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Hydrology and Earth System Sciences Discussions

Interactive comment on "Catchment features controlling nitrogen dynamics in running waters above the tree line (Central Italian Alps)" *by* R. Balestrini et al.

Anonymous Referee #1

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HESSD-2012 "Catchment features controlling nitrogen dynamics in running waters above the tree line (Central Italian Alps)" by Balestrini R., C. Arese, M. Freppaz, and A. Buffagni.

This manuscript (MS) evaluates chemical composition of stream waters in the alpine zone of the Masino river catchment in the Italian Alps. Its major aim is to show how geographical and morphological characteristic of individual sub-catchments (proportion of soils and rocks, slope, elevation etc.) predetermine concentrations of nitrogen forms and DOC in streams and the N retention capacity in catchments. The results

confirm general patterns observed for European alpine lakes, showing that percent soil and vegetation cover in catchments and soil pools significantly correlate with in-lake concentrations of NO3 (negatively) and DOC (positively) (Camarero et al. 2009). The MS presents interesting and original data and may attract scientist interested in water chemistry, modeling of acidification, N cycling, and evaluation of critical N loads in alpine ecosystems. There are, however, a number of flaws and uncertainties, which need clarifying. Especially, the estimation of N retention is not clear and deserves better explanation. I recommend this MS for publication in HESSD after an intermediate revision and summarize my comments chronologically as follows:

Page (P) 10452, Line (L) 2: Change "sixties" to "1960s".

P 10452, Ls 12–17: This part is not relevant for the MS and can be safely removed.

P 10454, Estimate of nitrate retention: I do not understand the used approach. N retention in catchments is usually based on mass budget studies, including atmospheric inputs of DIN (NO3+NH4) and terrestrial export of NO3. Here, the estimate is based on NO3 concentrations and their relationships with Ca concentrations in June, i.e. in the time when water composition is mostly based on snowmelt. I have the following questions to this approach: (1) Why is Ca used? Ca is not a conservative ion (as is e.g. Cl). While in June both NO3 and Ca could mostly originate from precipitation accumulated as snow in the catchment, it was not most likely true in summer, when some Ca could be liberated from (or retained in) soils or generated by weathering. Any catchment sinks/sources of Ca would make the estimate of NO3 retention uncertain. (2) Is the equation correct? It probably should be: (NO3-Jun ïĆť Ca-Jul)/Ca-Jun = expected NO3-Jul. (3) Is it an original approach suggested by authors? If not, references to this method are missing. If yes, more should be done to introduce and advocate this method.

P 10455, Ls 1–9: This part is not relevant for the MS and can be safely removed.

P 10455, Ls 11–20: This part belongs mostly to methods. The abbreviations R1, N3 and others used in Table 1 are difficult to remember for a reader. I suggest using some simpler and more straightforward abbreviations like e.g., T for talus, V for vegetation, and S for soils if necessary. Moreover, difference between categories N3 and Veg. soil in Table 2 it is not clear to me. Some better description of these categories either in Methods in Table 1 could help.

P 10456, L 19: It is not necessary to use abbreviations NO3-N and NH4-N when N concentrations are given in mol/L.

P 10456, Ls 20–23: Why are not NH4 concentration in precipitation and snow and NH4 deposition included?

P 10456, L 25: Why is NO3 vs. Ca/Na relationship used? What does it indicate and why?

P 10457, L 3: Change "shown" to "show".

P 10457, L 4: Why is not Cl used in calculations instead of Ca when behaves conservatively?

P 10459, Ls 7–11: This part belongs to results.

P 10459, Ls 12–18 – DON discussion: The lack of relationship between N3 (or veg. soil) vs. DON in this study is surprising, especially when similar significant relationship exists for DOC (at least in 2007). Does it mean that some morphological parameters affect DOC:DON ratios of surface waters? Another explanation is that DON concentrations are too low, few or uncertain to exhibit a significant relationship. DON concentrations (and DON proportion in total N) usually increase with soil proportion in alpine catchments (e.g., Kopacek et al. 2000) with a relatively stable DOC:DON ratios.

P 10459, Ls 19–23: I do not understand this sentence.

P 10462, Ls 10–15: The efficiency to retain N may be affected also by many other factors like average soil depth and organic C content, water residence time in soils

(annual average precipitation), land use history, and historical (and cumulative) N deposition (e.g., Evans et al. 2006; Moldan and Wright 2011).

P 10465, Ls 1–2: The sentence "The sensitivity of the environments above the tree line to the N deposition is so mainly due to the relative proportion of vegetated soil within the catchments" is correct provided the catchments have similar soil characteristics, e.g. dry tundra. Provided there are some areas with wet soils or marches along streams, or the soils in the catchments differ in their dept (e.g. steep vs. flat areas) then the soil proportions are usually worse predictors of N retention than C pools in catchments (e.g. Evans et al., 2006).

P 10465, L 15: Change "plant roots" to "plants".

References: I checked references only randomly and they apparently require more attention. For example references to Evans et al. (2006) and Helliwell et al. (2008) are missing in the list.

Table 1: Could more apparent abbreviations be used and more details on individual categories given in the Table 1 or Methods? For example: details on N3 vegetation – does it represent grass, lichens, shrubs or any kind of vegetation? There are also the same abbreviations used for different categories: N3 = vegetation on rocks and debris (P 10471) vs. N3 = tundra (P 10480). Table 2: How do categories N3 and Veg. soil differ? To what area is % proportion of Veg. soil related (whole catchment or soil only)?

References:

Camarero, L. et al.: Regionalisation of chemical variability in European mountain lakes. Freshwater Biology, 54: 2452–2469 (2009). (doi:10.1111/j.1365-2427.2009.02296.x)

Evans, C.D. et al.: Evidence that soil carbon pool determines susceptibility of semi-natural ecosystems to elevated nitrogen leaching. Ecosystems 9: 453–62 (2006).

Kopacek, J. et al.: Factors governing nutrient status of mountain lakes in the Tatra Mountains. Freshwater Biology 43: 369–383 (2000).

Moldan, F., Wright, R.F.: Nitrogen leaching and acidification during 19 years of NH4NO3 additions to a coniferous-forested catchment at Gårdsjön, Sweden (NITREX). Environmental Pollution 159, 431–440 (2011).

End of review.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 10447, 2012.