Hydrology and Earth System Sciences Discussions

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Comment on hess-2021-16

Anonymous Referee #1

Referee comment on "Bending of the concentration discharge relationship can inform about in-stream nitrate removal" by Joni Dehaspe et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-16-RC1, 2021

The paper aims to explain evolution of concentration-discharge patterns in a stream network using a modelling approach. This is an interesting topic, following observations from many systems, where the c-q patterns become homogenised downstream, i.e. from highly variable and positive c-q slopes in first order streams to more linear responses, near chemostatic responses in downstreams.

The modelling approach adopted here explains one aspect of these previous observations, i.e. changes in curvature. The authors show that in 1st order streams curvature is larger than in higher order streams which can be explained by hydrological accumulation and homogenisation when moving downstream. Simply speaking, 1st order streams can have a larger variation in concentration sources compared to bigger streams. And/or activation/deactivation of these sources requires changes in flow discharge that can result in the 'bent' c-q relationship or simply speaking different slopes of the relationship for different flows.

The paper is heavy on modelling that can conceal the main findings of the paper, which is that 1) curvature is predominant in 1st order streams and 2) curvature is better explained by flow characteristics than nitrate uptake velocity. These findings can be explained by higher rate of biological processes in headwater streams (hypothesis investigated in this paper) but there are also other factors that can explain bending of the c-q curves, like stream morphology and flow-stage relationships, activation/deactivation of sources in relation to flow including presence of sewage pollution, drains etc. Thus, I am not convinced that the paper provides the one and only explanation for the observed patterns, rather than provides a plausible explanation for one of the possible explanations. This should be clearly communicated in the paper.

The modelling focus of the paper is, however, very dense and takes precedence over the problem – variations to c-q patterns and their controls. I would suggest 'moving' the modelling to the background of the paper and focusing more on the problem. This refocusing would make the paper easier to understand to a non-modelling reader and set it better in the previous research on the topic.

Finally, the original concentration and flow data disappear in the paper convoluted in different models. E.g. linking curvature to other models with inherent uncertainty like

Damköhler number or uptake velocity. Showing more raw data in the paper, e.g. providing traditional quantifications of the c-q slopes would be very useful for the reader to link their knowledge of the subject with the new findings of this paper. Also when showing variation in curvature, I would like to know how frequent are concave vs. convex shapes.

Specific comments:

The title could be improved. I am not a big fan of bent c-q, maybe come up with a better term? For example curved c-q relationship as opposed to linear?

Line 13 not clear what you mean by more positive slopes. Be exact.

Lines 13-15 – what about point source pollution impact on low flow concentration?

General: Large number of studies show that high-freq and low-freq c-q relationships are governed by different factors. Please be clear in your paper based on which type of data you derive/base your assumptions on.