EGU22-1196
https://doi.org/10.5194/egusphere-egu22-1196
EGU General Assembly 2022

Evidence that a northward range shift of sugar maple (*Acer saccharum* Marsh.) causes a net release of CO_2 from soil

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Climate change is expected to shift the home range of sugar maple (*Acer saccharum* Marsh.) northward, thereby encroaching onto the southern range of present-day balsam fir (*Abies balsamea* (L.) Mill.) forests. Such a shift from coniferous to deciduous forest stands will affect several edaphic properties and potentially modify soil organic carbon (SOC) storage and stability. For example, the more labile deciduous litter should decompose faster than coniferous litter, potentially resulting in lower SOC storage in forest floors. On the other hand, labile deciduous litter may result in a greater microbial turnover of SOC, leading to more stable SOC in mineral-associated organic matter (C-MAOM) in the subsoil. To test these hypotheses, we surveyed 30 mature forest stands in three regions along the sugar maple–balsam fir ecotone in southern Quebec, Canada. We dug three soil pits in each stand and measured SOC stocks in the organic forest floor as well as across five depth increments (0-5, 5-10, 10-20, 20-30 and 30-40 cm) in the mineral soil. We incubated mineral soil samples from each depth for 51 weeks and monitored CO_2 emissions rates, from which we quantified the bioreactive SOC pool. We derived two indices of microbial turnover of SOC at different soil depths based on $\delta^{13}C$ signatures. Finally, we used a wet sieving procedure to assess the proportion of C-MAOM at each soil depth. Results revealed that SOC stocks were 27% greater in balsam fir than in sugar maple forests. Most of this difference was attributable to the thicker forest floors under balsam fir, in accordance with slower litter decomposition rates. CO_2 emission rates in the first 10 weeks of incubation were higher in soil samples collected under sugar maple; thereafter, CO_2 emission rates were higher in soil samples collected under balsam fir. As a result, the bioreactive SOC pool over the course of 51 weeks did not differ significantly between stand types. We found significant region × stand type interactions on both indices of microbial turnover as well as on the proportion of C-MAOM in the mineral soil. More specifically, only in one region was microbial turnover higher under sugar maple than under balsam fir. Likewise, the effect of stand type on the proportion of C-MAOM was significant in only one region, and this effect was contrary to expectations (i.e. balsam fir > sugar maple). We ascribe this unexpected result to the presence of earthworms, which we only found in sugar maple stands in this region. Although we did not find generalizable effects of stand type on SOC turnover and stability, we did find significant generalizable patterns of decreasing SOC bioreactivity, increasing microbial turnover and increasing C-MAOM with increasing soil depth. Taken collectively, our results suggest that a northward shift of sugar maple will cause a net release of CO_2 to the atmosphere and potentially create a positive feedback on global warming.