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Hydrology and Earth System Sciences Discussions

Interactive comment on "Nitrogen retention in natural Mediterranean wetlands affected by agricultural runoff" *by* V. García García et al.

Anonymous Referee #2

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General Comments The manuscript reports an interesting study case of nitrogen retention in two small Mediterranean wetland-stream systems in Spain, of particular interest for the HESSD community as well as for the aims of the European Framework Directive (2000/60/EC). Although the paper is well structured, there is a need for more work in order to improve readability and provide further information to strengthen the discussion and the conclusion sections. There is a technical issue that needs to be addressed in relation to assumptions behind the equations used to quantify retention efficiency, nitrogen net removal and net hydrologic retention. It arises primarily due to the lack of inflow discharge measurements, information needed to calculate nitrogen flux and load to the wetland according to standard procedure from the literature in this field. Inlet discharge and retention efficiency are based on calculations using

input-output chloride concentrations and outlet measured discharge, data that have never been presented to the readers. The manuscript needs to show chloride data to support the use of Eq. 3 and to explore any seasonal pattern on hydrological inputs when using in conjunction with rainfall-discharge data. Based on the data available, perhaps a better mass balance by simple mixing model could help the authors to provide estimates of inlet discharge values for both wetlands. The use of Total Nitrogen Load instead of Total Organic Nitrogen (TON) is what general matters for management purposes, since DIN generally account for the majority of the nitrogen export. Is there any particular reason why TON is used in this study? The Introduction section is well written and clearly states the aims of the study. For completeness, it would be great if the authors could present the nature (composition/quantity) of the nitrogen inputs to the irrigated area which is clearly of interest for the aims of the work. There is also a need to address the wording issue in relation to "wetland-stream system" and "wetland hydrological regime" (intermittent, ephemeral, temporal, etc.), and keep them throughout the manuscript. The statistical approach for data analysis is accurately described and applied in the method and result sections. However, the manuscript needs some comments on why a negative retention value is set to "zero". The work concluded about the lack of seasonal patterns of discharge and nitrogen input to the wetlands, which resulted consequently in lack of seasonality on retention efficiency. I was surprised that both wetlands experienced high flow discharges during times of lack of rainfall indicating their water dependency on irrigation water or perhaps a shallow subsurface flow source. Clearly the Parra wetland experienced at those times increasing nitrate inputs to the wetland. Any comment on that? If this is the case, perhaps chloride data (not presented) could indicate some changes in their concentrations that could be linked to the above water sources. In this section, the inclusion of a new Figure with a paired analysis of inlet chloride and nitrate concentrations could help to identify any seasonal pattern in concentrations due to hydrological controls. In my opinion, the discussion section seems to be vague and focused on nitrogen species retention efficiency results from other studies. The effect of the wetland hydrological condition on processes

involved in N cycling is undermined in the discussion section. I could be wrong on my comment, but given the fact that "hydrological retention" explained the majority of the retention efficiency, how is that the authors then stated that high nitrate retention efficiency is mainly attributed to high denitrification rate? Please clarify this. It seems to me that a mass balance for these two wetlands is far more complex than assumption behind Eq. 3, particularly to the light of information contained in Table 2 showing that between 40-50% of the water mass was either store or loss from the system, and that the wetland reaches were not connected under certain hydrological conditions. There are a few ways that the authors could explore to overcome the problem. For instance they could use: i) a comparison of any estimates of Inlet discharge using Eq. 3 and one or two measured water inflows to the wetlands, ii) estimation of inlet discharges by using a simple 2 component mixing model for the wetland (already have the data for), or iii) applying Eq. 3 between transect reaches (T4-T3, T3-T2, T2-T1) and see how the calculation goes. Regarding the latter, it is unclear in the manuscript what is the purpose of obtaining water samples at 4 transects if only concentrations from T1 and T4 are used for nitrogen retention efficiency calculations. It is clear from the discussion that the authors are well aware of the relevant literature on factors affecting biogeochemical processes in N cycling and retention efficiency in wetlands and riparian zones, but this reviewer counted "82" references which should be cut down to less than 50. This reviewer encourages the authors to address some of the comments and suggestions that will improve and strengthen the manuscript. The authors have a good study case and data set in this work to impact positively in our understanding of improving water quality through the use of small natural wetland-stream systems in agricultural areas.

