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Possible Impacts of Climate Change on Daily Streamflow and Extremes at Local Scale in Ontario, Canada. Part I: Historical Simulation

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ABSTRACT
The paper forms the first part of an introduction to possible impacts of climate change on daily streamflow and extremes in the Province of Ontario, Canada. In this study, both conceptual and statistical streamflow simulation modeling theories were collectively applied to simulate daily streamflow volumes. Based on conceptual rainfall-runoff modeling principle, the predictors were selected to take into account several physical factors that affect streamflow, such as (1) current and previous quantities of rainfall over the watershed, (2) an index of pre-storm moisture conditions, (3) an index of pre-storm evapotranspiration capacities, and (4) a seasonal factor representing seasonal variation of streamflow volume. These rainfall-runoff conceptual factors were applied to an autocorrelation correction regression procedure to develop a daily streamflow simulation model for each of the four selected river basins. The streamflow simulation models were validated using a leave-one-year-out cross-validation scheme. The simulation models identified that the explanatory predictors are consistent with the physical processes typically associated with high-streamflow events. Daily streamflow simulation models show that there are significant correlations between daily streamflow observations and model validations, with model R2s of 0.68-0.71, 0.61-0.62, 0.71-0.74, and 0.95 for Grand, Humber, Upper Thames, and Rideau River Basins, respectively. The major reason for the model performance varying across the basins might be that rainfall-runoff response time and physical characteristics differ significantly among the selected river basins. The results suggest that streamflow simulation models can be used to assess possible impacts of climate change on daily streamflow and extremes at a local scale, which is major objective of a companion paper (Part II).

KEYWORDS
Rainfall-Related Streamflow; Simualtion; Statistic Methods; Ontario; Canada

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