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Interactive comment on "The postmonsoon carbon biogeochemistry of estuaries under different levels of anthropogenic impacts" *by* Manab Kumar Dutta et al.

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Comment : In the present study, large spatial extent has been covered which includes Hooghly River and other rivers of Indian part of Sundarban. My comments regarding the present study are as follows: 1. From the sampling strategy (line no. 150 to 153), it is apparent that only one-time discrete sampling has been done in all the sites in duplicate, whereas from the third objective of the study it is clear that the authors had the aim to quantify and characterise the air-water CO2 flux for the post-monsoon season. The authors concluded "During post monsoon, the entire Hooghly-Sundarbans system acted as a source of CO2 to the regional atmosphere." How can it be concluded

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(even quali-tatively) from such discrete data without performing at least one complete diurnal sampling at each site within post-monsoon season, while four months (October, November, December and January) are generally considered as post monsoon season in this region?

Response: As we have stated in response to the reviewer 1, the aim of the present study is to decipher the contrast in different components of C cycle of anthropogenically affected Hooghly estuary and mangrove-dominated Sundarbans. While it would normally be ideal to have both large spatial and temporal coverage including measurements of several parameters along with their isotopic compositions to decipher the same, it is rarely possible due to severe logistics and technical limitations at different levels. We are sure, working in this region, you are aware of that. As we have said in response to reviewer 1, there is only one location in the Sundarbans so far (Ray et al., 2018) from where measurements for all components of C exists. We have strived to make it more representative by larger spatial coverage. We are also aware that four months are generally considered as postmonsoon; however, in light of the limitations mentioned above and advantage of spatial coverage, the conclusions of the present study can be considered as representative of the postmonsoon. Moreover, in the comment below, you are stating that one of the findings of the present study is similar to the one you observed, i.e., both Hooghly and Sundarbans are source of CO2 to the regional atmosphere. Although your findings on Sundarbans remains limited only to Matla estuary, which can hardly be representative of the vast Sundarbans. Compared to that, the present data set is better placed to represent Sundarbans.

Comment: The study area and sampling locations are quite similar with the recent work of Akhand et al. (2016). Moreover, the third objective and one of the conclusions of the present study is also very similar to the Akhand et al. (2016). For example, the authors stated, “The entire Hooghly-Sundarbans system acted as source of CO2 to the regional atmosphere with 17 times higher emission from the Hooghly compared to Sundarbans”, whereas one of the key findings of Akhand et al. (2016) is “River

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dominated Hugli Estuary emits 14 times more CO2 than the marine-dominated Matla Estuary". Surprisingly, despite of such degree of similarity between two studies, there is no comparison of data with Akhand et al. (2016) and not even mentioning of Akhand et al. (2016) in the present work.

Response: We are familiar of Akhand et al. (2016), which deals with CO2 dynamics in the Hooghly-Sundarbans, especially diurnal observation in Matla estuary. We appreciate your effort in performing 24 hours measurements in this turbulence estuary of the Indian Sundarbans. Akhand et al. (2016) covered four locations in the lower Hooghly estuary and 3 locations from Matla estuary; whereas we covered 13 locations from Hooghly and 11 locations from the Sundarbans including all major estuaries of the Indian Sundarbans (Saptamukhi, Thakuran and Matla) and their related waterways. Given the disparity in sampling designs and locations direct data comparison between these two studies will not be ideal. However, we would be happy to include the said study in the introduction section a recent work on Hooghly-Sundarbans system.

Comment: Reviewer 2 already mentioned that line no. 455 to 460 are self-contradictory. I want to add that I agree with the authors statement that in the estuarine water of Sundarban, an important source of CO2 is mangrove sediment pore-water exchange during tidal pumping. This fact is also well established from the diurnal dataset of Akhand et al. (2013) and Akhand et al. (2016) in Sundarban. But, it is not clear to me, how this phenomenon can prove the exogenous origin of CO2?

Response: We will be happy to include the above references to support our statement in the revised manuscript. "Exogenous" means outside the estuary not outside the mangrove ecosystem. We will clarify it in the revised manuscript. For Sundarbans, "Exogenous" CH4 is already established and for more details please see Dutta et al. (2015) published in Marine Chemistry.

Comment: Moreover, except Hooghly and its distributary Muriganga, all other rivers (Saptamukhi, Thakuran, Matla, Gosaba and Bidya) in the Indian part of Sundarban

have lost their original connections with the Ganga because of siltation and their estuarine character is now maintained by the monsoonal runoff only (Cole and Vaidyaraman, 1966). So, the central part of Sundarban (which comprises a major part of Indian Sundarban) experiences lack of freshwater (Chakrabarti1998; Mitra et al. 2009). Hence, the source of the exogenous nature of CO2 input in the Indian part of Sundarban needs more clarifications.

Response: It is obvious that compared to Hooghly, the estuaries of Sundarbans lack freshwater. However, it does not appear to be completely cut off from the source as can be seen from salinity range (salinity: 12.74-16.69) during the study period. However, no correlation between pCO2 and salinity ruled out significant role of freshwater contribution on CO2 of the estuary. The sources of CO2 in the Sundarbans include in situ OM respiration along with possibility of supply through pore water exchange during tidal pumping (so called exogenous with respect to estuary). Following reviewer-2 suggestion, analysis of ECO2-AOU relationship indicated CO2 production by OM respiration in the Sundarbans during the study period. Unfortunately, our dataset is not sufficient to prove exogenous supply of CO2 through pore-water. We may use Akhand et al. (2013) and Akhand et al. (2016) in the revised manuscript to support the argument.

Comment: In line no. 479 to 481 authors stated "FCO2 measured for the estuaries of Sundarbans was markedly higher than global mean FCO2 (âĄŞ63 μmol m-2 d-1) observed in mangrove creek and other similar estuaries (Call et al., 2015)". Reviewer 2 already correctly identified that the value should be 63 m mol m-2d-1. It might be a typo by the authors, but it may convey wrong message to the global audience about Sundarban's mangrove surrounding water. Because, one of the key findings of Akhand et al. (2016) is that the fCO2 (water) value of the Matla, a mangrove dominated estuary of Sundarban, is at the lower end of the reported data from other mangrove ecosystems of the world. Biswas et al. (2004) also found that the Sundarban's mangrove dominated water is acting as a sink for atmospheric CO2 for all the four post monsoon months,

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while sampling in the three river-mouths. Also see Rosentreter et al. (2018), where they estimated world average flux of âĄŞ57.5 mmol m-2 d-1 of CO2 from the mangrove surrounding water, and also commented that the CO2 efflux from the estuarine water of Sundarban is much lower side than the world average even sinks for atmospheric CO2 in some cases.

Response: We are thankful to the reviewer -2 for pointing this out. After getting his comment we have rechecked the values with Call et al. (2015) and responded so in response to him. We believe that you are stretching it a bit too far for an unintentional typo in a manuscript undergoing peer-review process. As you said “It might be a typo by the authors..”. It was just that.

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J.A., Maher, D.T., Erler, D.V., Murray, R. and Eyre, B.D., 2018. Seasonal and temporal CO2 dynamics in three tropical mangrove creeks–A revision of global mangrove CO2 emissions. Geochimica et Cosmochimica Acta, 222, pp.729-745.

Response: We will be happy to include some of the references in the revised manu

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