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Discussions

Interactive comment on "Linking biogeochemistry to hydro-geometrical variability in tidal estuaries: a generic modeling approach" *by* C. Volta et al.

Anonymous Referee #1

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General comments

This paper represents a brave and useful attempt to develop a generic approach of estuarine biogeochemistry. It defines archetypal types of estuaries, applies average constraints typical of the temperate climate zones of the world and applies a detailed hydro-sedimentary model coupled with a biogeochemical model to calculate hydro-sedimentary, C and nutrient behavior. The value of the parameters describing the kinetics of the biogeochemical processes is chosen on the basis of a comprehensive literature review, and sensitivity tests are performed with the range of parameters found in the literature. The value of a number of integrative indicators of estuarine biogeochemistry is calculated, including Net Ecosystem Metabolism, CO2 efflux, C and N filtering capacity.

The major weakness of the work, to my eyes, lies in the lack of a clear discussion of the representativeness of the three types of estuaries considered. In the Summary, they are presented as "end members estuaries", which is completely unclear at that stage of the paper: what is a marine, a river or a mixed estuary? Later on we understand that these are not at all 3 end members but two extreme and one intermediate cases! (by the way, "mixed" is not the best name for the intermediate as it is very confusing!) Not all river-sea interface system are covered by these three type of estuaries. The authors introduce the definition of alluvial estuaries, but they do not indicate how this definition match with other estuarine typologies such as that of Dürr et al 2011. This question is crucial when global extrapolation are made from the model results: "The average C filtering capacities for baseline conditions are 40, 30 and 22 % for the marine, mixed and riverine estuary, respectively. Extrapolating these filtration rates to all tidal estuaries worldwide results in a global outgassing flux between 0.04 and 0.07 Pg C yr" How was this extrapolation done? What are tidal estuaries? Is the river type estuary a tidal estuary? What about other types of river-sea interfaces (deltas, fjords, lagunes,. . .)?

Another concern I have is about the structure of the biogeochemical model. When a sensitivity analysis is made by varying the parameters values, this does not tell anything about the uncertainties linked to the structure of the equations themselves! Let me take the example of denitrification, which completely governs the response of the model in term of N filtering capacity. The structure of the model does not take into account benthic processes. Yet, in the real world, these are likely to be dominant in nitrate elimination in all estuaries with oxic water column, which is the case for all simulations shown (oxygen concentration stays between 260 and 320 mM). The fact that the model nevertheless calculates some denitrification is because of the way denitrification is calculated, as a function of organic matter and nitrate concentration, with just an inhibitory factor of oxygen, which never completely vanishes, even at high oxygen concentration. This is a choice often made by other authors, but an on/off representation could be justified as well,. . .and would lead to completely different conclusions about the N filtering capacity.

“No data is available to constrain average total organic carbon and suspended particulate matter concentrations at the lower boundary. Hence, both concentrations are arbitrarily set to 0, thus assuming that at a distance of 50 km from the estuarine mouth there is virtually no input flux of SPM and organic matter from the coastal shelf into the estuarine system during the flood tide.” This is questionable!

Detailed formal remarks

“This dynamic interplay between hydrodynamics and morphology results in a continuum of estuarine shapes that cover the entire spectrum between two end-member cases: systems with rapidly converging banks and channels with parallel banks, which are rarely found in nature and are typically man-made (Savenije, 1992).” Unclear sentence: what are the two end members? What is rarely found in nature? And what is the third end member referred to in the Abstrat? Please rephrase!

At first sight Fig 3 looks rather redundant: only the x axes differ in scale. The point should be clearer by using the same scale. This is true, too, for the following figures!

Table 8: problem with the alignment of figures in column a (shift of 1 line)

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 6351, 2015.