

Reviewers comment

This paper presents a hard work from the extensive field coverage of 27 Indian monsoonal estuaries twice during the discharge period of two different years. In the growing concern of climate change when many of the biophysical and biogeochemical models are suffering from the lack of data sets from the tropical rivers, I am sure this paper once published will significantly fill that gap and heavily used by many researchers.

Author's response

Thank you very much

Reviewers comment

However, the manuscript requires to provide clarity and corrections on certain issues before it is published.

Author's response

The manuscript will be revised to improve the clarity as per your suggestions/comments

Reviewers comment

The DIC concentrations and fluxes are influenced by the rainfall variability among the four regions, the discussion will be benefited if it starts with this information.

Author's response

Yes. Concentration and fluxes of riverine DIC are strongly influenced by the variability in rainfall over catchment of the river (region). This information will be provided in the initial part of the discussion during restructuring the discussion part of the manuscript.

Reviewers comment

From Figure 1, it is apparent that many of the east flowing rivers, especially in the central and southern regions, are sourced from the western catchments but none in the vice versa direction. This is important and highlighted because high rainfall SW regions have less discharge and DIC fluxes but much of this rainfall might be sourcing the less rain fed SE rivers and contribute to high DIC fluxes. I strongly suggest the authors to include a Table of all rivers sampled (grouped into four regions) with details of their size-class (large and medium), catchment size, length of the river, soil organic carbon, discharge rate, mean DIC concentration, export flux, yield, etc. for better utilizing the hard work of this study by scientific community.

Author's response

A table containing the information of all rivers including their size-class (large and medium), catchment area, length of the river, soil organic carbon, discharge rate, mean DIC concentration, export flux, yield, etc will be provided as suggested by you (and also the Reviewer 1)

Reviewers comment

Many of the statements are repeated throughout the manuscript which makes it length, for example, parts of section 4.2 and 4.4 carry some common information. Restructuring of discussion by appropriately merging relevant subsections will improve the focus and clarity.

Author's response

The manuscript will be restructured to avoid repetitions and to increase the focus and clarity of the manuscript. Reviewer 1 also suggested to re-structure the manuscript to avoid some repetitions.

Reviewers comment

Number of figures can also be minimized, for example, merge figs.4 & 5 and 6 &7.

Author's response

Figures 4&5 and 6&7 will be merged as you suggested

Reviewers comment

The manuscript requires thorough editing for English grammar for better reading.

Author's response

The revised manuscript will be proof read by the English language expert

Specific Comments:

Reviewers comment

Line 43: delete 'about'.

Author's response

'about' will be deleted.

Reviewers comment

Line 54: it is an obvious statement, delete.

Author's response

The sentence will be deleted

Reviewers comment

Lines 55-57: how much increase? Specify 'Mississippi river'.

Author's response

As per Ren et al., (2015) the total increase in DIC export throughout the 21st century from the Mississippi River to Gulf of Mexico would be over 90% due to the combined effect of climate-related changes along with rising atmospheric CO₂. This will be mentioned in the revised manuscript to obtain clarity.

Reviewers comment

Lines 76-81: include carbon studies from Gupta et al. (2008) in the Chilka lake, a brackish water estuarine system. Also, include Bhavya et al. (2018) for Cochin estuary.

Author's response

Chilka lake (Gupta et al., 2008) and Cochin estuary (Bhavya et al., 2018) studies will be included

Reviewers comment

Lines 81-82: Carbon export fluxes from the Chilka lake (Gupta et al., 2008) and Cochin estuary (Gupta et al., 2009) on east and west coast of India respectively were earlier reported.

Author's response

A sentence “Carbon export fluxes from the Chilka lake (Gupta et al., 2008) and Cochin estuary (Gupta et al., 2009) on east and west coast of India respectively were earlier reported” will be added here (L 81-82) as you suggested.

Reviewers comment

Lines 95-102 & 120-124: Too big sentences.

Author's response

These sentences will be modified.

Reviewers comment

Lines 132-134: Year 2011 was a normal monsoon year but 2014 was an El-Nino year.

