Fungi can mediate ecosystem responses to global change

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We investigated the role of mycorrhizal fungi in sequestering or releasing carbon from soils under global change, particularly anthropogenic nitrogen enrichment. Our goal was to determine whether fungi might form positive or negative feedbacks on climate change by mediating atmospheric carbon dioxide. We examined this issue in boreal soils in Alaska, where a significant portion of the Earth's carbon is stored. We used microscopy and DNA sequencing to characterize shifts in the abundance and diversity of fungi under nitrogen enrichment, and we found that ectomycorrhizal abundance and fungal diversity declined. In addition, soil CO_2 efflux slowed. To examine rates of uptake of organic compounds by fungi, we used nanotechnological "quantum dots" to visually track movements of (labile) glycine and (recalcitrant) chitosan through the soil and into ecto- and arbuscular mycorrhizal fungi in the field. We observed that ecosystem-level uptake rates of glycine as well as chitosan declined as nitrogen availability increased. It is possible that the use of organic nitrogen by mycorrhizal fungi may decrease as a result of nitrogen enrichment. Overall, our findings suggest that in the short term, mycorrhizal fungi may form a negative feedback on global warming owing to decreases in their abundance, use of recalcitrant organic nitrogen, and soil respiration.