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Biogeosciences Discussions

Interactive comment on "Drivers and modelling of blue carbon stock variability" *by* Carolyn J. Ewers Lewis et al.

Anonymous Referee #1

Received and published: 1 October 2019

Review of bg-2019-294 "Drivers and modelling of blue carbon stock variability" by Ewers Lewis et al. In this paper, the authors look to create a framework for modelling shallow carbon stocks (0-30cm) in vegetated coastal ecosystems. They use a combination of geomorphological, anthropogenic and ecological variables, combined with carbon stocks from a large number of shallow cores (n = 287) to construct the model and estimate carbon stocks for a region in southern Australia. The model could account for $\sim$ 49% of the variability in shallow carbon stocks, with plant community being the strongest predictor in the model.

Generally this is an interesting paper, but I have some points that should be clarified. 1. Can these shallow carbon stocks be considered "blue carbon"? There is growing evidence that carbon within the surface layers is still highly susceptible to degradation.

A typical profile of carbon down the soil profile in these vegetated habitats show a decline with depth until reach a pseudo steady state. Do the authors have some deeper cores to show that carbon density in the top 30 cm is representative of long-term sequestration? Along these same lines – some of the plant communities looked at in this study (e.g. mangroves) can put "new" carbon into depths below 30cm through root production. The combination of these factors may lead to erroneous definition of carbon stocks as "blue carbon".

2. I wonder how applicable the use of contemporary variables is to the assessment of carbon stocks that are assumedly a function of conditions over the last several decades. This might be worth considering, and could explain the 50% of variability unaccounted for by the model outcomes. For example, community composition is changing in temperate regions such as the study area in this paper. Assuming a sediment accretion rate similar to SLR ($\sim$ 3mm/yr) – the 30cm soil profile used in the model integrates $\sim$ 100 years of environmental, ecological and anthropogenic conditions. Could this discrepancy in the temporal scale used for the predictor variables and carbon stock accumulation be an issue? 3. It would be good to see some kind of power analysis to assess whether the sample size is appropriate. I note there are R packages to do this for this kind of modelling approach.

Minor comments: Title – see comment 1 above, I am not sure the paper really assesses blue carbon due to the shallow sediment profile analysed. Also as this is a regional study, I think it might be appropriate to include something to clarify that in the title.

Abstract – Aims 1 and 2 should include the term regional, as the paper doesn't really produce a model that is applicable beyond the region of the study area

Abstract – last sentence. Without testing the validity of the modelling method to other regions, I am not sure this statement can be made. Suggest removing this statement or validating the modelling method elsewhere

Introduction Ln 40-43 Stocks of carbon are not directly related to greenhouse gas in-

ventories which are based on flux rates.

Line 86 – Best not to start a new paragraph with “However” as this is a conjunction for connecting sentences within a paragraph.

Materials and methods Ln 153-159 Can the authors expand upon the methods used, including accuracy of analytical methods, the number of samples analysed by FT-MIR vs EA, and the results of cross validation between these 2 methods.

Ln 168 – 172 Assigning catchment characteristics to estuarine communities makes sense, but looking at Figure 1 most samples were collected from coastal embayment’s. How might the influence from multiple catchments affect the model?

Ln 182-187 What was the vertical accuracy of the DEM? Considering the small elevation gradients across the intertidal zone, this is important.

Ln 210 – Is the 2001 data the most recent, or is this a typo?

Ln 215 Why was 30cm chosen as the depth representative of blue carbon stocks (see also earlier comment)? Can the authors add a few comments about this?

Results Throughout the results and the discussion the error associated with all estimates should be included. This error should combine model error and uncertainty in the spatial coverage of habitat areas.

Discussion Ln 434 As with the use of “however” to start a paragraph, “Further” should also be avoided.

452- 454 See earlier comment regarding applicability of this modelling framework to global assessments.

Data availability – I would like to see all of the underlying data made publically available rather than just the model outputs. These data can easily be attached as a supplementary.

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