Please note the reviewer comments are marked in black and the author comments marked in green.

Interactive comment on "Dynamic C and N stocks– key factors controlling the C gas exchange of maize in a heterogenous peatland" by M. Pohl et al.

Anonymous Referee #2
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This manuscript reports on a study of soil C and N stocks and C gas exchange in a disturbed peat and landscape. Three soils, representing a gradient in soil C stocks and GWL level were investigated. By recognising the heterogeneity of such landscape, and attempting to capture it in GHG exchange studies this project makes a very useful contribution to the scientific literature. Also, the concept of dynamic soil C and N stocks is interesting and warrants discussion in the literature.
Overall I am in agreement with the manuscript in its current from but feel that the following suggestions would improve it.

Comments of #2

1. Comment: Title: While it may have been a peatland can it still be called that? There is a mosaic of soils but can an arenosol be considered peat?
   - Of course, an Arenosol is not a peaty soil. The term "peatland" is used in a broader sense to characterize the landscape. It is (still) largely dominated by organic soils, but reveals smaller patches of sandy soils.

2. Comment: L28 How can this be considered a gradient of pedogenesis? Are these soils not the result of drainage and disturbance? Indeed more detail is need on this regarding the study sites. Can the authors provide information on the disturbance history?
   - The reviewer is right. The sentence is rephrased in lines 26-27 (page 16136, lines 13-15): "…, where we selected three soil types representing the full gradient in GWL and SOC stocks (0-1m) of the landscape: …".
   - As the reviewer suggested we also added a short paragraph summarizing the land use history (point 2.1, page 16140, line 7, now lines 125-141).

3. Comment: L167 More detail is needed. Was the model run separately for each soil type and if so how were the differences in soil properties overcome?
   - The models were calculated separately for each soil type. We therefore described in this paragraph (page 16141, lines 9-14) that site-specific half-hourly temperature data was derived from correlations between the respective half-hourly climate station temperature records and site-specific, manually measured, discontinuous temperature data. Differences in temperatures models between soil types are likely related to differences in soil properties.

4. Comment: L255 More detail is needed on why NEE was transformed in this way.
   - In order to allow for application of the log link function for GLM analysis, data must consist of positive values only. As CH_4 and NEE fluxes can be both positive and negative, data was transformed to all-positive values by adding the minimum value to all values (as stated on page 16145, lines 13 and 15), which is a common procedure prior to the application of

logarithmic functions in statistical analysis. We changed the beginning of sentence from: "Accordingly, …" to "Analogously, …" (page 16145, line 15; now line 270).

5. Comment: Given the importance of soil C dynamics I wonder why the authors did not measure heterotrophic respiration? This could reveal more about the influence of GWL and soil C on soil respiration.

   - The main reason for not presenting data on heterotrophic respiration is the fact that the function of the plant-soil system as a source or sink C gases is simultaneously determined by soil- and microbe-induced fluxes to the atmosphere and the plant-mediated C gas fluxes into the plant-soil system. In other words: correct statements can only be made if all relevant C gas fluxes are measured – as realized in our methodological approach. Measurements of heterotrophic respiration (i.e. system respiration without plant respiration) are thus insufficient to address the study objectives.
     We revised the relevant sentences in the introduction to emphasize this (page 16138, lines 1-10, now lines 64-75): "In light of the extreme complexity of site conditions, it seems quite unlikely that the common focus on interactions between C stocks and particularly relevant control parameters like groundwater and temperature (Adkinson et al. 2011, Berglund et al. 2010, Kluge at al. 2008, Jungkunst and Fiedler 2007, Daulat et al. 1998) will result in reliable and generalizable conclusions about the C gas fluxes of degraded fens; mainly because this approach fails to account for the plant-induced C gas input counteracting the C gas emissions determined by soil characteristics and microorganisms.
     Therefore, new insights are much more likely to be derived from system-oriented studies analysing all interrelated C gas fluxes, e.g. CH_4 exchange, CO_2 uptake during photosynthesis and CO_2 emission via respiration, together with the underlying processes and control mechanisms (Chapin III et al. 2009, Schmidt et al. 2011). Indeed, there are numerous indications suggesting that this approach may also be promising for the C gas exchange of drained fen sites."
     As well on page 16139, lines 19-24 (now lines 108-111): "The present study tests the above-mentioned assumption by means of multi-year manual chambers measurements, subsequent modeling and complex statistical analysis of all relevant C gas fluxes, i.e. the net CO_2 exchange resulting from gross primary production (plant photosynthesis) and ecosystem respiration (sum of plant and soil respiration) and the CH_4 exchange, of maize cultivated on different groundwater-dependent soil types representing a steep SOC gradient."

     Further details can be found in our reply to comment 1 of Reviewer #3.