Forecasting in Quebec for flood prediction and dam management – An overview of the current operational methods and challenges producing forecast uncertainties

Dominic Roussel, P. Eng, M.Sc.

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Développement durable, Environnement et Lutte contre les changements climatiques

Québec

Presentation summary

- **Context of the forecasting team**
- Methods currently used for hydrological forecasting
- Finding an optimal solution for producing and communicating forecast uncertainties

Context of the forecasting team

Forecasting history:

- 1996 : July 19 – 21, Saguenay's flood

- 1997 : Beginning of Quebec's public forecasting
- 2011 : Richelieu's flood

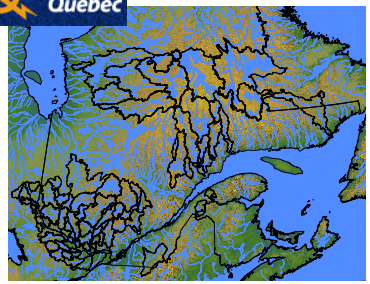
- 2013: Two main usages (public dam management and public security watchfulness)

Context of the forecasting team

Users	Needs	Responsibilities
Public dam managers (in MDDELCC)	Reservoir level forecasting, management and what-if scenarios	Managing public dams with regards to various constraints
Ministry of public security	Flood forecasting	Alert the decision makers, first responders and general public regarding flooding

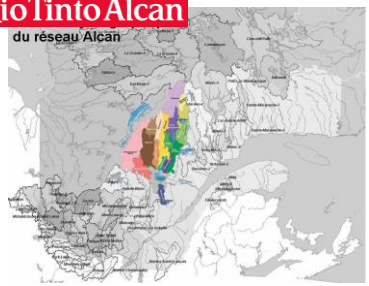
Context of the forecasting team

Hydro Québec

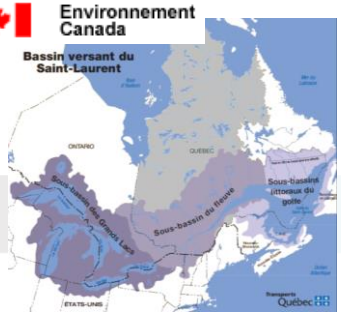


Rio Tinto Alcan

du réseau Alcan



Environnement Canada



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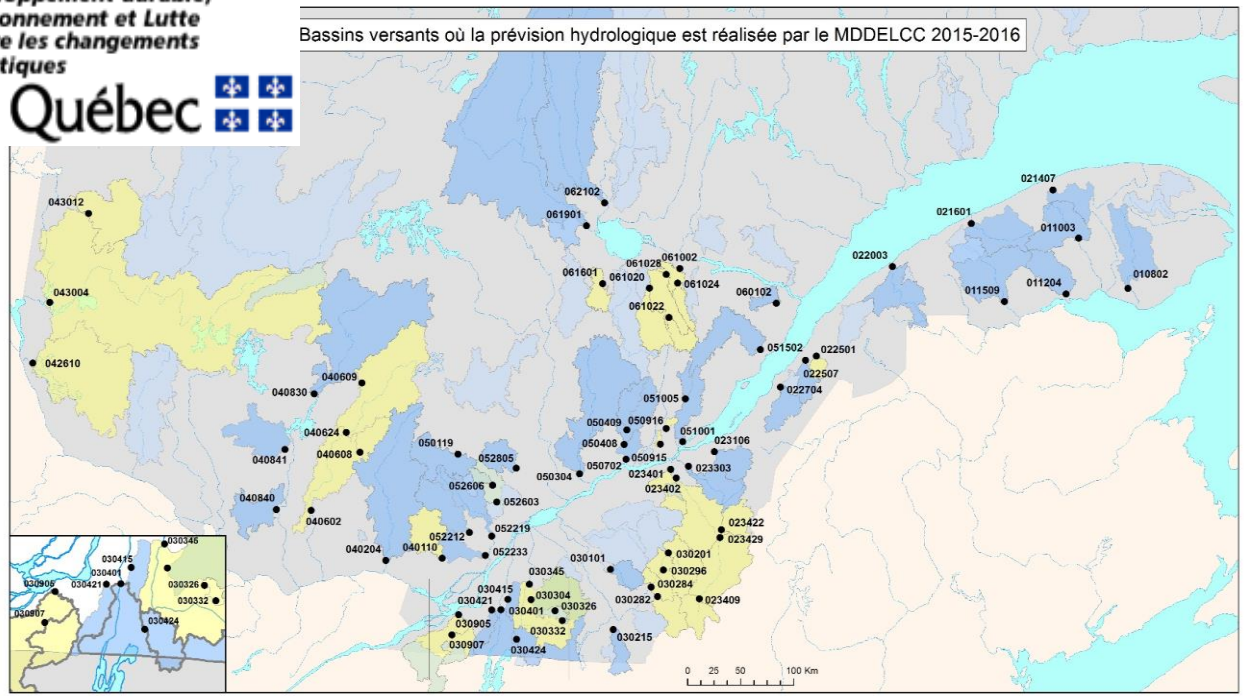
Bassins versants où la prévision hydrologique est réalisée par le MDDELCC 2015-2016



