



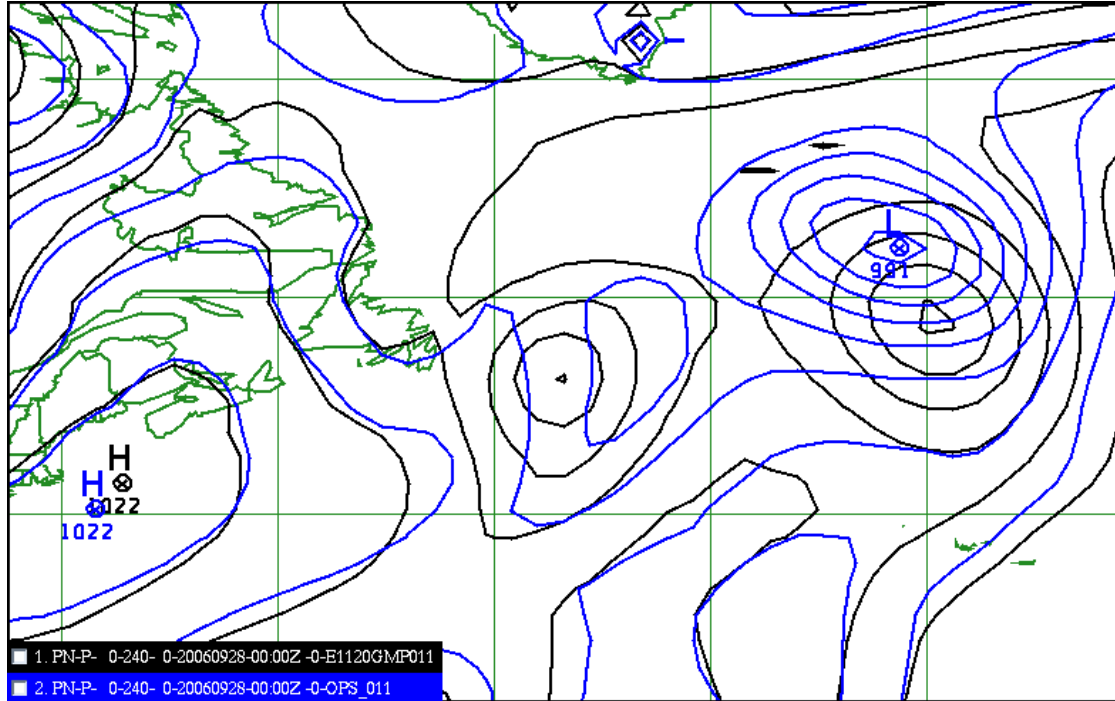
François Anctil

Quantifying and reducing the predictive uncertainty of floods

22nd Canadian
Hydrotechnical Conference
Montreal,
April 30, 2015

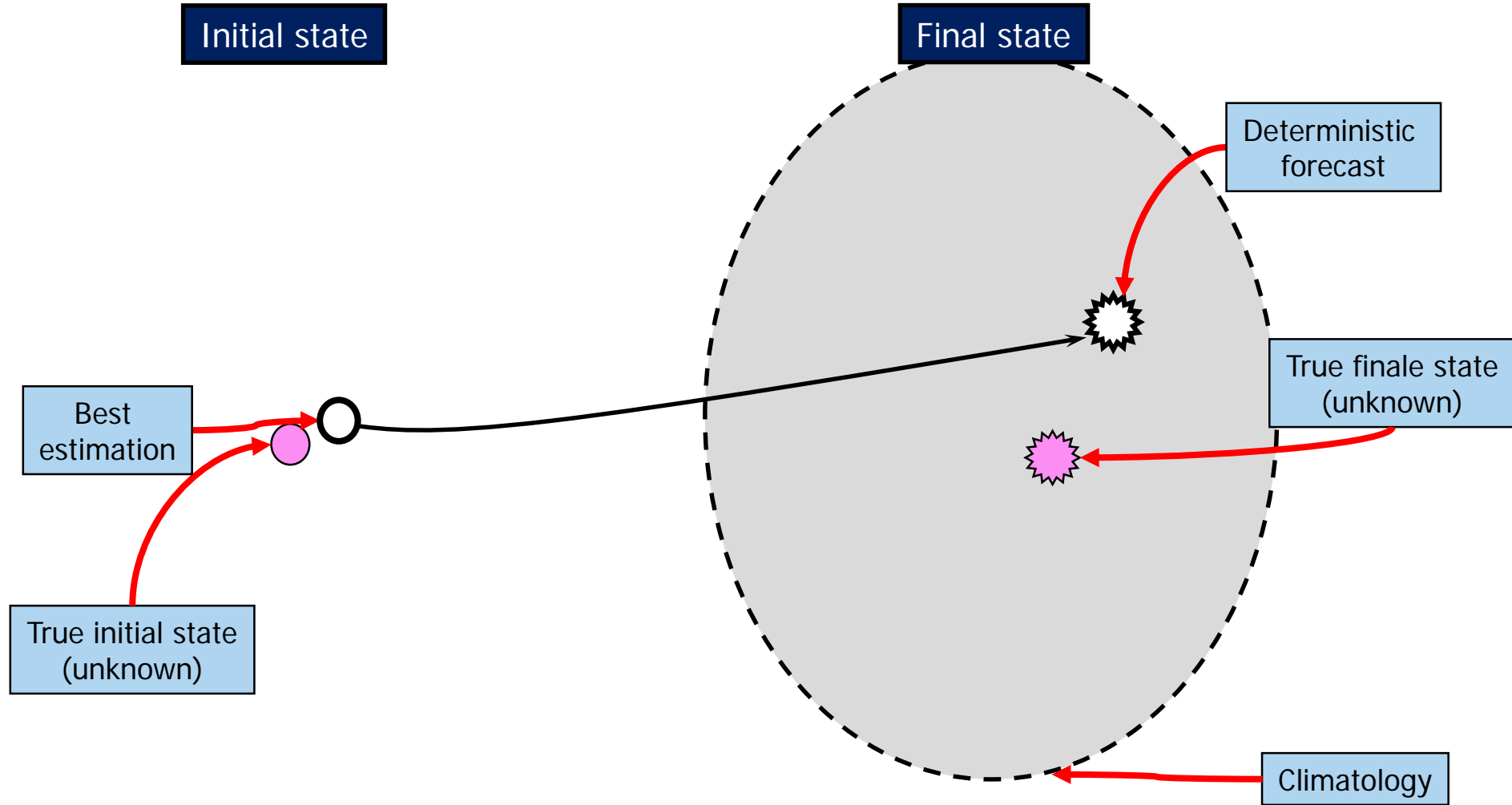


Predictability of weather

