

## ***Interactive comment on “Anomalies in the Carbonate System of Red Sea Coastal Habitats” by Kimberlee Baldry et al.***

**Anonymous Referee #2**

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General comments: In this paper, Baldry et al. combine carbon measurements from the open ocean and east coastal areas in the Red Sea to model ecosystem-driven changes on the carbon system of coral reefs, mangrove forest, and seagrass meadows. In this region, oceanographic studies in general as well as carbon and ecosystem studies are heavily underrepresented, despite its extreme conditions regarding hydrography and vulnerable ecosystems. The paper by Baldry et al. represent an important contribution to the biogeochemical research from the Red Sea, and by using novel data, historical data, and a model tool, they increase our knowledge about driving forces for coastal ecosystems.

More specific comments: The word “trend” is used but the word refers to change over time, and you do not use the word this way. As I understand, you simply mean linear

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relationship between e.g. offshore salinity and distance from a point in the southern Red Sea, or alkalinity and the mentioned distance.

Every now and then you put up statements and explain them later in the manuscript, e.g. P2, L22 about linear trends, P4, L18 where you introduce D without explaining it until later in the text. I encourage you to gather the statement and explanation, to make the reading easier.

You refer to numerous interesting papers, please include a separation between “;” and the following author name. This comment is valid for the whole paper. E.g. L 28: (Bauer et al., 2013; Camp et al., 2016; Cyronak et al., 2018; Gattuso et al., 1998; Guannel et al., 2016; Unsworth et al., 2012) – here I have added space.

You discuss several limitations with the single-end-member model, but you actually did choose this model. Please add an argument stating why, despite all its limitations, you made this decision.

You use the words strong or weak linear increase when you actually mean high or low  $r^2$ . Just be aware that strong/weak linear increase might also be understood as a line with high or low slope.

Detailed comments: P1 L16: you introduce the word “trend”, which refer to change over time. But this is not what you mean, right? Rather use “linear relationship”

P2 L11: I suggest a more direct language: As such, these non-conservative changes can be measured as anomalies from the carbonate system which has experienced conservative mixing. L22: You state “The linear trend in offshore carbonate system concentrations...” without explaining or showing what you mean by this. Again, I suspect that you mean simply linear relationship and not trend. L23: suggest to not use the word “norm” but only “expected conservative behaviour”

P3 L27: second last word: switch “a” with “an” L27: please add if this method also use non-linear curve fitting L29: add full address of Dr. A. Dickson the first time he

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is mentioned L35: which type of CTD is used L36: I guess you used a plastic tube to transfer the water from the water samples to the glass bottle?

P4 L1: add reference for VINDTA-3C L11: references for long-term changes: it seems like you have older refs than Steiner et al. 2018, please add L17: add the word “observed” so the sentence reads “describing the linear variations of observed S, TA and DIC ...” L19: define D here (distance from a defined zero point in the southern Red Sea) L19: explain difference between observed S, TA and DIC and predictions of  $S_o$ ,  $Tao$ , and  $DIC_o$  (both along the north south axis). Why don't you use observed offshore values in Eq 1 and 2? L31: “All other open waters” means 200m < transition < coastal? And would you please define coastal?

P5 L2: what is an “observed estimate” L6: to ensure clarity, add “coastal” to “observed TA and observed DIC” L18: change “two-end-member” with “single-end-member” L20: as above L29: suggest changing “linear trends with D for S ... variables” with “how S, temperature and carbonate variables vary along the central axis from south to north”. L30: add “to” between the words “used investigate”

P7 L3: suggest a simpler language: “The offshore carbonate system of the Red Sea was characterized along the south-north ...”. L4: suggest “Offshore waters exhibited significant and strong (high  $r^2$ ) linear increase in S ...”. This sequence of words should be use all over, because the words “strong” or “weak” are connected to the linearity and only indirectly to significance. L6, L9, L10, L11: as above Are the strong/weak linear trend values summarized in a Table? If so, this should be announced early in paragraph 3.1. L32: you describe the “Coastal observations”, but then the word “central axis” should be exchanged with something else, since the coast is not along the central axis. Maybe just use “from south to north”. L37: change “end-member” with “waters”

P8 L7, L10, L14, L18, L19, L22 and more: as above. In general, I advise you to not use “end-member” when you mean “waters”. It is just confusing. L31: do you really mean “trend”, if so, over which time. If not, change with “linear relationship”

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P9 L15: you are comparing to a “norm”, are you referring to anomalies (P2, L12) or expected conservative behaviour (P2, L23)? L18: as above L22: delete “norm or” L24 and 25 and the rest of this and next paragraphs: use other words for “norm”

P10 L15: you write “seasonal trend”, do you actual mean “seasonal variation”? If so, change all over P21 L5: change “The latitude at which time series stations are at is indicated by the text “Ts”” with “Time series stations are indicated as TS”. Refer to Figure S1 in the figure text

P22, Figure 2: define  $O_i$  earlier in figure text. L7: change “estimate” with “determine” L9: after “central axis at distance  $D_i$ ” add “from a fixed reference point in the southern Red Sea”

P23, Figure 3: L3: suggest text “ Offshore observations of S, T and carbon variables (left) and four coastal ...”

P24, Figure 4: L3: change “end-members” with “waters” L4: after “included” add “in the”

P26, Figure 6: A, B, C, D, AB, BC, CD are not explained

Table S2: in the footnote you use a \* as a multiplicator, this is confusing since the same sign is used as footnote numbering. Please change Table S3 and S4: please include units where you can (T, TA, DIC,  $pCO_2$  etc). Table S4: change title from “By Habitat descriptive statistics for carbon variable habitat groups for all coastal ...” to “Descriptive statistics for carbon variable habitat groups for all coastal ...” Table S5: add units where feasible Table S7: as above

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### C4