First we would like to thank Carley Coccola for her constructive comments and detailed review of our manuscript. Original comments by the reviewer are in normal text and our responses are in bold.

This manuscript uses historical data for four large river basins in the Midwestern United States to look at hydrological processes with the intent of examining whether any changes in hydrology to date have been influenced by climate change or human activities (specifically, artificial drainage). Research questions investigate: changes over time in climate, land use alteration, and streamflow; times of year changes are most prominent; and, if any changes can be explained simply by climate. While this article has potential, it should undergo additional editing and a significant rewrite prior to publication. The manuscript length should be reduced to improve both the focus and flow of the paper. Constructive comments are included below with the intent that they may help in further refining this manuscript.

Please note this review does not cover the statistics used as there are other reviewers better positioned to evaluate these methods.

Response: The authors agree with the referee that the manuscript is long and could be shortened (perhaps by 1000-1500 words). However we do not believe it is feasible to significantly rewrite and remove detail from the paper without diminishing content or the approach. Our intent was to be as transparent as possible about the factors which were not explicitly considered in our methods and to include multiple lines of evidence at multiple time scales (daily to annual) to arrive at our conclusions inductively. We have included historical and geographical details, such as the names, number, or locations of dams in each basin, to discuss factors other than drainage that affect basin streamflows. We will carefully edit such details in our revised manuscript such that we directly refer back to these points in our discussion and omit those never discussed again. This should help improve the flow of the manuscript and reduce the overall length. Furthermore, we have adopted some of the subsequent comments made by the reviewer to remove redundant language, run-on sentences, and ancillary details. However, we respectfully disagree with many of the suggested stylistic changes.

Abstract (pages 1-2): Guidelines for the Hydrology and Earth System Sciences Discussion (HESS D) journal note that abstracts should include a summary of the manuscript, highlighting key points and suggestions for future research (n.d.). This abstract is lengthy, with a word count of roughly 510 words. The abstract could be significantly shortened by further summarizing ideas and only including key points.

There are statements in the abstract that are not discussed in the paper and therefore, remain unsubstantiated. For example, Abstract, page 1, lines 13-15 states: “This makes it difficult to quantitatively disentangle the effects of climate change and artificial drainage intensification on the observed hydrological change, often spurring controversial interpretations with significant implications for management actions”. This is never elaborated on and no examples of controversial interpretations or their implications for management are provided in the body of the manuscript.

Response: We briefly discuss the difficulties associated with disentangling the effects of climate and artificial drainage on streamflows on page 4, lines 4-16, and point to a review of the artificial drainage debate by Robinson 1990. In our revised manuscript, we plan to add reference to a recent controversial paper by Gupta et al. 2015 who report a lack of LULC impacts on streamflow change in the Upper Midwest, followed by several discussion papers.

Another example is on page 2, lines 2-5 of the abstract which states: “Acknowledging both economic benefits and apparent detrimental impacts of artificial drainage on river flows, sediments, and nutrients, we question whether any other human activity has comparably altered critical zone activities, while remaining largely unregulated and undocumented.” Economic benefits are very briefly discussed in the introduction, but the body of the manuscript does not include comparison of impacts from any other activities to the impacts of artificial drainage. The presence of dams is noted in study areas, but there is no mention of how they may impact hydrological processes in basins over time. There is also no discussion on how artificial drainage impacts nutrients. Nutrients are only referenced in the first and last sentences of the introduction (page 2, line 10 and page 3, line 10). The reference to nutrients should be removed from the abstract as it is not elaborated on in the body of the manuscript.

Response: Dams and most other hydrologic alterations are highly regulated in the US, but drain tiles have gone almost entirely unregulated. Our point in asking the question you refer to is to highlight the fact that the changes we attribute to tile drainage are comparable with changes that have been documented for other large anthropogenic changes, prompting the discussion of whether lack of regulation is a sustainable path forward. Water quality implications provide the basis for studying these hydrologic changes. Thus, we feel it is relevant to mention water quality in the introduction and cite relevant papers in the revised manuscript that discuss linkages extensively between drainage and ecosystems (e.g. Blann et al., 2009), nutrients (e.g. Gilliam et al., 1999) , and sediment (e.g. Skaggs et al., 1994).

