

General Comments -

This manuscript gave an in-depth review of our current understanding of dryland eco-hydrology and technical advances in the quantitative assessment of human versus climate change related drivers of fundamental ecological and hydrological issues in dryland. This is a timely synthesis considering the renewed interest from both research communities and agencies on the climatic change impact on the dryland ecosystem and the resultant alteration of dryland ecosystem goods and services. This manuscript is well prepared and written and should be very valuable for both the researchers and land managers in both arid and semiarid land regions.

The following are three of my suggestions for changes; the specific comments following the suggestions are mainly editorial correction for typos.

1. The interactive effect of fire and encroachment is somewhat confusing in the way it is written (Page 4793 L7). Based on my reading, the authors suggest that drought and fire are going to result in more woody encroachment in Southwest US. If this is what the authors believe, I think the authors need to collect more citation/evidence to support this assertion. In general, the lack of fire or above-average precipitation is the main driver of woody encroachment. Using West US as an example, though fire does not easily kill mesquite, fire does usually result in decrease in mesquite density. Creosote bush definitely does not survive well with fire. Juniper is fire intolerant and fire definitely will not lead increase in wood density. The example of Eucalyptus response to fire in Australia seems to be in an odd to those observed in North America, but we need to make this more explicit.

We reworded this paragraph and combined this paragraph with the following one to make it more consistent with the current literature findings.

“These effects are likely to change markedly with increases in global temperatures, increases in the severity of high intensity rainfall events, and greater spatial variability in groundcover and therefore the capacity of the soil to resist erosion. The replacement of grassland by shrubland exposes more of the surface to the action of raindrop impact resulting in accelerated erosion and potential sedimentation (Abrahams et al., 1994). These regional studies reinforce the notion that more catchment-specific data are needed for both the ecological (e.g., tree rooting depth, canopy architecture and structure, depth of water intake) and hydrological (soil texture and hydraulic conductivity, soil moisture availability, hydrological connectivity) components of these systems, in order to improve our catchment wide modeling of the likely ecohydrological effects of vegetation change.”

2. One of the challenges as I can see in dryland ecohydrology is the disconnection of researchers focusing on upland processes (ecophysicologists, hydrologists) and those primarily on the biological processes in the streams (stream ecologists). Stream ecologists may view aquatic ecosystem and associated fish and wildlife as being the “eco-“ in ecohydrology and the renewed interest in environmental flow calls upon such intergradation. Authors mentioned the impact of upland activity on stream and fluvial habitats (4785 L5) which is very good. It would be great if some information of impact on stream and fluvial habitats for fish and wildlife in dryland can be provided. This is

only a wish list from me and it could be out of the scope of this review or out of the comfortable zone of authors. I would be equally supportive if authors want to have only a short paragraph to raise this issue as a challenge or authors decide not to address this issue in this review at all.

We agree with reviewer that terrestrial-aquatic interactions are important in ecohydrology. We added further discussion materials on this.

“One of the challenges in dryland ecohydrology is the disconnection of research focusing on upland processes and studies on stream biology. When some of the methods developed in humid regions are applied to drylands, some distinctive ecohydrological features of dryland streams need to be accounted for. For instance, biotic indices (e.g., invertebrate taxa richness) can be used as indicators of stream health and land use impacts (Lenat and Crawford, 1994), and to characterize terrestrial-aquatic interactions in drylands, but characteristics that are uniquely associated with drylands (e.g., ephemeral streams) need to be considered and further explored.”

3. In addition, the authors pointed out the runoff responses under different regions and vegetation types are the key uncertainty in the hydrological community (4791 L 26).

I agree with that we have very limited, controlled experiments to understand the hydrological responses due to woody encroachment into grassland and savanna (compared with forested land), I would argue the real challenge is, in fact, that we have limited understanding in terms of the runoff coefficient change for the same woody encroachment but under different precipitation region (or along a precipitation gradient) (See Huxman et al., 2005).

We agree with reviewer on this point and we added the following paragraph.

“More importantly, there is limited understanding in terms of the runoff coefficient change for the same woody encroachment areas but under different precipitation regimes.”

Specific comments –

4777 – Missing a “,” after “Odum School of Ecology and Warnell School of Forestry & Natural Resources”;

It was fixed.

