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Biogeosciences Discussions

Interactive comment on "Blue carbon stocks in Baltic Sea eelgrass (*Zostera marina*) meadows" *by* Maria Emilia Röhr et al.

Anonymous Referee #1

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The manuscript by Röhr et al. presents a potentially interesting dataset on sediment organic carbon stocks and sedimentation rates in constrasting seagrass meadows in the Baltic Sea region. At this stage, however, I cannot recommend publication as there are a number of fundamental flaws in methodology and presentation of the results which compromise the use and interpretation of the data. I have recommended rejection to indicate that it needs a very thorough overhaul; although I feel that with proper re-analysis of (samples and) data, this could certainly be resubmitted.

My main concerns are outlined below.

-The authors mention that sediments were not acidified to remove carbonates as the inorganic carbon content in their samples was low but they indicate a range of up to 0.3 % inorganic C. I do not understand why a simple acidification procedure was not

followed for all samples – if some samples contain 0.3% inorganic C this could substantially influence the d13C values measured, since OC concentrations are often also low. Table 1 shows organic matter contents (is this really %OM, or %OC ? This should also be clarified) and the averages are as low as 0.42 % for some sites. If this is %OC (and even worse, if it is %OM), that would imply that up to half the C measured could be inorganic carbon, and this would severely bias the OC stock numbers as well as the d13C data. Acidifying these samples after weighing them takes a few minutes – and avoids any concerns on bias due to inorganic C contributions- hence I do not understand why one would not due this routinely on all samples. The authors should either show more convincing data that the data are not biased by inorganic C contributions, or re-analyze their samples with proper acidification to remove carbonates. All d13C data should also be presented somehow in Tables or Figures and not merely in the text as is currently the case.

-The authors provide estimates for Corg accumulation but it's very unclear what these actually represent and how they should be intepreted. In their study, they measured sedimentation rates using sediment traps (hence, the downward flux of suspended matter and OC) but this is not the same as OC accumulation rates, since much of the OC reaching the surface is likely to be mineralized rather than buried. %OC and d13C data should be clearly shown for but the sediment trap samples and sediments profiles. On L225-230 the authors explain how "Corg accumulation" was calculated: Results for carbon burial (applied by multiplying the Corg stock, regional seagrass area and sedimentation rate estimate from literature) in each area are given as Corg accumulation (t y-1)". This does not make sense, since (i) this formula does not match in terms of units (Corg stock: g C m-2; area: m2; sedimentation rate: g DW m-2 y-1; so you end up with gC x g DW m-2), (ii) why use sedimentation rates from the literature when you measured these with your sediment traps ? The literature sources referred to here for sedimentation rates are not from these sites, hence they are unlikely to be very meaningful. In order to obtain Corg accumulation rates for your study sites, the %OC profiles should be combined with sediment dating techniques (e.g. 210Pbxs) or

site-specific sedimentation rates.

-The authors mention a few times that sediment density is a factor that partially explains the OC stocks. This is not a causal factor – density and %OC are expected to be inversely related in sediments since organic matter has a much lower density than the mineral fraction. See for example the supplementary information in Donato et al. (2011) Mangroves among the most carbon-rich forests in the tropics. Nature Geoscience, doi: 10.1038/ngeo1123. http://www.nature.com/ngeo/journal/v4/n5/extref/ngeo1123-s1.pdf

-L233: be more specific in terminology: how do you define "eelgrass carbon sequestration rate": carbon burial ? net primary production ? Why do you need this (a rate) to calculate the total Corg pool (= a stock) ?

-L326: how can the Corg stock be as low as <0.001 mg C cm-3 ? Please check these numbers. You refer to Figure 3 here but I don't see these low numbers on Figure 3.

Minor comments: -L17: account –>→ accounts

-L17: oceanic carbon burial : organic ? total ?

-L19: organic carbon

-L20: accumulation rates

-L24: organic carbon

-L27-28: these should be expressed in areal rates (or in areal rates + integrated over the relevant areas)

-L29-30: see comment above regarding density

-L31: DistLm: explain

-L44: Atmospheric carbon dioxide

-L59: 10ˆ-10 : something wrong here. Express this is e.g. PgC

-L66 and further: salinity has no units – avoid using psu

-L73-74: 7% decline per year – but a total 29% loss since 1879; these numbers are indeed often cited but they are somewhat at odds – if the 7% per year is consistent, that would lead to >29% loss in 4 years.

-L96: "typically faster": ambiguous: do you mean that seagrasses have faster turnover rates, or other sources ?

-L98: use the correct terminology: "isotopically heavier in d13C" is not correct: "enriched in 13C", or "have higher d13C values"

–L103-106: explain how identifying/constraining sources can lead to more reliable estimates of the capacity of the meadows to store and sequester carbon. I don't think this is the case – they allow you to budget the fate of seagrass C more accurately, but to determine the organic C stores or sequestration rates, you don't need the source information ?

-L333: "ranged from": but then you provide an average +/- stdev.

-L385 and elsewhere: when presenting a range of d13C values, provide the lowest (most negative value) first.

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