Further, the HESS D guidelines state abstracts should include information on future studies to further research in this area. The abstract does not address this, but rather concludes with a note that artificial drainage needs to be better documented without providing any indication as to how this could be undertaken.

Response: We have rewritten the abstract for the revised manuscript as per the suggested comments and reduced the word count by roughly 150 words.

Length and structure: As noted above, this manuscript should be rewritten and the length of the paper should be significantly reduced. The length is not justified and the manuscript is heavy on details that do not add value. For example, there are lengthy descriptions of each of the study basins which in total span roughly five pages of the discussion paper. These study area descriptions contain large amounts of detail that while interesting, do not contribute to the research questions.
For example, the study area description for the Chippewa River Basin notes (page 8, lines 7-8) “The first hydropower dam on the Chippewa was constructed in 1878, and by 1950 there were a total of eight dams on the mainstem Chippewa River, which have heavily regulated streamflow in the basin”. As the manuscript does not reference these early dams or this timeframe again, this information is not necessary. Further, the study area description already contains statistics on the total number of dams in the basin which provides the reader with a better indication of human alteration in the study areas. To shorten the study area section of the manuscript, the authors could choose to start with a description of all four study basins, highlighting any similarities and differences. This could be followed by any key points for each individual basin that relate to the research questions.

Another significant issue with the length and structure is the large amount of text included in parentheses. This was often distracting, interrupting the flow of sentences. A word count revealed almost 600 words in parentheses, not including references or acronyms. These sentences should be

rewritten with the information directly included or removed. In some cases, information in parentheses was already included earlier in the manuscript. A couple of examples are included below.
- Page 12, lines 23-26: "We performed one-tailed student's t-tests (and Wilcoxon Rank Sum tests if the data did not meet parametric assumptions after testing log, square root, and arcsince transformations) and Kolmogorov-Smirnov (KS) test using the statistical program R to analyze changes in the mean and distribution of annual and monthly total flow (Q at the basin outlet) and precipitation (P) volumes between the defined pre-period and post-period."
- Page 15, lines 19-22: "While relative amounts of drainage in this inventory should be reliable (i.e., greatest in MRB and IRB, relatively low, but tile drainage growing recently in the RRB, and very little in the CRB) the lack of historical documentation on changes in location, density and type of tile installed limits our ability to model hydrological change at the large landscape scale."

The manuscript also contains redundancies which should be removed to shorten the paper and improve the flow. For example, the results and discussion section on page 22, lines 1-2 repeats some of the study methods noting: "We ran 286 t-tests and 286 KS tests, splitting the monthly precipitation and flow data at the flow and precipitation breakpoints, LCT breakpoints, as well as the 1974/1975 breakpoint." Instead of restating the methods, the authors can launch directly into the results. For example: "Results from the t-tests and KS tests suggest: : :". Another example of repeated results is on page 30, lines 1-19 of the conclusion which should be removed.

Response: As noted above, we have retained some of the historical and geographical details as they are later discussed in the paper and removed those not discussed. We have reduced the overall text of the manuscript, including the amount of text in parentheses. We feel that redundancies identified by the referee in the results section are necessary to integrate and conclude our study. Nevertheless, we will state them more concisely in our revised manuscript.

Importance of Research and Linkages to Literature: This manuscript could be strengthened by better identifying linkages to real-world application as well as how it furthers the current state of literature. For example, an ongoing debate in the hydrological community at the moment relates to the question of whether stationarity is dead (see for example: Milly et al., 2008; Lins & Cohn, 2011; Montanari & Koutsoyiannis, 2014; Milly et al., 2015). This manuscript relies on historical data to examine whether climate change or human activities have influenced hydrological process to date in order to inform future management and policy decisions. Given this, it would interesting and relevant for the authors to comment on or acknowledge the debate of stationarity versus non-stationarity.

