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Interactive comment on "A zero power warming chamber for investigating plant responses to rising temperature" *by* Keith F. Lewin et al.

Anonymous Referee #2

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In this manuscript [bg-2017-208] Lewin et al. describe a novel chamber design for terrestrial ecosystem warming experiments. The chamber utilizes heat exchangers and a hydraulic piston system to vent a greenhouse-like chamber. Since this system operates on relatively simple, mechanical principles and does not require electrical power, it offers a potentially useful tool for experiments in remote settings where power supply and maintenance are often major challenges. The authors demonstrate that the prototype chamber increased daytime air temperature and average of 2.6 C, compared to an ambient plot and could achieve higher temperatures than a reference chamber with a fixed level of venting while avoiding the extremely high temperatures of an unvented chamber. As the authors rightly point out, there is a need for expanded experimental studies on the effects of warming temperatures on plants and ecosystems. Further-

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more, they note that all warming methodologies have potential shortcomings and that new warming techniques may be required for certain geographical, ecological (and cost) considerations. Overall, the authors present convincing evidence that this prototype chamber performs well under favorable, arctic growing season conditions. I list my questions and concerns below.

General Comments

I would also like to see more explanation of how the system is adjusted to control internal temperature (e.g. page 3, lines 27-32). It sounds like by adjusting the pistons, fluid, and vents, the chamber could be adjusted to maintain either a higher or lower amount of warming, specific to the local conditions. If so, this is a nice feature that could be highlighted more, but it also sounds like it might also require a lot of work during the installation phase.

Since the authors' intended setting for this equipment is in the arctic, it would be useful to know more about how the system might cope with more adverse weather conditions. Will the system be damaged if the hydraulic fluid freezes (below -10C) and if so, would the system need to be taken down before colder temperatures are expected? Additionally, how does the chamber perform under high winds or snow?

Overall, I found the design quite clever and am convinced that it performs better than a similar chamber with a constant amount of venting. However, I'm curious to know why they chose this approach, rather than a slightly more complex system, such as a computer-controlled venting system. Given that there is likely some power being used at one of these experimental sites (to operate meteorological dataloggers), and that solar and battery technology is increasingly efficient, adding a simple computer control system could be programmed to control temperature more precisely (possibly activating hydraulically-activated vents). The system relies on passive solar, so my guess is that solar panels might work. Cost and transport considerations could be the key factors, but I didn't see a clear rationale. Perhaps providing some information on shipping

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weight and volume or cost comparisons could help to really show the advantage of this method. Otherwise, if it's simply a matter of reliability, that's potentially valid as well.

Specific Comments

From an organizational standpoint, I would consider the analysis of attenuation of solar radiation is a characteristic of the "chamber operational overview" and should appear in that section (3.1). Especially considering the prototype and reference chambers had similar materials.

The suggestion that the "potential for negative impacts of an elevated VPD on stomatal conductance and photosynthesis is minimal" (P9, L24-25) may be valid for this system, it may be worth noting that it may not be valid for all ecosystems.

Technical Corrections

The term "snapshot" (P6, L10 and elsewhere) seems a bit colloquial. Consider using a phrase like "sample time series" or "sample period of data".

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