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Interactive comment on "Spatio-temporal analysis of nitrogen cycling in a mixed coniferous forest of the northern United States" *by* I. Howard and K. K. McLauchlan

Anonymous Referee #2

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GENERAL COMMENTS

Howard and McLauchlan set out to assess the century-scale trajectory of N availability in the forests around Demming Lake, and to determine influential drivers of d15N trends in tree wood across space and time.

This paper makes several exceptional contributions which make this dataset well worth publishing: the ability to compare wood to sediment data, rigorous temporal and spatial analysis, and a wood d15N chronology that is longer than any previously published.

Greater organization is primarily what is called for. Particularly in the description of statistical methods, the discussion of the biogeochemical and ecological effects of fire

suppression, and in speculation of the ultimate drivers of the observed trends. Their argument for fire suppression as the most likely driver of the temporal shift in d15N, despite an acknowledged lack of expected time lags, needs strengthening. In addition, the wood 15N proxy method has several interpretation challenges, which I believe the authors well understand, but should clarify in the text.

SPECIFIC COMMENTS

3618:24 – "...a variety of negative environmental consequences... have been attributed to increases in Nr." It seems appropriate to site more seminal papers of previous decades here, in addition to these recent papers.

3619:5-18 The case for retrospective studies as a means to understanding modern processes, and the particular time scale of interest, could be laid out more clearly here.

3620:13 – A leap is made from inferring "fractionating pathways" to inferring "N availability;" the link ought to be explained.

3622:1-10 – It would be useful to know which of the mentioned species are N-fixers. Either here or later in the paper, It would be useful to note how fire return, its reduction, and the growth of hardwood species, is significant for the balance of N fixation at this site.

3623:4-5 – "The wood samples were not subjected to any chemical pretreatments based on results from Doucet et al. 2011." I would like to see the authors elaborate about their choice for foregoing pretreatment of samples, as on reviewing Doucet et al. 2011 and Gerhart McLauchlan 2014, it appears that different authors have concluded that different methods are appropriate at different sites.

3623 – Statistical Analyses – This section would benefit from greater organization. Specifics about parameters for the tests are jumped into before an outline of the tests is provided, for example. It would be useful to lay out questions, statistical methods

employed and reasons for choosing them, and then specifics on how the methods were employed.

3627 – These paragraphs are a mix of method description and results, which buries the results. I would prefer to see the description of the tests moved to the statistics part methods section.

3630:8-26 – These two paragraphs could be condensed and combined, as ideas are repeated and scattered between the two of them. The second paragraph has an opening thesis about nutrient status, but the examples given are not nutrient-mediated, but pertain to regeneration from the seed bed, which is mentioned but not explained in the preceding paragraph.

3630:27 – I am confused by the authors' opening statement, "Altered biogeochemistry would explain the sharp declines in wood d15N in many of the trees following the implementation of a no-burn policy in the 1920s." The authors subsequently say that the effect of such policy on wood d15N would probably be lagged. This is an important point. The authors' concluding statements point to fire suppression as their preferred explanation for the d15N trend, but this paragraph does not make a case for how d15N could respond so quickly (though it does explain why a lag would be expected).

3631:24 – What is meant by "a time course" of ecosystem processes in soils? I don't think this is a recognizable term without explanation.

3632:3-5 – ". . .the fact that both old-growth and younger trees are exhibiting a similar timeline of rapidly declining d15N, an external rather than internal force must be driving this macro-level change." A diameter-independent effect of outer rings on pine wood d15N could be an "internal" cause of this pattern; in the absence of more evidence about tree ring d15N patterns in general an external force would not seem to be required. Are there other trees outside this treatment areaâĂŤideally of a similar speciesâĂŤthat don't show this pattern? Something like a control dataset would be useful.

TECHNICAL CORRECTIONS

3618:4 – Nr has not yet been defined in the MS

3620:16 – Period missing after "north-central US"

3626:17 – should read "shift beginning in the 1920s."

3628:6 – should read "varies anywhere"

3630:9 – Remove the word "Fire" and start the sentence "Suppression of the type of low intensity ground fires. . ."

3630:18 – Period missing after "US"

3632:3-5 – ". . .the fact that both old-growth and younger trees are exhibiting a similar timeline of rapidly declining d15N, an external. . ." there is a word or phrase missing before this comma.

Interactive comment on Biogeosciences Discuss., 12, 3617, 2015.