A New Approach to Synthesizing Results from Global Change Experiments

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Plants and soils affect the climate, and how they respond to global change will shape future trajectories of climate change. Here we propose a new approach to test whether global change - elevated CO_2, warming and changes in precipitation affect the biological activity of plants and microbes, responses that could in turn feedback to reinforce or dampen changes in our climate. We use multiple data streams from global change experiments to constrain simple biogeochemical models, allowing us to estimate the effect of global change on model parameters which cannot be measured directly. Treatment effects on model parameters are then quantitatively summarized across different experiments by meta-analysis. We recently used this approach to show that although elevated atmospheric CO_2 increases the inputs of carbon to soil by 19.8%, it also increases the decomposition rate of soil organic matter by 16.5%, suggesting limited effects of atmospheric CO_2 enrichment on long term soil C storage. We also propose a similar, but more mechanistic approach using a model that includes a microbial and enzymatic link, allowing for potential feedbacks between microbial biomass and soil organic matter decomposition. We outline how our approach could be applied to numerous other questions related to plant-soil feedbacks to global change using more advanced biogeochemical models and different experimental manipulations.