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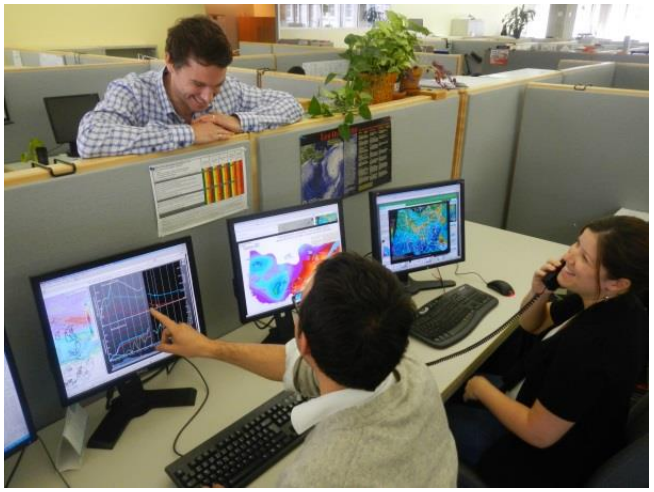
Context of the forecasting team

- Forecasting team selected for a LEAN Optimisation project by the MDDELCC

- LEAN project completed in fall 2015



- Project results:
  - Effort savings (25%)
  - Team of 10 compressed on now 6 forecasters
  - Team efforts refocused on 4 main activities:
    - Forecast expertise
    - Liaison with users
    - Forecasting system management
    - R&D projects
  - Performance indicators on these activities (management, scientific, user)

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Methods currently used for river forecasting

Inputs → Modeling → Expertise → Outputs

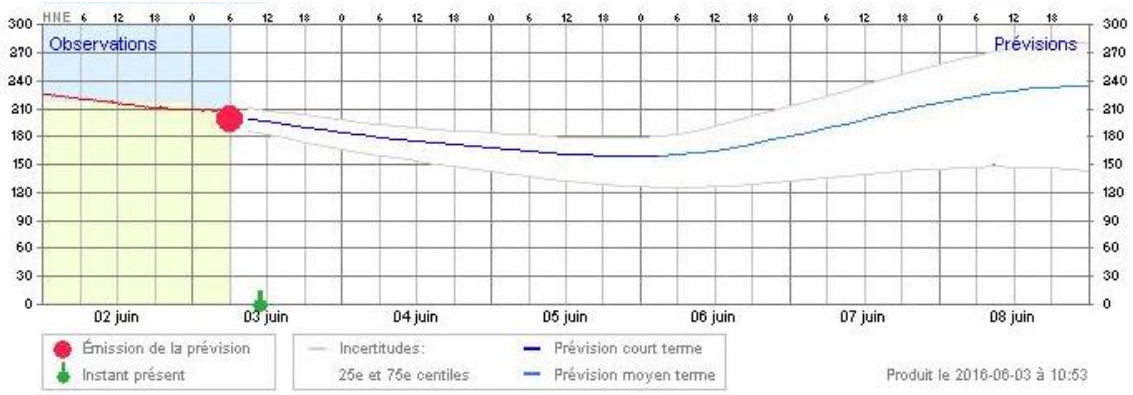
- Water gauges
- Precipitation gauges
- Temperature gauges
- SWE measurements

