

Interactive comment on “Carbon Stocks and Accumulation Rates in Salt Marshes of the Pacific Coast of Canada” by Stephen G. Chastain et al.

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Received and published: 30 May 2018

SHORT RESPONSE TO ANONYMOUS REVIEWER #1 ON “Carbon stocks and accumulation rates in salt marshes of the Pacific Coast of Canada” by Chastain et al.

We thank anonymous reviewer 1 for comments which we think will help clarify the paper. Here we provide a brief response detailing how we intend to address reviewer concerns.

#1. Reviewer 1 writes: “...I have a major problem with the estimate of the mass accumulation rate. There is no details on ^{210}Pb data and not enough on the dating method. ... “

RESPONSE: (1) A raw data file including ^{210}Pb xs and original ^{210}Po activity was
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provided to the PANGAEA data archive for release when this paper is published. The appendix tables C2-C6 provided with the manuscript will now also include measured dry bulk density, % organic carbon, soil carbon density, subsample depth intervals (cm), total $^{210}\text{Po}/^{210}\text{Pb}$ activity, SD of total $^{210}\text{Po}/^{210}\text{Pb}$ activity, ^{210}Pb xs, age (yr), SAR, and CAR. (2) more detailed information about ^{210}Pb methods are provided below.

#2. Reviewer 1 continues: “...the authors use an another technic, the alpha spectrometry. The problem of this method is that it measures ^{210}Pb only. But the ^{210}Pb -dating method is based on the decay of the excess Pb, ie the fraction of ^{210}Pb not supported by its radioactive parent (^{226}Ra) in sediment. This implies the authors made assumptions to estimate this supported fraction, this information is not given in the article. How the authors determine this supported value ? did they use the same value for the 4 cores. What is the error associated with the assumption ? In addition, $^{210}\text{Pb}/^{210}\text{Pb}$ xs are not presented which is a critical aspect as these data define the SAR. The method used to estimate SAR/MAR is also not enough detailed.”

RESPONSE: We thank the reviewer for pointing out this lack of clarity in our description of ^{210}Pb dating methods and will revise the methods section accordingly. Our analysis follows published methods in which ^{210}Po is measured using alpha spectrometry (and ^{210}Pb is calculated from this by assuming secular equilibrium (e.g., Binford, 1990). The assumption is made that no unsupported ^{210}Pb is present at the depth of lowest observed activity. Financial constraints prevented us from also measuring ^{226}Ra , wo the lowest ^{210}Po activity is assumed to estimate background for calculating the ^{210}Pb xs throughout the core. We do not use the same background value to estimate supported ^{210}Pb in all 5 cores, as the lowest observed activity varies from core to core. This methodology is consistent with previously published papers using alpha spectrometric techniques to estimate ^{210}Pb systematics and SARs in sedimentary systems (e.g., Brossier et al., 2014; Chambers et al., 2017; Galka et al., 2017; Greiner et al., 2013; Kolker et al. 2009; Wachnicka et al., 2013).

#3. Reviewer #1 further states: “...From the CSR (constant rate of supply) model)

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based on the inventories, it is possible to calculate directly age of each layer, and then to estimate SAR and MAR, such values would have been interesting to discuss also (temporal trends, potential change in accretion regarding sea level rise). . . .”

RESPONSE: Sediment accumulation rates (SARs) were provided in the supplemental information for all 5 dated cores (figures C2 through C11). Soil carbon density vs depth for each core is also plotted in Figure 3 of the manuscript. We can easily add an additional figure and discussion of CAR vs depth for each dated core. We can also include a more thorough discussion of the average and standard deviation of calculated CAR with depth. All associated data will be included in tables with the revision.

#4. Reviewer #1 states: “. . . I do not understand why the authors speech two times about ^{137}Cs , there is useless. In fact in such environnements, where accretions could have change, ^{210}Pb IN EXCESS is indeed appropriate, ^{137}Cs is interesting only to validate the chronology..”

RESPONSE: The reviewer rightfully points out that ^{137}Cs has limitations, which we describe in the manuscript. Therefore, we are not certain what the reviewer’s concerns are with our mention of ^{137}Cs . Our text describes that most previous estimates of marsh CAR on the Pacific Coast (and the full global dataset) are calculated using ^{137}Cs dating, and that our work provides more accurate accumulation rate estimates using ^{210}Pb at our study sites. If necessary, we will edit the text for clarity.

#5. Reviewer #1 writes: “The second problem is the sampling. . . . the authors determine SAR only on 4 cores sampled in different systems. Do they assume there is no change in sediment according to the position along the transects ? What about the morphology along these transect ? Regarding the purpose of the article, I would have expect to have a higher number of cores on which ^{210}Pb was determined in order to obtain more reliable SAR and then CAR. Whereas ^{210}Pb is already mentioned in the abstract, there is no data of this radionuclides nor figures presenting profiles with depth. Considering the objectives of the article, that imply to know rather precisely

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SAR/MAR in order to calculate CAR, the number of dated cores is also too weak to be representative of the different systems.”

RESPONSE: First, as stated for #1, data were supplied to PANGAEA for release at publication and will be supplied in the appendix tables with this manuscript.

Second, we acknowledge the reviewer’s concerns regarding the small number of cores dated (although we dated 5, not 4 cores). We agree that marsh dynamics result in high spatial variability, which we observed in the field and is apparent in estimations of variability (standard deviations) within and between marshes cores. Our sampling strategy was intended to capture spatial variability of carbon dynamics between different marshes in the region within the limits of our funding budget. However, a comparison of stratigraphies of cores within the marshes will allow us to make a meaningful comparison of stocks and accumulations between the dated and undated cores. For our revision we will highlight the ^{210}Pb dated cores in Figures 2 and 3 to highlight the how representative our ^{210}Pb dated cores are for each marsh and elaborate on this analysis in the Discussion.

Finally, we were surprised to see a recommendation for rejection based on a small sample size, given that we have doubled the number of studies using ^{210}Pb dating on the west coast of North America. Thus, we believe our results substantially improve quantification of CAR on the Pacific coast of North America.

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Interactive comment on *Biogeosciences Discuss.*, <https://doi.org/10.5194/bg-2018-166>, 2018.