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Biogeosciences Discussions

Interactive comment on "Species-specific trajectories of nitrogen isotopes in Indiana hardwood forests, USA" *by* K. K. McLauchlan and J. M. Craine

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Reviewer #1

There were two main points, both of which are important to develop: 1) clarifying the role of the heartwood-sapwood boundary and soil profile, and 2) more aggressive attribution of causes for these patterns.

The boundary between heartwood and sapwood has been the subject of much study as methodologies for wood δ15N analysis have been developed. A recent, comprehensive study by (Doucet et al. 2011) found that nitrogen translocation did not generate significant isotopic fractionation across the heartwood-sapwood boundary. We now

cite that study in this manuscript. The results from the Indiana wood reported here are consistent with that larger study, with differences in N concentration but not δ15N values observed across the heartwood-sapwood boundaries (Fig. 4). A figure for wood N% similar to Fig. 2 might be useful, but the N concentration data is already shown for each individual tree in Fig. 4.

Soil δ15N values do tend to increase with depth in the soil profile. Because this is one of the few repeatable and interpretable patterns of natural variation of stable N isotopes, ecologists have tended to focus on it (Amundson et al. 2003). However, in this case, the magnitude of the soil profile change is insufficient to fully explain the species-specific differences (Templer et al. 2005). Further, consistent rooting differences between hardwood species would not explain the opposite trends in wood δ15N values over time. We did add text that considered rooting depth as an additional hypothesis (line 22 p. 5944).

Regarding tradeoffs between describing pattern and attributing process, we acknowledge the frustration that it would be nice to attribute causes to these patterns. However, it is simply too speculative at this point to firmly offer a single reason behind the trends observed. The contribution of this manuscript is to publish a new dataset, not to conduct large-scale studies that would better address the multiple working hypotheses regarding temporal change in N cycling in this region.

Reviewer #2

This reviewer raised an important point regarding the approach to temporal analysis. We had originally chosen piecewise linear regression, because we had an expectation of a mid-century change N cycling due to the onset of anthropogenic N deposition, and we wanted to test that. Breakpoint analysis, regular or Bayesian, is the best tool for identifying when something changed. The previous breakpoint analysis led to the discovery of the species-specific trajectories that were so interesting.

However, at the suggestion of the reviewer, we did try some additional approaches, and they were better. In summary, simple linear regressions illustrated the main patterns while avoiding uncertainty about the exact timing of the breakpoint, uneven temporal spacing of the samples, and changes in variability over time. This is an improvement, so we changed the analysis (Fig. 2), as well as the methods, results, and discussion section related to this analysis.

The reviewer made another good point about the heartwood-sapwood boundary. Text has been changed to diminish the idea that variation in N concentration in the most recent few wood samples is due to this boundary.

Thank you for the terminology correction (about increment borer v. core). Now it is sounding much better.

Literature cited Amundson, R., A. T. Austin, E. A. G. Schuur, K. Yoo, V. Matzek, C. Kendall, A. Uebersax, D. Brenner, and W. T. Baisden. 2003. Global patterns of the isotopic composition of soil and plant nitrogen. Global Biogeochemical Cycles 17. Doucet, A., M. M. Savard, C. Begin, and A. Smirnoff. 2011. Is wood pre-treatment essential for tree-ring nitrogen concentration and isotope analysis? Rapid Communications in Mass Spectrometry 25:469-475. Templer, P. H., G. M. Lovett, K. C. Weathers, S. E. Findlay, and T. E. Dawson. 2005. Influence of tree species on forest nitrogen retention in the Catskill Mountains, New York, USA. Ecosystems 8:1-16.

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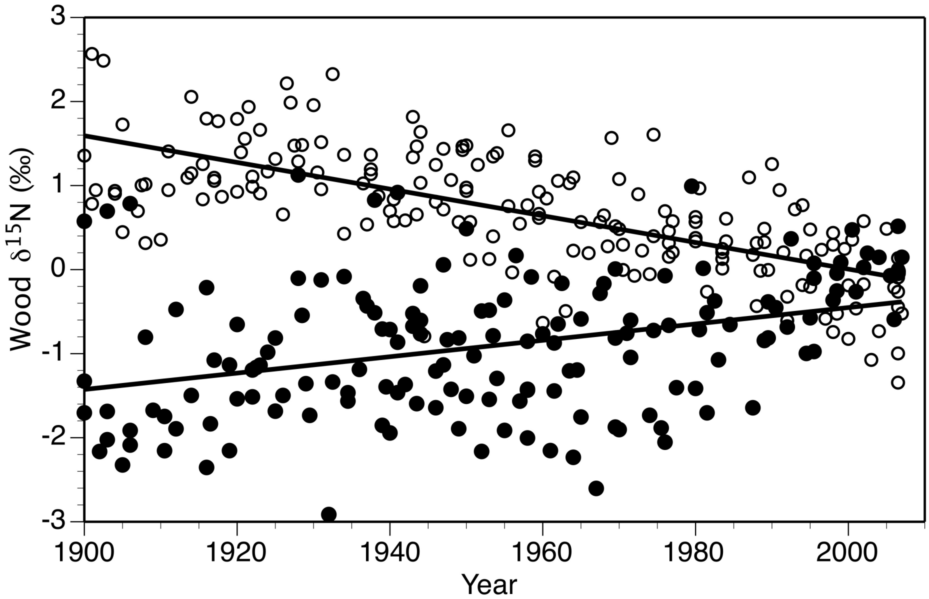

Fig. 1. New version Figure 2.