Author's response

The mean values of normal monsoon and weak monsoon (El Nino) provides better mean concentrations rather than the mean of two normal monsoon years (expected to be higher side than long term mean) or two weak monsoon years (expected to be lower than long term mean). Therefore, field sampling in this study was conducted one during normal monsoon year and the other during weak monsoon year

Reviewers comment

Please comment or speculate the variability in light of having used discharge data of earlier years from the published literature. Authors may refer to Indian Annual Rainfall Statistics reports available online at www.imd.gov.in.

Author's response

We will consider the Annual Rainfall Statistics report from IMD, New Delhi for discharge data.

Reviewers comment

Lines 134-137: These are contradicting the statements made at lines 130-131.

Author's response

Lines 130-131 mean to say that it is from starting point (origin) to ending point (estuary) of the river, i.e. entire length of the river; whereas Line 134-137 means that it is the length of the estuary (upper and lower estuaries) but not the entire length of the river. However, these sentences will be modified to obtain clarity.

Reviewers comment

Line 139: replace was with ‘were’.

Author's response

Sorry for the mistake. ‘was’ will be replaced with ‘were’

Reviewers comment

Line 174: specify the source of catchment area.

Author's response

Source of the catchment area will be provided.

Reviewers comment

Lines 185-186: give mean \pm SD values.

Author's response

Mean \pm SD values will be provided

Reviewers comment

Lines 207-208: delete 'by the Indian monsoonal rivers'.

Author's response

'by the Indian monsoonal rivers' will be deleted as you suggested

Reviewers comment

Lines 216-17: repeated statement

Author's response

The repeated statement will be deleted

Reviewers comment

Lines 250-254: Provide full details in a Table for better usage of this work by many researchers.

Author's response

A table will be provided with complete details as mentioned above

Reviewers comment

Line 256: Include Gupta et al., 2008 for Chilka lake. Bhavya et al. 2016 covers only dry season (postmonsoon), replace it with Bhavya et al. 2018 for all seasons.

Author's response

Gupta et al., 2008 will be included for Chilka lake. Bhavya et al., 2016 will be replaced with Bhavya et al., 2018.

Reviewers comment

Lines 260-262: Rather relationship with TOC (DOC+POC) is better.

Author's response

The relationship with TOC will be examined and will be provided as you suggested.

Reviewers comment

Lines 282-286: It seems this ground water regional variation is following the variability of DIC in the regional estuaries. Does this mean the cause factors for DIC variation are also applicable for its variation in the ground water? Please make a statement on this.

Author's response

Since ground waters are one of the important sources of DIC in estuaries, it is possible that ground water DIC concentrations will have significant impact on DIC concentrations in estuaries. However, due to the influence of other factors such as hydrology, lithology and environmental characteristics of the catchment on DIC concentrations in estuaries, it is very difficult to make a statement that only ground water is the cause factor for variability of DIC concentrations in estuaries.

Reviewers comment

Line 285: provide units for all the values.

Author's response

Units will be provided for all the values as you suggested

Reviewers comment

Lines 286-289: Grammatically sentence not correct.

Author's response

The sentence will be corrected

Reviewers comment

Lines 304-307: Please comment, if not speculate, on whether these soil characteristics are limited only to surface or extended to the vertical strata as well, which can give an insight into whether the source of low DIC in these surface and ground waters are same or different.

Author's response

We considered the characteristics (lithology) of only surface rocks/soils in the catchment area of the river/region from soil maps of India available in literature. We have not discussed the vertical strata of the rocks/soils. It is possible that vertical strata of the rocks could have influenced the low DIC concentrations in ground waters of the SW region. However, we have not focussed on the reasons for spatial variability in ground water DIC concentration as it is not the scope of this study.

Reviewers comment

Lines 310-312: Weathering rates may be high due to highest precipitation but DIC flux from the weathering of lateritic soils to the SW estuaries (refer lines 304-307) could have been far lower than other regions.

Author's response

DIC concentrations and export flux are far lower in the SW region than the other regions and it could be due to, at least partly, the dominance of lateritic soils in the catchment of SW rivers. However, the dense rainfall over the SW region increases the scouring of DIC from soils and therefore causes elevated yield of DIC (DIC export per unit area of catchment) from SW rivers.

Reviewers comment

Lines 316-318: better integrate these with statements made at lines 365-471 and attribute to intense precipitation, presence of less weathering lateritic soils and soil organic carbon.

