In this document we respond to all the comments of the 3 reviewers. We appreciate the generally very positive comments and use the opportunity to further clarify our methodology and our results.

Referee #1

Overview

The authors classify several hundred USA catchments according to hydrological signatures in the decade 1948-58, and then examine how that classification changes in succeeding decades. The authors' idea of testing whether hydrological classifications can be used to analyse hydrological change with time is new (at least to me) and worthwhile. However, there were a number of points where clarification is needed, and these are detailed below.

We thank the reviewer for his assessment regarding the novelty of our study. We agree that some aspects of our work can be clarified and respond to the detailed comments below.

Main points

1. 6601L24-25 "Climate change will increasingly create . . ." and all following text to the end of the paragraph. The sentences do not flow logically; I think the whole paragraph needs rewriting.

This paragraph will be restructured so that the message is clear.

2. 6603L14 "For a more detailed discussion of these signatures see Sawicz et al. (2011)." Only 4 of the 6 signatures used here were also in Sawicz et al 2011, who provided some justification for the selection of signatures: "largely uncorrelated and that have an interpretable link to catchment function". Why did the authors change two of the signatures? What is the justification for including Q_{10} and Q_{90}, and omitting streamflow elasticity and rising limb density?

This sentence was changed to reflect that only 4 of the 6 signatures used in this manuscript are used in Sawicz et al, 2011. The primary reason for omitting these signatures was because streamflow elasticity and rising limb density were shown to have the least amount of influence in the clustering algorithm used in Sawicz et al. (2011). As a result, we decided to replace these signatures with Q_{10} and Q_{90}. These new signatures contain different and uncorrelated (in relation to the other signatures) information about the hydrologic behavior of the catchment. We added a discussion of this rationale to the paper.

3. 6603L15 "The signatures used here are . . ." One of the Sawicz et al 2011 criteria for signature selection was that signatures be largely uncorrelated. Is there redundancy in using the slope of the FDC, and also Q_{10} and Q_{90} (whose difference will correlate with slope of FDC)? Or in using both B_{FI} and Q_{90} (which are likely to be correlated)? Why is Q_{90} in mm units, but Q_{10} in dimensionless units?

While it is true that the S_{FDC}, Q_{10}, and Q_{90} signatures are all based on percentiles within the Flow Duration Curve, the information that each signatures contains is different. The three signatures are largely uncorrelated with one other. The value of Q_{10} (which is normalized by the mean streamflow value, resulting in a dimensionless value) describes high flow of the system, Q_{90} describes the non-normalized low flow of the system, and the S_{FDC} describes the center of the FDC (i.e. the moderate flows). The primary reason for the normalization of Q_{10} and not Q_{90} is the meaning behind these signatures. Q_{10} when normalized gives us information about how high flooding events are versus the average flow. Q_{90} is a simple measure of the amount of water available at the 90th percentile. The correlation values between the signatures are shown in the table below.

4. 6604L1 "Ratio of snow days" I think it would be more hydrologically relevant to use the ratio of average annual snowfall (calculated using precipitation and a temperature threshold) to average annual total precipitation.

The reviewer's signature would put a stronger focus on how much precipitation falls as snow, while we were more concerned with the length of a potential cold season. We find our signature a valuable indicator of seasonality. We by no means claim that there aren't other useful signatures, but out initial investigation of an extensive list of signatures hydrologically relevant signatures, we limited our study to a set of roughly six signatures to make their use feasible.

5. 6606L11-15 "A more widely spread cluster of catchments is found along the southeast coast of the US and is characterized by the permeable geology of this region, exhibiting therefore flat flow duration curves (FDC) and relatively high baseflows (Group 2) (Bloomfield et al., 2009). These catchments experience storms of short duration with dry summers resulting in significant low flow periods." These two sentences seem inconsistent with one another. Can a region simultaneously have flat flow duration curves with high baseflows, and also have low summer flows?

The short answer to this is yes, and these catchments experience such behavior. June and July only consist of 16.7% of the duration of the year, but catchments belonging to Group 2 only experience about 7% of the total annual flow on average. The summer months of June and July experience the lowest flow values, and it is very likely that the streamflow during these months are not reflected in the S_{FDC} (representing only the center 33% of the FDC). These same catchments experience a median Baseflow Index value of 0.67.

