Please see the response to reviewer 1 for comments on applicability of the Clymo model

Responses to other comments of Reviewer #2

Reviewer #2 appropriately noted that it would be valuable if we could provide "a **quantification of the area emerged from isostatic rebound in the early Holocene and how it compares with the area submerged due to sea-level rise at the same time**". We have been able to develop a rough estimate of the former. We used Andrews' (1973) map of the probable extent of land submerged by ancient seas. We then determined the area of wetland that presently exists in that region using a data set available from the Commission for Environmental Cooperation (2005) - ~330,000 km^2 (~27% of the area of Canadian peatlands that exist today) indicating that peatland development on rebounding postglacial marine surfaces occurred over an extensive area of northern Canada. This figure represents the maximum area of peatland that may have originated from tidal wetlands in Canada, alone. Indeed, some of these wetlands could have originated in lake basins, such as kettle basins, but studies show that large blanket mires such as those occupying the Hudson Bay Lowlands developed from tidal marshes which followed the marine water retreat (Glaser et al, 2004; Pendea et al, 2010).

Although the peatland initiation on postglacial former marine surfaces was time-transgressive, evidence shows that early (post emergence) fen ecosystems remained active for a significant period of time - in fact the bog phase did not follow the salt marsh phase until after as much as 2500 years in southern James Bay (Glaser et al., 2004).

Quantification of the area of tidal salt marsh (we assume that is what reviewer #2 is referring to) lost to rising sea level is an excellent suggestion, but this task is much more challenging as these deposits are now located offshore. We assume that the carbon stored in them largely remained buried, but the active carbon sinks were lost. Further research on this question is merited, but it would constitute a paper (or more) unto itself. Previous studies have indicated that changes in productivity of peatlands were a possible explanation for the early Holocene carbon dioxide flux - and Reviewer 2's comments show that our report suggests just one piece of the puzzle.

Naturally, more empirical evidence on early peatland ecology in northern Canada is needed, but we suggest that the peatland initiation and carbon storage model documented in our James Bay core could have been common throughout the former postglacial marine surfaces of northern Canada and future research should consider this possibility in explanations of fluctuations in atmospheric carbon dioxide levels.

Page 1116, line 16

To some degree we are comparing apples and oranges, reinforcing our position that these long-term global averages are inappropriate when considering contemporaneous changes in atmospheric carbon dioxide. We take reviewer #2's concerns into consideration and will revise the statement in our abstract to read (additions underlined): "The short-term C accumulation rates during the tidal marsh and incipient fen stage (87 and 182 $gCm^{-2} yr^{-1}$, respectively), were as much as six times higher than the global long term (millennial) average for northern peatlands."

Page 1116, line 17-18

This statement is not a conclusion, but a suggestion of a wetland feature that has (as far as we can tell), as yet, to be considered. Rather than intending it as a conclusive statement, we offer this wetland carbon record as a suggestion of the need to for broaden our considerations of carbon dynamics in the early history of boreal and subarctic "peatlands" and to stimulate future research in this direction.

Reviewers appropriately note that we should not compare our decadal scale rates to those derived from averaging peat accumulation over millennia. Our intention was to point out that we need to consider decadal scale rates (and their drivers) if we are to explain the role of wetlands in fluctuations in atmospheric carbon dioxide in the early Holocene. Indeed the higher rates calculated over decadal scales in tidal-to-fen transitions, as compared to those derived from ancient peat deposits, confirm that the latter may not be useful to resolve the enigmatic fluctuations in atmospheric carbon dioxide noted by Yu et al. (2011).

Page 1116, line 23

We have revised our text.

Page 1117, line 28

Autocompaction can occur as plant structure is lost, tissue is partially decayed, and water held in plant tissues is lost - a phenomenon that occurs in all wetlands. Clymo (1984) mentions loss of plant structure in bogs, and autocompaction in peatlands is suggested by Aaby and Tauber (1975) and Barber (1981). We have added this support to our original text.

Page 1119, line 14

We are grateful to reviewer #2 for noticing this! Pendea and Chuma (sic) is now in our reference list.

Page 1119, line 19, and 22-25

We will remove the extraneous explanation about macrofossils.

Page 1120, line 16

The same error was noted by Reviewer #1, please see our response there.

Page 1121, line 3

The term usually used is "above ground" testing, but "ground" was mistakenly deleted from the text. It will be returned.

Figure 2

The ages presented here are calendar years, thus the axis labelling is correct.

Figure 3

The combination of age and depths scales in figure 2 was produced with specialized software used in preparation of pollen diagrams. Not having comparable software available for figure 3, we felt it was important the depths The figure caption is easily edited to add that the wetland deposits are in the AMC core.

We tried placing the plots side-by-side, but this required too much condensing laterally.

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