We would like to thank both reviewers (Dr. Jentzsch and anonymous reviewer 2) for their constructive criticism and comments that helped us improve our paper. In following we address the general comments raised and for minor comments we will take those into consideration during our final revision of the paper.

First, both reviewers commented the first two conclusions drawn from this study and its broad applicability. We agree that our study is based on a specific peatland system: continental bogs which covers majority of Canadian extensive peatlands (e.g. Webster et al. 2018, https://doi.org/10.1186/s13021-018-0105-5), thus drawing general conclusions to all peatland types should be avoided. In our revision we will rephase the wording to avoid confusion. However, note we have specifically discussed the future need to work on other peatland types, e.g. Line 391-393 and the need to study other restoration stages, e.g. Line 367-370. We also agree on the suggestions from both reviewers on revising the title to be clearer and add more details about the model descriptions.

On comments from Dr. Jentzsch (reviewer 1)

Dr. Jentzsch further suggested to elaborate structural changes in a restored peatland with time in the introduction section and move the explanations of model data discrepancies into discussion. We believe these are good ideas and will revise accordingly.

Specifically, they commented on the rationale of the selection of new acrotelm thickness 20, 40, 100 cm. These were designed to test the model sensitivity to different ecohydrology settings, representing a varying stage of post restoration. The acrotelm thickness was 30 cm in 2013 when the flux measurements started, thus the 20, 40 cm were selected by +-10 cm. Field data at BDB from earlier publications (e.g. McCarter and Price, 2015, https://doi.org/10.1002/eco.1498) suggests ~2009 (c.a. 10 years after restoration) the new acrotelm is ~15-20 cm thick, we would expect that with a decadal or two 40 cm thickness would be reached. Thus, the testing range 20-40 cm roughly represents ~10 to ~30 years of post restoration. Another reason for selecting 40 cm is because the pristine peatland, Mer Bleue, another continental bog in Canada with an extensive research, has an acrotelm of ~40 cm (defined by average of long-term water table depth, see He et al 2023 HESS, https://doi.org/10.5194/hess-27-213-2023). The selection of 100 cm acrotelm thickness is hypothetical but rather used to demonstrate the importance of mestelm collapse layer in supporting the moss growth, and to validate/evaluate the ability of the model to reproduce the measured empirical threshold (-100 cm water tension) for moss growth. We have discussed this e.g. Line 381-384. This further shows the robustness of the model to reproduce the ecohydrological controls of the restored site. We are currently doing further research to attempt to simulate the creation of a mesotelm and new catotelm layer on top of the residual peat. This research will evaluate how the compaction/collapse of the mesotelm layer, by increasing bulk density, reducing porosity and hydrological conductivity of the mesotelm layer will influence the water table depth and water availability for the mosses and other vegetations. However, there are very few, if any restored bogs that are old enough to have developed a thicker restore peat layer than 30-40 cm. We are looking at some older block cut peatlands as an analog for older restored sites.

Dr. Jentzsch also suggested us to compare the simulated long term BDB CO2 flux data with the simulated MB data rather than measured data. While we are unsure if we fully understand the rationale behind this suggestion. The comparison (simulated BDB vs Measured MB) was made to show first the flux magnitude (mean), second the annual variations (S.D.). Our earlier model evaluation at MB showed that the simulated NEE was -67± 51 g C m^{-2} yr^{-1} for 2012-2016, -90 ± 35 g C m^{-2} yr^{-1} for 2004-2012 while the corresponding measured NEE was -102 ± 40 and -115 ± 33 g C m^{-2} yr^{-1}, respectively (Fig. 5b in He et al. 2023, https://doi.org/10.5194/hess-27-213-2023). This confirms that CoupModel can reproduce the measured S.D. as the observed MB data. Thus, no difference will make as the current version when we compare the simulated BDB vs simulated MB. Nevertheless, we will add the comparison in our revision.