4783, L23 – “dependent on more water resources than they do not control”. Change “than” to “that”.

“than” was changed to “that”.

4785 L5 – “Moreover, the conversion to cropland has the potential to reduce runoff dramatically with important impact on stream and fluvial habitats”.

The authors need to provide more evidence to support the point that conversion to cropland may reduce runoff.

We reworded this sentence and added one reference for this.

“Moreover, the conversion of grassland-dominated system to cropland has the potential to reduce runoff dramatically (Twine et al., 2004) with important impact on stream and fluvial habitats.”

“Twine, T. E., Kucharik, C. J., and Foley, J. A.: Effects of land cover change on the energy and water balance of the Mississippi river basin, *Journal of Hydrometeorology*, 5, 640-655, 2004.”

4789, L4 –“Woody thickening or encroachment, is the increase in the density and cover of woody plants into open grasslands and woodlands, and is a global phenomenon (Archer et al., 1995)” – I would think thickening is a type of encroaching processes such as transition of cluster to woodland. But thickening cannot occur until there are woody plants already literally. Encroachment, to my understanding, also refers the process of woody plant moving into open grassland. So it might be better to use these two terms more deliberately.

We removed “woody thickening” to make the statement more accurate.

4790, L7 – “1. Enhanced levels of infiltration surrounding the canopy are a defining feature of arid zone shrub communities (e.g. Bhark and Small, 2003)” and L24 “3. The degree to which woody and encroached communities enhance water erosion (either through physical effects or by reducing infiltration) is poorly understood (Eldridge et al., 2003)”. Both increase and reduction in infiltration associated with woody canopy were explicitly stated here and needs some tight up. In addition, I would prefer not to use “enhance” before “erosion”.

We changed “enhance” to “increase”. Actually we refer to increase in “infiltration” and “erosion” associated with encroachment, they are not conflicting.

4971 – L19 – “However, the relationships among litter depth, type and interception are not known for semi-arid Australian landscapes.” I would not limit the statement to Australia only. I think this is not well known for the semiarid landscape worldwide in general.

We removed “from semi-arid Australian landscapes”.

4791 – L26 – “Data on the differences in runoff coefficients across soil types and vegetation communities are needed in order to parameterize runoff and erosion models for wooded communities.”

I think the big knowledge gap is, in fact, how the runoff coefficient changes across different precipitation for the same vegetation (encroachment species) that largely prevent us from parameterizing runoff and erosion model.

We added the following statement in the revision.

“More importantly, there is limited understanding in terms of the runoff coefficient change for the same woody encroachment areas but under different precipitation regimes.”

4793 – “Predictions of more frequent drought for the south-western US are likely to result in an increased frequency and severity of wildfires, increasing the proliferation of shrubs by removing competition from grasses and reducing biological soil crusts (Eldridge et al., 2011).”

I think the general opinion is that drought and fire prefer herbaceous life form and lack of fire increases the proliferation of shrubs. “proliferation of shrubs by removing competition from grasses” needs to have more vigorously test or evidence.

To avoid confusion, we combined this paragraph with the following one to make it more consistent with the current literature findings.

“These effects are likely to change markedly with increases in global temperatures, increases in the severity of high intensity rainfall events, and greater spatial variability in groundcover and therefore the capacity of the soil to resist erosion. The replacement of grassland by shrubland exposes more of the surface to the action of raindrop impact resulting in accelerated erosion and potential sedimentation (Abrahams et al., 1994). These regional studies reinforce the notion that more catchment-specific data are needed for both the ecological (e.g., tree rooting depth, canopy architecture and structure, depth of water intake) and hydrological (soil texture and hydraulic conductivity, soil moisture availability, hydrological connectivity) components of these systems, in order to improve our catchment wide modeling of the likely ecohydrological effects of vegetation change.”

4792 L20 – need a space after (2009).

It was fixed.

L4793 – “Here the replacement of grassland and shrubland exposes more of the surface to the action of raindrop impact resulting in accelerated erosion and potential sedimentation of drainage (Abrahams et al., 1994).”

Should be “replacement of grassland by shrubland”?

“and” was changed to “by”.