Achievements, challenges and vision on ensemble forecasting at Quebec’s government

Thomas-Charles Fortier Filion
Collaborators: Richard Turcotte, Charles Poirier, François Anctil

2014-06-24
Water in Quebec

- Largest freshwater area in Canada
  175 000 km²
- 3% of the world renewable water
- More than 500 000 lakes and 4500 rivers
Operational hydrology: Main active organisations

- Mainly mid latitude watersheds
- Great Lakes / St. Lawrence and other trans-boundary system
- Entire province with a focus on southern Quebec
- Lake Saint-Jean watershed
Centre d’expertise hydrique du Québec (CEHQ)

- Agency of the Quebec ministry of the Sustainable development, the Environment and the Fight against Climate Change
- More than 210 employees
- Located in Quebec city and in 9 service centers distributed all over southern Quebec

www.cehq.gouv.qc.ca
CEHQ’s forecasting history

- 1996: July 19 – 21, Saguenay’s flood
- 1997: Beginning of Quebec’s public forecasting;
- 2011: Richelieu’s flood
- 2013: Two main activities, forecasting for public dam management and public security watchfulness.
“Dam” forecasting

- Managing 700 public dams (44 in real time)
- Multiple objectives and usages (water supply, flood control, leisure, energy production …)
- Watersheds sizes ranging from ~100 to ~10 000 km²
Hydrological forecasting

Quebec's Cooperative Weather Network + Climatological Network

Snow survey network + Vertical inflows

Hydrometrical network

Hydrological model

Hydrometrical network

Temperatures and precipitations

Recent past

Future

Canadian Meteorological Centre (GEM) + Meteorologists

Post processing uncertainties

Flow

Recent past

Future

Interactive updates

Simulation

Observation

Forecast

Quebec
Modelisation extent

- 577 347 km²
Hydrological model HYDROTEL

Soil type
INRS
Université d'avant-garde

Soil usage

Hydrological processes simulated

Flow over the watershed and in the hydrographic network

Vertical balance

Hydrological model HYDROTEL
2014 – Operational forecasting
2020 – Long-term extent (temporary)
Flow forecasting team

2 Coordinators, 7 operational forecasters, 2 computer scientists, 1 science advisor


<table>
<thead>
<tr>
<th>Prerequisites</th>
<th>Authorized practice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 0 – Forecaster in training</strong></td>
<td></td>
</tr>
</tbody>
</table>
| None | • Can practice only in internships B1 to B3, accompanied by a forecaster level 3.  
• Can never practice during spring flood. |
| **Level 1 – Forecaster trained off spring flood** | |
| Stages B1 to B3 completed over a minimum period of one year covering winter and summer-aurora water regimes | • Can practice outside spring flood without supervision.  
• In spring flood may practice only under the B5 internship, accompanied by a forecaster level 3. |
| **Level 2 – Trained forecaster** | |
| Stages B1 to B5 completed over a minimum period of two years | • Can practice at any time without supervision.  
• Excluding spring flood and through an internship, may accompany a forecaster level 3.  
• Can not supervise the practice of forecaster. |
| **Level 3 – Supervisor forecaster** | |
| Stages B1 to B6 completed over a minimum period of three years | • May supervise the practice of forecaster.  
• In spring flood may accompany a forecaster level 1. |
Post processing uncertainties
Post processing uncertainties

Calibration and application of errors model

- Calibrated to include 50% of forecasts
- First model
  - One explanatory variable
  - Forecast horizon
- Second model
  - Two explanatory variable
  - Forecast horizon
  - Mean flow over the past 6 hours
Post processing uncertainties

Calibration and application of errors model

- Calibrated to include 50% of forecasts
- First model
  - One explanatory variable
  - Forecast horizon
- Second model
  - Two explanatory variable
  - Forecast horizon
  - Mean flow over the past 6 hours
Post processing uncertainties

Calibration and application of errors model

- Calibrated to include 50% of forecasts

- First model
  - One explanatory variable
  - Forecast horizon

- Second model
  - Two explanatory variable
  - Forecast horizon
  - Mean flow over the past 6 hours
Internet dissemination

- Historical data
- Real time data
- 1 million views each year
- 17 million extractions
- Forecasted data
Operational issues for using ensembles

- Public Security
  - Timing uncertainty is crucial

- Managers of dams
  - Tools to assist in decision making are both complex and rare
  - No absolute criterion helping decision-making for multi-purpose dams
  - Decision based on the deterministic forecast is easier to explain
  - Uncertainty evolves quickly in the short term

- Rapid availability
  - Decision support
  - Acquisition time and running time
  - Currently available around 10 am
Collaboration

- Research in collaboration with university
- Main collaboration:
  - Chaire de recherche EDS en prévisions et actions hydrologiques (CRPAH)
Thank you!

Questions?

Centre d’expertise hydrique du Québec
675, boulevard René-Lévesque Est
Aile Louis-Alexandre-Taschereau, 4e étage, case 28
Québec (Québec) G1R 5V7
www.cehq.gouv.qc.ca