Response: The reviewers comment about non-stationarity is appropriate for this manuscript. Thus we have made changes to reflect her suggestion and briefly acknowledge the relevance of our study to the stationarity debate in the introduction and discussion.

While the introduction attempts to draw connections between artificial drainage and impaired waters under the Clean Water Act, this is not elaborated on later in the paper. The paper also notes how undertaking the research at the basin level is important as this is the same scale regulators use (page 2, line 25; page 29, lines 7-8). However, the authors do not mention any implications of this research for water managers or regulators.

Due in part to the length of this paper and its overall scope, further discussion of points pertaining to the Clean Water Act and the implications of this research for management are discussed briefly, p. 30, lines 31-32 and p. 31, lines 1-6. We will further emphasize the policy/management implications in the

conclusion, in which we call for better documentation of tile drainage activities and recommend increasing watershed water storage.

On page 29, lines 21-22, the authors state: "Until we have the information necessary to calibrate and validate watershed models, it will be difficult to deconvolve proportional impacts of climate and land use impacts [sic] on flows at large spatial scales." This is followed on page 30, lines 24-28 by the statements: "Increases in precipitation in the Midwestern USA contribute to recently observed increases in streamflow, but the magnitude of precipitation increases alone cannot explain the observed increases in flow for agricultural basins. Therefore, it appears that the pervasive and extensive artificial drainage in agricultural basins has contributed to increase streamflow, not only at 102-103 km watershed scale, but also at the scale of very large basins studied here." The first statement from page 30 notes it is difficult to determine whether the impacts to hydrological processes can be attributed to human land change or climate change; however, the statement that follows attributes artificial drainage to streamflow increases at the watershed and large basin scale. These statements appear contradictory, and there is no acknowledgement of any other factors which may have affected streamflow beyond precipitation and artificial drainage. It seems unfounded to draw a clear line between streamflow and artificial drainage. It would perhaps be better for the authors to change the language to "suggest" a connection or to recommend this warrants further investigation.

As noted earlier, recommendations for future research directions are not included in this manuscript. The statement on page 29, lines 21-22 (referenced above) notes more information is needed to determine whether impacts are related to climate or human land-use change, but no recommendations are given for how future research could better calibrate or validate watershed models. Study limitations should be clearly outlined and linked to opportunities for future research.

The authors stand behind the statements made on page 29, lines 21-22 and page 30, lines 24-28, as they do not in fact contradict one another. We found that precipitation alone could not explain the observed increases in streamflow; however we did not report on the relative importance of climate versus land use change. We still do not know what percentage of the total change in flow is explained by precipitation versus other causes, such changes in ET from vegetation and temperature change, or changes due to agricultural drainage. To do this would require additional analysis and modeling, which is beyond the scope of the present paper. Besides, accurately calibrating and validating such models will be difficult without more detailed documentation of drainage activities. Therefore the relative importance of precipitation and land use changes on streamflows at large scales (10^4 km^2) remains an unanswered question that may only be possible to address in the future if agricultural ditches and tile drains are permitted and reported at a national scale.

Grammatical/minor comments:
The manuscript appears to spell the word gauge "gage". As authors, it is important to write for your audience. As HESS D has a global audience, it is important to use the language reflected in international literature. All spellings of "gage" should be corrected to "gauge".
- Some examples: page 11, lines 13, 15, 16, 18, 19, 20, 22, and 23; page 18, line 1, title 4.3; page 19, line 8.

There are several instances where "&" is used instead of "and". This makes the manuscript feel less polished and professional.
- Some examples: page 10, line 13; page 16, lines 10, 13, and 17; page 17, line 11; page 27, line 29.

