Chapter 6: Hydroclimatic Conditions and Patterns – P. Whitfield Comments and Study Response

General Comments

The chapter addresses the question "How has climate affected the change in lake level relationship between Lake Michigan-Huron and Lake Erie" but the underlying question is whether the magnitude in changes to the connecting channels and those of isostatic rebound have had an important effect. Using an approach involving comparative and statistical hydrologic data analysis, the conclusion is reached that climate has played a dominant role, while channel conveyance and glacial isostatic adjustment have had a smaller effect. The study purports to be integrated, but rather it seems to have been rolled up from a large number of sources. The report itself focuses on the importance of climate in the in lake levels it does not adequately link those changes to the climate system – i.e. changes in precipitation are noted that parallel changes in lake level, but these are not linked to the NAO or the AMO, or ENSO so the climate link is not as well established as it could potentially be.

> Agree with the reviewer that the report does not link the changes in the climate system to what has been observed. The intent of this phase of the report was not truly attribution in terms of climate variables, but attribution in terms of climate (essentially NBS) as opposed to conveyance change. As such it was beyond the scope of this phase of the study and is being addressed in the second phase. The introduction has been re-written to better articulate the scope.

It is unwise to presume that because the climate system has a large role that the other factors have been adequately eliminated. I read this report looking for an analysis that tried to separate out the other sources of change in some way, but did not find such. Since in this time period, changes in channels have taken place and also changes in landuse, the issue is very confounded. Given that it is difficult to follow the methodologies and logic in the report, and that it is generally an extensive summary of the climate analysis, these other effects have not been adequately addressed The report is often disconnected and does not always flow well. In my mind there are gaps where there should be connecting the pieces of text from original sources. While I found the text to be generally well written, it is these jumps and gaps that need to be improved to more clearly convey the methodologies, results, and conclusions. I have pointed out a only a few of them in the comments below.

> As was mentioned in the previous reviewer's response, it was a very challenging to collate the various studies into one cohesive Chapter, particularly given that some of the results were being generated as the Chapter was being written. The 2-month period between the initial version of Chapter 6 and the final version of Chapter 7 has allowed the authors to revisit the results and have more in-depth discussions with the various investigators of each of the studies and allow for some re-analysis and re-writing of the Chapter. We think the reviewer will agree that this concern has now been addressed in Chapter 7. This has greatly helped to improve the final product.

To make a suggestion for how this report might be improved, consider building a time line figure that shows when changes in the climate system features changed [NAO, AMO, ENSO]; when conveyance might have been affected [dredging, ice jams, floods], and isostatic rebound; and also major landuse changes; then relate the observed and detected changes to that. This is a very complex problem, and the clarity of the presentation is critical.

> Since a synoptic analysis was beyond the scope of this work, it would be difficult to portray all of the potential shifts in the climate system. However, this will be addressed as the Study continues. In response to timelines for potential conveyance change, this is now included and highlighted in Section 7.3.2 Assessment on the Impact of Historic Anthropogenic Changes.

Specific Comments:

Page 149. Paragraph 2. This presupposes that the other potential factors are less important than climate.

> Agree and this section has been re-worded.

Page 149, paragraph 3, line 3. There should be some explanation as to why there is a greater focus on the period 1996 to 2005 and what impact this has on the conclusions of the chapter (if any). I would have expected to see some analysis that used a time line
based on events, dredging, ice jams etc. that would directly affect conveyance. Also, some plan to assess the magnitude of isostatic rebound.

> Agree and highlight that the 1996 to 2005 periods shows the largest change in fall and sharpest decline in lake levels. It is for this reason that this period was focused on.

Section 6.1. The science question is 'how has climate affected the lake level…' addressing that question does not rule out other effects.

> Agree and the Chapter does try and estimate using the deterministic, stochastic and other methods, the percentage of the change that can be attributed to climate or conveyance changes.

