Reply on RC1
Jennifer A. Holm et al.

Author comment on "Exploring the impacts of unprecedented climate extremes on forest ecosystems: hypotheses to guide modeling and experimental studies" by Jennifer A. Holm et al., Biogeosciences Discuss., https://doi.org/10.5194/bg-2022-65-AC1, 2022

Dear Biogeosciences Reviewer,

We appreciate your review and comments on the following paper “Exploring the impacts of unprecedented climate extremes on forest ecosystems: hypotheses to guide modeling and experimental studies”. Your time spent on this peer-review process is appreciated. There are valid points raised, and others that we help to clarify. Below is a point-by-point response to the reviews.

In general, we think clearly stating at the beginning of the manuscript that this study was not intended to solely be an original research paper, but rather a review of how models currently capture unprecedented climate extremes on forest ecosystems by using a handful of novel model results, will alleviate many of the reviewers’ concerns. In order to fully investigate responses to such novel climate extremes that have not been experienced, we had to generate original model results which we believe is a strong novelty of this paper.

R1 has concerns about:

1. R1: The novelty of the paper; and whether this paper was a review paper or a research paper.

Answer: We believe the strong novelty of our study is the assessment of unprecedented climate extremes (UCEs) and their impacts. In the revised manuscript, we will improve the text about tighter linkages between concepts, hypotheses, and model outcomes. For example, we want to emphasize that a goal of this paper is to demonstrate how to use these vegetation demographic models (VDMs) to help generate future hypotheses about UCEs. Therefore, we used the models and sites as conceptual “experimental” tools to investigate the given hypotheses.

We will also revise the manuscript to state more clearly at the beginning that this is more of a review and “guidebook” manuscript, but with a combination of original research in order to address novel forest responses to climate extremes. We believe this combination of original research with review of current limitations of models is a strong novelty in and of itself.

We would like to clarify that the original “research” aspects of this study were the new
UCE model results, and specifically the integrated C-loss with sensitivity to different climate change treatments which has not been done with these models, and is a knowledge gap that was filled by this study. The discussion section and detailed tables are designed to be a “review” and to help guide future research.

2. R1: While one paper can only tackle so much, R1 thinks this study would benefit from additional simulation experiments.

Answer: The scope of our paper was not to do many, in-depth, detailed experiments. But rather focus on how models currently capture UCEs in extreme durations/lengths and interactions with climate change. Therefore, we are not fully sure if there would be a strong benefit to adding in additional simulations experiments, which would be a large, costly endeavor and make the already very long manuscript even longer.

Probably the strongest point to not adding more simulations, is that additional simulations as suggested by R1, by itself, may not lead to the novelty and clarity that R1 seeks. We plan to re-write the manuscript to state that outstanding modeling perturbations and experiments are for subsequent studies. The initial modeling investigation here was to highlight how VDMs (as opposed to typical LSMs) could be used to answer hypotheses and guide future studies.

3. R1: Lack of model validation at the two sites, and site-level observations to inform model parameterization.

Answer: We agree that model comparison to some site-level observations is a worthy improvement to the paper. Upon revision of the manuscript, we will include site level benchmarking observations such as biomass, stand density, and leaf area index to do basic level model validation. We will also add a sentence that both models have already been run and validated at these sites in previously published papers (Xu et al. (2016); Medlyn et al. 2016), thus making model application possible with a “built in” reasonable degree of validation. These references were included in the original manuscript, but we failed to make a clear connection that they were publications that validated the models at the two sites.

4. R1: Reporting uncertainties in model parameters.

Answer: The ED2 and LPJ-GUESS models are well documented and investigated VDMs, with many previous studies that have looked into parameter uncertainty. Upon revision of this manuscript we will include a general description of the model parameters with the largest uncertainties. For example we know that parameters related to plant hydraulics and non-structural carbohydrate storage have large uncertainties and thus included these parameters in Table 1.

However, the aim of the paper was not to do in-depth, detailed experiments with tuned parameters specific to each site. But rather set up a general modeling framework so that hypotheses about unprecedented climate extremes could be investigated, and provide understanding on how model behavior of physiological and ecological processes might be lacking in state-of-the-srt ecosystem models in order to capture extremes.

We were glad to hear that R1 thought the paper was a “very informative read” and that “the presented framework is practical and logical”. As well as “the manuscript is in itself coherent, well-written, the structure is easy to follow with the aid of straightforward visualizations and tables.”