6. 6607 and Figure 3 caption: "CART decision tree showing what physical and climatic characteristics control the classification". I found this statement misleading in two respects. First, because the CART tree shows how signature values control the classification, rather than how physical and climatic characteristics control the classification. Second, because the CART tree effectively is the classification, albeit summarised and simplified a little. The inputs to the CART tree were the inputs to the Autoclass classification, and the outputs of the CART tree are the classes produced by the Autoclass classification. The purpose of the CART analysis is unclear – is it intended to convert a black box classification process into a white box?

The caption for Figure 3 will be corrected to indicate that the signatures, not the physical/climatic properties, are the information that the decision tree is formed from. To answer your second point, the purpose of the CART analysis is to form a predictive model from which we can predict which class a new catchment will belong to on the basis of differences in the values for the six signatures.

7. 6608L18 "With the exception of the catchments in the western US, which experience a dramatically different distribution of precipitation" This complexity might be avoided if the authors used fraction of annual precipitation that falls as snow, rather than ratio of snow days.

See above response to comment 4.

8. 6609L8 to end of paragraph "We briefly discuss the potential impact of both climate and land use change on hydrologic signatures" I found much of the material in this paragraph quite

speculative; it needs tightening up or removing. While some specific comments are present in the paragraph, the entire paragraph needs critical review to identify unsupported assertions, vague statements of impact ("can allow more water", "might occur"), and statements of impact which do not specify the direction of anticipated change ("altering the distribution of", "Changes to S_{FDC} are influenced by").

We agree with the referee, and this paragraph was rewritten to ensure that any claims that are made have substantive reason/proof that they are so. However, because of the limitations of an empirical analysis and the data available, the conclusions that are reached can only be suggestions rather than validated results.

9. 6609L12 "These changes altered catchment behavior by impacting precipitation patterns" Such effects have been recognised for tropical deforestation and subsequent conversion to agriculture in eastern Amazonia and West Africa, but I am not aware of similar results for anywhere in North America, so a relevant citation is needed to support this statement.

The sentence was reworded so that this claim is removed.

10. 6609L14 "Logging for example can allow more water to be stored in the soil while simultaneously decreasing the amount of water leaving a catchment through evapotranspiration, therefore impacting runoff ratio (Woodbury et al., 2006)." I found this statement very unclear. I don't see how the Woodbury paper is relevant, since it does not address the effects of changes in land cover on any aspect of the water cycle. It is not clear whether the authors mean to say logging (where forest may be followed by either another forest, or by a new land cover) or deforestation. My understanding is that the main long-term hydrological effect of changing land cover from forest to short vegetation is typically a decrease in evaporation and an increase in runoff. The precise mechanisms by which these changes take place depend on the context; for some climates and tree species the change is mainly through a reduction in the interception of rainfall, but in other settings it is mainly through reduced transpiration (though there are numerous other consequential changes to water flow pathways).

The referee is correct with his assessment that logging does not impact runoff ratio and will be removed. Long-term effects of forested area changing to short vegetation is a general increase in runoff, and this statement will be made clear.

11. 6609L16 "Changes in agricultural extent will impact catchment behavior . . ." and also L19 "Increasing agricultural activity likely increases evapotranspiration" What was the land use or land cover before agriculture? Is the agriculture irrigated? If yes, is the water source for irrigation from within the catchment, or is it "imported" water via a canal or from regional groundwater?

Land-use for the states these catchments are located was largely grassland before the expansion of agriculture in these regions. The method of irrigation in the areas that experience increasing agricultural use is largely extraction of water through regional groundwater. Information including land-use prior to agriculture will be added, as well as a general mention of the possible irrigation water sources will be included.

12. 6609L16 "by altering partitioning at the land surface (for example changing S_{FDC}) or by altering the distribution of quick versus slow flow paths (B_{FI})." What is the difference between "partitioning" and "distribution of quick versus slow flow paths"? If partitioning refers to evaporation vs runoff, then surely R_{QP} is more affected than S_{FDC}? Why did the authors choose to use S_{FDC} as the example for partitioning?

Partitioning of water at the land surface can be interpreted in a number of different ways (evaporation vs runoff, overland flow vs baseflow, etc.). We agree that it is better to highlight the R_{QP} here as opposed to the S_{FDC}, and we have adjusted the wording to indicate this.

13. 6611L9 “We identify groups of catchments that change class assignment between decades” Given the arbitrary and sharp nature of the class divisions, we would expect some random changes in class membership between decades, because of sampling variability. Can the authors quantify the uncertainty in class membership? If hydrology was stationary, how many catchments are expected to change class each decade because of sampling variablity?

