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

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Collaborators :
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2014-06-24

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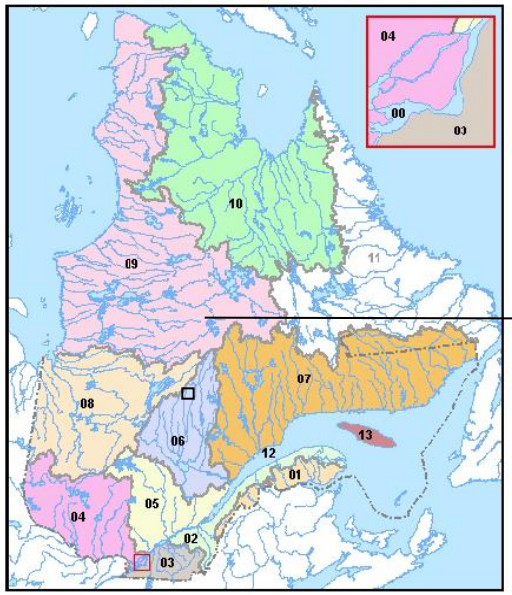
Water in Quebec



- Largest freshwater area in Canada 175 000 km^2
- 3% of the world renewable water
- More than 500 000 lakes and 4500 rivers

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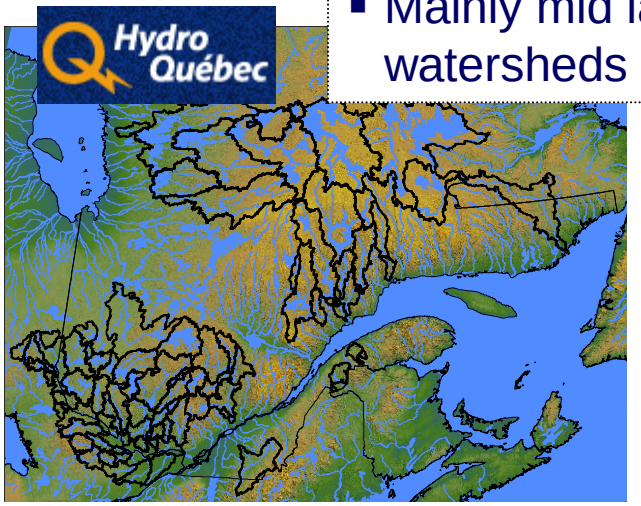
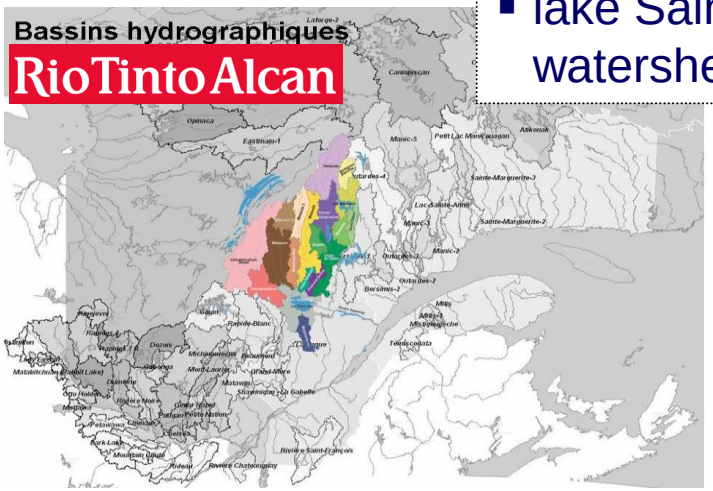
Operational hydrology : Main active organisations

- Mainly mid latitude watersheds

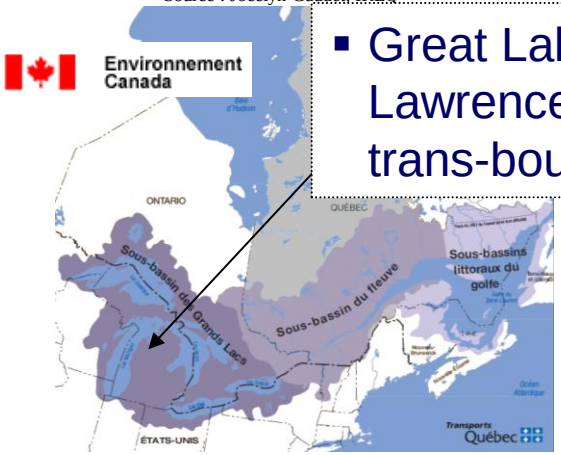


- lake Saint-Jean watershed



Source : Jocelyn Gaudet, IREQ

- Great Lakes / St. Lawrence and other trans-boundary system



Source : Marco Latraverse, RTA

- Entire province with a focus on southern Quebec

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Centre d'expertise hydrique du Québec (CEHQ)

www.cehq.gouv.qc.ca

- 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

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.