Specific comments:

P5341 Title: Perhaps the word "wetlands" should be changed by "wetland-stream". Similarly, "wetland-stream" should be used throughout the manuscript when referring to the Taray and Parra wetlands.

P5342 Abstract, line 11. Change "a mean value of" by "on average".

P5345 line 4. Do the authors refer to "seasonal hydrological/chemical loading"? In the current form it is not clear what the authors mean by "season".

P5345 line 11. The word "and" is missing after the semicolon.

P5345 line 19. The wetlands are located "at the base". Do you mean "at the outlet" of small catchments?

P5345 line 24. Rephrase "Both wetlands are temporal". Use consistently either "intermittent" or "ephemeral" to refer to hydrological regime throughout the manuscript. Also rephrase "hydrological parameters are shown in Tables 1-2". Table 1 contains information on land uses and wetland's geometry while Table 2 shows discharge and concentration data. In strict sense these are not hydrological parameters.

P5346 line 16. Transect separation, it should be "approximately" 100 m, as the T2-T3 distance is about 150 m.

P 5346 line 21. .."Taray wetland water surface disappeared only in transect 3 during Aug-Sep 2007.." How is this affecting the retention calculation when using Eqs. 1 to 3?

P5347 lines 6-17. The authors stated that Inlet discharge was impossible to measure but the reader finds inlet discharge information on Table 2 without any clue of how those values were estimated. Please clarify this in the caption.

P5347 lines 8-17. This information is not used in the manuscript for calculation, thus it should be cited as a data source in Figure 1 or Table 1 captions. Also, since rainfall data have been used to explore seasonal variation on wetland hydrological regime, information regarding the source of the data should be provided here.

P5348 line 8. Although commonly used, chloride is not a conservative but instead a passive tracer.

P5348 line 14. The authors should present the assumptions that hold Eq. 1. Since

they are common on subsurface flow with steady state conditions, can Eq.1 be used for wetlands? Please clarify.

P5349 lines 1-5. Similar to above comments regarding assumptions. Stanley and Ward (1997) used measured inlet-outlet discharges. Also in line 5, should the ratio Clin/Clout be Clout/Clin? This is a key issue since all the results, discussion and conclusions come from these calculations.

P5349 line 18. Rainfall data is brought into results but not presented in the methods section. Here is the time to compare monthly rainfall, outlet measured discharge, and chloride information in order to analyze whether or not a seasonal pattern can be identified. Since most of the calculations are based on Chloride data, the data must be presented and analyzed in the same way that Nitrate data (Figure 4).

P5352 line 2. Change “correlations done” by “correlations performed”.

P5353 lines 19-28. Since hydrological retention is responsible for most of the retention efficiency, I do not understand why the authors claim that denitrification is mainly the mechanism of nitrate removal. Please clarify.

P5354 lines 24-26. I will argue that the Parra wetland does indeed present a seasonal pattern in removal efficiency as it can be seen from Figure 5. The increase in nitrate and water inflow (Figure 4 and 5) to the wetland from irrigation areas or other water sources not accounted for (i.e. shallow subsurface flow) resulted in a decrease in efficiency from 96% (Oct-Nov 07) to less than 40% (Feb-Mar 08). Please clarify.

P5357 lines 13-26. The discussion should be improved by quantifying the residence time for both wetlands, as well as incorporating the residence time values from other studies rather than qualitatively describe them as low or high values. Also, what is the hydraulic residence time? (line 21).

P5358 Conclusions. This is the section where the key findings of the work should be highlighted!!, Rather, there is only 5 lines of text mentioning some of the key findings. I

would recommend to rewrite this section.

P5359 References. The number of references is extremely excessive for a manuscript that deals with nitrogen retention efficiency. The current number of 82 references should be cut down to less than 50.

Figures and tables

P5367 Table 2. Please clarify that inlet discharge is estimated by Eq. 3.

P5370 Figure 1. They are great plots. Perhaps you could introduce here the locations of the rainfall gauges in the catchments. Also in the caption replace the words “black lines” by “T1-T2-T3-T4” represent transects.

P5372 Figure 3. Use monthly rainfall amounts. Why is the Inlet discharge (estimated form Eq. 3) used in this figure? I would prefer outlet discharge since they have been measured.

P5373 Figure 4. This figure is perfect!!!! A similar one should be included for Chloride.

P5375 Figure 6. In my opinion this figure should be removed since all the information is provided in the text.

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