Hydrol. Earth Syst. Sci. Discuss., 6, S613–S620, 2009
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Hydrology and Earth System Sciences Discussions



# *Interactive comment on* "Modeling nutrient in-stream processes at the watershed scale using Nutrient Spiralling metrics" *by* R. Marcé and J. Armengol

**R. Marcé and J. Armengol**

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Final response to Anonymous Referee #1

OVERVIEW: This manuscript is a modeling exercise where the HSPF modeling code for in-stream phosphorus dynamics is changed from a more explicit process-based algorithm to a more simple nutrient spiraling configuration. The model is applied to the Ter River basin in Spain where the spiraling metrics are calibrated. The results from the modeling are compared to field measurements in the same basin. Spiraling uptake length and discharge data are mined from many previous studies to show that impacted streams show a power law between Sw and Q. The Sw v. Q relationship for impacted streams is compared to the same relationship from unimpacted streams.



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GENERAL COMMENT: This manuscript is technically good, and covers an interesting topic. There is some similar prior work by Wollheim et al. (2006 and a few others) that should be in-cluded in the context and may help explain some of the dynamics that are being seen in this manuscript. Also, the Sw v. Q relationship may be the most notable result, but I question the validity of the relationship because of spurious correlation. There are other specific points that should be addressed, which are listed below.

Autors: We want to stress that in our opinion the most relevant result of our work is not the relationship between Sw and Q, but the fact that impaired streams have lower re-tention efficiency. This point is detailed in following comments, and the new version of the paper enhances this point of view.

SPECIFIC COMMENTS: (I use page and line number in the following way to indicate where the comment is directed: 503(12) is page 501 and line 12) 502(24): Remove last sentence on circular reasoning. This same idea comes up at the high-visibility points in the manuscript. It is a point to make once in the manuscript in the Methods section. Find something more supportive of the work to state at the end of the abstract.

Autors: We deleted this sentence and similar reasoning in most places of the manuscript. Here, we replaced this with the main conclusions arising from the bibliographical data analysis.

503(27): ‘cultural eutrophication’ is a confusing term. Is the culture being eutrophied? I recom-mend cutting the word ‘cultural’.

Autors: Ok, done.

503: I would also note that methods mentioned in the first paragraph use real data to arrive at process. The modeling mentioned in paragraph 2 has the drawback that it is an abstraction of reality - probably less realistic than the data-driven approaches in paragraph 1.

Autors: We added a sentence to include this reasoning (now in the last sentence of the



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second paragraph).

503(27): I would replace ‘However, the fundamental problem’ with ‘A problem’. Upscaling is a problem in modeling, but it is only one problem (not ‘the’ problem). You hit on other equally im-portant issues with modeling in the previous paragraph.

Autors: Ok, done.

506(3): I think this sentence minimizes the manuscript. See my earlier recommendation for these ideas on circular reasoning.

Autors: As stated above, we removed this confusing reasoning from most places of the text.

506: More study site information is required: temperature, precipitation, seasonality, soils, what type of industry.

Autors: Ok, done. The supplementary information is spread in section 2.1.

507(4): What does the term ‘semi-distributed’ specifically mean? I see others use it, but I think it is a very poor description of a model. ‘Distributed’ means that the model uses partial differential equations. ‘Lumped’ means that the model uses ordinary differential equations. I think HSPF uses ordinary differential equations, thus it is a lumped model. I don’t think lumped means any-thing bad, it just describes the mathematical formulation. I suggest not using the term ‘semi-distributed’ because it does not mean anything specific about the model structure.

Autors: The term semi-distributed is a customary term in the modelling literature, and we think that the referee is not interpreting the term in the sense we apply it. Any way, it is clear that the term is confusing, and we simply deleted it.

508: The correction factor is confusing. It should be better explained.



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Autors: We added additional explanation for the correction factor (first paragraph in section 2.3).

515(15): The relationship between Sw and Q has some spurious correlation, thus I question the validity of discussing any correlation. Sw can be stated as Sw = u/kc and Q can be restated as Q = uA if A is stream cross-sectional area. Thus, this relationship may be simply due to the fact that u is a term in both variables. Can this be reanalyzed as 1/kc versus A? A strong correlation in that relationship would be much more interesting.

Autors: This comment motivated a series of comments in the open discussion. In the last version of the paper we followed the last recommendation of the referee (S368-S369) about including additional analysis relating vf against Q.

