Hydro Power Generation and Climate Change Research – As good as it gets?

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Hydro-Québec relies on Climate

- 97% of the electricity generated from hydro
- 57 Power houses (35,125 MW)
- 26 Reservoirs
- 196 TWh generated in 2009





Hvdro









Projected Precipitation Changes in Québec







Hydro

2uébec

Objectives and Approach

- Improve our knowledge of future climate :
 - To limit the adverse effects for specific fields of activities and/or
 - To take advantage of some potential changes
- Approach
 - Identify the main issues
 - Participate in the development of climate scenarios
 - Analyze the impacts of CC on targeted activities
 - Develop and implement adaptation strategies





HQ Major Concerns Related to Climate





Hydro-Québec C.C. Project / Ouranos: Energy Resources program

Hvdro

Impact Assessment Modelling Chain

GCM

Emissions scenarios



Impacts of CC

- Water Management
- Energy demand
- Urban Drainage
- Fish Habitat
- Irrigation and Agriculture

Hydrological Model



"Scaling" methods to correct residual biases (climate model vs observations)

RCM

Dynamical

Downscaling





Possible future Hydrographs







Changes in Mean Annual Flow







Hydrological Projections Results since 2005

LaGrande-2: Evolution of Results of Mean Annuel Flow Changes in 2050 HSAMI Hydrological Model with Perturbation Delta Method (PDM)



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Adaptation example: Should we consider climate change in management practice?





Options to adapt

Reference Case

Current Climate

Current

hydrology

Initial

Operating rules

Initial

Physical

Hvdro

Duébec

Climate Evolution + adapted operating rules **Climate Evolution** + adapted + adapted **Climate Evolution** operating rules configuration Initial **Operating rules** Initial Initial Physical Physical

configurationconfigurationconfigurationPerformancePerformancePerformancePerformance1234



Benefits of Adaptation

Annual Hydroelectric Generation at Chute-des-Passes







Conclusions

- Hydro Quebec is affected be CC and considers operational and structural changes to adapt (incentive: postive effects!)
- Despite all remaining climate projection caveats and uncertainties the information we have is sufficiently mature to show anticipated changes and the underlying level of confidence
- Evaluations and decisions should rely on as many climate scenarios as possible. Uncertainties need to be accepted and used.
- Nobody said it would be easy: It is a long and tedious process
- Good communication is key!





Thank you for your attention!

Questions? Suggestions?

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New Project to enhance Competitiveness in a Changing Climate

Adaptation Case Studies in the Energy Sector – Overcoming Barriers to Adaptation

Objective: Collect examples of hands on adaptation to climate change to built a catalogue of adaptation practices for all to learn from

Funded by

- Natural Resources Canada (NRCan)
- Ouranos
- Hydro Quebec
- Manitoba Hydro
- Ontario Power Generation
- Rio Tinto Alcan





Adaptation example II: Using climate projections in load and sales revenue forecast





Electricity demand in Québec

- highly weather sensitive due to electric heating.
- load and sales revenue forecasting requires weather and climate information.
- beyond 10 days, forecasts are made using reference climate for normals.
- last decades were warmer than average in southern Quebec

We need to know:

- How can anthropogenic warming be taken into account in the estimation of electric demand ?
- Should special attention be accorded to very cold days to account for winter peak load?





Temperature Change in Southern Quebec

Temperature evolution Southern Quebec Reference 1901-1970







What about extreme cold temperatures?

Daily mean temperature (° C)





