

## ***Interactive comment on “QUAL-NET, a high temporal resolution eutrophication model in large hydrographic networks” by Camille Minaudo et al.***

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Received and published: 25 January 2018

Authors are grateful for comments and suggestions from Referee 2. All raised issues were listed below and carefully answered.

//— R2C1: The hypothesis and purpose of the study is somehow unclear. I do not really understand what the objective of this paper. Does the paper focus on the new modeling approach or the eutrophication in the modelling study?

//— A: The main objective was to assess the hydrological versus biological control of water quality in a eutrophic system. We proposed an original model to determine the controlling factors based on high temporal frequency. Thus, presenting the new model approach had to be a second objective in this paper.

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//— R2C2: I found the manuscript written with unclear messages. The manuscript seems were written without final editing. I think it needs a language editing. Also, please avoid repetition of adverb such as “yet” and “additionally” in the text.

//— A: A native speaker went carefully through the manuscript to clarify as much as possible our messages.

//— R2C3: The manuscript states that most of biogeochemical processes are water temperature dependent, however, I found that it does not provide modeling result on temperature variable. How does the daily temperature look like? During the travel time from S1 to S2, does it highly fluctuated? During summer, does the temperature at S2 close to the temperature value at S1?

//— A: That is correct. We agree that presenting results of water temperature estimations is necessary. Water temperature was highly seasonal and fluctuates between 0 and 30°C (Figure A8). In summer in the Loire River, amplitude of diel cycles ranged between 0.2 and 1.5°C. Seasonal variations between S1 and S2 were very close (Figure A9). Temperature variations at the daily scale were highly contrasted at the two stations, highlighting meteorological and hydrological controls on water temperature.

//— R2C4: The fluxes and concentration of point sources were considered constant over the time in the model. Further explanation on how much and how fluxes and concentration were estimated is needed.

//— A: The regional Water Agency (“Agence de l’Eau Loire Bretagne”) publishes N-P-C and total effluent fluxes exiting WWTP for all domestic and industrial effluents. It was estimated in 2010 that point sources represent in the Middle Loire sub-catchment (our study) 322 kgP day<sup>-1</sup> and 1.9 tN day<sup>-1</sup>. Model QUAL-NET uses directly this data. We would add this information to the manuscript.

//— R2C5: The manuscript does not discuss how the model treats the nutrient source coming from re-suspended sediment and nutrient fluxes between water and sediment

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interface. I think a paragraph discussing this would be helpful for the reader.

//— A: This might have been unclear in our manuscript. The model estimates for each river reach and at each time-step quantities of suspended particles eroded or that settled on the river bed (based on sedimentation velocities). Particles are both inorganic and organic with three levels of lability. Re-suspension might fuel the water column with soluble reactive phosphorus via desorption processes from suspended matter.

Diffusion processes for nutrients between the two layers are also considered. The benthic compartment can be either a source or a sink of nutrients, depending on redox conditions. All these processes are modeled using Billen et al. 2014 (Ann. Limnol). Equations in this formulation provided estimates of NH<sub>4</sub>, NO<sub>3</sub>, PO<sub>4</sub>, SiO<sub>2</sub> and O<sub>2</sub> fluxes across the water – sediment interface. The sediment layer was split into two sub-layers. The one at the bottom was considered compact and not erodible, the other one could potentially be re-suspended. Nutrient fluxes between these two sediment layers were also considered in our model.

//— R2C6: (Page 1: Line 19) Change “or” to “end” //— A: there was no “or” page 1 line 19

//— R2C7: (2:15-30) “Yet” and “additionally” adverbs were used extensively. //— A: We carefully read the manuscript and tried to avoid these adverbs.

//— R2C8: (2:31) Instead of “context”, perhaps use “study”? //— A: We really meant “context”.

//— R2C9: (3:3, 7, 26) Missing multiply mark “x”. Also, in the figure 1. //— A: OK, this was modified.

//— R2C10: (3: 18-20) Please reorganize these unclear sentences. //— A: OK “Since 1990, phosphorus concentrations were divided 2.5-fold and phytoplankton blooms declined 3-fold (Floury et al., 2012; Minaudo et al., 2015; Oudin et al., 2009). Algal

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blooms are still occurring from time to time, questioning the source of phosphorus.”

//— R2C11: (3: 22) Change “the fusion” to “a couple” //— A: We changed it to: “It is the coupling between a thermal model T-NET (Beaufort et al., 2016), and a biogeochemical model, RIVE (Garnier et al., 2002).”

//— R2C12: (4: 16) In Figure 2, switch delta x with delta t. //— A: OK

//— R2C13: (7: 19) In Figure 3, change the color lines and add a list of abbreviations to improve the figure clarity. //— A: We don’t think this is needed: variable names already have abbreviations and are organized. Our objective with this figure really was to show the complexity of our model and the fact that variables are highly inter-dependent.

//— R2C14: (7: 31) What and how many variables were calibrated? //— A: Two variables were calibrated: TSS and Total Inorganic P concentrations. To achieve this, 5 coefficients in total were manually calibrated (see Table 1 in the manuscript).