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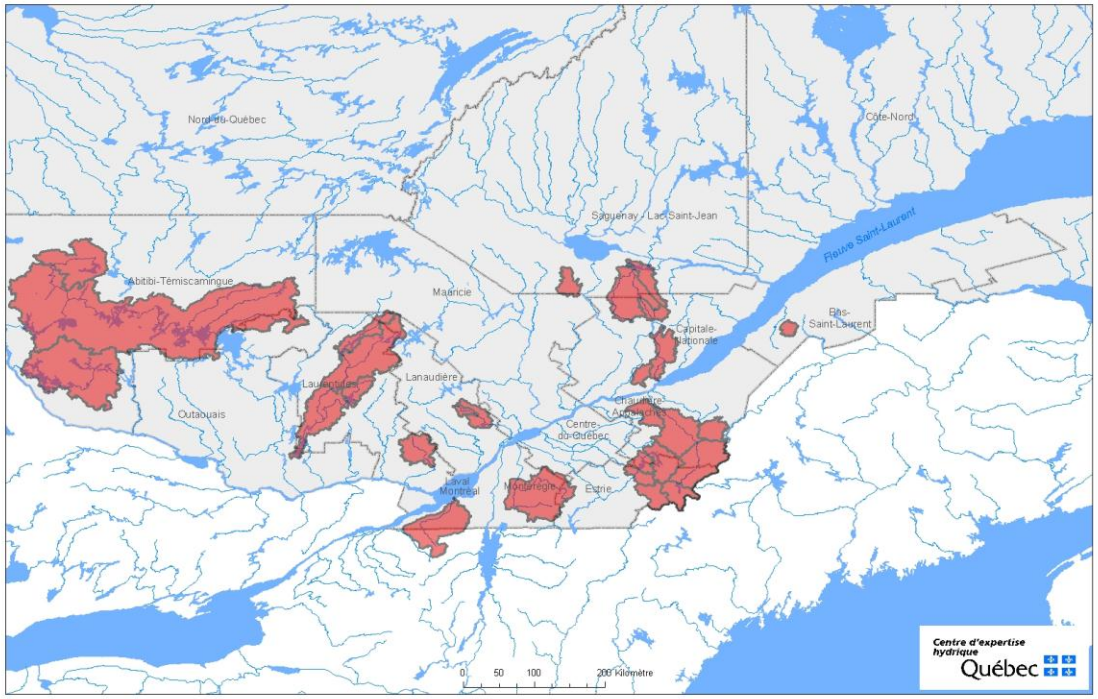
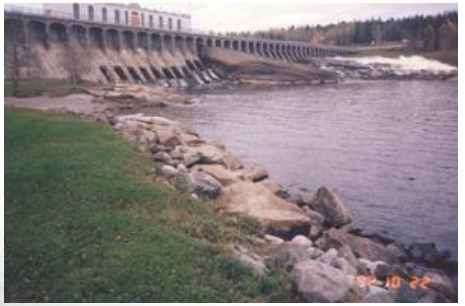
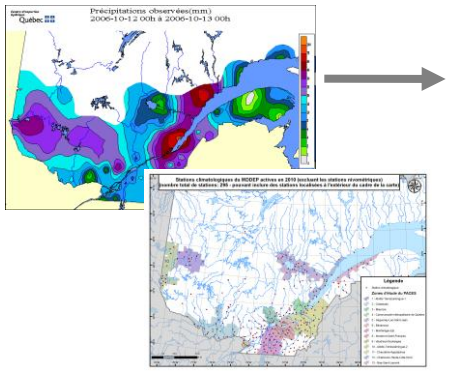
"Dam" forecasting

- 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

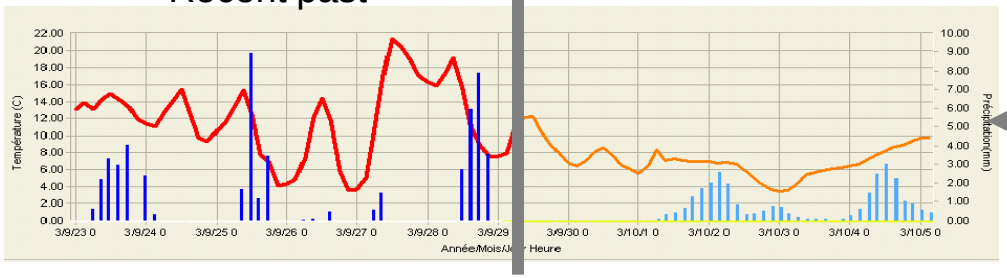


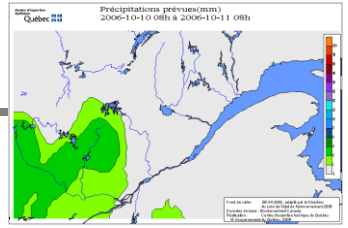
Quebec's Cooperative Weather Network + Climatological Network

