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Decadal redistribution of a 15N tracer in a mixed deciduous forest

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The impact of atmospheric nitrogen deposition on forest carbon storage depends on whether this N is retained in plant or soils, or lost from the system entirely, and the timescales over which N redistributes. Past tracer studies show that litter and soil dominate the short-term fate of added 15N, yet few have examined longer-term dynamics or differences among forest types. This study is examining the decadal fate of a 15N-NO_3- tracer in a mixed deciduous stand evenly composed of ectomycorrhizal (ECM) and arbuscular mycorrhizal (AM) tree species. Measurements for years 0, 1, and 5-6 are complete, and all ecosystem pools were resampled in year 10 (2017). Similar to prior tracer studies, litter and soil dominated the first-year fate of N with 59% of the added 15N; this 15N was expected to mineralize over time, with some moving to trees, to deeper soil, and net losses. Concurrently, the 15N initially retained by trees (11%) was expected to be decrease through annual turnover of plant litter, and AM species were expected to lose more than ECM. However, litter showed surprisingly persistent 15N enrichment over a decade, declining by only $\sim$4‰ in both ECM and AM trees. Foliage and bark showed clear separation and parallel declines in 15N enrichment for ECM and AM tree species. In addition to illustrating the decadal fate of deposited N, these measurements are also being used to test simulations of C-N cycling by the Community Land Model (CLM5.0). In contrast to measurements, the model predicts that trees acquire a large (> 50%) portion of added N within the first year of addition, and that soil pools retain N primarily after uptake and cycling of N through trees. The model thus misses the large, rapid soil N sinks observed in field studies, and this misrepresentation should lead to early overestimates and later underestimates of terrestrial C storage.