

ADAPTATION OF THE HYDROTEL DISTRIBUTED HYDROLOGICAL MODEL TO THE QUEBEC BOREAL ENVIRONMENT



PROJECT LENGTH

3 years • Completed in March 2009

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CONTEXT

In 1950, the boreal, sub-Arctic and Arctic parts of Quebec started cooling off, but then in the 1990s started warming up. If current trends continue, the hydrology of these basins is likely to change. Thus, to ensure optimal planning for hydroelectric energy production, there is a need to determine the conditions of future water inflows. Analyzing the hydrological behaviour of these basins is complex, and few hydrological models are adapted to the boreal environment and able to use remote sensing and geographic information systems (GIS) data.

OBJECTIVE

Apply and adapt HYDROTEL to the Quebec boreal environment to better understand and predict past and future hydrological behaviours.

RESULTS

All project objectives were reached using a combination of field experimentation and hydrological modelling.

- Procedures for acquiring geographic and hydrometeorological data were documented.
- The use of recent remote sensing methods made it possible to improve our geographic knowledge of the high boreal region of Quebec.
- The specific hydrological behaviour of wetlands and lakes with multiple outlets was efficiently studied and described using sub-models adapted to the boreal environment.
- Many evapotranspiration equations were carefully compared and reviewed.
- The sub-model for water migration in the soil was thoroughly analyzed to assess the sensitivity of each parameter and suggest appropriate adaptations.
- The PHYSITEL/HYDROTEL software was extensively modified to integrate these new sub-models.
- This new version of the software was used successfully to evaluate the improvements it produces, before being tested on comparisons of past and future hydrological behaviours.

IMPACT

- The application and adaptation of the HYDROTEL model to the boreal environment in Quebec will allow Hydro-Québec to better understand past and future hydrological behaviours in these watersheds, and improve the management of hydroelectric production.
- The improvements made to the PHYSITEL/HYDROTEL software are already being used by Hydro-Québec and by the Centre d'expertise hydrique du Québec (CEHQ) in predicting inflows to reservoirs and dams. In addition, the IMTA (Instituto Mexicano de Tecnología del Agua) used HYDROTEL to determine the hydroelectric potential of several watersheds in Mexico.

PARTNERS

- Hydro-Québec
- INRS-ETE
- Ouranos

FUNDING

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TEAM

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PROJECT OVERVIEW

- The current version of HYDROTEL was applied to the Nécopastic basin to assess the difficulties of using the model under boreal conditions.
- The modelling of processes associated with the thermal and hydrological budgets of wetlands and lakes were adapted/improved.
- A calibration method suited to the data available was established.
- The potential for using Canadian Regional Climate Model (CRCM) data to reconstruct and simulate the hydrological behaviour of the Nécopastic under varying climate conditions was determined.