We agree that the remnant infilled ditches can influence the C uptake functions as Dr. Jentzsch pointed out. Note Nugent et al. 2018 https://doi.org/10.1111/gcb.14449 discussed the influence of remnant ditches on C fluxes at BDB. Their analysis suggested the effect of ditches at the ecosystem level was small as ditches represent a minor fraction of BDB, but a higher CH_4 flux was measured when *Typha latifolia*-invaded drainage ditches were in the tower footprint. No clear influence on CO_2 was found. We will rephase the C uptake function here to CO_2 uptake function to avoid confusions.

Finally, we agree that an additional conclusion from our climate change simulations should be added.

On comments from reviewer 2

First Reviewer 2 suggested us carefully checking the terminology of C used in the paper, we fully agree and here only CO_2-C is addressed, we will revise that to avoid confusions.

Reviewer 2 also suggested to add details of the study site e.g. peat depth (mean peat thickness is ~2.2 m, and a maximum of 3.75 m), and vegetation composition. We will revise this in our revision.

Note details of flux footprint and vegetation survey distribution and results were given in Nugent et al. 2018 https://doi.org/10.1111/gcb.14449. Their footprint analysis revealed the restoration area was classified as 96% restored field and 4% infilled ditches. The restored section was surrounded by forested peatland which limits fetch to 200 m toward the west, 150 m toward the north and south, and 100 m toward the east (abuts an unrestored section). The dominant wind direction was west and north, but 30% comes from the south from August to December. Seldom is the wind direction from the east (ECCC, 2023 station ID: Riviere Du Loup). Table 1 from their paper (in Nugent et al. 2018 https://doi.org/10.1111/gcb.14449) shows the vegetation survey results and its distributions. Note the vegetation distribution in the field is quite homogenous across the major survey direction. There is difference for the remnant ditches and the field. However, since only 4% surface is covered by the ditches, and an average approach is used in CoupModel by using results of "all directions" (term used in their Table 1) to initialize the vegetation cover. Thus, we believe the influence of vegetation composition with tower footprint on our simulation results are minor. Unfortunately, a detailed footprint map is not available, but we will add a few sentences to motivate our vegetation initialization in the revision.

Table 1 Percent vegetation cover and ditch cover of BDB for three 30° direction bins for the area of the mean growing season 80% probability tower flux footprint, taken from Nugent et al. 2018 https://doi.org/10.1111/gcb.14449

Physiographic feature	Functional type	30–60° (NE)	200–230° (SW)	290–320° (NW)	All directions
Field	Vascular	66	76	72	75
	Ericaceous shrubs	36	42	42	39
	Sedges	27	35	26	33
	Typha latifolia	0	1	10	0
	Non-vascular	55	74	51	69
	Sphagnum	50	67	33	61
Ditch	Vascular	85	83	73	85
	Ericaceous shrubs	63	53	41	51
	Sedges	30	23	25	29
	Typha latifolia	0	6	19	6
	Non-vascular	41	39	57	44
	Sphagnum	14	7	2	8
FC_{ditch}		7	2	4	4

Reviewer 2 commented on the correlation analysis (see L 295-299) between the simulated annual CO_2 fluxes and the annual mean climate variables, i.e. precipitation and air temperature. The results show both non-significant correlations, but air temperature showed a slightly higher correlation coefficient. We will rephase this to make it clearer.

Reviewer 2 also suggested to provide some data for earlier years after restoration. We had provided that in the introduction section, see Line 56. These measurements were made right after the restoration and showed a source to the atmosphere 200-500 g C m^{-2} yr^{-1} (Petrone et al 2001, https://doi.org/10.1002/hyp.475)

We agree on the comments made on future climate extremes, nutrients and pH effects should be included in the future studies on L404-405, thus will add it into our revision.

Comments on Line 455, note we have described the trend of NPP moss in L. 276-278.

Finally, Reviewer 2 commented on the figures S3, S4 in the supplement, suggesting showing the climatic water balance – difference between precipitation and ET. We agree and will do that accordingly.