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Interactive comment on "Predictors and mechanisms of the drought-influenced mortality of tree species along the isohydric to anisohydic continuum in a decade-long study of a central US temperate forest" *by* L. Gu et al.

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This study explores drought-induced tree mortality over a 10-year timespan in a temperate forest in the central US. Measurements of predawn leaf water potential and tree mortality were collected for six tree species throughout the growing season, so it is a unique, long-term dataset that spans years of moderate to severe drought. There were no direct measurements of mechanisms of tree mortality during drought (such as native embolism or changes in non-structural carbohydrates), however, so it would be appropriate to reduce mention of "mechanisms" throughout the discussion (and in the

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title).

I recommend removing some of the figures that are repetitive (e.g. Figures 9-11) and developing other points in the discussion (Figure 5). The authors have an excellent dataset for further developing an analysis of differential effects of moderate versus severe drought. The study found that stem mortality lagged 1-2 years after drought, and species intermediate along the anisohydric-isohydric continuum had higher survival over the decade of moderate to severe droughts.

Introduction

Well-written, good summary of drought strategies in trees.

This paper focuses on a current hot topic in research (mechanisms of mortality during drought), and the background information in the Introduction could be updated:

P1287, line 14-17 states that loss of conductivity "has not been clearly established as a direct agent of mortality in mature plants." This is incorrect (as mentioned in the discussion). Hydraulic failure is nearly universally high during drought mortality events and has been implicated as the mechanism of tree mortality in mature aspens in Colorado (see Anderegg et al. 2012, reference provided below).

McDowell et al. 2013 (reference below) also found an interdependency of carbon and water during drought mortality and could be cited in P1287, line 21.

P1287, line 14-17: Besides biotic agents such as insects and pathogens, fire can also interact with drought to cause tree mortality (see Pratt et al. 2014, reference provided below).

Materials and Methods

Gu et al. (2015) has been cited frequently in the methods of this paper, yet it is listed as "under review". These citations should be removed, unless it is accepted for publication in the near future. Then cite as "Gu et al. (in press)".

Wordy in places, could be condensed:

P1289, line 15-17 could be reworded to "The study was conducted at the Missouri Ozark AmeriFlux (MOFLUX) site, previously described in Gu et al. (in press)." Or if Gu et al. (in press) is not accepted before press of this paper, delete its mention entirely.

P1290, line 11 could be reworded to "Measurements of precipitation, temperature, and relative humidity were made at the top of the 30 m flux tower. . ." and then delete these statements from lines 15-16.

P1291, line 23-24 should be deleted and "mean daily precipitation rate" should be listed with other predictors in line 20.

P1292, line 21 delete "if happens".

P1291, line 7: Were samples collected at ground-level for all trees? Any samples collected from high in the canopy?

P1291, line 2: How "frequent" were visits to the site to monitor tree mortality?

How is the PLWPI calculated? The description is vague in P1292, line 1-2. Based on the units in Figure 4, it looks like a summation of seasonal water potentials, rather than an average. Please include an equation with units for repeatability. Should the units be MPa day-1 instead of MPa day?

P1295: The description for PTAI and VPDI is also vague. Figure 8 shows annual values, but over what time interval were these values calculated? (I see this information is given later; perhaps state earlier?) Are there gaps in the MOFLUX tower meteorological data? If a lot of data was missing, couldn't this affect the values since they are summations? How were gaps handled?

Results

In general, it is better to simply state results and reference the figure, as in P1297, line 21 "Potential abiotic factors of tree mortality varied widely. . . (Figure 1)". Avoid phrases like, “Figure 1 documents that from. . .”

Be careful to only state results in the Results section, and leave interpretation for the Discussion:

P1299, line 11-15: Leave classification of species as anisohydric or isohydric for the discussion.

P1300, line 1-3: Remove from results, put in discussion.

P1301, line 17-18 and 23-24: Remove from results, put in discussion.

P1297, line 24-25: Could you include a general description of drought severity? Were the droughts in 2007 and 2012 classified as severe? Were other years (2011, 2013) classified as moderate drought years?

