

This study investigates the importance of calcium carbonate in sediments for regulating pH and carbonate buffering capacity in the water column at a highly productive land–sea interface. The authors have also quantitatively evaluated these effects in three sites, including a reference site, a low CaCO₃ site, and a high CaCO₃ site. Overall, this is a good study. However, the description of the overall study framework could be further improved, and the limitations regarding the application and interpretation of the results are not sufficiently clear. My major comments are as follows:

We appreciate the suggestions and questions the reviewer came up with. In this response, we reply the comments one by one. New figures are attached in this response. The text added to the revised MS are shown in *italic*.

1. The overall framework of the experimental design should be described more clearly. The abbreviations for the three sites should also be clearly defined, particularly which site represents the reference site, which site has CaCO₃-rich sediments, and which site represents the fishpond site. It would be helpful to include a flowchart of the experimental design showing the three sites and the experiments conducted at each site.

Thank you for the constructive advice. SSW is the abbreviation of Sansha Bay according to the pronunciation in Chinese. We added the abbreviation in the revised MS (line 82), illustrating the origin of the station names. In order to illustrate the characteristics of different sites, some schematic diagrams and a sediment photo were added in Fig.1 as shown below.

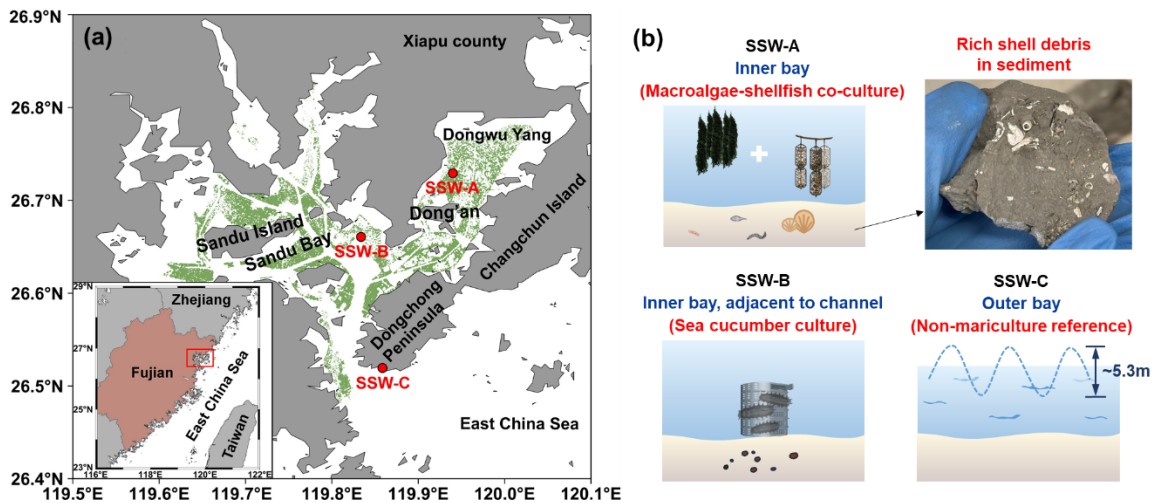


Figure 1: (a) Sampling stations (red circles) in Sansha Bay (Abbr. SSW). The inserted map shows the location of the bay. The green-shaded area within the bay indicates the distribution of mariculture. (b) Schematic diagrams of mariculture types of different sites.

In Method, sections 2.3 and 2.4 describe the quantitative approaches, aiming to figure out how the organic carbon degradation and CaCO₃ dissolution affected the carbonate system in water columns. In the updated version, we combine them into one section “2.3 The

influence of benthic effluxes on carbonate system” (start from line 173). A flowchart (as Figure 2) showing the quantification framework will be added in this section. The original sections now become the subsection 2.3.1 and 2.3.2.

2.3 The influence of benthic effluxes on carbonate system

With the analytical results of the above-mentioned parameters, the total benthic fluxes of DIC and TA were calculated using the radionuclide approach (the ^{224}Ra – ^{228}Th disequilibrium), and the relative contributions of organic carbon degradation and CaCO_3 dissolution to the benthic DIC flux were quantitatively determined using $\delta^{13}\text{C}$ -DIC values of porewater. Thereby, the impacts of these benthic processes on water-column carbonate system, including CO_2 concentrations, pH, calcite saturation (Ω_{calcite}), were then quantified via the flux proportions and the CO2SYS program (Lewis et al., 1998). A schematic flowchart illustrating the quantitative approach is provided (Fig. 2) and detailed descriptions are presented in the following sections.

