Authors Response to Reviewer 1

Smeaton et al. applied geochemical and geophysical methods to investigate the carbon stock in five representative fjords in Scotland and then used these five fjords using seismic and geochemical data and further modeled these five fjords. Results suggested strong similarity in estimated and calculated carbon stock numbers. They further applied this model to upscale to the national level and calculated the carbon budget in all Scotland fjords. This manuscript presented an interesting case study and also a valuable methodology advisable for future studies. I believe this manuscript is suitable for publication after minor revision.

We thank the reviewer for the very helpful review, which highlights the significance of the national stock estimates and rigorous methodology adopted.

I only have one major concern about the manuscript, or maybe because I did not understand the methodology clearly, which requires further clarification. My understanding is that authors used seismic and carbon data to estimated carbon stock in these five fjords and then correlate them with parameters such as rainfall, catchment area, etc. These parameters were further used separately to calculate the carbon stock in each fjord.

An Excel file detailing the statistical tests and results was has now been attached to the submission further detailing the methodology and providing greater clarity. We ask that this be included with the supplementary material; we make reference to this table in the revised manuscript text (lines 206-208).

In my opinion, I believe it could generate a much more reliable number if the authors could incorporate all the parameters into one equation, such as carbon stock = a*precipitation*catchment area*runoff*tidal range. I am sure the equation could be further optimized based on the available data from these 5 fjords. This method has been largely used by Syvitski et al in modeling sediment discharge from global rivers.

The approach highlighted by the reviewer was undertaken. However, equations utilising all the parameters to determine C stock were highly variable and never produced C stock estimates comparable to the 5 fjords for which data was available. Several iterations of this equation were tested with little success (all of this is now included in the new supplementary table). We believe this numerical approach could be successful and could be used to further refine the these first order estimates but the lack of detailed C stock data is currently preventing its use; we have added a sentence (lines 320-322) to highlight this opportunity.

We believe the methodology utilised in this manuscript is the best suited to produce a first-order national C stock estimate with the current data availability, but we recognise going forward refinement of these estimates could use alternative numerical approaches as highlighted by the reviewer. This point, as noted above, is now acknowledged in the revised manuscript.

Minor comments:

Line 180: change to Identified in Table 1.

Brackets have been removed.

Line 206: a reference would be good.

Reference added: McIntyre and Howe, (2010), Scottish west coast fjords since the last glaciation: a review, Geological Society, London, Special Publications, 344, 305-329, 1.

Line 224: as mentioned in the major comment and repeat again here: What if you combine all the parameters together, such as OC = a* tidal range*precipitate*catchment area*runoff. You could also modify the equation based on the best fitting. I think in this way, you could generate a more reliable OC and IC number.

See above comment.

Line 254: . . .. available to test. . .. .

Typo corrected

Line 265: change carbon data to carbon concentrations?

Data changed to concentrations

Lines 272-273: How do you conclude without glacial samples from all fjords?

It is true that we only have glacial sediment samples from Loch Sunart and the data produced from these samples has been used to calculate the C stocks for glacial material in all 111 fjords. In Smeaton et al. (2016) we compared the C concentrations from the glacial marine sediments to glacial till deposited on land at the end of the last glacial period within the wider region. The C concentrations found in till compared well to that of the glacial marine sediment. Therefore we believe that C data from the Loch Sunart glacial samples is largely applicable to the wider network of fjords. We do accept there will be an error associated with these calculations which is reflected in the confidence level we have attributed to the calculations.

Line 283: If sills are a major reason affecting IC storage, then how it is possible to factor sills into the numeric model?

Though the sills are not directly used in the calculations, the physical attributes of the fjords (Table 1) used in the calculations do reflect the role of the sills. The fresh/tidal ratio represents how restrictive the fjord geomorphology this is directly linked to the sill attributes.

Line 295: change my to by

Changed

Lines 334-336: any reference?

References Added: Bianchi, T. S.: The role of terrestrially derived organic carbon in the coastal ocean: a changing paradigm and the priming effect., Proc. Natl. Acad. Sci. U. S. A., 108(49), 19473–81, doi:10.1073/pnas.1017982108, 2011.

References Added: Middelburg, J. J., Vlug, T., Jaco, F. and van der Nat, W. .: Organic matter mineralization in marine systems, Glob. Planet. Change, 8, 47–58, 1993.

Line 370: also depend on how deep is the seagrass habitat deposits

The depth of the seagrass sediments from Rohr et al. 2016 is unknown, this is the reason we do a like for like comparison (i.e. top 25 cm). The lack of fully depth integrated records is an issue for comparison is an issue highlighted in lines 363-373.