Yes, there is a degree of uncertainty in this classification. We will add some statistics on this that we already used in our previous paper (Sawicz et al., 2011, HESS). The interesting aspect is mainly which catchments are more or less similar with respect to their hydrologic behavior – and in how far climate controls this.

14. The authors do not cite much literature on the previously-identified decadal-scale changes in the hydrology of the USA. For example, I would have expected to work of Dettinger, Cayan etc on changes in winter and spring hydrology (streamflow amount and timing) in the western USA to be mentioned in relation to the change in number of snow days and its effect. Similarly the work of Bosch and Hewlett and others more recently, in relation to impacts of forest-related land use changes. Also, the papers by McCabe and Wolock (1997) or Lins and Slack (1999), which had the same US-wide examination of trends in streamflow. There are also numerous region-specific papers, which are relevant (e.g. Garbrecht et al 2004 on changes in Great Plains streamflow).

The papers listed here are good examples of those that would be helpful to the discussion. McCabe and Wolock (1997) discusses the probability of detecting a trend in changing water balance values, which would be helpful in our discussion for the Runoff Ratio. Lins and Slack (1999) investigates the change in streamflow percentile values over time, which would directly relate to S_{FDC}, Q_{10}, and Q_{90} in our study. Garabrecht et al. (2004) discusses the change in streamflow, ET, and precipitation in the Midwest, where most or our interesting change take place in our study. These three papers will make good additions to our work and we will work them into the text.

15. 6614L26 “no general trends were found that suggested agriculture had an effect on R_{QP}.” This statement would be more useful if the authors also provided information on the land use before agriculture (was the new agricultural land previously forested, or was it being used for a less intensive form of agriculture?). This should then be followed up with a discussion citing the relevant literature where such trends had been detected by other studies.

Information at the catchment scale about land use is largely unavailable for the time series in this study, so we are limited to land-use data at the state level to inform our conclusions. We will make clear what literature is available on this topic within the revised manuscript.

Minor points

16. 6600L9 “This activity allows us to assess . . .”. I would say something like “This analysis allows us to assess . . .”

We agree with the referee and this change will be made.

17. 6600L11 “We found situations where catchments belonging to one class would diverge into multiple classes, and conversely cases where catchments from different classes would converge into a single one.” I would rewrite with explicit mention of decades, rather than use of diverge/converge

This section will be altered to clarify the decades involved and how the catchment classes change through time.

18. 6603L14 Sawicz et al 2011 is missing from the list of references.

The missing citation will be added.

19. 6600L23 “has seen steep rise in interest in recent years suggesting that there is significant interest” Rephrase to avoid using “interest” twice in one sentence. Insert “a” between “seen” and “steep”.

We agree with the referee and this wording will be changed.

20. 6601L4 “Tracers provide more insight, but are not widely available” I would say it is the data which are not available, rather than the tracers themselves.

We agree with the referee and this wording will be changed.

21. 6601L18 “As the topic of catchment classification is increasing in interest, there is the recognition of the increasing nonstationarity of the hydrological cycle,” I don’t see how these two phrases are connected.

They are not. We meant to say that classification is increasingly a research topic, while nonstationarity is also becoming more and more relevant and hence has to be considered in classification.

22. 6604L3 “This signature is a proxy for flow seasonality . . .” It is presumably only a limited proxy for flow seasonality, which also varies for other reasons, such as the seasonality of precipitation minus evaporation.

The Ratio of Snow Days is indeed limited in its proxy to seasonality of flow, since there are other climatic properties that might control seasonality of flow. The sentence will be written to reflect this.

23. 6604L21 “The input variables characterizing the catchments, i.e., the signatures, were log transformed and modeled as normally distributed continuous variables with an associated degree of uncertainty.” How was this uncertainty quantified?

The value of uncertainty was found through sampling uncertainty values (1% to 6%, at intervals of 1) for each signature as a percentage of the total range of signature values. The probabilistic nature of the clustering algorithm results in different clusters for each time the algorithm is run. To identify the uncertainty value that we ultimately chose (4%), the uncertainty value which delivered most similar clustering results from 10 algorithm runs, as measured by the Adjusted Rand Index, was chosen as our ‘representative’ level of uncertainty.