Temperatures and precipitations

Recent past

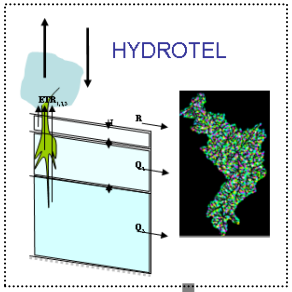
Future

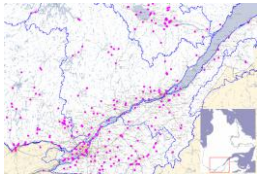




Canadian Meteorological Centre (GEM) + Meteorologists

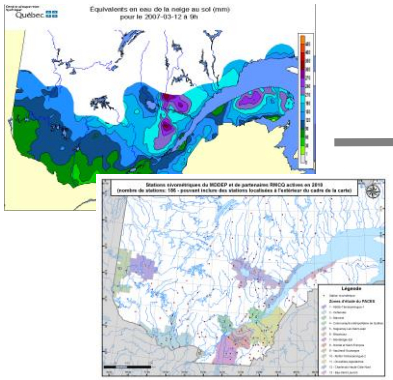
Hydrological model



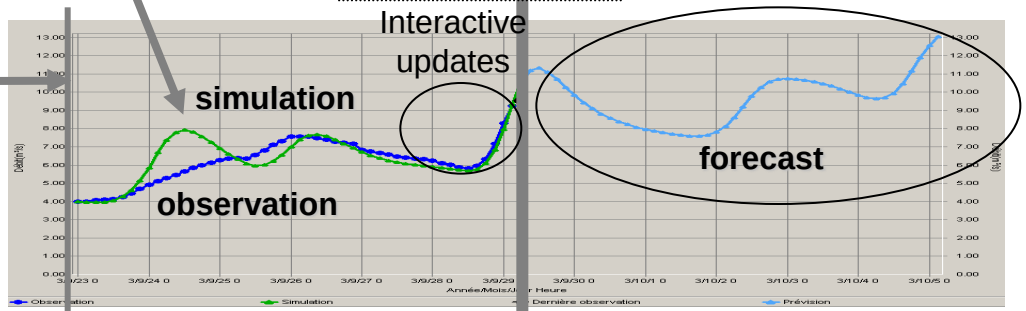


Hydrometrical network

Snow



Snow survey network + Vertical inflows



Post processing uncertainties

Recent past

Flow

Future

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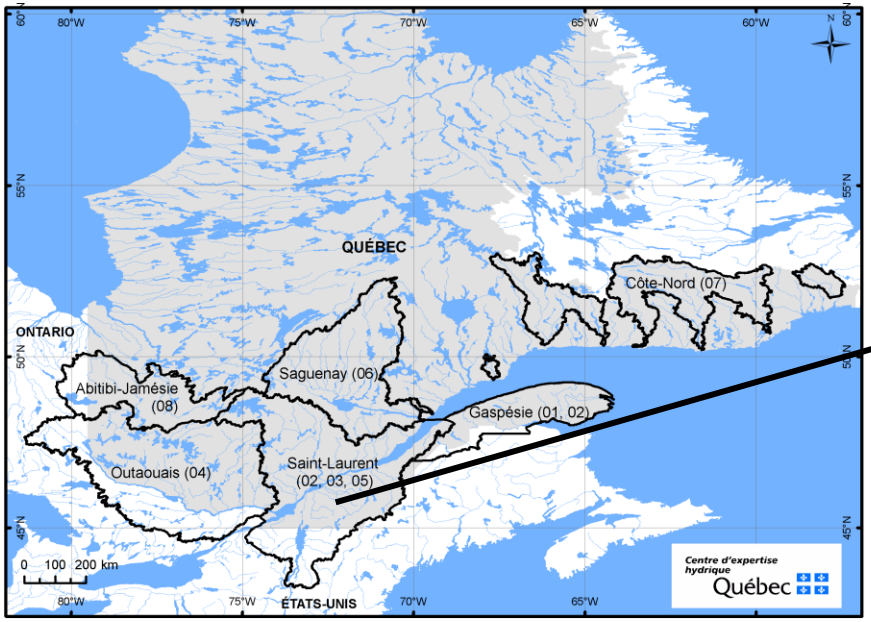
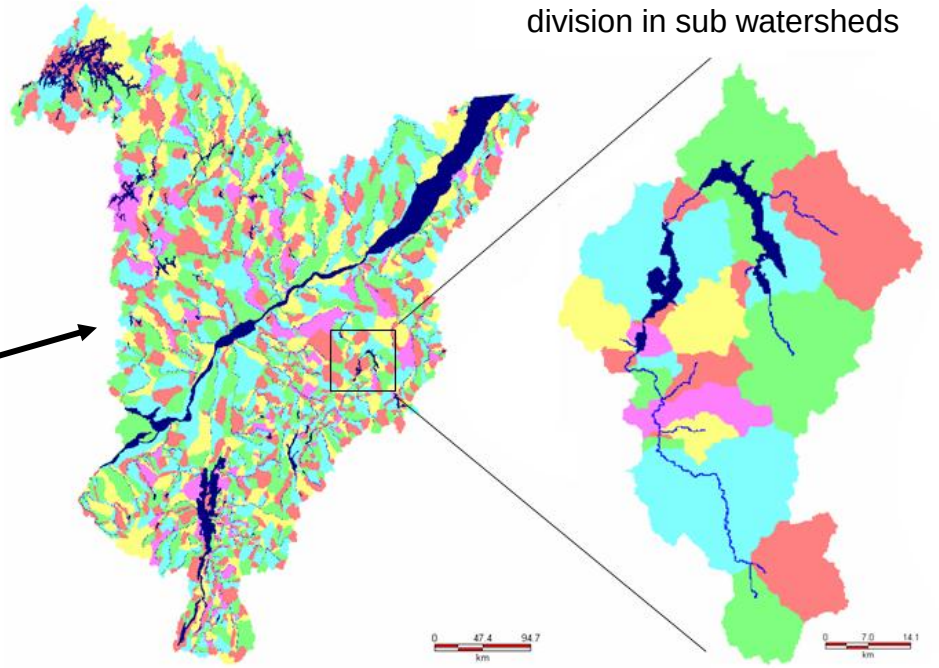
Modelisation extent