- RDPS (EC) forecasts
- GDPS (EC) forecasts

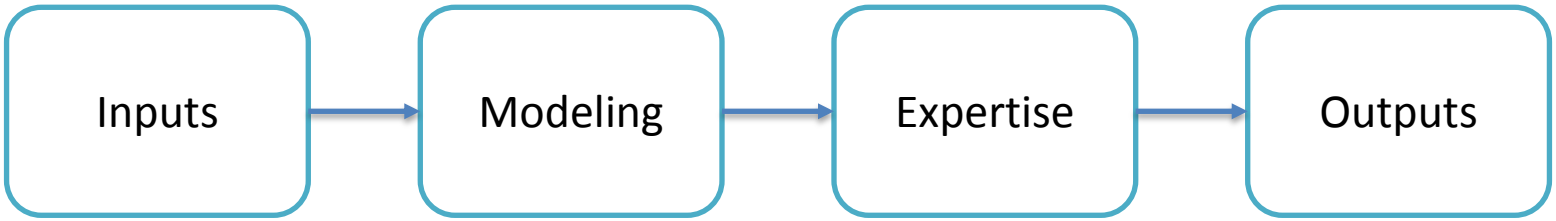
- Distributed snow cover model (HYDROTEL)
- Distributed hydrological model (HYDROTEL)
- Reservoir model

- Manual data assimilation
- Automated data assimilation
- Uncertainty calculation

- Hydrographs
- Maps
- Communications



Methods currently used for river forecasting



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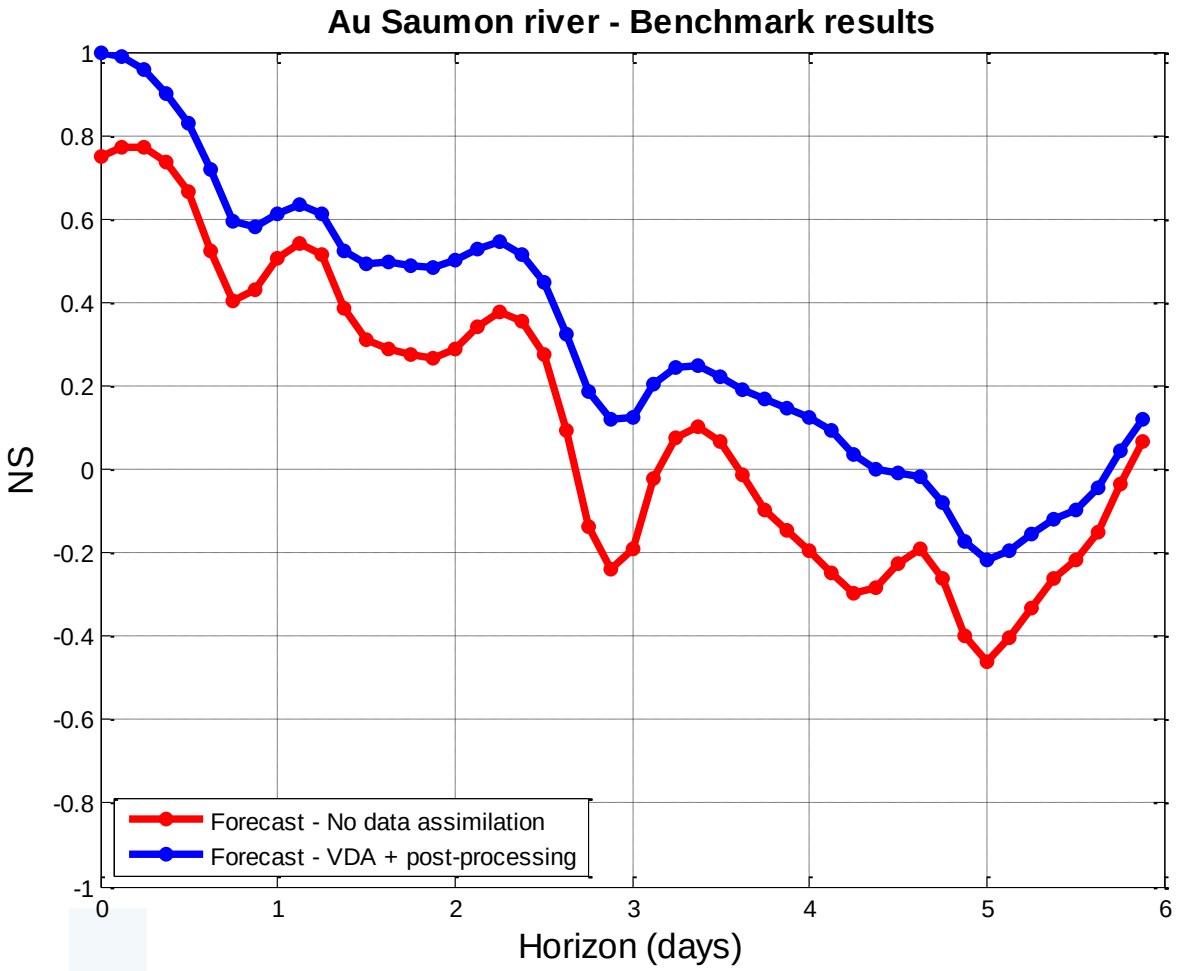
How to improve? What to improve?