24. 6609L27 “the S_{FDC} signature is less unaffected extreme flood and drought events.” Some words seem to be missing from this phrase.

This sentence will be rewritten to address this mistake.

25. 6610L21 “(most extreme center of mass value of −4 % between periods 1 and 2)” Which centre of mass is referred to here? How can a centre of mass be a negative percentage?

It is not sensible to call it ‘center of mass’ and we will rephrase the text.

26. 6612L10 “Initially, the primary catchments that split into classes C0, C3, C4, and C5 because of to differences in values of S_{FDC}, B_{FI}, and R_{SD}.” This sentence doesn’t make grammatical sense.

The sentence structure will be addressed.

27. 6612L12 “The energy-limited catchments are further separated from the waterlimited catchments in C1 (dark green) during the baseline period.” I couldn’t interpret this sentence. Which classes are being referred to as energy limited? Along which axis is this separation taking place? With respect to which other decade or place are you saying that the separation is further? I had a similar difficulty with the first half of the following sentence.

The catchments within C1 are the water-limited catchments. This sentence will be revised for better understanding.

28. 6627 “the boarder color” border, not boarder?

The referee is correct and this error will be corrected.

References:

Garbrecht J.D., Van Liew M., Brown G.O. 2004. Trends in precipitation, streamflow, and evapotranspiration in the Great Plains of the United States. Journal of Hydrologic Engineering 9(5):360-367.

Lins, H., and J.R. Slack, 1999: Streamflow trends in the United States. Geophysical Research Letters, 26, 227-230.

McCabe, G., Jr., and D.M. Wolock, 1997: Climate change and the detection of trends in runoff. Climate Research, 8, 129-134.

Referee #2

The authors classify the hydrologic behavior of a subset of the MOPEX database. The classification is based on six hydrological signatures in the decade 1948-58. This baseline is then used to capture/explain changes in hydrological behavior for three subsequent decades (until 1988). The use of CART decision tree gives a clear insight in the classification procedure/results. The paper addresses current issues in hydrologic research. The paper is well structured and well written. For me, the paper is worth being published after minor revisions. I have only a few comments:

P6602L9: You assume that a decade is both “required and sufficient”. Why? From my point of view most of the signatures react very sensitive to the length of your dataset. This point should at least be discussed at the end of paper.

It is true that signature calculation is sensitive to the length of time of the dataset. We found that a decade captures variability reasonably well and provides relatively stable estimates in preparation to Sawicz et al. (2011). The impact of time series length itself could form a separate study. We will add some discussion on the need to explore this issue further in the conclusions section.

P6607L21: “Pike-Turc” equation. Here a reference is missing (Pike (1964)). You find a good discussion of this “Bodyko type” of equation in Wang & Wu (2013) or Gerrits et al. (2008). Maybe you can include these reference in your discussion of threshold values. Sawicz et al. (2011) missing in the references

We agree with the referee and the above citations will be incorporated into the manuscript, along with the addition of the missing citation.

Figure1: Why you define a class “0”, this is a bit misleading (“NULL=void” class)?

Class 0 is only an arbitrary distinction of the class that has roots in the clustering algorithm used. However, we find that the naming structure to make more sense to start at ‘class 1’ and will adjust this.

Figure3: Does the decision tree directly show the “physical and climatic characteristics” that control your classification? What I derive from the figure, are only threshold values. Interpretation of possible causes can be found in figure 1, not in figure 3.

Only the signature values are used to create the Classification and Regression Tree found in figure 3, and not the physical and climatic characteristics that the citation mentions. The initial caption was wrong and has been changed to reflect this.

Figure5: Difficult to read; improve quality, resolution is not sufficient.

We will improve the quality of this figure for the revised manuscript.

References:

Wang, D. and L. Wu (2013): Similarity of climate control on base flow and perennial stream density, Hydrol. Earth Syst. Sci., 17,315-324, www.hydrol-earth-systsci. net/17/315/2013/.

Gerrits, A. M. J., H. H. G. Savenije, E. J. M. Veling, and L. Pfister (2009), Analytical derivation of the Budyko curve based on rainfall characteristics and a simple evaporation model, Water Resour. Res., 45, W04403, doi:10.1029/2008WR007308.

Pike, J. G. (1964), The estimation of annual runoff from meteorological data in a tropical climate, J. Hydrol., 2, 116– 123.