There are some circumstances where using the word “we” may be unavoidable. However, sentences written in the first person tend to be more passive and informal. The word “we” is used heavily in this manuscript; 89 times in fact. In many cases, these sentences could be easily rewritten in a more active form to remove the “we”. Some examples are included below.
- Page 11, line 11: “We followed a multiscale approach to analyze streamflow change: : :” could be rewritten as: “A multiscale approach was used to analyze streamflow change” or “Streamflow change was analyzed using a multiscale approach: : :.”
- Page 13, line 16: “We have computed average annual water budgets for each basin: : :” could be changed to “Average annual water budgets were computed for each basin: : :.”
- Page 5, lines 10-11: “We discuss the unique properties and histories of each basin below” could be changed to “Unique properties and histories of each basin are discussed below”

Acronyms are not used consistently throughout the manuscript. In some cases, acronyms are defined then never used again or change throughout the paper. More consistency is needed to help the reader follow defined terms. Some examples are listed below.
- Page 23, line 9 defines joint probability distribution function as “joint PDF”. However, on page 24, line 9, the authors use the acronym “JPDF”.
- Despite that each study basin is given a three letter acronym, the authors will at times continue to write out basin names. The Red River of the North Basin is defined as RRB early in the manuscript (page 6, line 1), but then later referred to as both the Red River Basin (page 14, line 19) and the Red River of the North Basin (page 18, line 16).

Commas are used heavily throughout the paper and result in run on sentences or disconnected thoughts. In many cases, these lines could be separated into multiple sentences or rewritten to remove commas. Some examples are included below.
- Page 15, line 3-5: “Although the 2012 census attempts to correct for incomplete and missing responses, because drainage enterprise records have traditionally been so poorly documented, it is difficult to know just how different the census reported acreage is from the actual acreage.”
- Page 29, lines 16-19: “Though drainage census data are prone to reporting the information necessary for modeling basin hydrology in large agricultural watersheds (such as drain size, depth, spacing, and extent), these are the most comprehensive inventory of drainage in the United States.”

Section titles should be concise, consistent, and reflect the underlying discussion. Section titles 1.1 (page 2, lines 8-9) and 1.2 (page 3, line 11) are the only titles in the manuscript phrased as questions, and only one of them includes a question mark.

The abstract and conclusion both state the data for this study corresponds to a 79 year period (page 1, line 17; page 29, line 7). The reader is left to assume this timeframe corresponds to the precipitation data outlined in the methods that date from 1935-2013 (page 10, line 19); however, this 79 year period is never explicitly stately.

There are many awkwardly worded sentences that should be rewritten. Some examples: page 9, lines 19-21; page 15, lines 3-5; page 27, line 19; page 28, lines 22-24.
Page 3, line 28: Sentence begins “And although the conversion of perennial grasses: : :..” Rephrase.
Page 22, lines 2-4: Sentence begins with “Because the p-values of the statistical tests: : :.” Rephrase.
Page 30, line 9: Typo. The comma should be changed to “with the” to read “The introduction of artificial drainage combined with the replacement of: : :”

Page 8, line 1 refers to “the Driftless Area downstream of Chippewa Falls and Eau Claire.” The “Driftless Area” should be defined for readers who may not be familiar with this term.
Page 30, line 32: This statement needs a reference.
References
Please see attached supplement for references.
Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-571/hess-2016-571-SC1-supplement.pdf

Response: We appreciate the reviewer’s attention to grammatical detail and the comments she has provided. We have incorporated many of these suggestions in our revised manuscript. However we respectfully disagree with the reviewer’s comment about first person writing sounding passive or informal. Writing in the first person is often a more direct writing style.

References:

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Skaggs, R., Brevé, M. and Gilliam, J.: Hydrologic and water quality impacts of agricultural drainage, Crit. Rev. Environ. Sci. Technol., 24(1), 1–32, 1994.