Methods currently used for river forecasting

- Benchmark setup project:
  - Provide a testing platform as close to the operational context as possible.
  - Allow testing of improvements over a sufficient period and subset of catchment.

- Benchmark current state:
  - 10 catchments
  - 5 years of forecast
  - Automated testing using a variational data assimilation method (*Abaza and al., Thiboult and al.)*

Methods currently used for river forecasting



Methods currently used for river forecasting

Successful alert rate

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Forecast - No data assimilation	0.83	0.80	0.60	0.80	0.60	0.00
Forecast - VDA + post-processing	0.67	0.80	0.60	0.60	0.40	0.00

False alert rate

	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6
Forecast - No data assimilation	0.17	0.71	0.57	0.69	0.75	1.00
Forecast - VDA + post-processing	0.20	0.56	0.50	0.66	0.83	1.00

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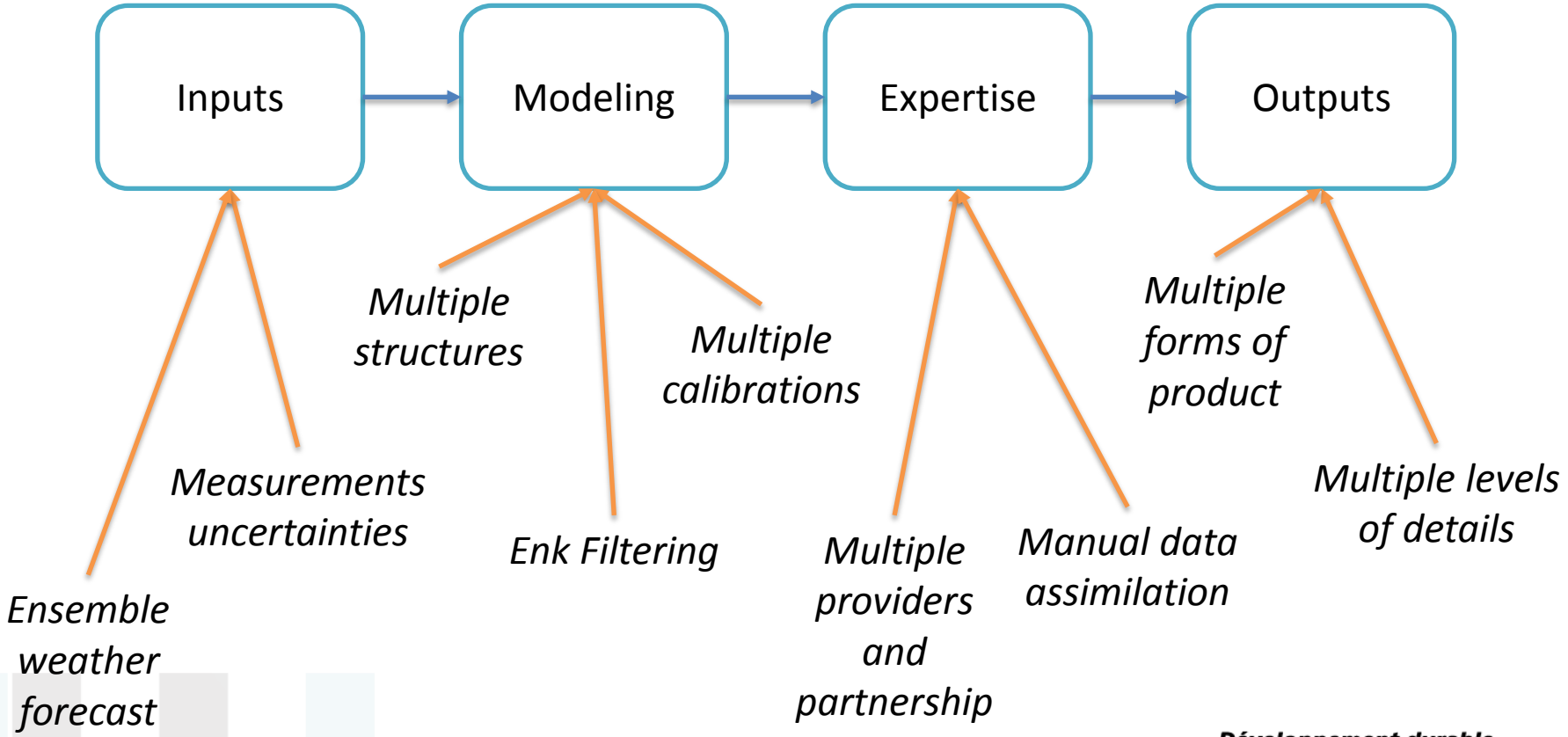
- **Finding an optimal solution for producing and communicating forecast uncertainties**

