

I enjoyed having the chance to review this manuscript, which explores patterns of temporal variability in the relationship between nitrate concentration and river hydrology. The framework presented provides an interesting and novel way to explore this by incorporating the concept of synchrony between C and Q as well as over different time steps. This manuscript is well written and has already been improved through a first round of reviews. The discussion does a good job of tying together the patterns observed to highlight potential drivers in the landscapes studied. I have a few suggestions for clarification or additional interpretation that I hope might further improve the paper:

General comments:

1) Transformations in-river and in-reservoir

The potential for autochthonous processes to influence concentration patterns of nitrate should be at least noted in the introduction and discussion.

Lines 45 to 50 – denitrification is mentioned here, but are there other biological processes that may be introduced as influencing nitrate concentrations in rivers? Microbial, algal, and plant uptake and transformation may be an important factor in larger systems and summer months?

Line 343 to 345, Line 368, Lines 434-443, Line 485 – these would also be places to note in-stream or reservoir transformations in the list of processes at the beginning of discussion.

In interpreting results and discussion it may be worthwhile to consider whether some of the patterns observed relate to in-stream processes and transformations or whether there are stronger correlations with other factors that suggest nitrate is behaving more conservatively.

Looking over results there are a couple of potential connections. Is there any way to estimate residence time or travel time in the study watersheds? If I'm interpreting Figure 5 correctly it looks like Asynched watersheds might have lower BFI, but higher FARL. Does this suggest that in-stream and in-reservoir uptake and transformation of nitrate may be an important factor in certain watersheds? Relationships with WWTPs might impact directly by acting as a point source, but retention and release, transformations with loading of C and P might something to consider. Particularly if there is seasonality to some of the timing it could be noted as a potential influence on unexplained variability in C-Q relationships and synchrony.

2) Noting the limitations of a monthly timestep and options for next steps of analysis at a finer temporal scale

Line 148 to 150 – I’m not sure that I understand how “a narrower window would risk fragmenting the seasonal synchrony into noise”. I do understand why a monthly timestep is appropriate to identify seasonality of synchrony. Challenges with working at a finer timestep than monthly may relate back to the frequency of water sampling and limitations of WRTDS in accounting for hysteresis in C-Q if present at sites. A more specific statement about limitations of using the C timeseries constructed with WRTDS at finer timesteps might be appropriate.

I don’t think that there is a need to change what has already been done here, but in terms of next steps that could be added to discussion and addressing some of the hypothesis about source and connectivity, exploration of the dataset with WRTDSplus and quantifying whether C tends to peak on rising or receding limb of events or is a function of the antecedent moisture conditions might be suggested as an opportunity for future research.

For example this might be something to mention around line 433 in the discussion.

Specific comments:

Line 93 – Can the authors add a statement here regarding the timing of gaps and ensuring that linearly interpolated discharge data did not coincide with likely peaks of discharge? I mention this consideration in that timing of data gaps can often coincide with hydrologic extremes that may impact measurement equipment or exceed the range of a rating curve. If gap filled data was timed to peak flow this could impact your analyses even if only constituting a short time period in the record.

Line 504 – Maybe mention the likely importance of tile drainage again here?