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Interactive comment on "Effects of different N sources on riverine DIN export and retention in subtropical high-standing island, Taiwan" *by* J.-C. Huang et al.

Anonymous Referee #1

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General The study by Huang et al. quantifies DIN fluxes from Taiwanese watersheds across a range of land use, population, and Nitrogen input rates. The results are compared extensively to other world watersheds reported in the literature. The watersheds of Taiwan have greater precipitation and N input rates than is typical in global syntheses, so studying these watersheds is a good rationale for expanding the global response surface for looking at N retention capacity. They find that watershed N retention declines with increasing N loading (or impact), and that much of the decline is due to increasing NH4 exports. The Taiwanese watersheds have a much higher proportion of ammonium export than other world watersheds, especially in the impacted watersheds.

Overall this is a good paper, but I am unsure that the export flux estimates are robust. Whereas the ammonium concentrations were estimated monthly, nitrate concentrations were only measured 4x per year. This is very infrequent, and may miss many of the storm events, when concentrations are often quite dynamic compared to baseflow. This is particularly true in impacted watersheds (both urban and agricultural). I assume many of the nitrate measurements were collected during relatively lower flows since these are more frequent. If concentrations dilute during storms (as is common for DIN in many agricultural systems), this would be an overestimate of N exports. It will be impossible to address this with the data in hand. However, this must be evaluated (e.g. what is the mean flow during sample periods compared to annual mean flow? What are flow weighted concentrations?), and then discussed for each N form. Perhaps there are some estimates of storm event nutrient samples that can be used to discuss this issue as well.

The limited nutrient sampling may also contribute to the patterns in NH4:NO3 in Taiwan compared to other world rivers. Error in this ratio is likely to be greatest in more disturbed watersheds due to dynamic flow and concentration patterns. This also needs some discussion.

Further DIN alone does not represent the N export budget. DON and PON are likely also important, the latter particularly in Taiwan with high flows, large storm events, and steep slopes. These are not considered at all. Part of the difference might be due to the relative importance of organic vs. inorganic forms across watersheds. Discussion about how this may influence the results is also needed.

The method for estimating fertilizer and human waste loading to each watershed is not described. While N deposition estimates are likely fairly robust, these other loads are not as easy to obtain, and so should be included. It is especially a problem when scaling to watershed boundaries, which likely differ in scale from where the data to estimate loads comes from.

BGD

12, C7658–C7661, 2015

I also think there needs to be more discussion on why export ratio is higher in impacted watersheds. Discussion (e.g. 16412.8-11) doesn't discuss why change in population or land cover result in lower retention rates. Why are these watersheds at more advances stage of N excess. Mechanism of increasing rainfall would also affect low impact watersheds, so this alone not a reason.

Is population the best indicator to classify watershed impact? It seems ag land cover would be better, given the sensitivity to this.

The writing overall is very understandable, but the text still needs a good edit.

Specific 16400-21 Most watershed N retention is not in rivers, but in the terrestrial part of the watershed. 16402.26. What is mean annual precip? 16403. 12. Change to N loading (deposition usually refers to atmospheric only). 16406.3. NH4 retention capacity is really also nitrification capacity, i.e. NH4 converted to NO3 and exported in this form 16407.24 Runoff cannot be only factor controlling DIN export, because Taiwan N exports seem to be disproportionately high, perhaps due to differences in inputs mentioned. 16408.19-24. I don't understand the example. Wouldn't 100% rice field in N.A. be the same as ~66% rice cover in Taiwan? 16409.2 Why compare NH4 flux to global NO3 flux? This sentence is unclear. I think you are saying the NH4 is much more predominant in Taiwan watersheds compared to the rest of the worlds rivers. Please rephrase. 16409.9 NH4 is not volatilized (NH3 is). Once dissolved in water NH4 is not volatilized. Note that NH4 is oxidized to NO3, so something in Taiwan seems to be limiting this process. 16409.19. Sentence is contradictory. If not very low, then DO demand is not high. Nitrification can still occur at lower DO levels than what is low in Taiwan. 16409.21-30. If residence time is low, then removal cannot explain low NH4 in the low and moderately disturbed watersheds. Explanations need to be consistent. 16411.2 Change irrelevant to "Small compared to. . ." 16411.24. But the N retention capacity of regrowing forest is finite. Once mature, they will be N saturated, and become leakier, according to Aber et al. N saturation hypothesis. Please add some discussion of this. 16413.16. Mention of dry year comes out of the blue here.

BGD
12, C7658–C7661, 2015

No mention of climate variability earlier, and I don' think the statement is true. During dry year, nutrient fluxes from watersheds will also be much lower, whereas residence time of coastal systems will not change as much since they may be tide dominated. Figure1. No legend for populations Table 5 does not match the presentation of results in section 3.2 (for fertilizer and human emission) or totals in 3.2. Puts doubt into other results.

Interactive comment on Biogeosciences Discuss., 12, 16397, 2015.