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Can we disentangle climate and microbial diversity effects on soil respiration in managed forests?

Marleen Pallandt[1,2], Daniela Guasconi[1,2], Jūratė Aleinikovienė[3], Dorian Behling[4], Sara Filipek[4], Aleksi Lehtonen[5], Tijana Martinovic[6], Boris Ťupek[5], and Stefano Manzoni[1,2]

[1]Stockholm University, Dpt of Physical Geography
[2]Bolin Centre for Climate Research
[3]Vytautas Magnus University Agriculture Academy, dep. of agroecosystems and soil sciences
[4]Wageningen University & Research
[5]Natural Resources Institute Finland
[6]Institute of Microbiology of the Czech Academy of Sciences

Soils store large amounts of carbon (C), and even minor changes in C stocks can have profound impact on climate. Microorganisms play a critical role in regulating C stocks by processing soil organic matter (SOM), which forms and stabilises SOM but also releases greenhouse gases such as CO_2 into the atmosphere. Despite their key role, microbial processes are generally not explicitly included in decomposition models to predict respiration rates and soil C turnover times. In these models, decomposition rates are only affected by environmental drivers, such as temperature, soil moisture, plant litter inputs and existing SOM content. In addition—and possibly interacting with the environmental drivers—it is theorized that increased microbial diversity would contribute to accelerating decomposition rates, but this relationship needs to be explored with empirical data. We use data from the HoliSoils project (Holistic management practices, modelling, and monitoring for European forest soils; https://holisoils.eu/) collected from managed forest sites across Europe. In this dataset, microbial diversity data, micrometeorological data and soil respiration rates from trenched (providing estimates of microbial respiration) and untrenched plots (including autotrophic respiration) were collected following the same experimental design. First, we fit a non-linear model to capture the effects of temperature and soil moisture on respiration at these sites, allowing the fitting parameters to vary across forest management treatments. We then explore differences across sites and managements in the fitted model parameters such as activation energy, base respiration and moisture sensitivity in light of the different management practices and microbial diversity for each site. These results can be particularly useful for the development and parametrization of microbially explicit SOM decomposition models.