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Whole soil warming promotes subsoil carbon gain depending on land management practices in temperate climate

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Abstract:

Global warming has the potential to stimulate soil microbial metabolism and enzymatic activity, which leads to the acceleration of biogeochemical processes and may influence soil carbon sequestration. However, the direction and magnitude of these changes are uncertain, as deep soil microbial community and enzyme activities are poorly constrained. In particular, management effects on the warming responses of microbial communities at depth are unknown. Here, we conducted an in-situ soil warming (+4°C) experiment down to 2.0-m depth in an agricultural Cambisol to study the warming responses of soil properties, extracellular enzyme activity, eco-enzymatic stoichiometry, and microbial community composition under two different land management practices.

Our findings indicate that one year of soil warming altered the carbon and nitrogen contents, depending on soil depth and land management practices. Interestingly, we found that warming had no effect on topsoil C and N content for both land management, while subsoil (>30 cm) showed a contrasting response to warming: it significantly increased for cropland but not for grassland. These findings imply that the effects of warming on soil C and N content are likely to be influenced by how land is managed and the depth of the soil being studied. We also detected a contrasting trend of warming responses for soil microbial communities and enzyme activities, which were dependent on soil depth and land management practices. Likewise, our results indicate that microbial resource limitations shifted in warmed soil with land management and soil depths. These findings imply that the effects of warming on biogeochemical cycling and C storage are likely to be influenced by depth and management practices. Overall, our study suggests that sustainable land management fostering deep soil C accrual may be a possible solution (short-term) to preserve more C in the soil-system in response to elevated warming to combat future climate change.