- 577 347 km²



division in sub watersheds



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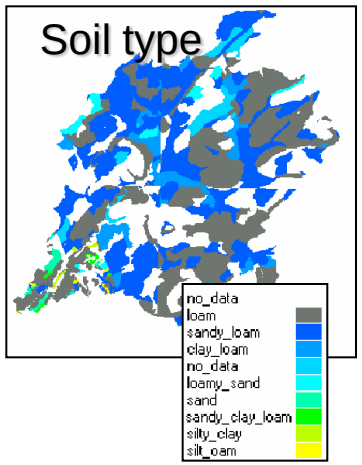
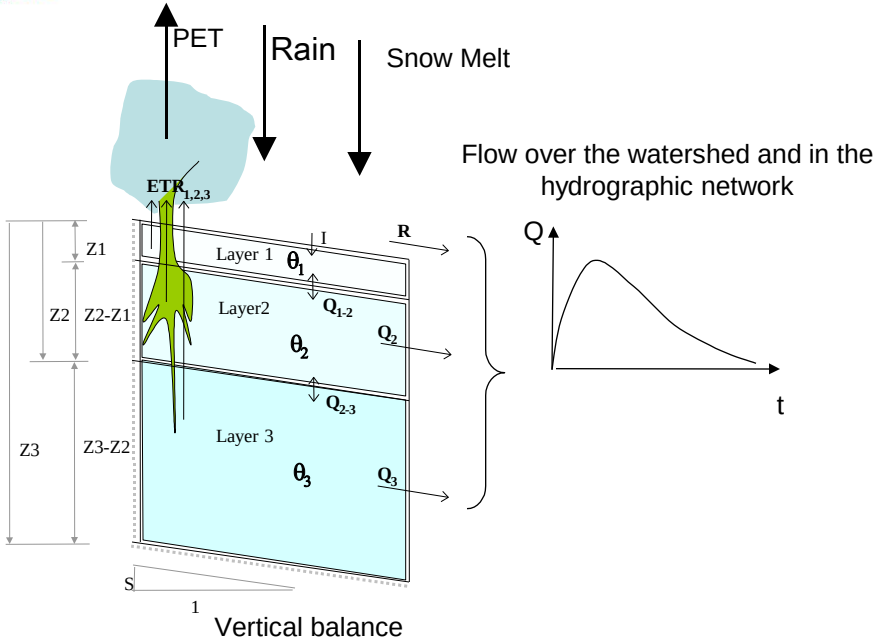
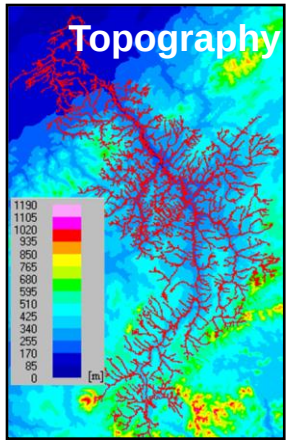
Hydrological model HYDROTEL

