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Interactive comment on "Contributions of the direct supply of belowground seagrass detritus and trapping of suspended organic matter to the sedimentary organic carbon stock in seagrass meadows" *by* Toko Tanaya et al.

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General comments

Comment #1: The study by Tanaya et al. reports findings in the context of blue-carbon science, specifically as a representation for the Indo-Pacific region. The authors demonstrated meticulous planning for the study and the manuscript is generally well-written. Our group is similarly involved in blue carbon studies and we draw some corollary between this study and our findings. In addition, we suggest some recom-

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mendations that may improve the authors' present and future outlook in this field. One of the highlights of this study is the argument on the contribution of biomass derived organic carbon (OC bio) to the organic carbon pool (OC total) as the highest globally (P2L8). The data is presented in percentages (i.e. 19% OC bio and 81% OC sed) rather than the actual organic carbon stocks. It may be apt to complement such comparisons with actual global stock values (in equivalent measures as grams C per meter squared or megagrams C per hectare).

Reply #1: Concur.

Change #1: We have revised the data presentation to include a comparison of OC mass in this study with that of a previous study (Fourqurean et al., 2012) as per your suggestion. We have removed the sentence (page 10 lines 17–21): "If we assume... (Fourqurean et al., 2012)". Instead, we have added a new table (Table AC1) and the following sentence: "The averaged OCbio was significantly higher in this study than that in the previous study by Fourqurean et al. (2012) (W = 1691, P = 0.006), whereas the averaged OCsed was significantly lower in this study than in the previous study at both vegetated and no-vegetation points (vegetation, W = 6952, P < 0.001; no-vegetation, W = 225, P = 0.039) (Table AC1). Hence, the contribution of OCbio to OCtotal at our sites was higher than the global average". We have revised the phrase in the abstract (page 2 line 8) by replacing "the highest in globally compiled data" with "higher than globally compiled data".

Comment #2: They then rounded off their study by stating below-ground biomass is a driver for sediment OC storage (P2L14-15). It may hold true for this specific study, which is represented by findings from two sites. The authors rightly indicated past studies (e.g. Kennedy et al., 2004; 2010 and Howard et al. 2017 – P11L14) showed no relationships between seagrass biomass and sediment OC stocks. This is consistent with our recent study as well (Rozaimi et al. 2017). However, our other studies suggest otherwise whereupon biomass is indeed important in driving sediment OC stocks (Serrano et al. 2016; Rozaimi et al. 2013). Tanaya et al. provided possible explanations on why they had different outcomes (P11) but alternatively, it may be plausible that their study sites may simply have exceptional sediment OC storage characteristics compared to other Indo-pacific seagrass meadows.

Reply #2: Concur.

Change #2: We have added the following sentence (page 11 line 18): “although we could not exclude the possibility that our sites may have specific sedimentary OC storage characteristics different from those of other Indo-Pacific seagrass meadows”. We added the relevant literature (Rozaimi et al. 2017) after “Howard et al., 2017” (page 11 line 14).

Comment #3: Further to the above, it has to be clearly noted this study reports findings from surficial sediments (up to 16 cm depth: P5L5). This depth is within the range of vertical rhizomal growths for Indo-pacific seagrass rhizomes (especially T. hemprichii). So clearly autochthonous inputs play an important role in retaining seagrass-derived OC within this depth layer. However, the context of the authors’ findings within 15 cm sediment depths up-scaled to 1 m, on the assumption that sediment OC density is constant (P10L18) may be too broad an assumption. In our published results (Rozaimi et al. 2017), we found variability in surficial downcore OC content (up to 30 cm sediment depth, albeit as %OC) as well as changing _13C sediment signatures with increasing sediment depth. In other studies (Rozaimi et al. in preparation), we did not find consistency in downcore OC content or OC density in cores up to 1 m. Conventionally, the scaling-up approach is employed (and admittedly we have used scaling-up approaches to model sediment OC stocks up to 1 m) to contextualise findings relative to regional and global estimates as that in Fourqurean et al. (2012). The authors’ assumption in this regard may be corroborated if other evidence can be presented to support the notion of past seagrass occurrences in their study site (re: Serrano et al. 2016; Belshe et al. 2017). Or simply, such investigations may be room for improvements in the authors’ future work.

Reply #3: Concur.

