Manuscript: Climate Change Analysis

Name of Reviewer: Barrie Bonsal

August 5, 2011

Comments to Authors

General Comments:

It appears that the overall climate change objective of the study is to carry out a climate change analysis, in a multi-pronged approach, to assess potential changes to future net basin supplies for the Upper Great Lakes. This particular report describes the generation of several future NBS sequences using a variety of methods and sources to set the context for potential adaptations to future climate change. Specifically, the report describes three main efforts required and undertaken to generate NBS sequences using both GCM and RCM models.

It is clear that a substantial amount of work and synthesis has been carried out in the generation of these NBS sequences. For the most part, it appears that the work is methodologically sound, however, the in-depth procedures (different GCMs/RCMs, downscaling methods, time periods, base climate periods, hydrologic models, calibration methods, etc.) make the report difficult to follow, and at times, difficult to clearly understand the ramifications of certain decisions. Some specific comments related to this are provided below.

Given all of these results with different methodologies, several questions arise including: What are the next steps? What are the main recommendations? What are the uncertainties? How can we realistically reduce these uncertainties and provide useful information to users? What about future climate variability and its impacts on NBS? There is a bit of this information in section 3.5, but it is very general. I would suggest that the results should be synthesized (perhaps in a Table) and for each variable (e.g., temperature, precipitation, evaporation, lake level, NBS) outline what consensus there is, what is unknown, what is the level of certainty (even qualitative similar to the IPCC reports; likely, very likely, etc.), areas of further research, etc. This should apply both to future mean conditions and variability. This may be planned in the future but it is not clear from the report and without this synthesis, the work itself is not that practical for decision makers.

Another concern involves the revised Figure 1.2: Why was the statistical analysis and teleconnections dropped in the revised climate change strategy? It has been shown that teleconnections such as ENSO, PDO, and NAO have significant impacts on Great Lakes climate, particularly the inter-annual to inter-decadal variability (including extended periods of above or below normal lake levels). These teleconnections will almost certainly have an impact on future variability but exactly how climate change will impact their frequency and intensity is uncertain. Nonetheless, they need to be considered in a climate change analysis. How are these teleconnections represented in the various GCMs used in

the report (e.g., are they able to replicate these teleconnections in the historical record, what are the projected future changes and resultant impacts on lake levels)?

Specific Comments:

Section 2:

1. Table 1: Are these errors significant? What was the RMSE? This is a short period for which to test a model and more evidence should be provided that this is a "reasonable simulation".

2. What is the basis and implications of only using the SRES A2 emission scenario for the future modelling?

3. Page 12, Bias Correction Procedure: It appears from the information on page 14 that all the months are lumped together as opposed to carrying out the procedure on each month individually. If this is the case, wouldn't this smooth out the differences in the correction procedure? In addition, any idea as to why the models simulate such a huge bias in these components? I would think that this is important to understand this to know for certain that "the nature of the bias is more or less time invariant" (as stated at the bottom of page 12).

4. How is lake ice cover handled in the models (i.e., this would have a great impact on evaporation)?

Section 3:

1. Page 35: Section entitled "**Critique of Delta Method Applied to Regional Hydrologic Model**: How exactly is this section critiquing this method? As far as I can tell, it only describes and provides some results of the method.

2. Figure 3 versus Figure 7: The July – Aug temperature differences are very suspect. Why is there such a dramatic increase during these months when using the GFDL (seems suspect)?

3. The huge differences in Fig. 22 warrant more explanation.

Section 4:

1. Fig. 4-4-1 and to a lesser extent, Fig. 4-4-2 (Pages 90-91): As the resolution gets coarser, differences tend to be more positive. Can the authors provide insight into this occurrence? Why is this not apparent for Lake Erie (Fig. 4-4-3)?