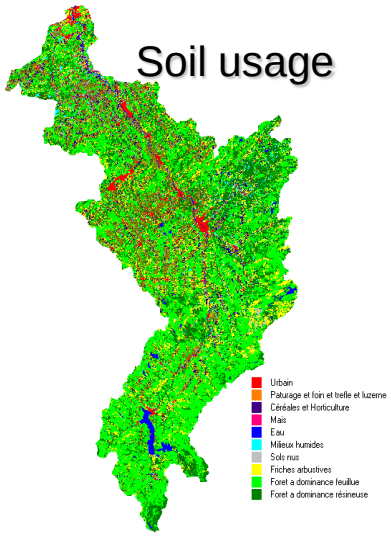


INRS
Université d'avant-garde

Hydrological processes simulated







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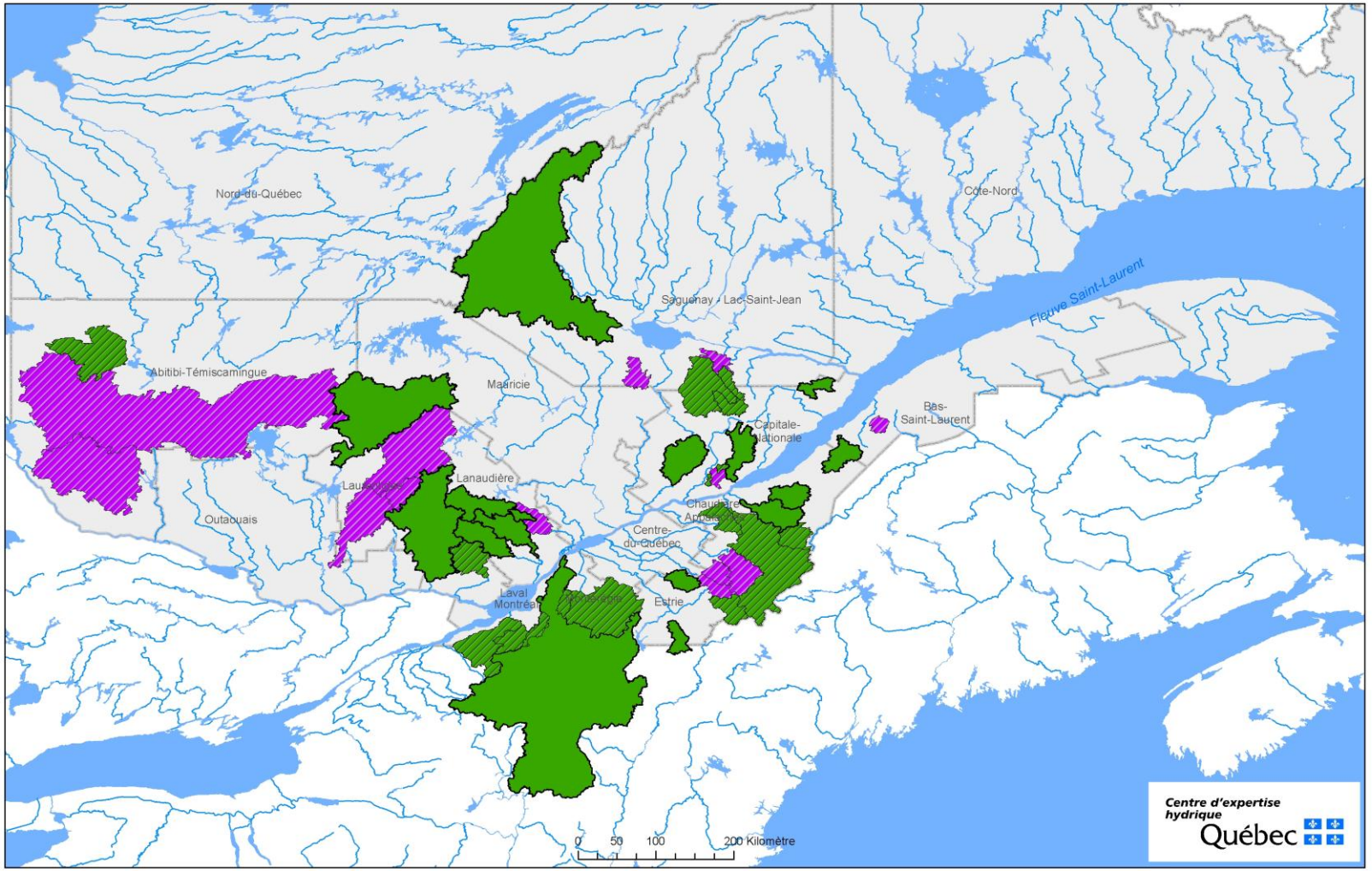
2014 – Operational forecasting



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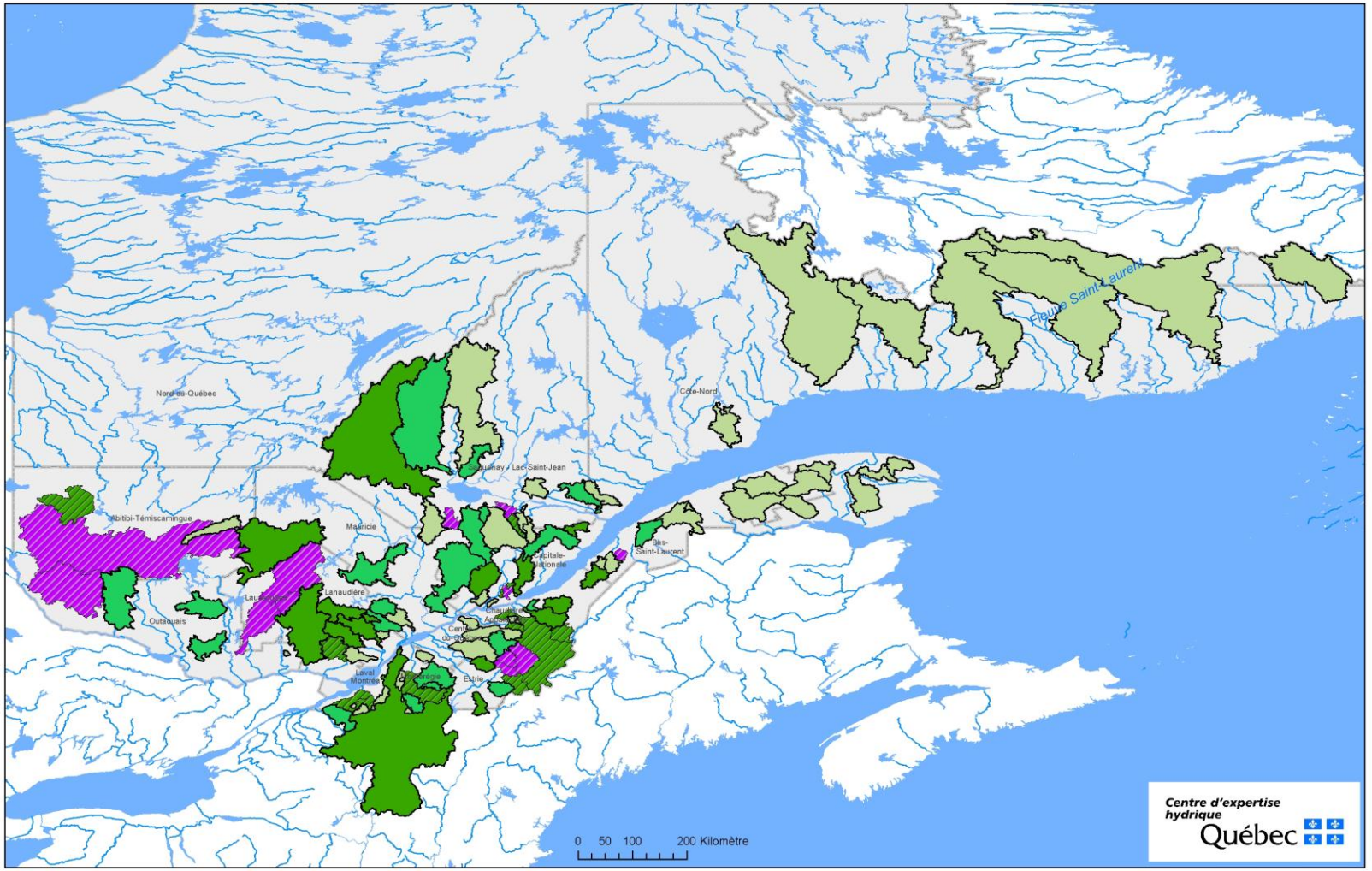
2020 – Long-term extent (temporary)