Page 151. Paragraph 4, last sentence. What is the magnitude of the differences between different data revisions? What impacts do the studies using different data revisions have on the conclusions of this study? Do the sources differ in their recommendations because of different data inputs?

> The data revision has been addressed by focusing on all analysis using a consistent and accepted series of NBS and flow data sets

Page 154. Figure 6-2. Is this figure from Quinn's report? Was this report corrected and updated to correct the many shortcomings? The two panels use the same y axis scaling but are presented with different lengths, making the "trend" on the left much greater than the one on the right. Is

the reader to infer that the line is a statistically important trend or has someone simple used Excel to draw a straight line through the data? Is there a real difference? Certainly this figure shows a series of phases and not an independent IID type process.

> There was much confusion concerning this figure and it has been re-done. The intent of this figure was to highlight a persistent difference (and bias) between the two NBS calculation methods. The current plot show annual and cumulative differences for Lakes Huron-Michigan and Erie.

Page 153. Onwards. Following the section describing Quinn's multiple reports the text becomes inadequately linked to the reports from which the figures and text has been extracted. I found it odd that the citations were to original literature like Mann, 1945 and not to the specific UGLS Project Reports. The text appears to be pieces pulled from those reports and not always well connected logically.

> Agree and the significantly revised version of the text addresses this point.

Page 156. Figure 6-3. It is most interesting that these two series are so similar yet one shows no change point and the other does. Perhaps these should be considered as covariates and reanalyzed.

> The analysis has been re-done with updated NBS values and both plots show no change point now.

Page 156. Paragraph 2, line 3. Here is another case where the logic doesn't flow well. The text indicates that the change-points due to climate removed so that the hydraulics could be studied, but it doesn't indicate how any of this was done nor does is inform the reader about what the result was. Adding a plot of the hydraulic component would be most illustrative.

> The text was changed to highlight the fact that covariates were used to minimize the influence of climate on the change point analysis.

Page 156. Figure 6-4. Again, it is most interesting that these two series are so similar yet one shows 2 change points and the other only one. Perhaps these should be considered as covariates and reanalyzed?

> The reviewer has brought up an interesting point that needs consideration. It was certainly beyond the scope of this work to re-do the analysis, but further work will take this comment into consideration. The drop in MH lake levels is much more pronounced, with no significant rise towards the end of the time period. The time series are different enough in our view to warrant this finding.

Page 157. "Connecting Channel Flows" - this paragraph is inadequate, and it is inappropriate to not fully address these changes. Trend analysis does not lead to a statement like "revealed no long-term trend".

The Study does agree with this point. It was important to highlight that based on the current flow estimates that there was no significant trend. No trend is as important as trend in this case. The current text highlight the fact that trend analysis will likely be re-done if the coordinate flow estimates change, partly based on the results of this Study.

Page 162. Paragraphs beginning “the first metric” is an example of one of the key issues with the report – it gives a loose description of the metrics and their precision, but does not indicate whether that is important or how the reader might use the information.

Agree and Section 6.3.2 has been completely re-written.

Page 164. Paragraph beginning “As noted earlier…” Needs to be rewritten –as you can not have this both ways. Choose either the description [which is an opinion] or the analytical result.

Agree and section 6.3.2 has been completely re-written.

Page 164. “To assess climate and conveyance ..” The last sentence in the paragraph needs to be rewritten using better wording, as the present wording is not clear.

Agree and Section 6.3.2 has been completely re-written.

Page 165. Figure 6-9. Replace with an adequate figure. This could be in a textbook of how not to prepare a figure.

The authors agree and section 6.3.2 has been completely re-written

Page 167 Figure 6-11. Pie charts are inappropriate to display this type of data.

Yes we agree and this was re-done as a table as well as change the analysis method (based on the absolute value of the contribution to change in fall) to remove the negative percentages.

Words and phrases that don’t belong in the report include “only a slight”, “reasonably’, ‘in part’. During a rewrite the author should consider using precise words when they are appropriate and avoiding words that imply precision when they are not

Agree and every effort has been made to remove vague language from the text.