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Microbial growth responses upon rewetting dry soil

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Increased rainfall and drought periods are expected to occur with current climate change, leading to fluctuations in soil moisture. Changes in soil moisture are known to affect carbon cycling. A pulse of carbon dioxide release (respiration) is often observed after rewetting a dry soil and a drying threshold is observed before this pulse emerges. Increased microbial activity is often assumed to be the cause for the pulse in respiration. Yet, the microbial growth responses that underlie this pulse are often not studied. The following questions will be addressed in this presentation. 1) Do fungal and bacterial growth explain the pulse in respiration upon rewetting a dry soil? 2) How does microbial growth respond to different drying intensities before rewetting? To answer the research questions, soils from Sweden, U.K. and Greenland were put in microcosms, air-dried for four days, a prolonged period or to different moisture content before rewetting. We measured soil respiration, fungal growth rates and/or bacterial growth rates at high temporal resolution during one week after rewetting.

Our results suggest that the respiration pulse upon rewetting dry soil is not due to high microbial growth rates. During the first hours after rewetting, bacterial and fungal growth rates were low whereas the respiration rates were high. As such, there was a decoupling between the pulse in respiration and microbial growth rates. Two patterns of bacterial growth were observed upon rewetting the three different soils. In “pattern 1”, bacteria started growing immediately in a linear pattern up to values similar as the moist control. In “pattern 2”, bacteria started growing exponentially after a lag period of no growth with a second pulse of respiration occurring at the start of bacterial growth. Manipulating the drying intensity changed the patterns. Soils with “pattern 1” were changed to “pattern 2” when subjected to more extensive drying periods whereas soils with “pattern 2” were changed into “pattern 1” when subjected to milder drying. Taken together, our results suggest that bacterial growth responses and the shape of the respiration pulse may depend on the size of the surviving biomass upon rewetting. Our results imply that drying-rewetting may be a carbon cost for the soil microbial community.