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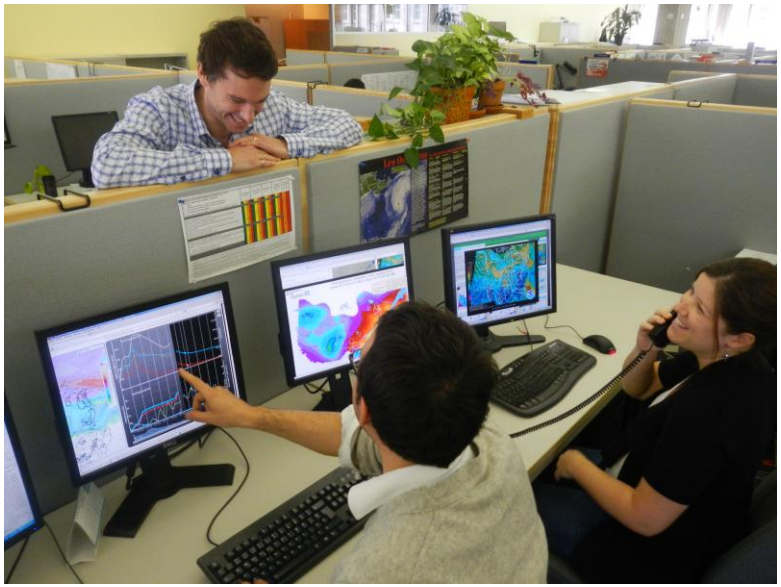
Flow forecasting team

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

Charles Poirier, Thomas-Charles Fortier Filion,
Simon Ricard, Audrey Lavoie, MarieÈve Boucher,
Amélie Thériault, Simon Lachance-Cloutier,
Philippe Noël, MartinPierre Lavigne,
Dominic Roussel, Pierre Lacombe,
Karine Guinard, Richard Turcotte



Prerequisites	Authorized practice
Level 0 – Forecaster in training	
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-autumn 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 0. • 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.

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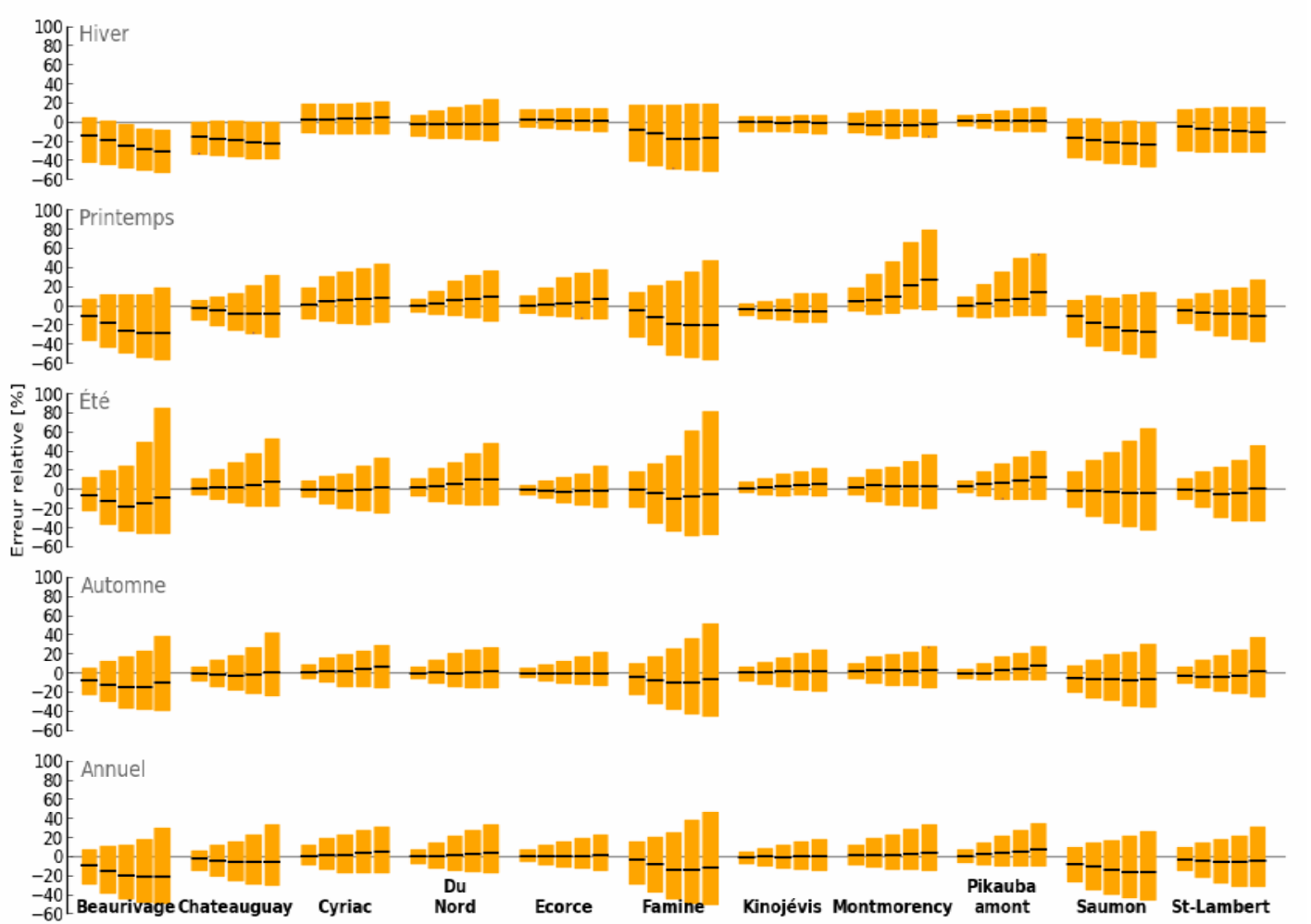
Post processing uncertainties



