Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-548-RC1, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Water yield following forest–grass–forest transitions" *by* Katherine J. Elliott et al.

Anonymous Referee #1

Received and published: 23 November 2016

Comments to Author

Summary: This paper investigates the potential effects of land use and land cover changes on water yield (Q) and evapotranspiration (ET) by focusing on shifts in tree species composition during old-field succession. From a long data set (about 80 years) the authors observed a management induced change in vegetation from forest dominated by Quercus and Carya to grass and finally to regrown forest dominated by Liriodendron and Acer. These shifts were evident in the Q data. The conversion of forest to grass resulted in increases in Q, similar to previous studies that have studied the effects of clear-cutting on Q. The regrowth of forest, however, resulted in a decrease in Q and the shift in tree species composition resulted in Q becoming lower than in the original forest. The authors claim that this shift in Q was a result of changes in ET because of differences in water use among tree species. Liriodendron and Acer

have a higher water use than Quercus and Carya. The authors also observed monthly changes in Q, especially in wetter months.

Contributions: Knowledge about how vegetation influences ET and Q is still not well understood. This research is therefore timely and important, and a useful step towards a better understanding of these ecohydrological issues. The authors present a good data set that in itself is worthy of publication; I can imagine that many scientists in the field could make use of these data. The text is relatively well written and logically organized text. Still, I do have some remarks detailed in a number of general and technical comments below.

General comments:

One thing I found curious was that the focus is entirely on Q since ET is hardly mentioned in the ms. The authors claim to have calculated ET but the only data I found was a long term average calculated from long term precipitation and runoff. I have no doubt the authors actually calculated ET (and there is very brief description of how this was done in the Methods) but I think these results should be presented (could be in the supplementary info) for the reader to be able to compare changes in Q and ET.

I found the description of some of the methods to be unclear and too brief. This is unfortunate, since the ms otherwise is well-organized and well written. The lack of a thorough methods description makes it difficult to value the validity of the results. I kept thinking "this is nice, but since I cannot fully appreciate the methodology I cannot judge if the conclusions are correct and logically follow from the results". Some examples may illustrate my point:

-Section 2.3.1: how was basal area, aboveground biomass and LAI estimated? Equations here could clarify this.

-Section 2.3.2: there is no explanation of the model (or are there several models? – it was not clear to me) used to estimate Q without treatment effects (equation 1). Was

this model developed in this project (and if so, based on what? Derivation, please) or is this something the authors have used previously (reference, please)?

-Section 2.3.2: the difference between QT and QT hat was not clear to me at first. I think I got it after reading the section several times, but then I am probably doing some guessing

-Section 2.3.3: some of the data before the first treatment was used to find regression models between Q in the treatment watershed and the reference watershed, but why was not all data from the pre-treatment period used? Seems arbitrary.

-What is the rationale of using both equation 1 and equation 4? Do they model similar/same data?

These methods are key to understanding the paper and need to be thoroughly described and explained. Schematic figures could help (e.g. to describe the concepts of chronological pairing and frequency pairing), if applicable.

The authors report monthly deviations in Q, but I miss a thorough discussion about potential causes of some aspects of these results. There is a discussion about Q being lower than expected during wet months during the growing season, and I agree with the authors here, but why is there no effect during other months in the growing season (i.e. months that are not classified as wet). Should you not expect to see the same pattern in those months? And I found no convincing explanation to why Q is higher than expected during wet months during the dormant season. Also, according to figure 4b, Q is lower than expected at around average wetness during the dormant season. Why is that?

Other small comments:

-A map of the watersheds, rain gauges, weirs/flumes etc. could be useful

-Finally a very small comment, and I admit being perhaps a little too strenuous, but I found the usage of semicolon a bit strange from time to time. As far as I recall, semi-

colon is used to connect two independent clauses, or when listing units that include commas.

Altogether, this manuscript is a valuable addition to the scientific field and I support its publication in HESS. The science is as far as I can tell sound but the science communication could be improved. I recommend major revisions of the manuscript before the editor considers publication of the manuscript.

Technical comments:

Line 35: here you say that ET increase by 3.4% but in the main text it is 4.5%; which is it?

Line 62: remove “the” before Brantley

Line 63: why do you use a plus sign after 20%? I suggest you use > if you mean more than.

