

Response to the interactive comment by Reviewer 2 (Christophe Rabouille)

Below the entire review is pasted in black and responses are in blue font.

The paper presents a synthesis of carbon cycling on the continental margins of the United States, including the Atlantic, the Pacific and the Arctic coasts. The authors concentrate on the CO₂ exchange between air and seawater as it is the most documented and tabulated parameter for carbon exchange in the ocean, and specifically in coastal zones. They propose an overall map of air-sea CO₂ exchange for the East, West and Arctic coasts which shows a large tendency of these shelves to be a sink for CO₂ (Fig. 3) and then discuss the results by geographic zone which makes a long and rather tedious paper to read. At the end, the acidification question is raised and shortly discussed. Overall, the paper is long but well written and proposes a good synthesis for all researcher interested by carbon cycling in the coastal zone. By discussing the different regions separately and addressing different “cases” (large shelves, upwelling, arctic, enclosed sea-GoM), they provide insightful explanation for the observed CO₂ fluxes. I think that the paper is publishable after minor revisions.

Response: We would like to thank Christophe Rabouille for reviewing our manuscript and for providing his constructive and positive comments. Addressing these and Reviewer 1’s comments will make for a much improved presentation. Envisioned changes are detailed below.

Detailed comments:

Page 3, line 10: The coastal ocean is defined as “non-estuarine waters”, which is questionable regarding CO₂ budgets for the coastal zone since estuaries and deltas are sources of similar magnitude compared to coastal ocean sink. . . It should be emphasized at this point in text that this cutting off estuaries and deltas is because of the paper by Najjar et al. (2018) which has already addressed the estuarine and tidal wetland’s part of the C Cycle.

Response: Agree. In the revision more information on estuarine waters will be added while, at the same time, emphasizing the reason for the cut off.

Page 5, line 15: “colder shelf water is denser”. The authors should cite reference work by Canals et al. (2006, Nature Vol 444, doi:10.1038/nature05271) on cascading in canyons which is the ultimate case of cold and dense water diving in the lighter open sea.

Response: Yes, thank you.

Page 6, line 8: “burial and export of carbon. . . remove atmospheric CO₂”. The authors should specify that this is true only for ORGANIC carbon, as inorganic carbon burial will result in net CO₂ increase in the zone of CaCO₃ formation ($2 \text{ HCO}_3^- + \text{Ca}^{2+} \rightarrow \text{CaCO}_3 + \text{CO}_2 + \text{H}_2\text{O}$).

Response: Agree. Will be done.

Page 14, line17-18: “DIC is a component of the brine whereas total alkalinity precipitates. . .as ikaite”. I do not understand why alkalinity would precipitate without DIC. He sentence should be modified to “precipitation of CaCO₃ as ikaite changes the DIC to Alkalinity ratio by consuming two times more Alk than DIC during the process. . .”

Response: Agree. Will be done.

Page 18, line 10: “. . . pCO₂ gradient are indicative” I would rather say “is the appropriate indicator for”

Response: Prefer to change simply to “indicate.”

Page 18, line 12: “and cross shelf exchange”, please add “potential” cross shelf exchange

Response: Adding “potential” would change the meaning in a way that is not intended.

Page 19, Fig. 6 legend: please add uncertainty to the slopes “1.86 ppm/y and 1.95 ppm/y “ as reported in text for the shelf seas (pge 18, line 14-17).

Response: Will be done.

Page 20, line 10: cut sentence after “oyster larvae in the coastal Pacific Ocean”.

Response: Will break into two or more sentences.

Page 22, line 13-16: These sentences which describe the overall CO₂ flux in the coastal ocean make little sense. The main conclusion of the study is that these margins are sinks for CO₂ (either natural or anthropogenic) and this should be the first and main sentence in this paragraph, before summarizing the details.

Response: Will be revised.