Geophysical Research Abstracts
Vol. 14, EGU2012-6722, 2012
EGU General Assembly 2012

Analysis and adaption of tools for water system management of the Lièvre River watershed, Quebec, Canada, to the context of climate change

R. Leconte (1), M. Trudel (1), S. Krau (2), and P. Côté (3)

(1) Département de génie civil, Université de Sherbrooke, , Sherbrooke, Canada (Robert.Leconte@usherbrooke.ca), (2) Département de génie de la construction, École de technologie supérieure, Montréal, Canada, (3) Rio Tinto, Énergie électrique, Saguenay, Canada

The basin of the Lièvre River (9542 km2), Quebec, Canada, has a water system consisting of three high-capacity reservoirs. During floods, the reservoir management gives priority to flood control and hydropower generation but also tries to respect constraints associated with environmental issues. Nevertheless, the basin is subject to floods, raising the need for improved water system management tools. Since these reservoirs are also part of the Ottawa River system, the main tributary of the St. Lawrence River, reservoirs of the Lièvre River also impact floods and low flows in the Montreal Archipel, through their influence on streamflows in the Mille-Îles and Des Prairies Rivers. Low flow is an important issue in this area since a large population relies on the streamflow of the Mille-Îles River for freshwater. The effect of an anticipated increase of extreme meteorological events as a result of climate change makes the evaluation of water system capacity of the Lièvre River even more important to reduce the impacts of such hydrometeorological events.

This kind of optimization problem has been studied in the past and there are many approaches to obtain, or at least to find an optimal solution, such as linear programming, nonlinear programming and dynamic programming. The later is widely used, but difficult to apply to systems with more than three reservoirs since computational time exponentially increases as the number of state variables increases. One of the goals of this study is to eventually extend the water system management to the entire Ottawa River watershed, which includes more than 40 reservoirs. A nonlinear programming approach using an interior-point algorithm has therefore been chosen for the Lievre reservoir system.

Constraints related to the Montreal Archipel constitute a further challenge as the many reservoirs on the Ottawa River watershed upstream from the Lièvre River are managed by various owners. It is therefore difficult to know with precision the management of the various reservoirs. Instead of explicitly simulating these reservoirs, it was decided to approximate the overall behaviour of the entire Ottawa River system using a neural network method to produce regulated streamflow hydrographs from natural streamflows, the latter simulated using a hydrological model. As regulation on the Ottawa River is mainly dictated by the spring melt, the performance of the neural network was improved by adding variables such as snow water equivalent simulated by the hydrological model and degree days of the last ten days. The Nash-Sutcliffe coefficient between the observed (regulated) streamflow and the simulated streamflow with the neural network reached more than 0.84. This allowed establishing inflow constraints to the Montreal Archipel that could be entered in the Lièvre river system optimisation algorithm.

The developed tool was used to simulate the management of the Lièvre reservoir system over previous years taking into account flow constraints of the Montreal Archipel. The next step will be to study the Lièvre River water system susceptibility to floods and low flow under climate change conditions and to investigate adaptation strategies to reduce adverse impacts of climate change.