Referee #3

The authors developed a signature based classification scheme for catchments using clustering and decision tree techniques and applied it to a subset of the MOPEX dataset. By repeating their classification procedure over different decades the authors studied temporal and spatial similarity and dissimilarity between groups of catchments over time. The paper is well structured and well-written and the idea is worth publishing. Nevertheless, I suggest to revise a number of points:

Main points

6603L14: Please comment why you selected the provided signatures

These signatures were selected from a much larger collection of possible signatures due to their ability to describe catchment function while providing independent, e.g. uncorrelated, information about catchment function. This general idea will be re-enforced in the manuscript. See longer discussions in Sawicz et al. (2011, HESS) and Wagener et al. (2007, Geography Compass).

6604: Q_{90} is in [mm], Q_{10} has been normalized and does not have a unit. Please explain why.

Q_{90} and Q_{10} are both measures of the FDC at different exceedence probabilities. The primary reason for the normalization of Q_{10} and not Q_{90} is the meaning behind these signatures. Q_{10} when normalized gives us information about how high flooding events are versus the average flow. Q_{90} is a simple measure of the amount of water available at the 90th percentile. An analysis of correlation between potential signatures showed that the water balance and Q_{10} were highly correlated, suggesting that high flow events shared information with the water balance of these catchments. The values of Q_{10} without normalization results in a 0.89 linear correlation with the runoff ratio. The linear correlation falls to 0.28 when Q_{10} is normalized with the mean flow.

6604: I expect that some of the provided signatures are correlated (e.g. Q_{90} and B_{FI}?). Please provide information on the correlation between the signatures.

The information about correlation between signatures will be added for transparency. The signature correlation values can be seen in the table below.

	R_{QP}	B_{FI}	S_{FDC}	R_{SD}	Q_{10}	Q_{90}
R_{QP}	1.00	0.10	0.03	0.00	0.08	0.37
B_{FI}	0.10	1.00	0.38	0.04	0.01	0.28
S_{FDC}	0.03	0.38	1.00	0.03	0.10	0.25
R_{SD}	0.00	0.04	0.03	1.00	0.29	0.00
Q_{10}	0.08	0.01	0.10	0.29	1.00	0.04
Q_{90}	0.37	0.28	0.25	0.00	0.04	1.00

6605L10: “A CART analysis (...) was performed using all six signatures to predict the class assignment generated from the AutoClass cluster result”. This sentence sounds like you are applying the CART analysis to understand and reconstruct the behavior of your clustering algorithm. Please explain in more detail why you applied the clustering and the CART analysis here.

Clustering was applied to understand similarity and dissimilarity between catchments. We then used CART to understand thresholds between classes. These thresholds (derived for the baseline period) are then used in subsequent decades to see how catchments change regarding their behavior, and hence regarding their similarity/dissimilarity.

6609: Your discussion on the potential impact of both climate and land use change on hydrologic signatures (line 8 to end) is very brief, in some cases speculative and it even contains a few inaccuracies. For instance I disagree with your general statement in Line 14 "logging can increase the amount of water stored in the soil". Logging (if you mean deforestation?) will increase mineralization in the soil, thereby decrease the soil organic carbon content and in turn may also lead to a reduction of water that can be stored in a soil. To my knowledge, the most significant impact of deforestation is the increase in water yield (Bosch and Hewlett 1982, Brown et al. 2013), which has not been mentioned in the text at all. I also disagree with the general statement you make in line 19: "increasing agricultural activity likely increases evapotranspiration". This depends on the type of the previous form of land use. If it was uncultivated land which was turned into (maybe irrigated?) cropland than it is true, but if it was a forest your statement might be wrong. There is a plethora of studies available which address the impact of changes in cover on water yield, ET and soil moisture dynamics. Since, such information is critical to understand the impact of both, climate and land use change on hydrologic signatures I suggest rewriting and re-structuring the entire section. Please try to make clear which change in land use is likely to have which consequence and please also provide information on the direction of change of your signature value wherever possible.

We generally agree with the referee's comments that great care needs to be taken when writing about the connection between the change in physical properties of the catchment (land use/cover, for instance) and hydrologic behavior of the catchment. This section will be revised in order to ensure that sufficient citation is provided to support the claims that are made between changes in physical properties and hydrologic behavior.

You argue that changes to climate characteristics seem to explain most of the observed class change transitions but you do not provide information on (decadal) changes of climate characteristics. Please provide data (e.g. time series plots of (decadal) mean annual precipitation, length of winter period, intra-annual seasonality of precipitation for selected locations) or literature. Both would help to follow your argumentation.