//— R2C15: (page 11, 12, and 13) I do not think lower roman numbering is necessary in the text. //— A: OK

//— R2C16: (13, 21) Consider improving “At finer resolution” words in the conclusion. What resolution? Time or space? Finer from what? //— A: You are right, we meant “higher temporal resolution”

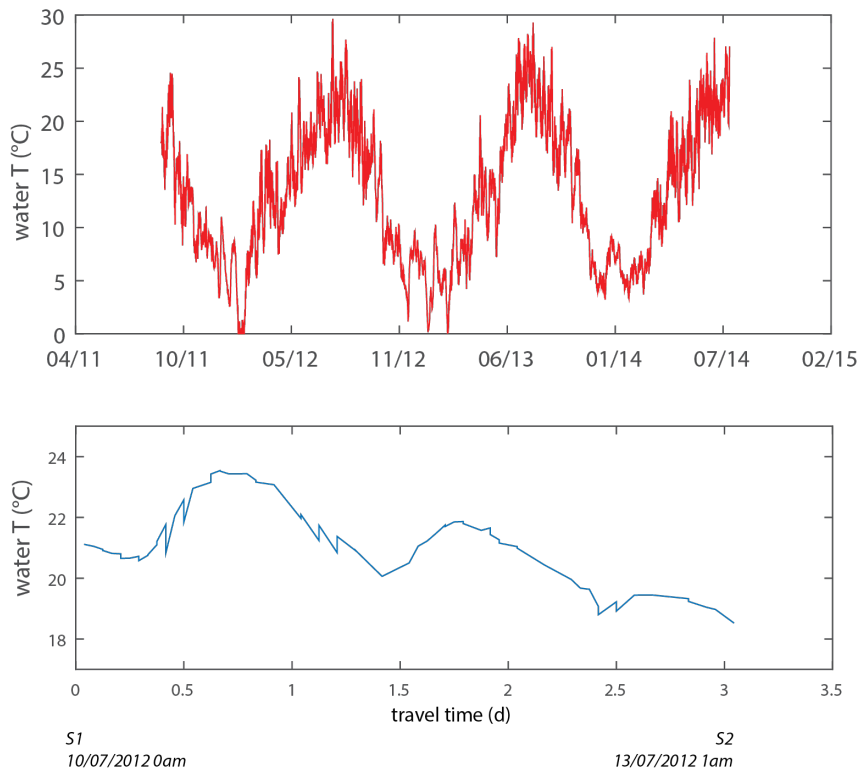
// ————— FIGURE CAPTIONS ————— //

Figure A8. Water temperature estimated with T-NET module: top panel presents hourly variations at station S2 over the period considered. Bottom panel plots the evolution of water temperature when the water moves downstream from S1 to S2 during summer

Figure A9. Water temperature estimated by T-NET module at S1 and S2

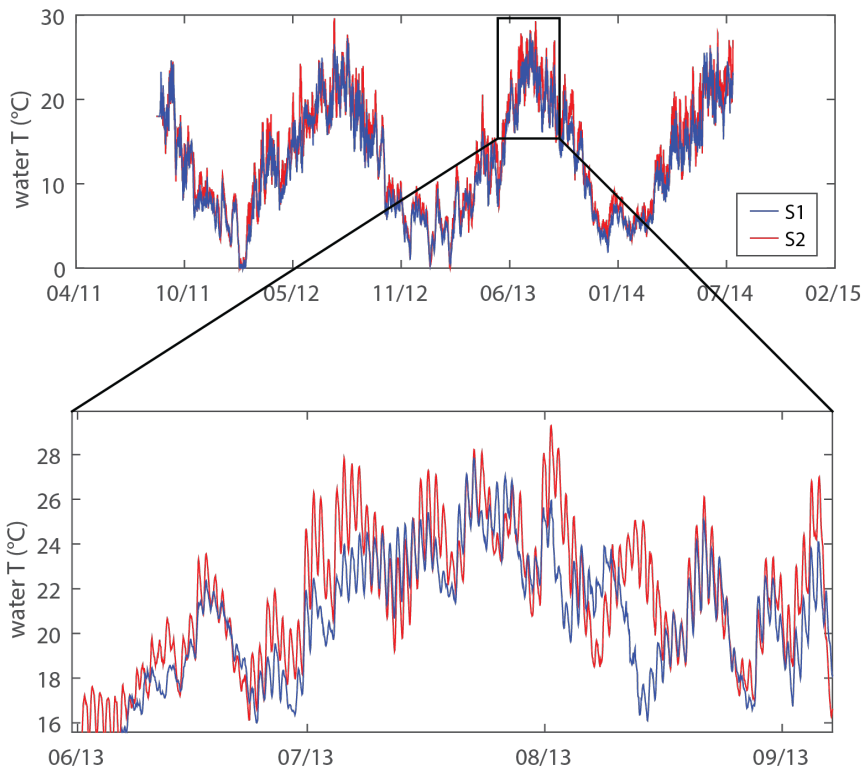
Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2017-229>, 2017.

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**Fig. 1.** Figure A8. Water temperature estimated with T-NET module. Temporal variations at S2 (top) and Lagrangian view from S1 to S2 in summer

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**Fig. 2.** Figure A9. Water temperature estimated by T-NET module at S1 and S2

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