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Partitioning autotrophic and heterotrophic respiration at Howland Forest

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Terrestrial ecosystem respiration is the combined flux of CO_2 to the atmosphere from above- and below-ground, plant (autotrophic) and microbial (heterotrophic) sources. Flux measurements alone (e.g., from eddy covariance towers or soil chambers) cannot distinguish the contributions from these sources, which may change seasonally and respond differently to temperature and moisture. The development of improved process-based models that can predict how plants and microbes respond to changing environmental conditions (on seasonal, interannual, or decadal timescales) requires data from field observations and experiments to distinguish among these respiration sources.

We tested the viability of partitioning of soil and ecosystem respiration into autotrophic and heterotrophic components with different approaches at the Howland Forest in central Maine, USA. These include an experimental manipulation using the classic root trenching approach and targeted $\Delta 14CO_2$ measurements. For the isotopic measurements, we used a two-end member mass balance approach to determine the fraction of soil respiration from autotrophic and heterotrophic sources. When summed over the course of the growing season, the trenched chamber flux (heterotrophic) accounted for 53 $\pm$ 2% of the total control chamber flux. Over the four different 14C sampling periods, the heterotrophic component ranged from 35-55% and the autotrophic component ranges 45-65% of the total flux.

Next steps will include assessing the value of the flux partitioning for constraining a simple ecosystem model using a model-data fusion approach to reduce uncertainties in estimates of NPP and simulation of future soil C stocks and fluxes.