

Interactive Comment by M. Murrell

We appreciate the short Interactive Comment provided by M. Murrell. The implications of our nutrient budgets should be applicable to estuaries in other geographic locations. To that effect, we consulted with an original LOICZ creator (D. Swaney) who provided some new articles summarizing LOICZ results across many estuaries. For the updated manuscript, we plan to eliminate redundancy of Results and review the study implications in light of the integrated findings from these summary articles to broaden the Discussion. Additionally, we have derived a summary table that compares and contrasts the two estuaries for a number of attributes (size, geomorphology, discharge, salinity, nutrients, LOICZ indicators). The updated manuscript is undergoing general edits to streamline and clarify the Results.

Interactive Comment by Anonymous Reviewer #1 (AR1)

Thanks to AR1 for acknowledging the efforts and value associated with our submission to *Biogeosciences*. We appreciate the review and recommendation for publication after moderate revisions.

- (1) This is a good suggestion given the international nature of *Biogeosciences*. As mentioned in response to comments provided by M. Murrell, the updated manuscript will provide broader implications of the study that should increase relevance for a wider audience.
- (2) AR1 is correct in their categorization of the LOICZ method as a mass-balance biogeochemical budget technique. The term “model” was adopted based on other published efforts (the LOICZ Biogeochemical Model or LBM; Giordani et al., 2008). We are amenable to changing the terminology but suggest that the method is a model except that it provides a static rather than dynamic representation of reality. In fact, a recent LOICZ review by Swaney et al. (2011) was entitled “The LOICZ Biogeochemical Modeling Protocol and its Application to Estuarine Ecosystems (In: *Estuarine and Coastal Ecosystem Modeling*, Baird, D., Mehta, A. eds. Chapter 9, pp. 135-159). We are unclear about AR1 comments on p. 2379 about the LOICZ approach.
- (3) We agree that Section 2.2 has been presented elsewhere (e.g. Gordon et al. 1996). The conceptual model and equations were provided for consistency with other LOICZ publications which included the formulations. This description will be omitted in the updated manuscript and replaced with additional references (Smith et al. 2005, C,N,P fluxes in the coastal zone, In: Crossland, et al. (eds) *Coastal Fluxes in the Anthropocene*; Swaney et al. 2011).
- (4) We greatly appreciate the comments regarding Section 2.3. This information was difficult to present in a way that was both comprehensive and concise for the reader. We have generated new maps showing coded sampling locations for the variety of data sources used in the LOICZ budgets. The updated manuscript will include a re-write of this section where data derivation and sources of information will be clearer for a broader audience. The new maps, Table 2, and the text description will be cross-referenced to provide a concise and specific synopsis of the data used in budget development.
- (5) It is very easy to increase the font size on the equations and axes in all graphics.

General edits

- p. 2378, Line 10: Biogeochemical model will not be capitalized and parentheses for DIN and DIP will be removed.
- p. 2379, Line 21: “Increased” will be added before “inorganic nutrient loading”.
- p. 2380, Line 6-7: The reference to Giordani et al. 2008 will be replaced with Swaney et al. 2011.
- p. 2381, Lines 6-14: We will include references describing the history of the St. Lucie estuary.

Interactive Comment by Anonymous Reviewer #2 (AR2)**Abstract**

We will edit the opening sentences following suggestions by AR2.

As mentioned previously, parentheses around DIN and DIP (pg. 2378 Line 10) will be removed.

The sentence describing the cyanobacteria bloom (pg. 2387 Line 16-18) will be edited.

Introduction

The sentence about south Florida estuaries will be edited (pg. 2379 Line 13).

Methods

The second paragraph (pg. 2381 Lines 9-14) will be edited using suggestions from AR2.

“And removed” will be omitted from text (pg. 2381 Line 28).

As mentioned, section 2.2 describing the LOICZ method will change in the updated manuscript. This section will rely upon previously published efforts detailing the conceptual and mathematical basis for LOICZ (Gordon et al. 1996; Smith et al. 2006; Giordani et al. 2008; Swaney et al. 2011). AR2 was correct that we overlooked the role of evaporation (pg. 2382 Line 18). While an entry in the LOICZ spreadsheets, in the absence of any data to estimate this hydrologic process, we assumed that evaporation was negligible at the estuary scale.

The LOICZ budget is based on the steady-state assumption over the time frame of interest (pg. 2383 Line 1-2). We discussed this caveat when beginning this study and readily acknowledge that C, N, P processes are probably not in steady-state on hourly to weekly time scales. However, source and sink processes should be balanced in static budgets that contrast wet vs. dry seasons over 7 different water years. Thus, we feel that both the steady-state assumption and therefore the implementation of LOICZ were justified given the study goals.

It is very easy to change the unit reference from mg L^{-1} to g m^{-3} (pg. 2383 Line 8).

AR2 is correct with their knowledge of microbially mediated cycling of N_2 between the atmosphere and estuary (pg. 2383 Line 20). However, the entire LOICZ approach was based on nutrient concentrations and elemental stoichiometry. This approach is valuable because it permits flexibility in situations when there are little available measurements of C-N-P rate processes. It provides an estimate of the relative difference between nitrogen fixation and denitrification based on these assumptions when empirically derived rate processes are lacking.

The present structure of sentence describing the downstream salinity values among the two estuaries is confusing (pg. 2385 Line 4-8). It will be simplified and clarified in the updated manuscript.

Suggested grammatical changes on pg. 2387-2388 will be incorporated into the updated manuscript.

Discussion

As mentioned, the Discussion will be re-visited to reduce redundancy with the Results and focus on the implications of the study in a broader context.

The suggested grammatical and form edits will be incorporated into pg. 2390.

We do not think that increased internal DIN production with increased external DIN loading to the CRE was caused by N-fixation (pg. 2390 Line 16). Rather, the text will be altered to explain that external loading to the CRE stimulates the production and remineralization of autochthonous organic matter. This is in contrast to the responses of the SLE to external DIN and DIP loading.

The paragraph about DIP in the CRE will be edited following the suggestions of AR2 (pg. 2391 Lines 3-11). We plan to clarify explanation of the climatic modulation of DIP concentrations in this estuary, and, emphasize the importance of increased flushing time relative to external nutrient loading.

As mentioned, we plan to introduce a simple table to compare attributes of the two estuaries. This table will be used to elaborate on St. Lucie anthropogenic characteristics and responses to external nutrient loading (pg. 2391 Lines 25-30).

The text will be edited on pg. 2392 to emphasize the importance of hydrodynamic flushing (Line 12) and specify water quality impacts on the St. Lucie Estuary (Line 18).

The first paragraph on pg. 2393 (Lines 1-10) will be edited to improve clarity. AR2 was correct that the sentence was confusing, that *Microcystis* does not fix nitrogen, and it can bloom when DIN and DIP supplies increase.