Author's response

This will be corrected and statements will be integrated during re-structuring the discussion part of the manuscript.

Reviewers comment

Lines 325-330: both the statements correspond to the weathering but the contribution of $\delta^{13}\text{C}$ values were differently reported. Pls check.

Author's response

Though, both the statements correspond to weathering of rocks, the resulted $\delta^{13}\text{C}$ of DIC is different. This is because the $\delta^{13}\text{C}$ of carbonic acid formed by dissolution of soil CO_2 is different from that of the $\delta^{13}\text{C}$ of carbonic acid formed by dissolution of atmospheric CO_2 . However, this will be mentioned in the text for clarity during revision.

Reviewers comment

Lines 352-355: Repetition of statements at lines 326-330 but with clarity here. Avoid repetition.

Author's response

Repeated sentences will be deleted

Reviewers comment

Lines 395-396: Are these discharge per day or year?

Author's response

These discharges are per year. This will be mentioned in the text for clarity during revision.

Reviewers comment

Line 401: Relatively higher export fluxes..... compared to what?

Author's response

It is compared to global rivers. The sentence will be modified to obtain clarity.

Reviewers comment

Line 405: When combined.....with DIC export flux?

Author's response

'with DIC export flux' will be added after 'When combined' at Line 405 as you suggested.

Reviewers comment

Lines 424-425: SW region is having highest rainfall but lowest discharge rate from smallest catchment area. If so, large amount of rainfall might be happening over the non-catchment area. What would be the fate of this? Please discuss on the possibility of its seeping into the ground water and its contribution of DIC flux to the SW coast of India, its relativity with respect to surface flux?

Author's response

The density of rainfall is high in the SW than the other regions of India. However, lower river discharge from the SW rivers is mainly due to small catchment area of the SW rivers than the other peninsular rivers. Though we have discussed the influence of ground water DIC concentrations on the export flux and yield of DIC from the Indian peninsular rivers, we could not quantify the ground water DIC flux to the coastal waters (Arabian Sea and Bay of Bengal) and their contribution to surface DIC export flux as we have not determined the ground water exchange rates, which is not within the scope of the present study.

Reviewers comment

Lines 432-433: include -ve sign for the r^2 values for having the negative relationships.

Author's response

Negative sign '-' will be given for the r^2 value, if the relationship is inverse.

Reviewers comment

Lines 441-442: Reference to the comment for lines 424-425. Does low DIC concentration in the ground water of SW region is also due to high dilution rate and possible lateritic soil strata? Please comment on what would be the ground water discharge rate and its associated DIC export flux to the SW coastal AS compared to the other regions.

Author's response

This comment is similar to the comment made above. Low DIC concentration in the ground waters of SW region could also be due to high dilution and different soil characteristics (lithology). Though we have discussed the influence of ground water DIC concentrations on the export flux and yield of DIC from the Indian peninsular rivers, we could not quantify the ground water DIC flux to the coastal waters (Arabian Sea and Bay of Bengal) and their contribution to surface DIC export flux as we have not determined the ground water exchange rates, which is not within the scope of the present study.

Reviewers comment

Line 469: soil organic carbon content....what is the source for this data?

Author's response

Soil organic carbon data has taken from *Kishwan et al., 2009* and *Sreenivas et al., 2016*. This will be mentioned clearly in the revised manuscript.

Reviewers comment

Suggested Literature:

1. Bhavya, P.S., Sanjeev Kumar, Gupta, G.V.M., Sudharma, K.V., Sudheesh, V. (2018). Spatio-temporal variation in $\delta^{13}C_{DIC}$ of a tropical eutrophic estuary (Cochin estuary, India) and adjacent Arabian Sea. *Continental Shelf Research*, 153, 75-85, doi: 10.1016/j.csr.2017.12.006.
2. Gupta, G.V.M., Sarma, V.V.S.S., Robin, R.S., Raman, A.V., Jai Kumar, M., Rakesh, M. and Subramanian, B.R (2008). Influence of net ecosystem metabolism in transferring riverine

organic carbon to atmospheric CO₂ in a tropical coastal lagoon (Chilka Lake, India).
Biogeochemistry, 87: 265-285, doi:10.1007/s10533-008-9183-x

Author's response

These two reference will be cited as you suggested for Cochin estuary and Chilka lake respectively.