Poster #1-4

Effects of Phenotypic Diversity on Litter Decomposition are Contingent on Linked Traits

Grace Pold[1*], Seeta Sistla[2], and Kristen DeAngelis[3]

[1] Graduate Program in Organismic and Evolutionary Biology, University of Massachusetts, Amherst, MA
[2] School of Natural Science, Hampshire College, Amherst, MA
[3] Department of Microbiology, University of Massachusetts, Amherst, MA, USA

Contact: apold@umass.edu

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Soil microbial communities show considerable differences in how their metabolisms respond to elevated temperatures, with some communities becoming more conducive to carbon storage, while others become less-so. Carbon use efficiency (CUE) - or the fraction of carbon taken up by a cell and incorporated into biomass and biomass products rather than being respired – is often cited as a key determinant of the intermediate longevity of soil carbon stocks. However, soil carbon cycling models fail to include the diversity of carbon use efficiency responses to temperature, so their effects are unknown. Therefore, we evaluated how incorporating taxon- level variability of CUE temperature responses into DEMENT affected on the local carbon cycle. The trait-based DEMENT model was chosen because it enables explicit organism-level tradeoffs and is therefore conducive to the introduction of diverse physiology.

Each taxon in the model was assigned a temperature sensitivity of CUE between -0.022 and +0.022ºC-1, and the outputs of this “variable CUE” scenario were compared for simulations run at 15 and 20 ºC. An additional run where all taxa were assigned the cross-taxon mean of the first (ie 0 ºC-1) was generated as a comparison. We found that warming led to rapid litter loss (37%) when CUE temperature response was allowed to vary among taxa, and that this was associated with a 47% larger microbial biomass pool over the first 5000 days. By contrast, warming led to just a 14% greater litter loss when temperature response was fixed. However, this conclusion was contingent on the relationship between the resources taxa allocate to extracellular enzyme production. Forcing taxa with greater decomposition potential to have a more positive growth efficiency response to warming selected for a smaller community enriched in extracellular enzymes and even greater litter loss (67%). However, forcing the carbon use efficiency of taxa with more enzymes to respond less favorably to temperature did not cause warming-induced losses of litter carbon.

As such, considering intertaxon variability in CUE temperature response led to changes in litter decomposition with warming which differed from that expected with a homogenous response under this model. This builds on the growing cognizance of the importance of explicitly considering the physiological ecology of soil microbes with respect to the carbon cycle, rather than some average.