Hydrol. Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/hess-2020-257-RC2, 2020

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Spatio-temporal controls of C-N-P dynamics across headwater catchments of a temperate agricultural region from public data analysis" *by* Stella Guillemot et al.

Anonymous Referee #2

Received and published: 12 September 2020

General Comments: This manuscript provides a descriptive analysis of spatial and temporal patterns of DOC, NO3, and SRP in catchments of the Brittany region of France. The multi-element, many sight approach utilized does provide interesting insight into the potential influences of changing seasonal hydrology/ flowpath and landscape characteristics on the biogeochemistry of the study region. Overall, the manuscript is well written, I enjoyed reading the manuscript, and for the most part the author's interpretation of the patterns observed are supported by their statistical analysis. The paucity of other studies focusing on multi-element patterns, in headwater streams, that examine seasonal patterns, or that focus on multiple catchments is somewhat overemphasized in the framing of the research though and further cross

comparison with studies that include all or only some of those criteria would benefit the introduction and discussion. In specific comments a number of potentially helpful references to similar research are noted. Regarding the GAM model used to describe seasonality, this is a useful approach, but I also wonder if there may be opportunity to modify the presentation and possibly the models slightly to explore interactions between multiple drivers (e.g. season x land use or flow x soil).

Specific comments: Lines 45-50 – There have been a number of studies in Canada and United States to evaluate the influence of agricultural land use on DOC concentration and DOM composition. Although the statement that composition is usually quite altered is true, often concentration is more a function of the same factors as in non-agricultural catchments, in particular the presence of wetlands and soil drainage properties.

Lines 65-75- I understand the point that the authors are making here, but there are actually a number of studies meeting most of these criteria that could be helpful in interpretation of results and in understanding the generality of the patterns observed across regions. A couple of ideas that came to mind when reading this section were:

Fasching et al. 2019 in Ecosystems also use GAM models and the approach used to explore multiple drivers may be helpful, Natural land cover in agricultural catchments alters flood effects on DOM composition and decreases nutrient levels in streams - https://doi.org/10.1007/s10021-019-00354-0

Although larger watersheds in the region are also included in the analysis I would suggest that some comparison should be made with Moatar et al. 2017, WRR, Elemental properties, hydrology, and biology interact to shape concentrationâĂŘdischarge curves for carbon, nutrients, sediment, and major ions https://doi.org/10.1002/2016WR019635

The review and conceptual paper presented by Kaushal et al. 2018 in Biogeochemistry may also be helpful in evaluating the role of season and land use on multi-element water chemistry.

Line 68 – This is true, but there is a lot of study that goes on further upstream in even smaller catchments where land management can be linked directly to impact.

Line 73- maybe also ad “multi-element” to this statement because there are many studies that examine multi-catchment patterns for a single element.

Line 109- This is good. Often selecting sites in a stream network without spatial independence is a pitfall for many site studies in a region, particularly when working with data where the authors did not chose the original sampling locations.

Line 111- Please explain why these criteria were used for outlier selection and how commonly extremely high concentrations were observed.

109-112 – Were data examined to ensure that there were not seasonal biases in the timing of missing data and that certain sites were not heavily sampled only in one season (summer samples only for example)

Line 185- The seasonality metric is interesting, but doesn’t really separate the impact of flow condition or discharge from other factors like temperature that vary seasonally. Calculation of a similar metric for high flow vs. low flow for comparison to the SI might be quite revealing. An example of that methods is in Fasching et al. 2019.

Figure 4 – I think the information displayed here is valuable, but I wonder if a visual with additional information might be possible with the GAM results if the influence of 2 different drivers were displayed in a 3d version of the figure similar to Figure 7 in Fasching et al. 2019. It could be discharge or land use on the other axis.

-The discussion on DOC/NO3 patterns is well written and I agree with the authors general interpretation of the results.

-For the SRP discussion it may be worthwhile to reference the strong correlations that have been observed in small agricultural catchments between soil P and runoff concentrations. There are metrics included in the predictor dataset for TP_soil and P_surplus which appear to be model outputs. It may help with interpretation of results if it can

be noted whether these follow anticipated patterns of buildup where more intensive livestock or fertilizer input is occurring.

Line 380 – In the context of the observed seasonal pattern can you comment on the timing of nutrient applications and whether there is potential for depletion of soluble sources over time or not.

Table 1 – Presumably some fields are used for both summer and winter crops. A total % cropland variable might be useful if not already considered.

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