Figures 2-3 should be combined into one figure, since they show the same relationship for different study years. Perhaps just use “Figure 2 continued on next page” if necessary.

Figure 5: Very interesting! Check units of PLWPI, should it be MPa day-1? Include a description of how community PLWPI was calculated in the caption?

P1300, line 5-18: Long, could be condensed. Delete lines 7-14?

Figure 6: It is not clear from the caption what is represented on the Y-axis. Is it tree diameter? I would recommend adding labels and units, perhaps replace the labels 1-10 with actual size classes (such as <6 cm, 6-12 cm, etc.).

Figures 9-10 might be better placed in the Supplement. There is little mention of them in the Results, and the community patterns are already illustrated in Figure 8.

If a linear relationship is used in Figure 11, is there still an improved prediction relative to Figure 8d? It is not a fair comparison if different prediction equations are used, plus it is not overly convincing as an exponential relationship. Regardless, Figure 11 does

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not need to be included. It would be enough to state that using a composite MEPI5 improved prediction of community stem mortality from R2=0.84 to R2=0.93 (if true).

Figure 12: Interesting! The caption has a typo: “diving” should be “dividing”.

P1302, line 6-15: Could be deleted, because Figure 12 is a better illustration of this pattern.

Discussion

P1303, line 24-25: This is an excellent dataset to examine the importance of drought severity on stem mortality. It would be worth developing this point more, examining the different impact of a severe versus moderate drought on plant physiology.

P1304, line 7: It is difficult to state that hydraulic failure was not a factor in this forest, as native embolism or PLC was not measured. There were likely losses of conductivity, at least in 2012 when observations of leaf scorch were made.

P1305, line 17-29: Description of previous studies could be improved to highlight the contradiction amongst studies, relative to ecosystem type (since anisohydric species can only be compared relative to isohydric species within an ecosystem). For instance, “Anisohydric species have shown higher dieback during severe drought, relative to more isohydric species, in Australia and the eastern US (Rice et al. 2004, Hoffmann et al. 2011). In contrast, an isohydric species had much higher drought-influenced mortality than a co-occurring anisohydric species in the southwestern US.” Also clarify your findings in P1306, line 1-3: “Our results reveal that both anisohydric and isohydric species have higher stem mortality than species that fall intermediately between the two extremes.”

P1306, line 4-10: Very interesting! Might be a good ending point.

Conclusions

P1307, line 13-14: Hydraulic failure has been determined to cause dieback or mortality in multiple species. Change wording from “postulated” to reflect this fact.

P1307, line 15: “death” not “depth”

References

Anderegg, W.R.L., Berry, J.A., Smith, D.D., Sperry, J.S., Anderegg, L.D.L., Field, C.B. (2012) The roles of hydraulic and carbon stress in a widespread climate-induced forest die-off. Proceedings of the National Academy of Sciences of the United States of America 109, 233-237.

McDowell, N.G., Fisher, R.A., Xu, C., Domec, J.C., Holtta, T., Mackay, D.S., Sperry, J.S., Boutz, A., Dickman, L., Gehres, N., Limousin, J.M., Macalady, A., Martinez-Vilalta, J., Mencuccini, M., Plaut, J.A., Ogee, J., Pangle, R.E., Rasse, D.P., Ryan, M.G., Sevanto, S., Waring, R.H., Williams, A.P., Yepez, E.A., Pockman, W.T. (2013) Evaluating theories of drought-induced vegetation mortality using a multimodel-experiment framework. New Phytologist 200, 304-321.

Pratt, R.B., Jacobsen, A.L., Ramirez, A.R., Helms, A.M., Traugh, C.A., Tobin, M.F., Heffner, M.S., Davis, S.D. (2014) Mortality of resprouting chaparral shrubs after a fire and during a record drought: physiological mechanisms and demographic consequences. Global Change Biology 20, 893-907.

This was an interesting study to review, and I hope these comments are helpful,

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Interactive comment on Biogeosciences Discuss., 12, 1285, 2015.

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