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Interactive comment on "Temporal variation in carbon and nitrogen sequestration rates in boreal soils across a variety of ecosystems" *by* K. L. Manies et al.

M. Braakhekke (Referee)

m.c.braakhekke@uu.nl

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This paper presents a study on soil C and N accumulation rates on different time scales in boreal ecosystems. The authors used two techniques, 210Pb dating and 14C dating, to determine soil C & N accumulation rates on short and long time scale, respectively, for 5 ecosystems along a soil moisture gradient. Differences between the ecosystems are discussed in terms of factors that control C & N cycling. In general I find this an interesting and well written paper. Differences in soil C & N cycling in boreal ecosystems with different soil moisture regimes are highly relevant since climate change in high-latitude regions is likely to cause shifts in hydrological conditions, which will lead to vegetation change. It is also nice that the authors estimated accumulation rates on

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two time scales.

General comments

I have some concerns about the use of the 210Pb dating method to determine short term accumulation rates. It seems to me that this approach hinges on the assumption that the effects of organic matter decomposition and vertical transport on the 210Pb profile are negligible. For both processes this may not be true. Decomposition is likely relevant, particularly for the dryer ecosystems. In fact, the authors acknowledge in the discussion that the accumulation rates is the result of the balance between input and decomposition. Significant loss of organic matter by decomposition would cause 210Pb to become more concentrated, resulting in underestimation of the age. In two cases the 210Pb age is significantly lower than the 14C age (Figure 1)–it seems to me that this could be explained by the effects of decomposition. With regard to vertical transport, the authors indicate that this may be relevant for the Tussock grass site (section 3.1) because of the occurrence of 210Pb in the mineral soil. However, the fact that 210Pb is not found in the mineral soil for the other sites is no assurance that vertical transport is not relevant there. It is good that the authors include 14C measurements for validation of the 210Pb ages. However, I think some more justification of the approach is appropriate. For example, based on previously published decomposition rates for similar soils the authors could estimate the effects of decomposition on the 210Pb concentration. Also, I think a honest discussion of the limitations and uncertainties in section 4 should be added.

Specific comments

- p 3/l 55-56: This sentence is not clear to me. What does "these ecosystems" refer to?

- p 5/l 116: please indicate the units of the mesh

- p 6/l 148: "Bulk peat samples" suggests that these measurements were only per-

formed for the fen/bog soils but later text suggest that these measurements were done for all sites. Please clarify.

- p 6/l 154: "age of that profile": is that the age inferred from the 14C measurement of the "basal soil organic horizon"? p 7/l 174: I found this sentence somewhat confusing. It seems that the sample, including macrofossils, is homogenized, which is not the case, I assume.

- p 10/ l 235: please remove the closing parenthesis ")" at the end of the sentence of insert an opening parenthesis somewhere appropriate

- p 11/l 266: It is not clear to me how decreasing q10 values suggest that oxygen availability is a dominant factor for C preservation

- p 12/l 311: please add "of" after "many"

- Table 3: The short term accumulation rates were determined horizon-wise in the table single numbers are given. Are these averages over all horizons?

- Table 3: Please indicate what the superscript letters a,b,c mean. In the text (section 3.3) it is written that the decadal C accumulation rates are not significantly different between the sites, but this is not clear from the letter "a" in the table.

- Table S2 (supplement), caption: I assume you mean "younger" than 1950, not "older"

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