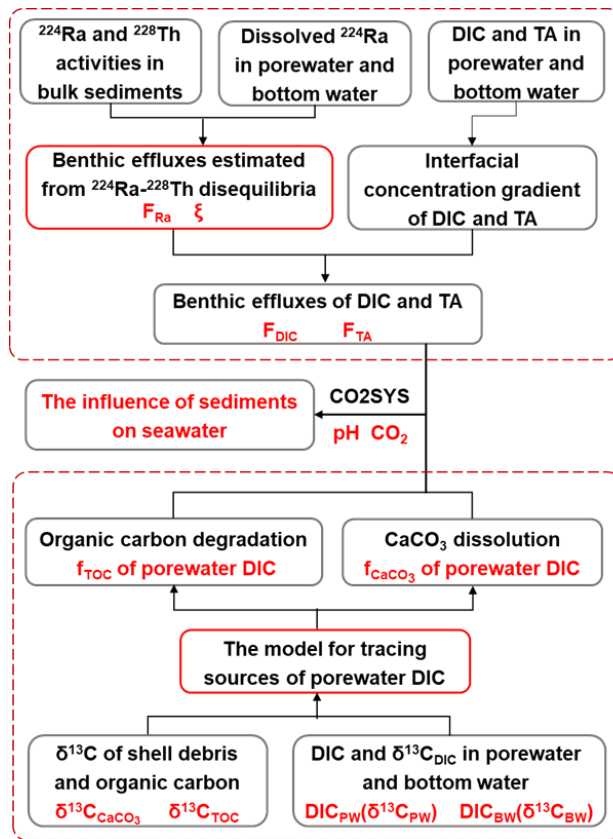


Figure 2: A schematic flowchart of quantitative approaches. The top frame illustrates the approach for benthic effluxes of DIC and TA; the bottom frame shows illustrates the approach for relative contributions of organic carbon degradation and CaCO_3 dissolution to benthic DIC. The red highlights key parameters in the assessment of the benthic influence on seawater carbonate system.

2. This study uses quantitative approaches and provides quantitative results; however, the presentation of the results is not sufficiently quantitative. A summary table should be included to clearly present and compare the major differences among the three sites.
3. A conceptual diagram should be included to summarize the major findings and mechanisms proposed in this study. Chemical equations are also needed in the diagram.

In consideration of comment 2 and comment 3, we removed the original Figure 7 and added the conceptual diagram as Figure 8 in the revised MS. Table 3 was added to summarize the specific DIC fluxes derived from TOC degradation and CaCO_3 dissolution (in Sect 4.3, lines 487-491). Another table showing CaCO_3 -derived TA was inserted into the conceptual diagram (Fig. 8). In this study, there are three highlights: 1) Both organic matter degradation and CaCO_3 dissolution in sediments are the sources to the elevated DIC and TA in seawater; 2) CaCO_3 dissolution in sediments enhances the alkalinity and balances the carbonate system of seawater; and 3) Active irrigation at the bottom triggers high biogeochemical reactions in sediment including CaCO_3 dissolution.

In this conceptual diagram, these highlights are illustrated. In particular, the table shows the benthic TA fluxes that CaCO_3 dissolution contributed and the buffering effect on the water column, which is further shown with the X-Y diagrams. The pH of water at SSW-A was higher than that at SSW-B due to a higher CaCO_3 buffering, although the benthic DIC flux at SSW-A was high. In the sediment, sea cucumber and benthic worms

In the revised MS, the diagram is involved as a summary of the sediment influence (lines 561-567), addressed as:

Overall, the benthic effluxes did not act to lower the CO_2 of water column in Sansha Bay. On the contrary, the sediment served as a source of DIC and tended to increase the CO_2 concentrations of the inner-bay seawater. The released DIC, derived from organic carbon degradation, weakened the buffering capacity and thereby potentially posed a risk of acidification in the inner bay. However, CaCO_3 dissolution in the sediment mitigated this risk by absorbing CO_2 and releasing extra TA. In particular, active irrigation in the seafloor promoted this reaction by enhancing the interfacial area, leading to a reduction of ~30% in the CO_2 generated from organic carbon degradation (Fig. 8).