In fact, we included new relationships for Sw vs. P concentration, vf vs. Q, and vf vs. P concentration (new Fig. 7). From this expanded analysis several conclusions were reached:

1. Actually, the referee was right. Sw vs. Q relationship is mainly governed by hydrology, since no relationship between vf and Q as found inside stream classes. This is not to say that the regression is spurious (see the open discussion of the paper for detailed reasoning), but diminishes the importance of the finding, since this is expectable from Sw governing equations. We agree with the last referee’s comment that we checked Doyle’s study with some bias. Actually, Doyle’s results put equal importance on hydrology and in-stream retention to explain Sw variability, but Doyle was not talking about Sw vs. Q regressions, but on Sw variability. Thus, our result agree with Doyle’s analysis: the Sw vs. Q relationship is mainly driven by hydrology, but differences between pristine an impaired streams (i.e. a good portion of the Sw variability) are driven by in-stream processes. We simply were looking at the problem in the wrong way. 2. vf do not show dependence on streamflow or P concentration, at least in the same way found for nitrogen retention in high impact stud-



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ies. This opens very interesting questions about the relevance of inorganic processing in the case of phosphorus and the main drivers of phosphorus retention in impacted streams, although it also raised doubts about the appropriateness of the database.

These points and other issues are discussed in a totally restructured discussion section.

517(1): Look at modeling work by Wollheim to put some context around what you are doing.

Autors: We found this reference and cross-citations herein extremely useful for our discussion. Thanks for this suggestion.

517(5): Put the Marti comparison into the Results. I was waiting for this to come up when I was reading the Results.

Autors: Ok, done.

517(25): This is not very clear at all. This is a very important paragraph - clarify your message. I think you are suggesting that the impacted streams are showing efficiency loss. If so, look at Mulholland et al. (2008) Nature and consider where the similarity between their results and yours.

Autors: This is an interesting comment. We copy here the section of the discussion where we take this into account:

“In any case, panels in Fig. 7 clearly state that nutrient enriched streams shows reten-tion ef ficiency loss. This is not at odds with Mulholland et al. (2008) results for nitro-gen, that shows not so evident differences between stream types. The reason is that we used nutrient concentration as the criteria for defining a stream as impaired, while Mulholland et al. (2008) separated streams by land use adjacent to the stream. Thus, urban and agricultural streams in Mulholland et al. (2008) actually included streams with very low nutrient concentration. Considering the tight relationship between nitro-gen vf and stream concentration reported by Mulholland et al. (2008), ap-



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plying our cri-teria for defining an impaired stream should result in retention efficiency loss in im-paired streams also for nitrogen.”

518(3-6): Again, I do not like the ‘circular reasoning’ idea ending all of your most important sec-tions. Mention it one place in the manuscript - probably in the methods. And, I think the idea of models being good heuristic tools is not a strong enough point to bring it up in three places in the manuscript. I think there is a stronger statement from this research that can be mentioned in these places.

Autors: As noted above, we deleted this reasoning from the high visibility points of the manuscript.

TECHNICAL COMMENTS:

504(15): This whole paragraph could be cut. It adds little and makes reading the Introduction more cumbersome.

Autors: We shortened the paragraph and merged it with the previous, although we maintained some sentences judged convenient for the reading of the paper.

504(26): Put this paragraph into the methods.

Autors: We do not agree. This put the problem in context for non-familiarized readers.

506(10): Sentence starting ‘Thus,...’ should just state the basin size. It is confusing as currently structured.

Autors: Ok, done.

507(7): Do not tail of with ‘...’. Say which factors are used to simulate the basin hydrology.

Autors: Ok, done.

507(26): First sentence can be cut. It is redundant with the section title.

Autors: Ok, done.



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508(1): What is ACA? Spell it out.

Autors: Ok, done.

508(16): Cut ‘a’ from ‘a power dilution dynamics’.

Autors: Ok, done.

508( 20): What do parameters a and b represent? Explain that they are parameters of the power law. Equations 1a and 1b need the b show in superscript.

Autors: Ok, done.

510: In equations 3 and 4, show that the terms are equal to −kcTP.

Autors: Ok, done.

511(1-6): The many sentences starting with ‘nonetheless’ and ‘however’ makes the paragraph harder to understand. It sounds like you are contradicting yourself.

Autors: This sentence is no longer in the manuscript.

511(24): Change ‘these data was’ to ‘these data were’.

Autors: Ok, done.

512(1): ‘first decimal place’. Do you mean one significant digit? The first decimal place may be quite precise depending on the number of significant digits.

Autors: You were right. Changed accordingly.

514(23-24): Merge the first two sentences.

Autors: Ok, done.

514(26): Does it ‘imply’ or does it say something directly? I think the latter.



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Autors: You were right. Changed accordingly.

515(5): Remove parentheses. Let the two sentences exist outside the parentheses.

Autors: Ok, done.

518(2): What is the coincidence that you are referring to?

Autors: This sentence is no longer in the manuscript.

Table 2 and all Figure Captions: These captions should be understandable without the text in the body of the manuscript. Spell out the terms: Sw, TP, TPc, ACA, etc.

Autors: Ok, done.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 501, 2009.



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