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Biogeosciences
Discussions

Interactive comment on "Evaluation and improvement of the Community Land Model (CLM 4.0) in Oregon forests" *by* T. W. Hudiburg et al.

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Author Comment to Referee #2

We thank the referee for valuable comments and respond to each below.

1) In Section 2.3, should this not be Table 2? And Table 1 is not referenced anywhere ein the text apart from here in error. Check the table numbering in general.

Response: Thank you for pointing this out. The reference to Table 1 will be changed to Table 2. A reference to Table 1 is now included in the Introduction, Methods, as well as in the Discussion section 4.1. We will also include a statement in section 4.1 about the spatial heterogeneity of the study region in general with reference to Table 1.

2) NRC reference is incomplete in Section 2.5.

Response: Thank you for noting this. We have updated the reference.

3) App. A, what is FSDS?

Response: Incoming shortwave radiation. We have clarified this in the Appendix.

4) Table 3, could you spell out Y and M?

Response: Yes, we can easily do this in a revised version of the manuscript.

5) Table A3 has the header below?

Response: This is a typesetting error we did not catch in the proofs. Thank you for finding it.

6) At times I feel the results have a laundry list feel to them. I am having a hard time seeing a transition from Results to Discussion. You might consider lumping these together as there is some redundancy across sections.

Response: We agree with the reviewer and can remove some of the redundancy. This should also help the overall length. We choose to keep the sections separate as we have added more discussion per the recommendation of another referee.

7) "In the summary, you mention how adjusting for historical harvest and fire emissions, as well as allowing stem wood allocation to vary with age, would likely improve model performance? Why did you not do this? I am especially concerned about the harvest and fire emissions. These are fairly straightforward to get. And having them would remove some of the guess work as to where model-data mismatch (MDM) is coming from? Is not the idea here to isolate what structural characteristics of the model are leading to MDM? In that case everything that confounds that should be controlled for. I will note that I am unsure how easy it would be to hard-wire historical trajectories of harvest and fire emissions into CLM.

Response: We agree with the reviewer and have spent a considerable amount of effort diagnosing the MDM. First, we would like to correct the statement that stem wood allocation does not vary with age. This is not entirely true because the equation allows for variation with the cumulative sum of annual NPP, which does result in different allocations at different age classes and we did adjust the equation to represent some of the variation across the region (Discussion section 4.1). However, there is still a considerable amount of work that could be done with age-related allocation for all plant components (not just wood) and physiology in CLM4 which is beyond the scope of this project. We showed that adjusting the equation to account for some regional variation helped, but did not solve problem entirely (Appendix A, section A3 and figure A1). We modified the text as follows: "The variation in stem biomass within an ecoregion varies by a factor of 4, especially in the Klamath Mountains, and capturing this type of variation would most likely require age-class dynamics be added to CLM for more than just stem wood allocation. Using existing foliage and wood NPP data computed from supplemental plots, we developed dynamic ratios of wood to foliage allocation that vary with annual NPP by ecoregion. Addition of subgroups within PFTs (e.g. pines versus firs) for the ecoregions with larger variation would also improve the model results, but may not be practical for larger regions."

Harvest: First, it would be relatively easy to adjust for harvest removals and biomass combusted in fire events for the historical period of a small portion of the region, but this would be an enormous task to reconstruct a historical harvest and fire history for each of grid cells at this spatial resolution over the 150 year simulation period. We stated this would be easy for future simulations because for future simulations, the harvests rates can be whatever we want them to be per management guidelines and plans. We will state this more clearly in the manuscript. The provided historical harvest dataset has already accomplished this, based on the same historical records available to us. Federal inventories, remote sensing, and timber records were used to create historical harvest rates at half-degree resolution from 1850-2006. The regional harvest rates in current decades match very closely with our estimates, but the spatial variation varies

with overestimates in the West Cascades and Klamath Mountains. We were able to correct for one obvious error in the Klamath Mountain historical data since submission that resulted in increased mean stem biomass and we will include this in the revised manuscript.

