

After reviewing this manuscript, I do not know that weather I should believe the estimated results for the mean annual net ecosystem metabolism (NEM), FCO<sub>2</sub>, and C<sub>Filt</sub> or not, because it is a big issue for air-sea interaction. I am confusing that the authors tried to use a simple 1D model coupled with Global News model in current study. How did they do? Many assumptions should be made to compromise the estimated results for air-sea CO<sub>2</sub> evasion. The authors should clarify many assumptions in their study. In the model, many parameters should be set up to simulate the state variables shown in Table 2. How did the authors select those parameters? The parameters and values should be listed clearly.

We agree with the reviewer that a better representation of carbon dynamics through the quantification of the Net Ecosystem Metabolism, CO<sub>2</sub> outgassing and carbon filtration in estuarine systems is a critical issue for air-sea interaction. This topic is a particularly pressing matter at the regional scale due to the difficulty of deriving consistent regional budgets from the upscaling of rare local measurements performed in morphologically complex and profoundly heterogeneous systems (Borges and Abril, 2011; Laruelle et al., 2013; Regnier et al., 2013). On the modeling side, the set-up of a reliable reactive transport model able to realistically capture the estuarine carbon dynamics generally proves a very costly endeavor in terms of data requirement to constrain the model (i.e. bathymetric data, boundary conditions, climatic forcing...) and in terms of time necessary to develop such model and run it (see e.g. Garnier et al., 2001; Huret et al., 2005; Arndt et al., 2011; Mateus et al., 2012). The model presented here is thus developed as a compromise, as it is currently the only one capable of running regional scale simulations with limited data and computation needs without sacrificing too much to oversimplification (as done when using box models to represent estuarine systems, Gordon et al., 1996). It follows from several studies published over the past few years (Regnier et al., 2013; Volta et al., 2014, 2016a, 2016b) that led to the development of a 1 dimensional generic estuarine model for tidal systems (Volta et al., 2014) forced by a set of generic parameters compiled from an unprecedented literature review (Volta et al., 2016a). This model was successfully applied and validated on several European estuaries (the Scheldt and Elbe, in particular, see Volta et al., 2016a&b) as well as at the regional scale of the North Sea, using a strategy similar to that presented here (Volta et al., 2016b). This strategy involved the use of the same boundary conditions as those used here for the east coast of the US. That is, the outputs of the global river model GLOBALNEWS and the global river carbon database GloRiCH to constrain upstream boundary conditions and the use of the World Ocean Atlas to specify the downstream boundary conditions. In other words, the model described in our manuscript has precisely been designed to produce regional estuarine carbon budgets using the

outputs of GlobalNEWS as boundary conditions and was already successfully used for similar purpose in another region.

As a consequence of the reviewer's skepticism and following numerous precise suggestions from the other reviewer, we have substantially modified the manuscript to better describe and justify our methodology, its underlying assumptions and potential limitations. We have also made the set-up of our simulations more transparent to secure reproducibility of our model results. In particular, the updated version of the manuscript now contains:

- A substantially modified introduction that puts our study into a more precise context and provides an improved description of the structure of the manuscript.
- Numerous additions to the model description section in order to clarify and substantiate all the assumptions on which our model relies on (i.e. calculation of boundary conditions, period of simulation, choice of databases, etc...), and which together, describe in much more detail the set-up of our simulations.
- 6 comprehensive tables (presented in the supplementary information) and which contain all physical forcings (i.e. estuarine geometry, wind speed, temperature...) and boundary conditions (nutrients and carbon concentrations, pH, alkalinity...).
- A new section (3.3. Scope of applicability and model limitations) which reflects on the strength and weaknesses of our modeling strategy in light of the current state of knowledge available to constrain a model such as ours. In particular, the adequacy of our approach to tackle regional scale modeling, the set-up of boundary condition with available databases and the quantification of the model's uncertainty are addressed in this section.

In 2.6 Model-data comparison, the description of this subsection is very poor. The authors described the model validation for other estuaries in the Europe. How did the authors validate the model for the study areas (U.S. east coast estuaries)? I would like to see the model validation in the study areas to convince me the model is capable and suitable to be used in U.S. east coast estuaries.

We understand the reviewer's concern about the limited validation of our model within the study area. This issue was also pointed out by reviewer #2. We thus expanded extensively section 2.6 to confront the annual CO<sub>2</sub> outgassing predicted by our model with 13 published estimates derived from direct measurements performed in estuaries located along the East coast of the US (Table 1). In addition, we provide a validation of our hydrodynamic model using several seasonal longitudinal salinity profiles in the Delaware Bay as well a validation of our biogeochemical model for two estuaries (the Delaware Bay and the Altamaha estuary). These additional simulations reveal that C-GEM is able to properly represent a pCO<sub>2</sub> (Delaware Bay) and both pH and pCO<sub>2</sub>

longitudinal profiles along the estuarine gradient (Altamaha). Also, in the new section 3.3 (Scope of applicability and model limitations), a paragraph discusses the issue of representativeness of the model's performance through local punctual validations in the case of regional simulations including numerous small systems for which the data that would be required to perform a local validation are simply inexistent.

We hope that all these modifications will convince the reviewer of the usefulness and relevance of our study and modelling strategy.

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