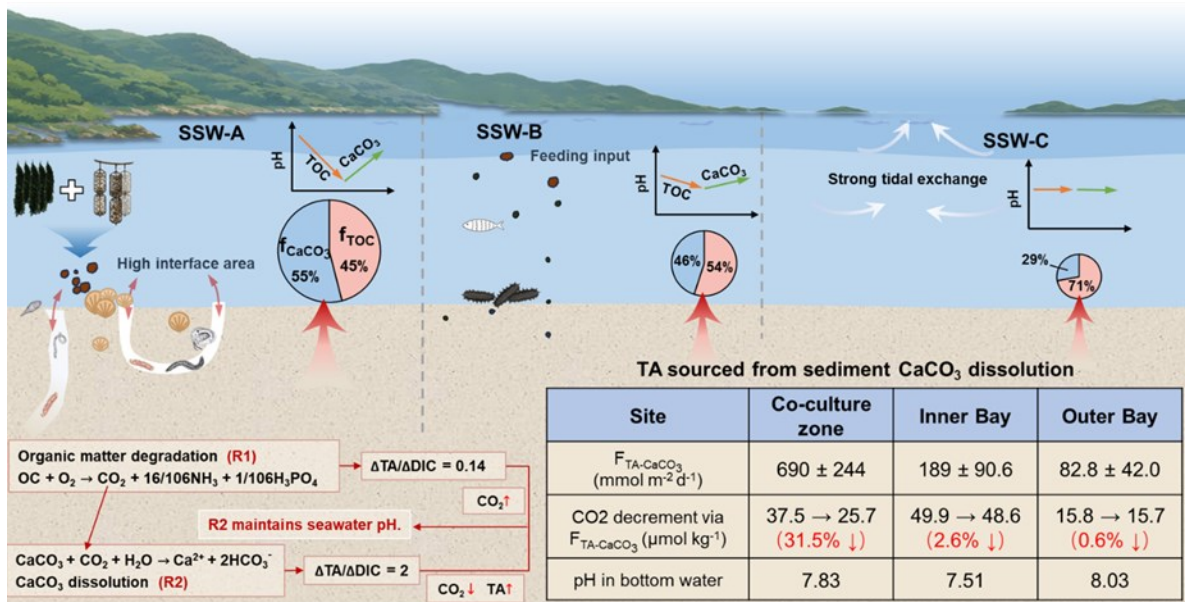


Figure 8: Conceptual diagram illustrating the mechanism of benthic processes regulating the benthic effluxes of DIC and TA in Sansha Bay. The DIC flux is presented with pie charts, of which the size indicates the proportion and the colors show the contributions of different processes (CaCO_3 dissolution in blue and TOC degradation in red). The axial pH graphs indicate the influences of benthic processes on water column. The inserted table specifies the TA contributed by CaCO_3 dissolution ($F_{\text{TA-CaCO}_3}$) and its effectiveness in buffering the carbonate system of the bay seawater.

4. How do productivity and water residence time affect the results of this study? Are the findings applicable to other environments? For example, would similar effects be expected in high-latitude or low-productivity regions? The applicability and limitations of the findings should be more clearly described and discussed.

In this study, we focus on the sources of benthic effluxes of DIC and TA so we would like to discuss the factors affecting the sediment processes directly. Generally high productivity means high organic carbon accumulation, i.e. high TOC concentration, in sediments. But in maricultural zones, there are multiple sources of sediment organic carbon other than primary production, like feeding, terrestrial inputs, feces, etc. As we did not quantify the carbon budget for the whole system, it's hard to recognize the influence of productivity on benthic effluxes based on the available data.

Table 2 shows that the residence time at SSW-A is the highest and that at SSW-C is the lowest. This pattern seems to match well with the variation of effluxes and CaCO_3 proportions: higher residence time of water column could lead to higher benthic effluxes and more CaCO_3 dissolution. But water residence time is an indirect factor on benthic processes. In comparison, the hydrodynamics, the disturbance by benthos and seafloor

topography are direct influencers on benthic exchanges. Therefore, the interfacial area enhancement was introduced to illuminate the influence.

The reference (Natividad et al., 2026) shows a good example of a clear quantification framework, and reminds us of identifying the role of sediment. In the revised MS, we demonstrated that the benthic flux cannot promote the carbonate buffering according to the $\Delta\text{TA}/\Delta\text{DIC}$ induced from the sediment release. But the role of CaCO_3 dissolution was highlighted and suggested that this process can occur in coastal zones (lines 544-548). The limitation on the TA-source estimate was also addressed (lines 548-560). At present, given that the study sites were located in a mariculture region, we still need more research to support the extrapolation. In the future, we are about to carry out similar work in other estuarine or polar zones to check the applicability.