Response to anonymous Referee #1 (submitted on 08 March 2020)

General comments:

I can see the authors have incorporated the comments from previous review and revised the manuscript accordingly. Improvements can be seen especially in the introduction and discussion.

A1. We thank you for having reviewed our manuscript. We are glad that you find the manuscript improved.

However, some fundamental issues have not been solved yet. For example, most of the manuscript focused on the model description and results. But the model is not new as the model has been applied to Seine River network before (see Laruelle et al. 2019), I think the authors need the clarify why you are repeating the work in different years, and what are the new scientific values from this work compared to the previous model applications.

A2. The paper of Laruelle et al., 2019 presents some results of a previous simplify version of pyNuts-Riverstrahler model while the earth of their article is focusing on the estuarine modelling (C-GEM). In this new work, we explain in details how we implemented the module by detailing the equations, the inputs and the validation of the river model. Moreover we bring new explanations about the entire Seine river network metabolisms (from Stream Strahler Order 1 to 7) where the other manuscript focuses on a small portion of the Strahler Order 7 and the estuary. As observed and modelled, CO_2 concentrations and emissions in/from small streams are not negligible and are essential to understand the Seine River metabolism.

The aims of the two works are thus very different. The methodology completed to describe the inputs (organic or inorganic carbon), the river modelling part and analysis, the metabolism of the Seine River are presented in this present work while the article of Laruelle et al., 2019 is only using the outputs of the pyNuts-Riverstrahler model. In addition, the manuscript of Laruelle et al., 2019 shows simulations only for the year 2010 when in this work, we run and validated the model on the time period 2010-2013.

We selected the time period 2010-2013 to propose a simulation envelope including a dry (2011), a wet (2012) and two years of intermediate hydrological conditions (2010 and 2012). With this time period, we cover the range of hydrological mean conditions that we can observe on the Seine River.

Also, although the author declare they have improved the text writing, there are still issues in the text that lowered the quality of the manuscript. The carbon budget in river systems is important to the global carbon cycle and this paper could make a substantial contribution to this topic, so I encourage the authors to improve the manuscript again to make this work a remarkable one.

A3. The manuscript has been already revised by a professional proofreader in order to improve the English writing.

Specific comments:

Line 20: process based -> process-based

A4. Change has been made

Line 21: supplemented by -> supplemented with

A5. Change has been made

Line 35: Metabolism -> Results from metabolism analysis

A6. Change has been made

Line 68-71: still hard to understand this statement; eutrophic systems are usually oversaturated with pCO2 respect to atmosphere;

A7. We changed the sentence as: [L 68-71] *"As a whole, eutrophic, oligo- and mesotrophic hydrosystems generally act as a source of carbon however, lentic systems may be undersaturated with respect to atmospheric pCO2 (Prairie and Cole, 2009; Xu et al., 2019; Yang et al., 2019)".*

Line 100-101: why not merge this paragraph with previous paragraph? Also, I think the work of Laruelle et al 2019 should be mentioned here as the content of this paper is similar to Laruelle et al. 2019

A8. Merge has been made and Laruelle et al. 2019 is now cited as: [L99-L100] *"It is only recently that we investigated pCO2 and emphasized the factors controlling pCO2 dynamics in the Seine River (Marescaux et al., 2018b) or estuary (Laruelle et al., 2019)."*

Line 477-478: these lines are better to go in next section 3.2
A9. We let the sentence in the section "3.1" as they concludes the section "3.1." and introduces the next section "3.2.".

Line 725-744: conclusion are a bit rough and just repeating the numbers of results. It is important to highlight the scientific values of your research and why your research is different to others.
A10. Thanks for your comment, we removed some results and added a new paragraph:

[L732-736] *"Our Riverstrahler modeling has shown that there are many factors that control CO_2 emissions in basins affected by human activity along an aquatic continuum. Once validated by field measurements, which are still too scarce, this generic modeling approach can be applied to any drainage system to better quantify lateral CO_2 emission on a continental scale. "*