

## ***Interactive comment on “Reduced phosphorus loads from the Loire and Vilaine Rivers were accompanied by increasing eutrophication in Vilaine Bay (South Brittany, France)” by Widya Ratmaya et al.***

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————— General comments ————— This study by Ratmaya et al., focuses on eutrophication trajectories over three decades in a large bay located in the French Atlantic coastal zone. It tries to link long term trends and seasonal evolutions in the main bay tributaries with the ones observed in the bay itself, based on a trend+seasonality time series decomposition algorithm. This study could be of interest for Biogeosciences readers, but suffers from too many issues such as lack of a clear research question, lack of structure within and between sections, and several

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technical issues that need to be addressed before it can be considered for publication. The main issues to me are the following: - Concentration time series in the Loire River (the main tributary) originate from a station located in a river section under estuarine influence but was considered as representative of the freshwater part. - Methodology is not clear, especially for the seasonal analysis using the DLM approach. Authors need to define clearly the metrics that were used in this work (e.g. little is said on MK slopes p-values although they appear in Tables) - Nothing is presented on the impact of estuarine zones on DIN and NIP, disabling the credibility of the interpretations made to explain eutrophication trajectory in the coastal zone. - If the presence of a dam at the outlet of one of the two tributaries is mentioned, nothing is explained on the potential impacts this should have on the nutrient dynamics discharged into the bay. Additionally, this manuscript needs language editing. Many sentences need to be either removed or modified for the sake of clarity. I decided to focus on specific comments on Method and Results sections, because I think interpretation in the Discussion section might change once everything has been addressed properly.

————— Specific comments ————— Page 2; Lines 28-29 (2;28-29): this hypothesis has been proven wrong in many studies. I don't think you should present your problematic this way. Page 3, section 2.2: explain that you extracted the longest records available. The reader doesn't know at this point that multi-decadal data is available. Page 3, section 2.2: If Montjean is considered as the last freshwater station on the Loire, why would you use concentrations originating from Ste Luce located in the zone influenced by estuarine salinity? This is a choice that could mislead your interpretations. Also, when computing loads, which site served as the reference? That means did you calculate loads at Montjean or Ste Luce and how did you proceed (e.g. catchment areas ratio)? Page 4, Line 4-5 (4;4-5): you should make sure this assumption on NO<sub>3</sub> being >90% TN is correct. For the riverine part, AELB also provides TN concentrations. 4;6: this method for load calculations is subject to large errors, especially on DIP. You should use a discharge weighted method, commonly used by our community, and recommended within OSPAR convention. 4;24: residuals

as white noise is an hypothesis that is not always met by these algorithms. Please, remove “white noise” in this sentence. We need a metric to assess if your algorithm performs well or note, especially when working at the seasonal scale with variables that don’t have stable seasonality patterns (e.g. phytoplankton biomass). 5;1: why was this log-transformation necessary? It needs justification. 5;7: reading log-transformed units is not convenient for the reader. You can log-transform the axis but still present actual values. Why did you log-transform the data in the first place? It makes the trend observation less clear to the reader. The authors decided to use units that are consistent in the manuscript, but not commonly used by researchers on lotic environment. Please, convert all mol/L into mg/L or  $\mu\text{g/L}$  5;8-9: the explanation on trends significance test is not clear nor properly justified. You need a metric for this. Why not use Sen’s Slope significance test? 5;11: the authors should define clearly which metrics were extracted for the time-series analysis and used for further analysis. 5;15: have you conducted MK test on de-seasonalized = observations – seasonal component, or on de-seasonalized = trend component? The latter discards residuals from the analysis and this choice should be justified. Also, I think residuals from your DLM algorithm should be plotted along. 5;17: it is not clear how you proceeded to identify seasonal trends. Did you use a seasonal MK test? This needs more details since it is the core of your analysis. Besides, how would you justify analyzing loads evolutions and not only concentrations since you show that Q was stable over time? Removing all the load trajectory description would save space for other elements in your paper, and benefit to the clarity of your messages. 5;21: What is STATGRAPHIC CENTURION and what are the metrics/analysis conducted with this? Please, add a reference for this. 5;26: how significant is this trend in Q data? A large slope in MK tests doesn’t mean that it is statistically significant. 6;5: this seasonal shift is not observable in Figure 3. Consider adding a Figure to show seasonal variations and evolutions. In the Result section, it is good to refer to Tables and Figures, but the reader also needs actual values included in the text, otherwise he always has to go back and forth from text to Table/Figure. 6;12: please, be more specific, and always use similar ways of describing the data: first,

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trends. Second, seasonal variations. It helps increasing the clarity of the manuscript and makes things easier for the reader. You have too many additional figures. Please, make a selection of the ones that are really useful to support your ideas. 7;19: add a section for this correlation analysis 7;24-29: Do you believe your DLM analysis is suitable for phytoplankton biomass description at the seasonal scale? You need to validate this first, and plots in Figure 7 don't help answer this question if you don't show residuals (you'll see that they don't look like white noise). Insets in Figure 7 are not explained. It has to be. Section 4: this section could be reorganized as follows 1) Nutrients and Chl-a trends at river basin outlets 2) Nutrients and Chl-a trends in the bay 3) River to bay continuum 4) Implications for management How does the estuarine zone could interfere in your interpretations? Same question with the presence of a dam at the outlet of the Vilaine river? This needs to be addressed, at list by listing the different processes that occur. Many has been done on the subject. 8;21: This can't be said like this. At the outlet of large and intensively managed catchments, nutrients variations are co-controlled by upstream hydrological variations, delivery to stream modalities (point or diffuse sources?), and by instream retention processes through physical and biogeochemical processes. 8;22: You should mention the North Atlantic Oscillation to explain the 7 years cycles. See also Dupas et al., 2018 (WRR) Figure 8 could be a great final figure, but needs to be explained once the processes explaining the different patterns in eutrophication metrics are completely described.

————— Technical comments ————— Page 1, Line 14 (1;14): remove "i.e., phytoplankton biomass", as eutrophication expression is not only phytoplankton excessive biomass. 2;5-7: this has to do with different source types and it should be explained. Environmental measures to tackle P were successful because P largely originated from point sources with limited legacy effects in the streams. For N, diffuse sources dominate and there is large legacy effect. 2;7-11: you should also mention freshwater ponds and lakes where eutrophication is still severe despite large P reductions. 2;16-17: I'd remove the codes for what you called "water masses". Do the authors mean "water body"? 2;18: an actual scientific reference would be better. 3;3:

“widest” is not correct. You may refer to “largest river basin”. 3;4: sentence is not clear, please, rephrase it. 3;22: sentence is not clear, please, rephrase it. 5;1: the use of “:” separates the sentence in a way that makes it hard to understand. Please, modify. 5;8-9: check for use of different tenses throughout the manuscript. 5;23: Change this section title to “Discharge and nutrients long term trends in freshwater basin outlets”

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