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Impacts of biodiversity and pH on soil respiration in soil organic carbon modelling

Matthias Kuhnert (1), Maaike van Agtmaal (2), and Pete Smith (1)

(1) University of Aberdeen, Institute of Biological and Environmental Sciences, School of Biological Science, Aberdeen, United Kingdom (matthias.kuhnert@abdn.ac.uk), (2) Imperial College London, Division of Ecology and Evolution, Unit C, Silwood Park Campus, Ascot, SL5 7PY

Soil processes depend on the microbial community. The biodiversity of microbial communities will have an impact on the processes and/or on the resistance and resilience regarding extreme impacts. Despite its relevance, biodiversity is not yet considered in soil organic carbon (SOC) models. Only environmental factors such as e.g. soil water content, soil temperature and pH govern soil processes in the model approaches. Several studies indicate a impact of pH on biodiversity. Therefore, in this study we test if pH impacts upon soil biodiversity, which is reflected by the Shannon index, and how the pH is associated with the soil processes. The target variable representing the soil processes is soil respiration. The experiments are applied in a lab experiment on 0.5 g soil, 4 weeks incubation, 5 dilutions (to change the biodiversity) and for 2 replicates each. Two soils are considered with pH 4.5 and pH 7.0. In an additional approach, pesticides are applied to the soil to simulate stress impacts. Two different SOC models of different complexity are used to replicate the results of the experiment. The more complex model, which was designed for small scale simulation was parametrized by the experimental data to provide input data for the less complex model, which is easier to apply at larger scales. The results show only a minor impact of biodiversity on respiration rates, but there was a relationship between pH and respiration. The respiration rates are higher for the soil with pH 7.0 than for the soil with pH 4.5. The stress increased respiration rate, but is still lower than the respiration rate for the soil of pH 7.0. The model simulations showed a relatively poor similarity for respiration for the pH 4.5 soil without stress, but reasonable results for the soils with pH 4.5 and with stress and for the soil with pH 7.0, with an overestimation by 5.3% and an underestimation by 5.7%, respectively. These preliminary results show the potential for up-scaling findings of lab experiments. Future studies are needed to validate these findings on larger scale experiments such as at plot or field scale.