

## ***Interactive comment on “Temporal variation of nitrate and phosphate transport in headwater catchments: the hydrological controls and landuse alteration” by T.-Y. Lee et al.***

**W. Wollheim (Referee)**

wil.wollheim@unh.edu

Received and published: 30 October 2012

### General Comments

This study quantified the inorganic N and P fluxes from Taiwan watersheds subject to annual typhoons and that are also undergoing agricultural intensification. The authors report that the response of DIN to agricultural activity is greater than for DIP, and that a large proportion of the annual fluxes come during the typhoon period. A greater proportion of DIP flux occurs during the typhoon period than for DIN, because DIP was highly correlated with sediment concentrations, which were also highly correlated with flow conditions. They point out that even the background fluxes of N are high, likely

C5359

because of high atmospheric deposition and geologic sources. Because N responds more than P to cultivation, the N:P ratios also increase with cultivation. Background N:P levels were much higher than world average, suggesting the possibility that these areas are already or are more prone to rapid N saturation.

This is a useful study that paints a picture of dynamics in Oceania watersheds. I think the methodology is fairly standard and robust, with the results being solid. I think the discussion could focus a bit more on the big ideas. We know that Oceania watersheds are more closely tied to their coasts because watersheds are small. It is known for example that Oceania has a disproportionate share of global land to ocean sediment fluxes because they are mountainous and have small watersheds (see publications by Syvitski and others). The study reported here identifies that geology also contributes to the high N and P fluxes in Oceania watersheds. More discussion regarding these similarities should be developed.

Further, the idea that these watersheds are, even when pristine, relatively high emitters of N in part due to the geology and N deposition (from China?) is also worth elaborating on. Does the response to agricultural intensification differ as a result, compared to other world regions or is it similar? In general, the discussion should tie more to the literature, focusing on some bigger ideas, and placing the results from this study in a broader context. Much of the discussion currently reads like a results section

There should also be some discussion about the lack of particulate phosphorus measurement in this study. The study focuses on DIP, but most P is thought to be associated with sediments. The result that DIP is correlated with sediments is suggestive of this. Some discussion of sediment P is needed, especially given the mountainous nature of Oceania watersheds. TP fluxes may be even more responsive. Sediments exported from Oceania watersheds should be high, in part because of typhoons, and so TP fluxes might also be high, and perhaps elevated in disturbed catchments. This ought to be discussed with reference to the literature.

C5360

The study is designed to look at an agricultural gradient, with one of the catchment being intensively managed. However, even this watershed is mostly forested (Table 2), so some justification is needed for why this should be considered intensively managed. It is not as intensive as many other agricultural watersheds worldwide. Also, it would be useful to have some ballpark estimate of how big fertilizer inputs may be relative to atmospheric and geologic inputs. Even if numbers are not available, this should be discussed as information that is needed to better understand the responses that were measured.

Make sure NO<sub>3</sub> units are as NO<sub>3</sub>-N. I'm not sure whether they are or not - I don't think so based on figure 2 pristine, but I may be mistaken.

The conceptual model (Figure 9) needs some work so that it can stand alone.

#### Specific Comments

90-91 At 8.9% ag (Table 1) I would not say that Yusheng is intensively cultivated.

114 How were three hour samples collected? By hand or with an autosampler?

170 - Doesn't seem to be highest with first storm in 2007. Be clear about which stream you are giving results for - not clear in the text.

180 use of term "carrying capacity" - how do you know what carrying capacity is? This term is specific to maximum amount. The point about N supply and transport compromise is for the discussion section, not results. In discussion, need to provide more theoretical context for these ideas.

180-183 - incomplete sentence

192 - first mention of forbidden cultivation. Please elaborate

199 - what are you comparing to the large rivers?

202 - typo

C5361

202-203. Doesn't make sense - please clarify.

203-204. wording unclear.

206-207. how are sediments released. Do you mean desorption in the river? Phosphate you measured was dissolved, right?

243-244. Unclear. Please elaborate.

254 - First sentence does not make sense - what does "Except for the concentration", refer to?

261 - Wouldn't high yields be due to fertilizer applications or human waste inputs? More discussion needed

281 - can you put together a course budget of inputs and outputs to confirm that they are N saturated.

293 - I don't understand how the immediate recovery implies the intrinsic storage is large. This requires more elaboration

297 - results

313 incomplete sentence

315 add: most nitrates WERE depleted IN the surface runoff. Sentence seems incomplete.

317 I don't think a ratio can be thought of as being diluted.

Conclusion - don't include results you presented earlier (e.g. line 331 - 333).

Eqn 1 - use subscripts with load to indicate month

Figure 1. Can't tell how the three sites are situated in relation to one another. What is inactive vegetation? Do you mean farming? Define the abbreviations for the three catchments in the caption.

C5362

Figure 6 - Hard to interpret. 4 axes per plot? Only two things plotted. I would simplify to only what you need to make the point. No legend is given that define bars vs. lines. kg unit is meaningless, is this supposed to be concentration or flux? Give each subplot its own letter in figure and in caption. Hard to compare the different types of rivers because scales vary for each - keep constant.

Figure 8. Create legend that indicates open symbols vs. solid symbols are from different flow levels.

Figure 9. This conceptual model needs work. It is difficult to understand. In caption state that arrow size refers to water runoff amounts (as opposed to nutrient runoff amounts). Conceptual model in a) shows NO<sub>3</sub> highest in surface soils, but surface runoff says NO<sub>3</sub> is low. Why is that? Doesn't match the description in the text, which says that surface nitrate is high. Unclear that the arrows in the stream refer to the change in concentration during the event. In general, this figure is very hard to interpret by itself. I suggest trying to redo it so that it does.

---

Interactive comment on Biogeosciences Discuss., 9, 13211, 2012.