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Biogeosciences Discussions

Interactive comment on "A Sedimentary Carbon Inventory for a Scottish Sea Loch (Fjord): An Integrated Geochemical and Geophysical Approach" *by* C. Smeaton et al.

Anonymous Referee #1

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Fjords (lochs) have been shown to be significant global sinks of carbon, especially with respect to their relatively small area on earth. In this study, Smeaton et al. conducted a seismic survey and collected sediment cores from Loch Sunart, a loch system on the west coast of mainland Scotland. The authors stated that lochs on Scotland mainland are comparable to some of the fjords in Norway, Canada, and Fiordland, and therefore, the methods and results from this study could likely be applied in studying other fjord systems. By using seismic data and sediment cores, the authors present a detailed method for calculating the inorganic and organic carbon budget in Loch Sunart. The authors further compared the carbon inventory with the peat & soil inventory in Scotland, which has been well studied. They concluded that Loch Sunart has a much

higher area-normalized burial rate of carbon than peat & soil systems on land, and therefore suggest that lochs should be treated as a standalone system when studying carbon dynamics. The manuscript is well organized and well-written; I believe with some moderate revision, this manuscript would be suitable for publication. Please see the suggested changes below.

Page 1, line 24: in or is? Page 1, line 26: are or area? Page 2, line 5: check citation format Page 3, line 13: What this statement is based on? Page 5, line 18: where or were? Page 6, line 16: Any reference for this method? To what I know, this method is not commonly seen while doing OC analysis. Page 7, line 3: Apparently, SARs are not the same during glacial and interglacial time period, and how do you justify this point? If you use constant SAR from LGM to modern, then you would overestimate Holocene SAR. Page 7, line 14&15: check the sentence. Page 10, section 3.2: the radiocarbon dating of core 2833 in Baltzer et al. (2010) is poor in the lower part of the core. Time dating of 17041 at ∼7 m depth is from LGM, however, there is no evidence showing the dropstone presented at the bottom of the core is whether from H1 or H2. It is likely that core 2833 goes back to ∼25,000 years, especially considering that presence of the fifth horizon in the inner basin & middle basin, which is likely the boundary of LGM (H1). Please justify this point. Page 11, line 18: What is this? Page 12, line 12: The number of decimals might be too high, unless if you can justify it. Page 12, line 17: check gramma Page 13, line 20: How the negative number is calculated? Page 13, line 20&21: This sentence is not supported by the data. Page 14, line 25&26: and also area < 10 m deep? Discussion: Although this paper is more of a methodology paper, I still think it might be interesting to make comparison to some other fjords globally in the aspects of sedimentation rates, carbon accumulation rates, and distribution pattern of carbon along fjords. Smith et al. (2015) summarized all global fjords, however, there is no OC accumulation rates from Scottish fjords yet. By making a comparison of the results in this manuscript to other fjords, even just fjords in NW Europe, it would make the paper more interesting. I would assume Scandinavian fjords would be different to Scottish fjords in carbon accumulation rates, etc. Page 15, line 23: check gramma

Page 16, line 25: What defines long-term here? Based on the data, the loch sediment chronology only goes back to ∼17,000 yrs. Fig. 6: not sure if it is better to show the thickness of each unit, other than the depth of each horizon because the thickness is more interesting and more related while calculating carbon budgets. Fig. 8 is not cited in the manuscript.

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