

Interactive comment on “Assessment of impacts of climate change on water resources – a case study of the Great Lakes of North America” by E. McBean and H. Motiee

Anonymous Referee #2

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General comments

The objectives of this paper are:

¶ To analyze historical annual precipitation, temperature and streamflow data series (as obtained from the North American Great Lakes) and attempt to identify trends using traditional statistical techniques (linear regression and the non-parametric Mann-Kendall test).

¶ To use linear regression to project those trends forward to the year 2050 (where it is

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assumed that any trends are due to climate change).

¶ To compare those results with the corresponding estimates obtained from Global Climate Models (GCMs).

I do not believe that this paper is rigorous enough in its analysis of historical data, projection of trends or treatment of the uncertainties associated with climate change.

With respect to historical data and trend projection, there is insufficient discussion on the quality of the data (e.g. could changes in stage-discharge relationships over time affect the quality of the riverflow data? How many raingauges were used in the analysis?). In addition, the reasoning behind choosing annual data rather than seasonal should be clarified (as it is possible that a seasonal analysis might be more informative, particularly as regards the trend analysis). The reliance upon linear regression as a projection method (rather than simply as a guide) is concerning, especially in the estimation of possible future annual flows as shown in Table 8.

The treatment of uncertainty is an important issue in climate change studies. It is largely absent from the discussion in this paper. In particular, the uncertainties associated with the trend projection (which was obtained using linear regression, often with very low R^2 values) must be very high, but no attempt has been made to quantify them (e.g. even calculation of confidence limits along the regression line might be valuable in at least indicating the uncertainties involved; extrapolation ranges rather than single values should be shown in the results tables). As a result, the value of the comparison of the trend projection with the GCM output is unclear.

Finally, the GCM output illustrated in Figure 5 is (at least partially) out of date. For example, the figure uses HadCM2, but the more recent HadCM3 data has been available since 2002.

Specific comments:

¶ Page 3184, lines 20 to 23 - presumably this is an average depth?

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Page 3185, lines 1 through 5 - is there any literature to support the suggestion that “Changes in land use have not been responsible for changes in annual flows..”. Also, lines 9 and 10, “While the general tenor of discussion” who is involved in the discussion? More references are required.

Page 3186, “Global climate change and climate change models”. This section needs to discuss the variety of GCMs which are available (together with their corresponding scenarios and the uncertainties associated with the model scenarios). In particular, the range of GCM model estimates available for the Great Lakes should be identified and the reasoning for the choice of models and scenarios clarified.

Page 3187, lines 7 to 10 - are there any more recent references available?

Page 3187, “3.1 Historical data assembles” - how many gauges have been used in the averaging process? Is there a wide variation in topography? What quality checks have been made on the data series? For example, could the trend suggested for the streamflow data have been influenced by: changes in gauging station datum and/or changes in the station’s stage-discharge relationship (especially with respect to extrapolation to flood events)? Why choose the period 1930-1990 (and not extend into 2000s)? Could the trend analysis be improved by splitting the data seasonally and then performing the analysis?

Pages 3188 to 3193: The R² values obtained in the trend analysis are very low, therefore the uncertainties associated with the extrapolations (to the year 2050) must be very high. At the very least, calculation of confidence limits should be considered and ranges shown on the results tables and figures.

Page 3192 and Figures 5a and 5b. Could the GCM results be updated? For example, HadCM2 is referred to in Figures 5a and 5b. However, HadCM3 output has been available since 2002

Page 3193, Section 5.3 “Prediction of flows to year 2050”. The discussion presented

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in this section needs to be reinforced with sufficient references to the relevant literature. The uncertainties associated with estimated future flow by a simple linear regression (Table 8) need to be discussed explicitly.

¶ Page 3194, lines 10 to 13 “The presence of significant positive trends...indicate that the hydrologic changes being incurred in the Great Lakes may be attributable to climate change.” Is there enough evidence to support this statement? The results of the historical data analysis (and trend projection) are consistent with the common general view of climate change (i.e. warmer and wetter), but what about the uncertainties associated with these results (e.g. the variation in GCM outputs shown in Figure 5)? Might they affect the conclusions?

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