

## Large carbon cycle sensitivities to climate across a permafrost thaw gradient in subarctic Sweden

This study used a biogeochemical model to examine effects of climate forcing biases in global climate reanalysis on carbon cycle predictions across a permafrost peatland thaw gradient. The main findings show that all peatland sites studied (bog, fen, palsa) remain carbon sinks, but that the bog and fen have a net positive radiative forcing because of high methane emissions. The study finds that climate responses can have major implications for carbon cycle dynamics in these systems. It is well written. Just a few comments below to help clarify some of the site descriptions, etc.

Specific comments:

Line 63-69: what about the mass-balance studies from Alaska that suggest that a significant portion of the permafrost peat is lost upon thaw (O'Donnell et al., 2014 Ecosystems, Jones et al., 2016 Global Change Biology).

Line 135-136: The seasonality of precipitation could be important. Is there information on whether its increased snowfall/depth (which could also warm soil temperatures)?

Study site description: has anyone studied the history of permafrost at this site (i.e., when it formed) and whether permafrost aggradation occurred syngenetically with peat accumulation? I would argue that this information is important in carbon dynamics with thaw.

Line 161: italicize *Sphagnum*

Line 173: It is unclear if the measurements described in this paragraph were conducted in this study or if the authors are reporting on measurements made by Bäckstrand et al. Perhaps that can be clarified at the beginning of this paragraph

Line 174-175: "chamber lids were removed in the Fall": Fall can be lowercase (as can spring, here and elsewhere; you don't capitalize "summer" later in the text). Can you be more specific about "fall" and "spring"? How closely did the measurements coincide with freeze-up and thaw? Which months? Do you suspect that there are winter emissions? How many chambers/peatland type? Do you have any idea when the fen and bog thawed (i.e., 5 years ago, 500 years ago, 1000 years ago) and when peat started accumulating at these sites? These could have important implications for emissions and the carbon balance of a peatland.

Line 365: how much does the water table fluctuate for the bog over the summer?

Line 408: "the higher CH<sub>4</sub> emissions in the fully thawed fen can be attributed to its faster thaw rate": Do you mean rate of seasonal thaw or do you mean rate of permafrost thaw? If permafrost thaw, how do you know how quickly it thawed?

Section 4.1, ~line 415: in addition to ALD, do you know if there is a talik in any of these peatland types in the winter? Also, I don't understand why the "fully thawed fen" or the bog have an ALD, if they're thawed. Perhaps a conceptual diagram would help readers envision the differences in permafrost regime of these different peatland types, or at least clarification about what is meant by ALD in the "fully thawed fen" and bog. An additional table might be useful that includes information about total peat depth, active layer depths, average water table depths, surface vegetation communities, and perhaps some information on the number of chambers per site (and was just one feature per peatland type studied or did you study multiple?)?

Line 481-482: Is the model dynamic? Is vegetation allowed to change as conditions change (wetter, drier), or did the model not run long enough for species changes to occur?