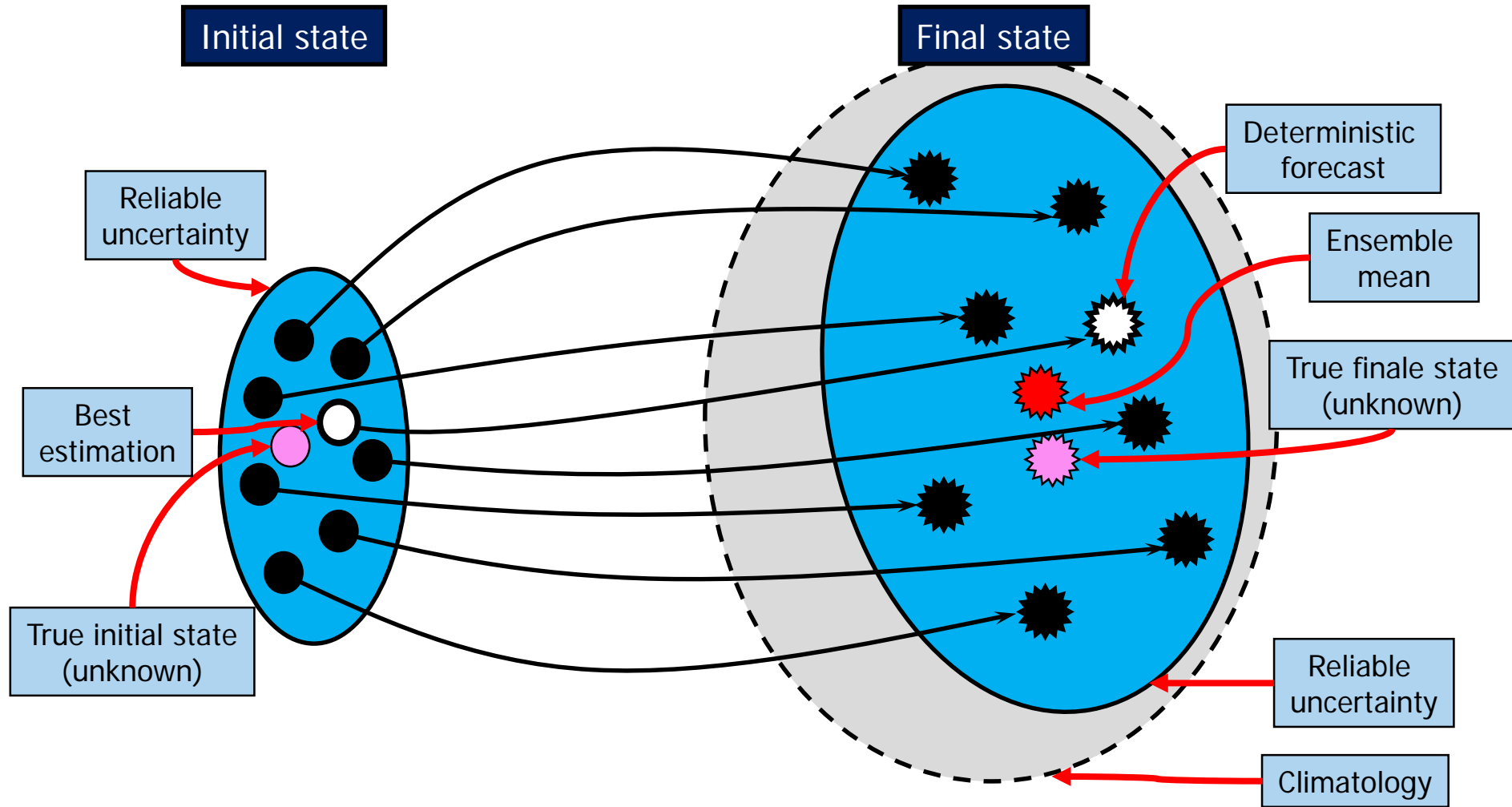


Variation in the 10th day forecast of the atmospheric pressure after modifying the 32nd bit of the initial states

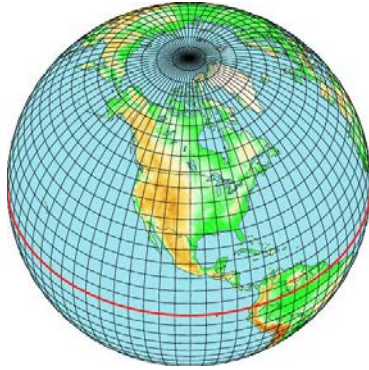
Deterministic forecast



Probabilistic forecasting



Ensemble prediction systems (EPS) in Canada

