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Interactive comment on "Nitrogen export from a boreal stream network following forest harvesting: seasonal nitrate removal and conservative export of organic forms" *by* J. Schelker et al.

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This study quantified nitrogen removal by the river system draining a third order watershed in Sweden. Nitrogen loading is elevated because of clearcutting in this primarily forested watershed. Because significant deforestation has occurred recently, loading into the headwater streams has increased. The amount of nitrogen entering the entire river network can be estimated based on the proportion of the watershed that has been clear cut (all in a similar time frame), and fluxes that are characteristic of forested and clear cut catchments. This modeled estimate of loading can then be compared to fluxes measured at the mouth of the watershed, and the difference is due to nitrogen

retention by the watershed. The study found that DON is not retained, where a significant proportion of nitrate is net retained (from 30 to 100%). Highest retention appears to occur following spring snow melt, lowest during the winter, and intermediate during the summer growing season. Retention was not related to flow conditions. Results indicate that increased export from small catchments due to clear cutting can be retained by the river network, buffering the impact in larger rivers and downstream water bodies.

This is an interesting study and well written manuscript. Overall, I believe that the analysis is sound. A few issues need to be addressed however to strengthen the paper.

I was surprised that removal in this relatively small network is so high. I think it is important to report the surface area estimate of the river network. In addition, there are lakes in the watershed, which likely increase significantly the surface area of surface waters. The lake in the mainstem in particular could contribute to the high removal. What is the surface area of the lakes, and their residence time?

The high removal estimates hinge on the loading estimates from the two clear cut catchments. One of these (CC-4) had much higher loading estimates than the other one (NO-5) and this was attributed to riparian buffer in the latter removing the inputs. The mixing model uses the average of these two catchments and I believe assumes the average applies to all cleared land in the entire watershed. The issue here is that this amount is based only two catchments with very different loading estimates. If the catchment with smaller increases is more representative, then the estimate of removal by the river system would be an overestimate. Is there any additional data available to assess which of the catchments is more representative (or whether an average is)? If riparian removal is inferred as the reason why the second catchment does not have as high response to clearcutting, are there any data on what proportion of clear cuts maintain the riparian zone? Another way to address this uncertainty, is to look at the range in watershed removal by looking at two scenarios, one where all clear cuts have

the low response, and the second where all clear cuts have the high loading response.

Greater confidence in the mixing model would be gained if there is also a conservative solute that responds to clearing, and then mixes throughout the network, where there is no removal. I believe that Shelker et al. 2014 may have this data. Use of a conservative tracer would also address the representativeness of the watersheds. I suppose the DON serves as a conservative tracer based on the result, but a priori this was not expected, whereas a solute like chloride would be conservative.

Although DON retention (or lack thereof) using the model is reported, no results on DON response to clear cutting are shown or presented in the results. I think this is important to include (perhaps adding a panel to Figure 2).

Some more discussion of the mechanisms that contribute to the removal efficiency patterns (both over time and vs. flow) would also strengthen the paper. It is not clear what the mechanisms are so that the snow melt period would have the highest retention. Flows are high and temperatures are cold which should lead to low retention. Transfer to the hyporheic zone, riparian habitats, or groundwater is suggested very briefly. But could these explain such high losses, and why during spring only? The U term would incorporate net losses to these areas. If U is higher because there is more DOM or it is more labile why is there no DON retention then (or at least conversion of DON to DIN), especially when DIN supply is limited. What about light coming through the riparian canopy? Is it high and canopy cover low, so more primary producer uptake of nitrate during spring? If clear cut removes riparian this could be a mechanism contributing to temporary removal at least - but how common is riparian clearing. And why a more important factor in the spring? For Q to not be a factor means that as Q increases so does the uptake rate (or uptake velocity) in order for retention to remain high. A plot of uptake or uptake velocity over time or vs. flow would help to evaluate this.

Specific Comments Equation 1. Units are confusing because of the use of mm/d (have mm, L, m2). Please use consistent units throughout (I suggest m), and make sure easy

to see that all units cancel out correctly. Concentration units with equations given in mg, but data given in micrograms. Please be consistent. What is size of the small catchments? What length of stream is above the sample site in these watersheds? Could some removal already have occurred at sample location? The scaling to 100% harvested assumes (equation 2) assumes linear relationship between % harvest and concentration. Should state this explicitly. 12071.5-6. Unclear what the values in parentheses mean. Negative values are confusing. I understand the negative value is used because it is removing N from the water column, but areal uptake should be reported as a positive value. 12075.6. Denitrification is a dissimilatory process. 12075.11. Dissimilatory reduction to ammonium (DNRA) is also a dissimilatory process, but seems unlikely in this site. Mostly occurs where there is low OM, and very high N (much higher than here). This discussion seems too speculative. If keep, then add refs on this process from the literature. 12075.18. Should include more evidence of high DOC in this catchment if want to make this point. Seems too speculative. Figure 1. Hard to see basin boundaries. Make darker lines. Figure 2. Really hard to tell the lines apart. Especially important to see BA1 and BA2. Can't tell the two lines apart in bottom panel (symbols too small). Figure 4. Points are very small so hard to tell them apart. So it is hard to make sense of what is happening. Not clear what points are (observed). Make points bigger. Add the seasonal demarcations so can tell evaluate result about high retention during spring, etc. Figure 5. Uptake should be in positive units.

Interactive comment on Biogeosciences Discuss., 12, 12061, 2015.