

The hidden half of ecosystem responses to climate change: what happens belowground?

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Our goal is to understand how soils and soil microorganisms will respond to climate change and how these responses will feedback to ecosystem carbon cycling. Saprophytic fungi responsible for decomposition and mycorrhizal fungi that transfer carbon from above- to belowground are likely to be the dominant biotic drivers behind the amount of soil carbon released to the atmosphere. Both types of fungi can respond to climate independently of plants and thus represent a large unknown in ecosystem responses to altered precipitation and temperature. A broad evaluation of climate change effects on soil fungi is integral to predicting future soil carbon storage and loss and may facilitate mitigation strategies.

We will ask three key questions:

- (1) How do roots and fungi respond to predicted changes in precipitation?
- (2) How do belowground responses to climate change affect soil carbon balance?
- (3) Are mycorrhizal fungi adapted to local climatic conditions such that fungal communities could be manipulated to facilitate carbon storage under projected climate scenarios?

To do this, we will use three approaches:

- (1) Determine functional responses of plant roots and soil fungi to altered precipitation with field manipulation of precipitation at the community level;
- (2) Determine response mechanisms and identify target fungi with greenhouse manipulation of precipitation at the species level;
- (3) Use experimental data to parameterize predictive models of ecosystem response to climate change.

The field experiment will be set up at the UT Ladybird Johnson Wildflower Center in Austin, TX. We will use six different precipitation manipulations ranging from historical mean annual precipitation for the region to predicted severe drought (2 SD away from the historical mean). This research will provide the information needed to quantitatively assess how belowground responses, particularly soil fungal responses, will alter soil carbon cycling under projected future climate scenarios. Ultimately, we hope this work will lead to the development of simple strategies for manipulating fungi to increase carbon sequestration in soil, such as 'high sequestration' fungal amendments.

Right: Experimental shelters in late Aug 2009, with grasses transplanted one week prior.

Below: Ground-eye view of plots with grasses in early Sept 2009, two weeks after planting. Irrigation poles are visible at the corners of each plot.

Below right: View of one plot with four subplots representing two plant communities (tallgrass, shortgrass) and two soil treatments (clay, clay plus sand).