Fire: The fire algorithm would also have to be turned 'off' in CLM and fire would have to be prescribed for this to work. Since we are also using CLM to make future predictions about fire and harvest, we needed to be able to use the fire algorithm and evaluate the emissions and burn area with observations as well. We reduced the fire woody biomass combustion coefficients in the model by 50% based on regional data (methods section 2.3), but we did not change the fire prediction routine or fire burn area calculations. This is an area of research for future versions of CLM (episodic fire rather than a 'slow trickle' of fire). In the meantime, we made historical comparisons of CLM4 simulated burn area (See attached figure and caption A2) with other datasets (MTBS; Eidenshink, J. et al. 2007 and GFED; van der Werf, G. et al. 2010) and show both over- and underestimation by CLM4 (see figure and caption below). The Global Fire Emissions database (GFED) underestimated burn area by 15% for the Oregon Biscuit fire in 2002 and was consistently the lowest burn area estimate compared other models in a synthesis by French et al. (2011). We will include this analysis in the appendix of the revised manuscript.

References: 1. Eidenshink, J. et al. A project for monitoring trends in burn severity. Fire ecology 3, 3-20 (2007). 2. French, N. H. F., W. J. de Groot, L. K. Jenkins, B. M. Rogers, E. Alvarado, B. Amiro, B. de Jong, S. Goetz, E. Hoy, E. Hyer, R. Keane, B. E. Law, D. McKenzie, S. G. McNulty, R. Ottmar, D. R. Pérez-Salicrup, J. Randerson, K. M. Robertson, and M. Turetsky. 2011. Model comparisons for estimating carbon emissions from North American wildland fire. J. Geophys. Res. 116:G00K05. 3. van der Werf, G. R., J. T. Randerson, L. Giglio, G. J. Collatz, M. Mu, P. S. Kasibhatla, D. C. Morton, R. S. DeFries, Y. Jin, and T. T. van Leeuwen. 2010. Global fire emissions and the contribution of deforestation, savanna, forest, agricultural, and peat fires

(1997â€`2009). Atmos. Chem. Phys. 10:11707-11735.

Interactive comment on Biogeosciences Discuss., 9, 12757, 2012.

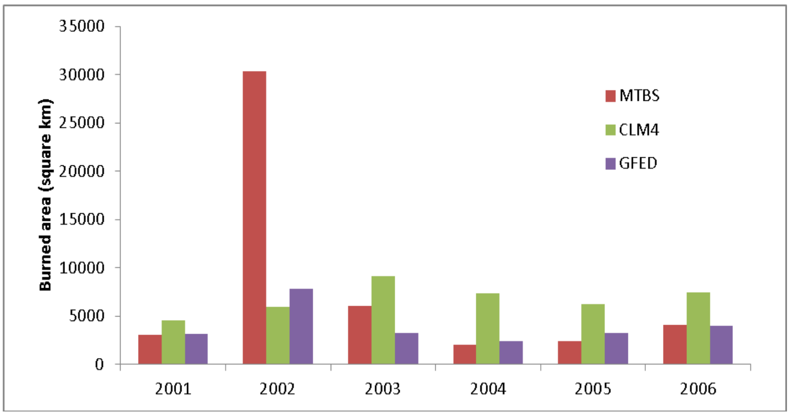

Figure A2. Historical annual area burned in Oregon (km^{-2}). Estimates are from the Monitoring Trends in Burn Severity database (MTBS; Eidenshink, J. et al. 2007), the Global Fire Emissions Database (GFED; van der Werf, G. et al. 2010), and CLM4. CLM4 overestimates burn area in Oregon for all years except for 2002 compared to the remote sensing based estimates. CLM4 does not include a fire suppression algorithm that could be contributing to the high bias. However, burn area estimates do not exceed more than 2% of the land area for any year. GFED estimates are known to be the lowest for burn area compared to other models (French et al. 2011)

Fig. 1. Figure A2