent water conditions, the potentially active bacterial communities showed a consistent wet-up response, reflecting contrasting life-strategies for different groups. Moreover, we found a significant positive relation between the extent of change in the structure of the potentially active bacterial community and the magnitude of the CO_2 pulse upon rewetting dry soils. We suggest that the duration of severe dry conditions (predicted to change under future climate) is important in conditioning the response potential of the soil bacterial community to wet-up as well as in framing the magnitude of the associated CO_2 pulse.