Line 67: This is not a recommended usage of semicolon. Semicolon is used to connect two independent clauses, or to separate units in lists where each unit contains one or more commas. It should very rarely be combined with conjunctions such as “and”.

Line 86: is “by” the correct preposition here?

Line 93: I found the word “studied” in this sentence strange.

Line 100: and I guess eastern in this case refers to eastern USA? Could be worth clarifying that

Line 101: Another use of semicolon that seems strange. While, in the meaning whereas, i.e. a comparison, should be separated by a comma rather than a semicolon

Line 102: I found this sentence unclear and I think that is partly because you have “rates” here. Are rates lower than L. tulipifera? Should the word “rates” be placed before the other species (Acer and Betula)?

Line 127-129: Why this hypothesis about monthly effects? There is nothing in the Introduction that prepares the reader for this hypothesis. You need some background or theory to argue for why this would be a relevant hypothesis. Now it feels like you added this hypothesis based on the results (which is odd!).

Line 138-140: A map of the relative positions and sizes of the watersheds, positions of rain gauges etc. would be nice.

Line 152: What do you mean by last decade here? The 1940s or 2000s or something else?

Line 168: Repetition of grass species – I do not think this is necessary.

Line 195: Remove “at diameter”

Line 201-203: How were basal area, aboveground biomass and LAI calculated? Equations could be useful (could even go into the supplementary info)

Line 225: model or models?

Line 226: What is the rationale of this model? Where does it come from? Derivation? Reference? You need to explain/derive this model. As it is now, I am left in confusion.

Line 239: P is not used in the equation. Is it necessary?

Line 244: Should this be Q(QT) or is there a Q too much? What is QT? Is QT observed Q in the treated watershed and QT hat the estimated Q in the treated watershed without treatment effects (estimated from the reference watershed)?

Line 251-252: I think I understand what you mean but I found this sentence unclear. Also, “basin” should be spelled with lower-case letters.

Line 264: Why did you use these years and not all pre-treatment years? Seems arbitrary.

Line 267: What does equation 4 do, that equation 1 cannot?

Line 279: I understand m and n, but where do the constants come from (0.40 and 0.20)?

Line 284: there is one parenthesis too much in the second term inside the square root sign. Should it be Ym in both terms? Then how do Var1 and Var2 differ?

Line 286: I think there is an equation number missing here

Line 287: “analyses” instead of “analysis”

Line 296: “. . .numerous species and stem diameter sizes. . .”

Line 298: “fitted” instead of “fit”?

Line 366: It would be nice to see these results. Also, the number here differs from the number in the Abstract

Line 375: Why >0.94 and not =0.94?

Line 379: no semicolon

Line 382: no semicolon

Line 383: remove “during” (or for)

Line 390: repetition of “for a” – remove one occurrence

Line 394: I suggest you replace the semicolon with a full stop.

Line 398: replace semicolon with comma

Line 411-413: Would it be possible to correlate the annual species weighted DWU with annual Q over time?

Line 416: What do you mean by “expected values” here? You have not calculated any expected DWU values.

Line 437: replace semicolon with comma

Line 464: Can you really draw this conclusion? You have no data on water storage, so you basically assume Q = f(S) and thus that S decreases when Q decreases. Would not this assumption contradict your assumptions when calculating ET? You assume that the change in storage is 0 over time when calculating ET, but in your further discussion (lines 466-480) you discuss carryover effects due to e.g. drought (i.e. less P than usual). If you calculate ET as P-Q you assume no change in storage during that time period.

Line 469: insert a “the” before “old-field succession watershed”

Line 470: “reference watersheds” or “the reference watershed”

Line 478-480: and why is Q higher in the treated watershed in wetter months during the dormant season? I found no explanation or speculation.

Line 481-483: Why is this effect only evident during wet months and not during e.g. months with normal wetness?

Line 516: no semicolon

Line 522: do you mean >75 year-old?

Line 538-545: I found most of this section repetitious. Is this section really necessary?

Line 552: no semicolon

Table 1: It is interesting that P differs between the treatment and reference watersheds (and the difference is about 10%) – are the rain gauges within the watersheds? If not, how far away are the rain gauges?

Table 2: Was the R2 for the evergreen really 0? If so, was that model ever used?

Figure 1: In the methods you mention estimating aboveground biomass but not leaf biomass – how was this estimated?

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