Change #3: We have deleted the sentence as per your suggestion. Instead, we have added a new table (Table AC1), see Change #1.

Comment #4: On a final note, it is particularly interesting the authors have data (though not apparently analysed as yet) that can be used in stable isotope mixing models. Mixing models have been increasingly used to account for the contributions of seagrass derived-OC to bulk sediment organic pool and could thus offer alternative insights to the authors' findings. We do wonder how the authors' approach in this study hold up compared to approaches such as stable isotope analysis in R (SIAR; e.g Watanabe and Kuwae 2015; Rozaimi et al. 2017) or eDNA approaches (Reef et al 2017). The lack of reference to SIAR, at least, is somewhat peculiar since there are co-authors in this current study, who are familiar with SIAR (i.e. Watanabe and Kuwae 2015). Overall, we view this study as interesting and may well be citable in future blue carbon endeavours.

Reply #4: We intentionally did not use the stable isotope mixing model because, in the case examined in the present study, it failed to reliably isolate the contribution of seagrass from those of algae and corals; rather, the strong negative correlations among the inferred values imply that one source is simply being traded off against the other. (see Parnell et al., 2010). We showed that the direct supply of belowground seagrass detritus was a major mechanism of OCsed accumulation at the back-reef site from the contribution of belowground detritus to OCdead and δ13Csed, and from the relationships among δ13Csed, biomass, OCsed and OCdead (pages 11 lines 23–30).

Reference Parnell, A. C., Inger, R., Bearhop, S., & Jackson, A. L.: Source partitioning using stable isotopes: coping with too much variation, PLOS ONE, 5, e9672, 2010, doi: 10.1371/journal.pone.0009672.

General technical comments:

Comment #5: Seagrass “bodies” is a peculiar term to use

Reply #5: Concur.

Change #5: We have deleted ‘bodies’ or replaced it with ‘plants’ or ‘biomass’.

Comment #6: On the use of “enrichment”: conventionally, communications in this regards may construe the presence of higher quantity of 13-C atoms (i.e. enriched samples) relative to non-enriched samples. In the text, readers may find some confusion on whether the authors refer to 13-C enrichment, or simply linguistic reference to higher amounts of a particular entity.

Reply #6: Concur.

Change #6: We have changed the term as per your suggestion.

Comment #7: P4L14-22: Content more suited in the Introduction section

Reply #7: We do not agree. We did not move these sentences because they are too long and detailed to be included in the introduction.

Comment #8: P11L14: A word missing after OC (perhaps OC stocks?)

Reply #8: Concur.

Change #8: We have modified “OC” to “%OC or OCmass” (page 11 line 14) as per your suggestion.

Comment #9: P21 Table 2: On data entries as 0.00 _ 0.00: do these data refer to nil values, or data values less than 0.001?

Reply #9: The data entries of 0.00 are values less than 0.01 g cm–3.

Change #9: We have changed the units of dry density from “g cm–3” to “mg cm–3” to avoid having entries of 0.00 (Table AC2).

Comment #10: P28 Figure 5: Axis labels are too small

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Reply #10: Concur.

Change #10: We have enlarged axis labels of Figure 5 (Figure AC3).

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Table AC1. Values of seagrass biomass organic carbon and sedimentary organic carbon mass in globally compiled data (Fourqurean *et al*., 2012) and this study (mean ± SD, *n*).

	Vegetated		No-vegetation	
	Seagrass biomass OC ($gC\ m^{-2}$)	Sedimentary OC ($gC\ L^{-1}$)	Seagrass biomass OC ($gC\ m^{-2}$)	Sedimentary OC ($gC\ L^{-1}$)
	mean ± SD (*n*)	mean ± SD (*n*)	mean ± SD (*n*)	mean ± SD (*n*)
Fourqurean *et al*., 2012	251.4 ± 395.6 (251)	12.32 ± 8.04 (410)	-	8.08 ± 5.90 (43)
This study	283.0 ± 200.8 (21)	5.03 ± 1.32 (21)	-	2.93 ± 0.73 (7)

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Fig. 1. Table AC1

Table AC2: Organic carbon content, δ^{13}C, and dry density of each sediment and dead plant component at the back-reef and estuarine sites.

