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Interactive comment on "Critical impacts of global warming on land ecosystems" *by* S. Ostberg et al.

Anonymous Referee #1

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The following are the primary areas of concern:

1. The methods for computing the impact metric (page 546) and for computing new climate scenarios (page 549) are critical to the study but hard to follow. Please improve the explanations (perhaps a schematic is needed for the latter).

2. Consider exploring which terms in the impact metric are most important for generating severe changes, by biome.

3. How does CO2 fertilization affect the results?

Specific recommendations:

Abstract. Quantifying potential impacts to ecosystems in not just important to mitigation but also adaptation.

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Abstract. "...limits warming to around 2 degrees..." Is this referring to global mean temperature?

Abstract. "...may experience at least moderate change" Moderate change to what specific land characteristics? The current text is vague.

Abstract. Define the acronym for AOGCMs.

Page 543. "Complicating the matter, there is considerable uncertainty..." It is worth mentioning the uncertainty related to decadal variability and therefore the need for multiple ensemble members even for single GCMs. Clara Deser has demonstrated that projected trends in temperature can vary dramatically by the mid-21st century from ensemble member to member for a single GCM.

Page 544. What is meant by "the space of GMT increase"? Please reword.

Page 545. What is meant by "interrelation of exchange fluxes"? Please reword.

Page 546. Define all of the variables in equation 1.

Page 546. The paragraph "Changes in vegetation....just one." is very unclear but critical to specifically understand how to compute the impact metric. Are all terms normalized? How are variables such as transpiration, PFT change, soil moisture, etc... combined into a single measurement?

Page 546. It would be very interesting to investigate which of the terms in equation 1 were the main drivers of projected severe ecosystem change. The metric could be computed by one term at a time to isolate the important sources (e.g. are changes in fire regime critical). The important terms likely differ by biome, so they could be grouped.

Page 547 and Supplemental Text 3. What specifically in the calculations allows a change from category A to B to produce a different impact metric than a change from B to A? It is worth discussing an example from Fig. S2.

Page 547. Spell out the acronym for LPJmL.

Page 548. What data is used to identify cultivated regions?

Page 549. It is worth discussing the MAGICC6 model given its importance to the study.

Page 549. The paragraph "We address. . . GMT change." is unclear. If needed, add a schematic to explain the methods.

Page 550. Change "Climate Research" to "Climatic Research" for CRU.

Page 550. Do the LPJmL simulations apply a CO_2 fertilization effect? How does that impact the sensitivity of different biomes and the area with severe ecosystem impacts?

Page 551. All of the non-Arctic regions that show up in red in Figure 2a are water-limited regions (not temperature), as shown by Nemani et al. (2003 Science).

Page 552. In Figure 2c, what do the less sensitive regions have in common?

Page 552. The areas that are most vulnerable appear to be savannas, tundras, and forest ecotones.

Page 553. How will consistent precipitation projections, among CMIP3 models (e.g. increased precipitation across the high latitudes) affect your temperature-based results? Not all precipitation projections among the GCMs are inconsistent (Kutzbach et al. 2005 GRL).

Table 1. Is "soil water content" referring to the total column or top-most 0.5 m layer?

Figure 1. In the caption, arrows are mentioned but there are no arrows in the figures. On the right of each plot, there is a vertical line with 2.0K, 3.5K, and 5.0K. Please explain.

Figure 3. This figure is hardly used at all. Can the different shapes of the curves by biome class be explained (perhaps linked to bioclimatic thresholds)? For example, why does the area of rainforest experiencing at least moderate change increase abruptly

after 3K? Does the model include the boreal heat stress factor? It is worth discussing why certain biomes are more sensitive than others.

Supplemental Figure 1. As far as I can tell, this figure was never cited.

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