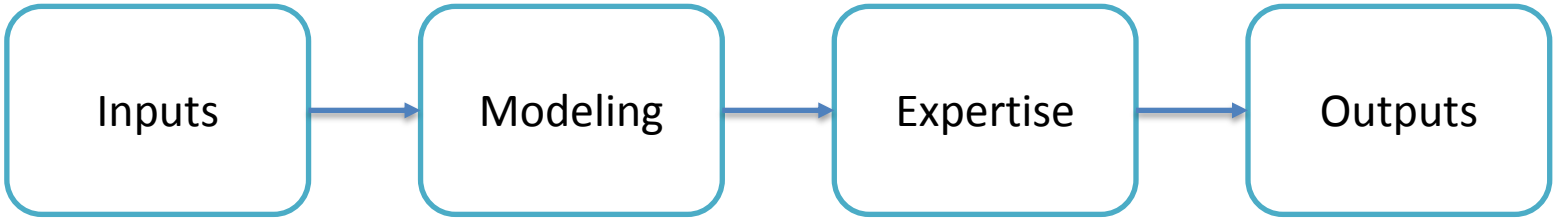
Finding an optimal solution for producing and using forecast uncertainties

- What's an optimal solution?



Finding an optimal solution for producing and using forecast uncertainties

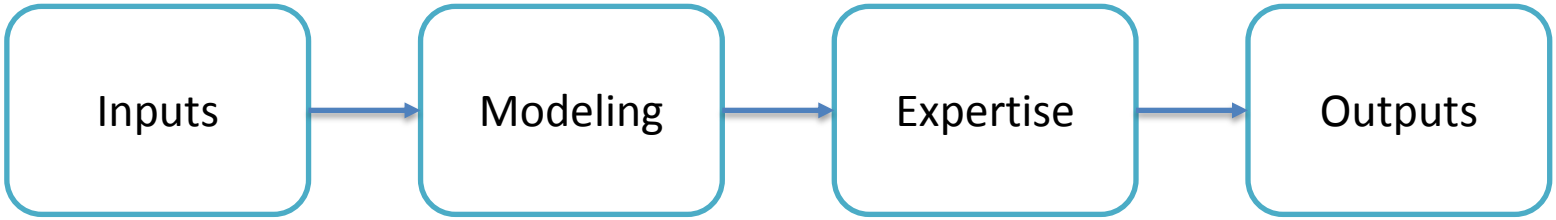
- An optimal solution should be **operationally sound**:



  - Takes into account the chain of production as a whole.
  - Forecasting teams have delivery time constraints.
  - Agencies have limited computation and maintenance capabilities.

