

Interactive comment on “Relative impacts of global changes and regional watershed changes on the inorganic carbon balance of the Chesapeake Bay” by Pierre St-Laurent et al.

Anonymous Referee #1

Received and published: 25 April 2020

General comments: The authors use a linked land-estuarine-ocean model to explore the inorganic carbon balance in Chesapeake Bay. Several sensitivity scenarios are conducted to determine the relative impacts of global changes and regional watershed changes on the inorganic carbon budget. These scenarios include a control experiment with realistic forcing of a period of 15 years from 2000 to 2014, an air pCO₂ change experiment, a temperature change experiment, a riverine nutrient change experiment, a carbon and alkalinity change experiment and a combined change experiment to represent the period of 1900-1914.

The carbonate system was validated by comparing model outputs against a variety of

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field observations along the main channel. The model displayed strong spatiotemporal patterns of DIC, Alkalinity, pCO₂. This study successfully quantified the contributions of variable anthropogenic stressors on the inorganic carbon balance. The global pCO₂ increase has enhanced bay-wide in-gassing, which, however, is mitigated by the temperature increase. Regional nutrient loading increase can enhance the in-gassing by increasing the NEP. Differently, the riverine carbon and alkalinity increase would reduce the in-gassing process. The manuscript is very well written, clear, and should be published with some minor revisions.

Specific comments: Line 118-119. Due to limited observations of DIC and TA, the author use the salinity derived DIC and TA as the forcing at the ocean side. It would be helpful to mention the pH range calculated with these salinity derived DIC/TA, making sure the pH is in a reasonable range.

Line 124. The 50 anthropogenic DIC might represent a small change to surface/bottom DIC, however, this DIC change could affect the surface water pCO₂ a lot and have a much larger impact on the air-sea gas exchange.

Line 146. Why not use the calculated DIC (from pH and the TA you prepared), which could be more accurate to represent the riverine forcing?

Section 3.1.1 Please provide some quantitative measures (e.g. RMSE, relative error) either in Figure 5 or in the texts. It's hard to see the performance of the model in carbonate system.

Interactive comment on Biogeosciences Discuss., <https://doi.org/10.5194/bg-2020-117>, 2020.

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