

Interactive comment on “Attaining Whole-Ecosystem Warming Using Air and Deep Soil Heating Methods with an Elevated CO₂ Atmosphere” by Paul J. Hanson et al.

Anonymous Referee #1

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The following is a review of the manuscript “Attaining Whole-Ecosystem Warming Using Air and Deep Soil Heating Methods with an Elevated CO₂ Atmosphere.” This manuscript details a newly developed air and soil warming study with elevated CO₂, located in the boreal forest of Northern Minnesota. The manuscript outlines the methods for achieving warming of soil and air, along with elevated CO₂. Undoubtedly this will be the foundational methods paper cited in future research articles.

Scientific significance: These types of large warming+CO₂ studies are highly valuable to the understanding of future climate scenarios and modeling of ecosystem carbon fluxes. This manuscript not only focuses on a study design that emphasizes temperature response functions, but tests a temperature increase much higher than past

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boreal warming studies (+9 C), which sadly could be a realistic scenario that hasn't been thought possible in earlier boreal warming studies. This study has the potential to significantly improve the current understanding of how boreal systems respond to warming and elevated CO₂, especially in respects to carbon budgets.

Scientific quality: The work that has gone into the outlined study is of high quality. The study design has been well thought out. The infrastructure to achieve the soil and air warming along with elevated CO₂ has been well tested and this manuscript illustrates the ability of the authors to achieve the goals of the study.

Presentation quality: The manuscript is well written, easy to comprehend and illustrates two years of environmental manipulation. Below I pose a few questions along with a general comment for the authors and editor to consider.

Overall, I believe this manuscript to be worthy of publication in Biogeosciences.

General comment: Hydrologic responses: An important component that I think is lacking in this manuscript are data relating to hydrologic changes due to the experimental manipulation. The hydrologic conditions drive this ecosystem, limiting decomposition and nutrient availability, while also suppressing soil carbon fluxes. The authors have chosen to allow soil drying (a viable future scenario) to occur with warming in this study. Lines 634-637 state that soil drying was correlated with plot temperatures, which is what readers would expect. However, readers will be interested to know the rate of change and magnitude to the water table with the various warming treatments. I would think a figure illustrating water table fluctuations and differentials between treatments would be very important. If the authors can provide data for the readers, it would be greatly appreciated.

Specific comments: Lines 147-158: Could you state the number of trees per open top chamber/plot, maybe it is a range?

Line 183: Was the regeneration of the black spruce natural or artificial? Trees are 5-8

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meters tall, but what is range in diameter? This will help readers better understand growth rates. I didn't see where the height of the chambers was mentioned. Please add this unless I missed it.

Figure 5 "Temperature profiles from -2m above through -2m below" : I have read this line a few times and I know what you are saying, but is the first -2m a typo? Did you mean to say 2m above the peat surface through -2 m below the peat surface? Something to look at.

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