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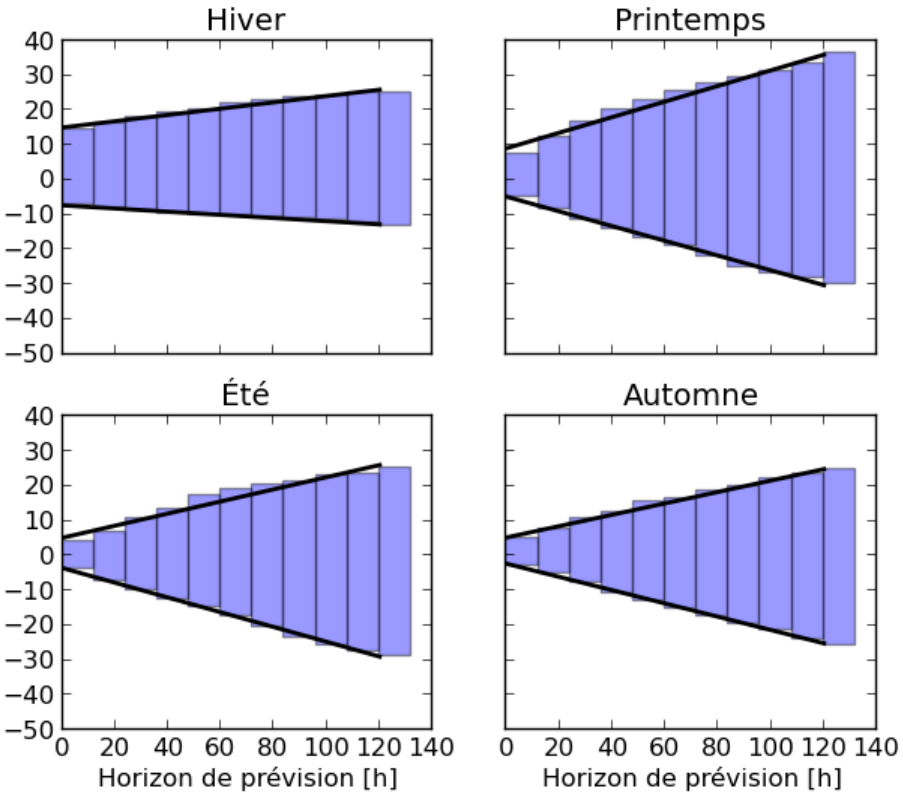
Post processing uncertainties

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



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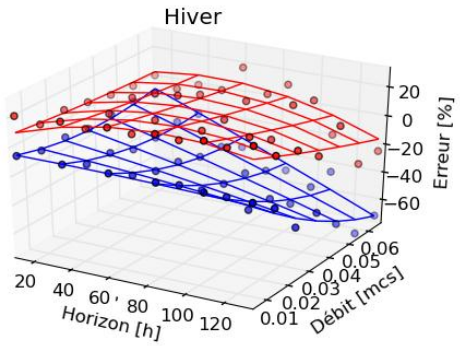