Finding an optimal solution for producing and using forecast uncertainties

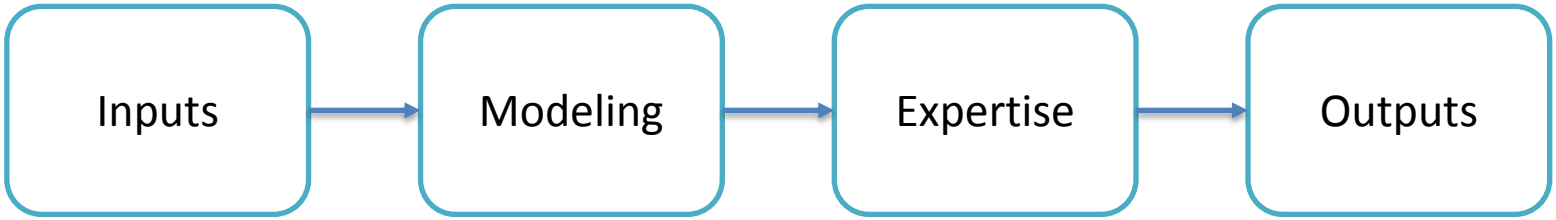
- An optimal solution should be **professionally sound**:



  - Forecasters have to take responsibility for their forecasts.
  - Forecasters have to explain the uncertainty to different users.
  - Forecasters need to interact with the process.

Finding an optimal solution for producing and using forecast uncertainties

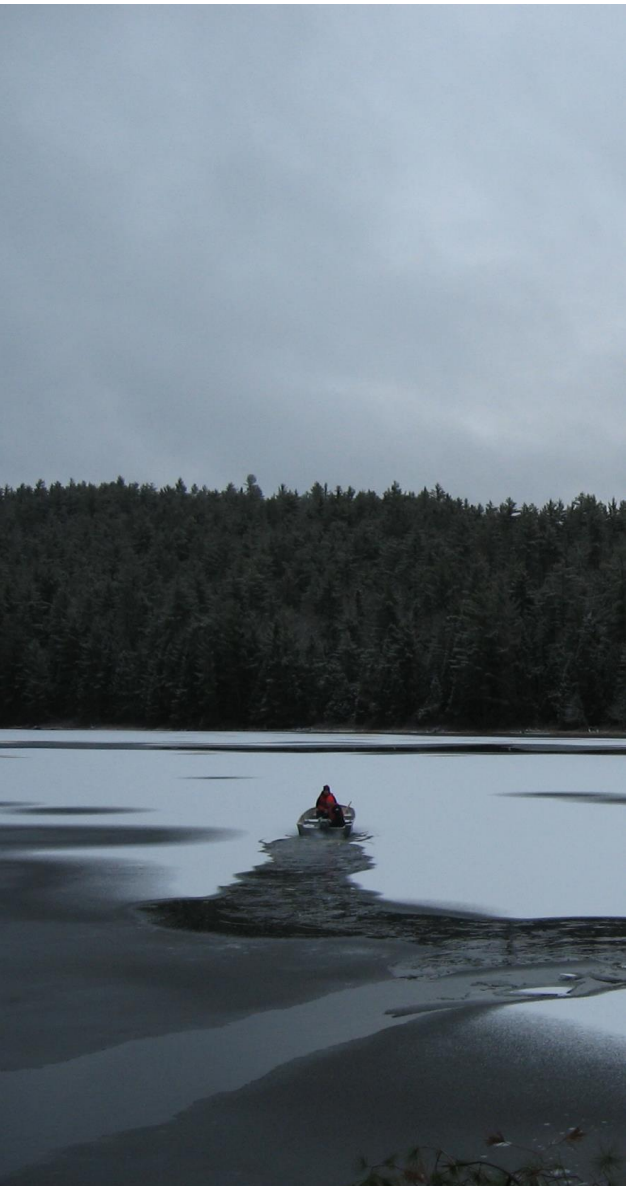
- An optimal solution should be **sound for the users**:



  - Users have different needs and responsibilities.
  - Improvements to forecasting need to have a real positive impact on the users.
  - User need a message (sometimes more than a forecast)

Conclusion

- Operational benchmarking can **help** operational forecasting teams **select improvements**.
- Operational benchmarking can provide the scientific community a tool to further assess the **impact of new methods** for the forecast's **end users**.
- Solution for using forecast uncertainties should be **operationally** sound, **professionally** sound and sound for the **users**.



Thank you!

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