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Interactive comment on "Anthropogenic point and non-point nitrogen inputs into Huai River Basin and their impacts on riverine ammonia-nitrogen flux" *by* W. S. Zhang et al.

Anonymous Referee #2

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General Comments:

This paper presents an adaptation of the Net Anthropogenic Nitrogen Input (NANI) approach to generate separate values of N inputs by non-point and point source. The authors also use ammonia-N in streamflow to estimate hydrologic N losses and approximate input-output balances. Overall this is an important addition to our understanding of N cycling in a watershed that has experienced rapidly increasing N inputs.

An important contribution of this paper is the study of N balances in a watershed with very high N inputs - approximately 272 kg/ha/yr for the entire watershed, much derived from fertilizers. It is very surprising and perhaps shocking that of this 272 kgN/ha/yr

less than 5% of these extremely high inputs – an estimated 3.8 – 9 kg of TN/ha/yr - were exported from the basin via riverine flows. This combination of high inputs and relatively low exports suggest incredible rates of retention and processing (>250 kgN/ha/yr) within the basin. The authors cite several studies that also found low % nutrient export, which is similar to what they found but for watersheds with much lower inputs, and attribute it as did those authors to retention in dams and water reuse. In the abstract, the authors state that water consumption, denitrification and dams influenced the export, but this is speculation. There could be other potential explanations including storage in groundwater, high rates of denitrification in hotspots, or some kind of error in accounting. This paper really underplays the implications of this large imbalance. It is hard to imagine how so much nitrogen can be removed by dams, which are a small part of the landscape. If rivers and riparian zones take up 5% of the landscape, then they would have to have a denitrification rate of up to 5000 kg N/ha/yr to remove the N delivered from across the landscape. Are there places that document such high removal rates? Some kind of reality check would be very helpful here, or at least an emphasis on this point. This issue is coming up in many large river balances, and thus more emphasis on this point is warranted.

Specific comments:

The authors have built upon their existing approaches to separate out the fluxes into point and non-point sources. Point sources are calculated from per capita household discharges and industrial N discharges prior to treatment, then applying a flux of waste factor and a treatment N removal factor to allow estimation of the point source inputs to streams. They employ a constant removal factor based on the current technology, a constant concentration in industrial effluent, and constant per capita N excretion rate. The one factor that varies over space is the wastewater volume. This method is quite different from say the most recent SPARROW model runs (JAWRA 2013), which employs data on plant-specific discharges AND concentrations, not removal estimates and per capita rates. A statement about the adequacy of this approach as compared to other more spatially explicit approaches is needed in the paper.

I am concerned that including the point source inputs via the waste that enters the stream is double counting the N inputs. Doesn't this value represents a fraction of the N in food? Since 100% of food comes back out in the waste according to your paper, this input is double counted. It can't be an input to the watershed as fertilizer then also as an input from waste – those same molecules of N fertilizer were only added once to the basin as fertilizer or imported N. It is a relatively small value, but still appears to be double counting.

P4, L13 – Here it is stated that in heavily polluted rivers more than 70% of the annual N load is ammonia-N, but on page 20 you state that ammonia is "only" 20-50% of total nitrogen export in the Huai Basin. Contradictory. Perhaps an important funding of this paper is that monitoring should include more N forms, particularly in these nutrient polluted waters? I'd be really curious to know what the nitrate concentrations are in a stream with watershed loads of 272 kgN/ha, and how they compare to human health standards in the US and EU. Ammonia can be toxic as well.

P5L7. Are effects are being seen in the Huai due to these high N inputs?

P6, L12. How is this different from other NANI models? What does this add? You never clearly state how this improved the model, it's not just that you label things differently (point source vs. non-point). A statement clearly explaining this to the reader would be very helpful.

P8, L22. Table 1 gives different references for the upland N fixation. This value of 15 kgN/ha seemed high to me, so I looked at the references, and the number of 15 actually comes from "other crops" from Yan et al. 2003, which refers to a string of other papers for this value, so I can't really tell where the 15 kgN/ha originated, except that it is refers to "other non-symbiotic crops" in Yan et al. (2003). So it would be better to clearly state where the value of 15 comes from and what it represents.

Yan, W., Zhang, S., Sun, P., & Seitzinger, S. P. (2003). How do nitrogen inputs to the Changjiang basin impact the Changjiang River nitrate: a temporal analysis for 1968–1997. Global Biogeochemical Cycles, 17(4).

P11,L20. Somehow emission per capita in urban areas is 4.77 kgN/ha/yr but consumption per capita in rural areas is 4.31 kgN/ha/yr. Is this correct? The paper states that people emit 100% of their N, so are rural and urban people eating different diets or ??

P16,L10. I don't understand why you say the mechanisms for biological N fixation is unclear. The process is well studied. Perhaps you mean that the reason for the positive relationship between N fixation and riverine AN flux is unclear? I expect that the crop N fixers like soybeans are spatially correlated with agricultural areas that receive N fertilizer and thus the relationship is driven as much by a correlation with agricultural areas as something about N fixers. Some N fixers may receive N fertilizers as well.

P18, L20. What's the mechanism for losing N through human consumption, if humans don't retain N?

P19,L1-19. This section about %TN export should be renamed to %AN export. The fact that you do not have TN values cannot be understated here. Ammonia nitrogen could be a small component of the flux to 70% of the flux, depending upon the location, etc. I think this is a major limitation of this study for looking at % export. The beginning of this section should acknowledge this limitation and indicate that you are going to address in the following paragraphs.

P22,L14-16. Need to soften these statements as currently they are too speculative and unfounded. These are potential influences, and not components that were evaluated or quantified in any way. Also, I couldn't find where this Tysmans paper specifically mentions the Huai River.

Technical comments:

P14,L2. Replace "contribute to" to "be attributed to".

P14,L12. Here you mention “new N”, why is this distinction important?

P15,L21. Should say “point source N” not “point N”.

Table 3 should stand alone without having to hunt for abbreviations.

Figure 2 should label all the fluxes according to their abbreviations in the text. Also, it would really help to indicate what is measured and included in NANI and what is not. The distinction between “direct” and “indirect” is not clear.

Interactive comment on Biogeosciences Discuss., 12, 3577, 2015.