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Functional resilience to drought and rewetting in soils under different land uses

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Climate change is predicted to affect the variability of rainfall as well as the average amount. The resilience of soils to a regime of repeated drying and rewetting is therefore important. In particular, we want soils to continue to deliver functions such as nutrient cycling, thus the functional resilience of the soil is key. In this work we sampled soils with different land-use histories of long-term grass, arable and fallow from the Highfield experiment at Rothamsted Research. They were then subjected to prescribed and controlled repeated drying and rewetting stresses. Prior to the initial stress and after exposure to different numbers of stress events, barley shoot powder was added to the soil and subsequent was measured at high temporal resolution. The resulting respiration profiles were used as a measure of the functional state of the soils viz-a-vis their ability to process a complex carbon substrate. We observed that initially the soils from all of the land uses were affected by the change in disturbance regime, as the respiration in response to substrate addition changed after the initial stresses. This showed that none of the soils was resistant to this stress. After 12 drying and rewetting cycles, despite the extreme disturbance regime, soil from the grass plots, and those that had recently been grass, adapted and recovered their prior respiration profiles. Arable soils, however, were less resilient and did not recover. This highlights the importance of considering the adaptability of soils when they are exposed to repeated stresses in order to consider the resilience of soil communities.