As the referee states, the data describing climatic properties through time are a vital piece of explaining the difference that we see in hydrologic behavior. This information will be provided in summary plots to clearly show the connections between change in climate and hydrologic behavior.

6615L21: I missed some conclusions regarding the value of the applied signatures. Please comment on that.

This comment is not quite clear to us, but the page and line selected states generally that signatures change over time to differing degrees. This point will be explored better and in more detail in the revised manuscript.

6616L23: If climate was found to be a primary control shouldn't we also ask and look for signatures which capture changes in climate and land use and include them in our classification attempts?

Yes, indeed. We generally find it very difficult to separate climate variability from other changes unless the climate signal change or other changes are very strong. We clearly need to identify better signatures to capture this and will add more discussion in this regard to the conclusions.

Minor points

6602L9: Please explain why you assume that "a decade is both required and sufficient" and provide examples on the variation of signature values within the selected decades.

In preparation for Sawicz et al. (2011), a decade of time was found to be sufficient to not be sensitive to a series of precipitation events, yet short enough to not be affected by climatic non-stationary. Of course, there is no exact temporal cutoff between the influence of a series of individual storm events and climatic behavior; however a decade of time tries to balance these two influences.

6602L19: You excluded catchments that were heavily impacted by human activity. Please briefly comment what do you mean by "heavily", how you quantified "impacted" and what exactly was visually inspected.

We found that some of the catchments had streamflow hydrographs that were clearly controlled by human activity (reservoir releases, for instance). Given that an analysis of this type of impact was not part of our paper, we excluded these catchments from this analysis.

6603L3: the cross reference to table 1 does not make any sense here

The referee is correct and this error will be corrected in the revised manuscript.

6603L14: Sawicz et al. 2011 is not on the reference list

This error will be corrected in the revised manuscript.

6604L3: "This signature is a proxy for flow seasonality...". R_{SD} sounds more like a proxy for the length of the winter period than for the flow seasonality. Please clarify.

You are correct that the R_{SD} is more a proxy for the length of the winter period, and the interpretation of R_{SD} will be made clear in the revised manuscript.

6608L8: You often refer to states and distinct geographical regions like the Appalachians. Someone who is not familiar with the geography of the US will have trouble to follow your argumentation. Maybe you could add some of the regions you mention in the text to figure 1.

This is a helpful suggestion, and will be incorporated into the revised manuscript.

6610L6: Table 1 is not very insightful, since the overall variation between the periods is almost negligible for most of the signatures. A nice way to emphasize the existence of spatio-temporal variations would be to draw maps which show the absolute percentage of change in the signature values over time relative to the baseline period.

This is a good idea and we will try to include such maps in the revised version of the paper.

6610L6 to end: Very detailed. You could limit the discussion to variables which showed variance and summarize overall patterns (trends/ no trend) at the end of the paragraph.

This summary of trends/no trends will be included to help guide the reader through this section.

Many abbreviations/ subscripted characters (e.g. S_{FDC} vs. S_{FDC}) are not used in a consistent way. Please correct

These abbreviations/subscripted characters will be made consistent in the revised manuscript.

Figures and Tables
Fig. 1: 0 Small and energy (...) Please explain what you mean with 50/50 blue/green water split

This information will be better explained or replaced in the revised manuscript.

Fig. 3: The caption is imprecise. Essentially it does not show physical and climate characteristics but the signatures you provided to CART and the way they were used to organize information. I suggest modifying the caption as follows "CART decision tree showing the signatures and resulting threshold values used for the classification of catchments in the baseline period".

The referee is correct and we will correct the citation to accurately reflect the CART analysis.

Fig. 5: The inlay, all marker shapes and colors and the interpretation of changes are almost impossible to read when printed on a regular inkjet printer. Please redraw (maybe enlarge the maps and align them in single a column). In the caption: Please explain what a "key change" is.

This figure will be made clearer in the revised manuscript.

References

Bosch JM, Hewlett JD (1982): A review of catchment experiments to deter- mine the effect of vegetation changes on water yield and evapotranspiration. Journal of Hydrology, 55, 3–23.

Brown, AE, Western, AW, McMahon, TA, Zhang, L (2013): Impact of forest cover changes on annual streamflow and flow duration curves. Journal of Hydrology, 483 (13), 39-50