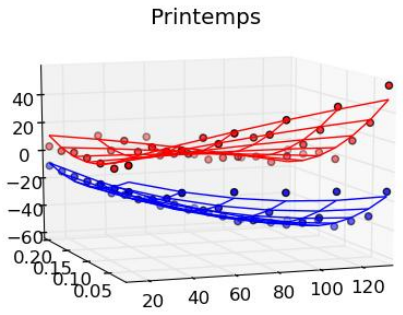

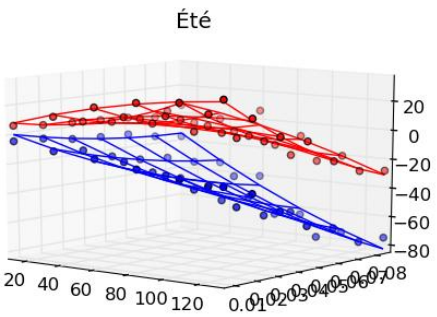

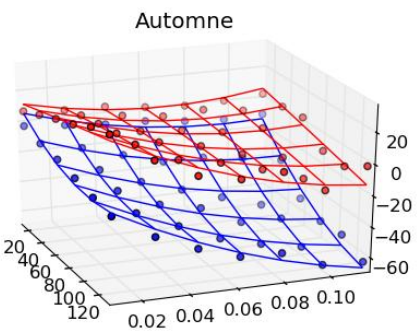

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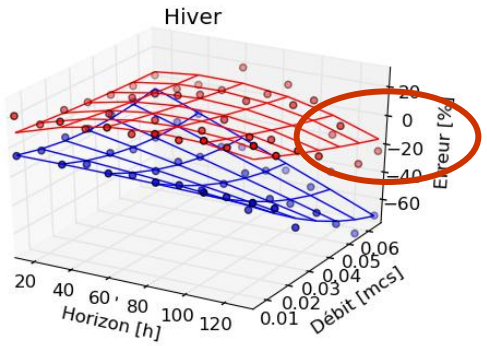

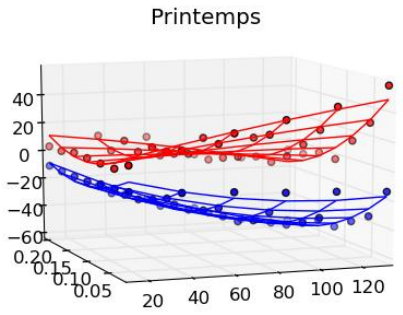

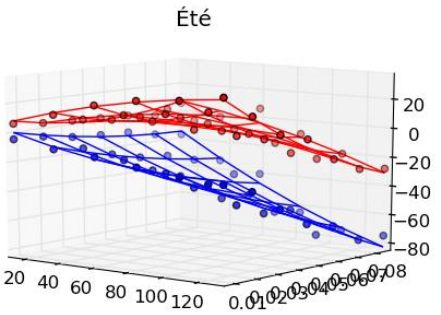

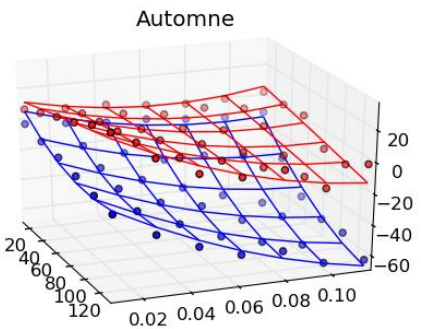

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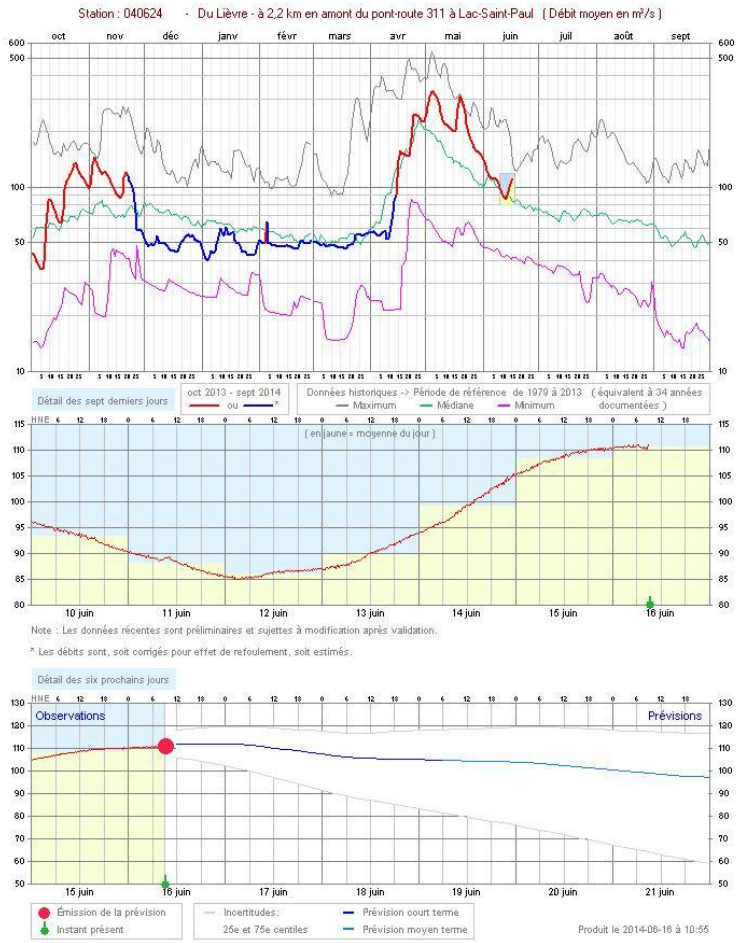
Internet dissemination



- Historical data
- Real time data
- 1 million views each year
- 17 million extractions

- Forecasted data

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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

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Collaboration

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

Chaire de recherche EDS en prévisions et actions hydrologiques

UNIVERSITÉ LAVAL

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Thank you !

Questions ?

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