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Accumulation of soil carbon under elevated CO_2 unaffected by warming and drought

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Elevated atmospheric CO_2 concentration (eCO_2) and climate change may significantly alter soil carbon (C) dynamics and thus feedback to future climate. However, only very few field experiments world-wide have combined eCO_2 with both warming and changes in precipitation in order to study the potential combined effects of changes in these fundamental drivers of carbon cycling in ecosystems. We exposed a temperate heath/grassland to eCO_2, warming, and drought, in all combinations for 8 years. Soil C under ambient CO_2 remained constant over time, whereas soil C stocks increased by 0.167 kg C m-2 yr-1 on average across all treatment combinations with eCO_2 and showed no sign of slowed accumulation over time. Further, the response to eCO_2 was not affected by simultaneous exposure to warming and drought. The robust increase in soil C under eCO_2 observed here, even when combined with other climate change factors, suggests that there is continued and strong potential for enhanced soil carbon sequestration in some ecosystems to mitigate increasing atmospheric CO_2 concentrations under future climate conditions. The feedback between land C and climate remains one of the largest sources of uncertainty in future climate projections, yet experimental data under simulated future climate, and especially including combined changes, are still scarce. Globally coordinated and distributed experiments with long-term measurements of changes in soil C in response to the three major climate change-related global changes, eCO_2, warming, and changes in precipitation patterns, are therefore urgently needed.