Biogeosciences Discussions

Biogeosciences Discuss., author comment AC1
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Reply on RC1

Raghab Ray et al.

Author comment on "Sedimentary blue carbon dynamics based on chronosequential observations in a tropical restored mangrove forest" by Raghab Ray et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2021-359-AC1, 2022

This is an interesting and relevant study that applies a chrono-sequence approach to study carbon accumulation in relation to time since mangrove restoration. The study reports that, based on isotopic signatures, the contribution of mangrove plant material was higher at older sites while younger sites have a higher contribution from riverine inputs. In general the paper is nicely written and uses standard physico-chemical analysis.

My concern is that the sample size is very limited; only 5 cores were used to study the chrono-sequence and no replicate cores were taken. I would agree that this can show some trends and differences between the ages, but a robust statistical quantification or test of the hypothesis is challenging. The study does not report results of statistical tests or uncertainty ranges. In short, I found it difficult to understand heterogeneity and uncertainty and this is really important as it defines the limits of interpretations. In my opinion, the authors should address this basic but critical issue.

Reply; Thank you for valuable suggestion regarding statistical validation with uncertainty range. In the revised ms, the 95% confidence interval was added for the Age – C stock relationship (Fig. 8). The results were slightly changed since the previous regression based on exponential function was done with a log-transformation of independent variable, which was not suitable for the comparison with a linear function model. In the present study, the exponential function model was fitted using nonlinear least square method with nls function of R and 95% confidence interval was added using predFit function of investr package of R. Conclusion was not changed but the uncertainty range of the model analysis has been clearly shown in the current ms. Furthermore, MixSIAR model enables to produce uncertainty ranges in contribution % of different end member to OC sources which is another very vital aspect of this research.

Figure 8: a) The relationship between mangrove age (*Age*) and carbon stock (*OC*), where the curve was drawn based on an exponential function model in Eq. 2: $OC = 171.07\exp(0.03558*Age)$, $R^2 = 0.9873$. The gray band means 95% confidence interval. (b) The relatioinship between mangrove age and carbon accumulation rate (CAR) on the basis of the exponential model (see Eq. 3).

Line 78: could use an additional sentence that links problem statement with hypothesis

Reply: A new sentences on problem statement is added

In this study, we address the question about how chrono-sequential observation in a restored mangrove forest could guide us achieving improved scientific understanding on C sources, stocks and to monitor the changes in accumulation rate at the early development stage and adult stages.

Line 127: This seasonal collection doesn't match with what is shown in Figure 1 and Figure 8(ie BS but not YM?) Please check

Reply: Thank you for the comment. The text is corrected as

A total of 8 cores were retrieved during the survey period with seasonal collection made at BS, AM, and MM site (dry and wet, total cores 6) and wet season collection from PM and YM site (one each).

Line 227: Are this mean values for the whole core? If so, add this to the figure caption.

Figure 2 caption has been edited by mentioning (mean±SD**)**

Line 400+: Consider adding an overview table where you summarize literature and your own data

Reply: Thank you for the recommendation. As proposed, a new table on comparative stock (Mg C ha^{-1})and organic carbon loading (µmol C m^{-2}) has been provided.

Table 2. Comparative results on carbon stock (Mg C ha^{-1}) in restored mangroves of known ages, and organic carbon loading (µmol C m^{-2}) in mangrove with other marine settings.

Location	Age (year)	Dominant species	Soil C stock Mg C ha^{-1}	OC loading µmol C m^{-2}	Reference
Philippines, Panay					
Bakhanwan EP	0	No vegetation	3.1-24.3	4-58	This study
Bare sediment					
Pioneer	0.25	*Avicennia marina,*	21.4	-	This study

		Rhizophora spp			
Young	10	*Rhizophora apiculata*	23.1	-	This study
Adult	20	*Rhizophora apiculata*	36.9-46.4	42-148	This study
Mature	30	*Rhizophora apiculata*	61.3-93.5	68-380	This study
Planted	-	*Rhizophora sp.*	-	310-1140	Unpublished data, Miyajima et al.
Naturally recovered	-	*Avicennia Rumphiana*	-	57-640	Unpublished data, Miyajima et al.
North-central Vietnam	0 - 27	*Kandelia obovata*	54 - 84	-	Van Hieu et al., 2017
Pichavaram, India	12-21	*Rhizophora spp*	41-94	-	Gnanamoorthy et al., 2019
Bhitarkanika, India	5	*Kandelia candel*	38	-	Bhomia et al., 2016

Sulawesi, Indonesia	>10	*Rhizophora apiculata*	150-300	-	Cameron et al., 2019
Continental margin	-	-	-	40-80	Mayer, 1994
Vegetated marine sediment	-	-	-	56-67	Miyajima and Hamaguchi, 2017
Floodplain	-	-	-	16-42	Goni et al., 2014

Line 450: I like this section as it justifies the chronosequence approach. This could be presented a bit earlier in the ms?

Reply: We agreed on that recommendation, and accordingly moved section 4.4.1 as 4.1 and stat the discussion by giving justification of chrono sequence approach

Please also note the supplement to this comment:
https://bg.copernicus.org/preprints/bg-2021-359/bg-2021-359-AC1-supplement.pdf