	Back reef			Estuary		
	Organic carbon		Dry density (mg cm^{-3}) mean ± SD (*n*)	Organic carbon		Dry density (mg cm^{-3}) mean ± SD (*n*)
	%OC (% DW) mean ± SD (*n*)	δ^{13}C (‰ vs. VPDB) mean ± SD (*n*)		%OC (% DW) mean ± SD (*n*)	δ^{13}C (‰ vs. VPDB) mean ± SD (*n*)	
Fine sediment	0.37 ± 0.13 (60)	−12.8 ± 0.8 (60)	893 ± 303 (60)	0.42 ± 0.20 (24)	−17.4 ± 3.6 (24)	760 ± 294 (24)
Coarse sediment	0.32 ± 0.13 (20)	−12.8 ± 1.1 (20)	292 ± 152 (20)	0.26 ± 0.08 (8)	−15.9 ± 1.5 (8)	475 ± 142 (8)
Dead leaf	24.80 ± 3.07 (3)	−8.9 ± 0.6 [a] (5)	0.05 ± 0.04 (20)	23.31 ± 3.86 [b] (3)	−9.3 ± 0.2 [a] (5)	0.03 ± 0.04 (8)
Dead sheath and rhizome	21.29 ± 4.07 (3)	−8.9 ± 0.6 [a] (5)	0.55 ± 0.63 (20)	27.52 ± 1.75 [b] (3)	−9.3 ± 0.2 [a] (5)	1.44 ± 1.86 (8)
Dead root	19.25 ± 1.67 (3)	−8.9 ± 0.6 [a] (5)	0.26 ± 0.25 (20)	19.94 ± 5.89 [b] (3)	−9.3 ± 0.2 [a] (5)	0.31 ± 0.35 (8)

[a]Total of sheath and rhizomes, and root.

[b]At one sampling point (FS1) where the dominant species was different, the values were dead leaf, 25.77%; dead sheath and rhizome, 19.05%; and dead root, 19.21%.

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Fig. 2. Table AC2

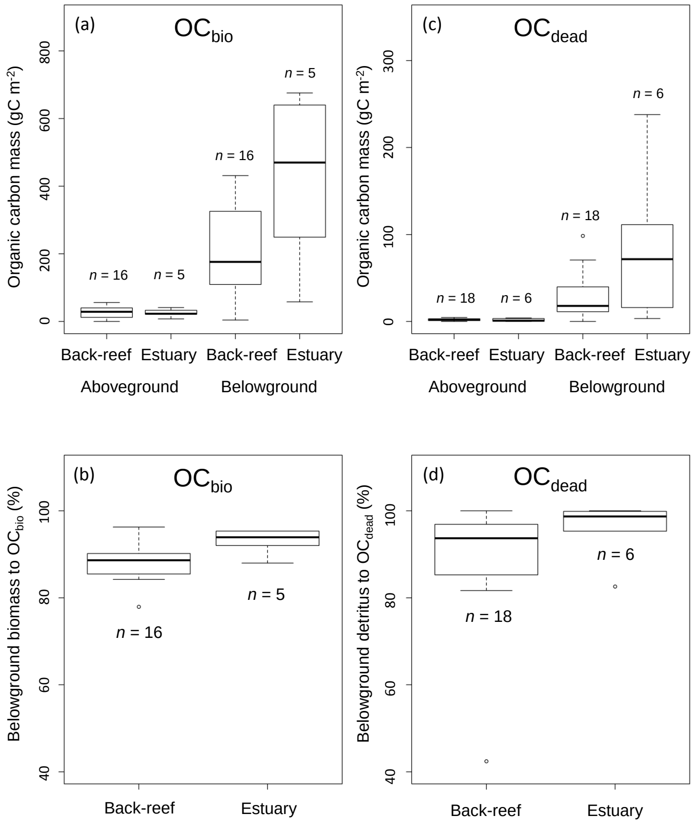

Figure AC3: (a) OC_{bio} (sum of aboveground and belowground biomass) (g C m^{-2}); (b) contribution of belowground biomass to OC_{bio} (%); (c) OC_{dead} (sum of above- and belowground detritus (g C m^{-2}); and (d) contribution of belowground detritus to OC_{dead} (%). Boxes show the 25% and 75% quantiles; horizontal bands inside the boxes are median values; whiskers show maximum and minimum values; and open circles show outliers. (a) and (b) show the data of vegetated sampling points and (c) and (d) show the data of vegetated and bare sampling points .

Fig. 3. Figure AC3