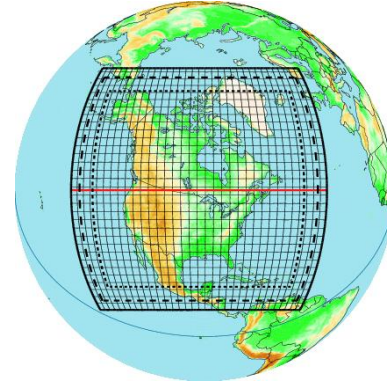


Global (GEPS)

20 members

15 days into the future

60 km horizontal resolution



Regional (REPS)

20 members

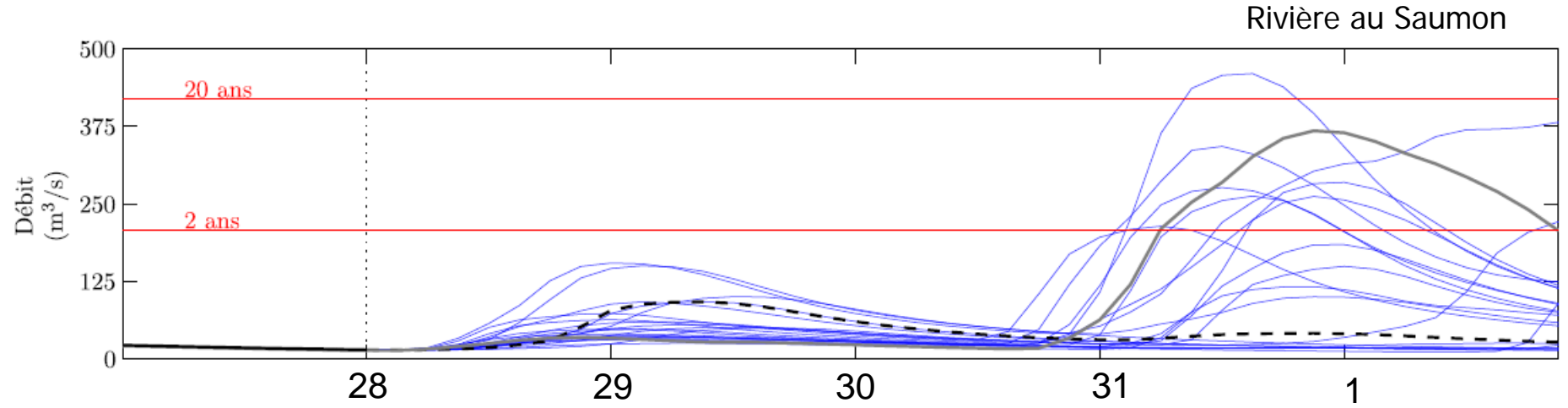
3 days into the future

15 km horizontal resolution

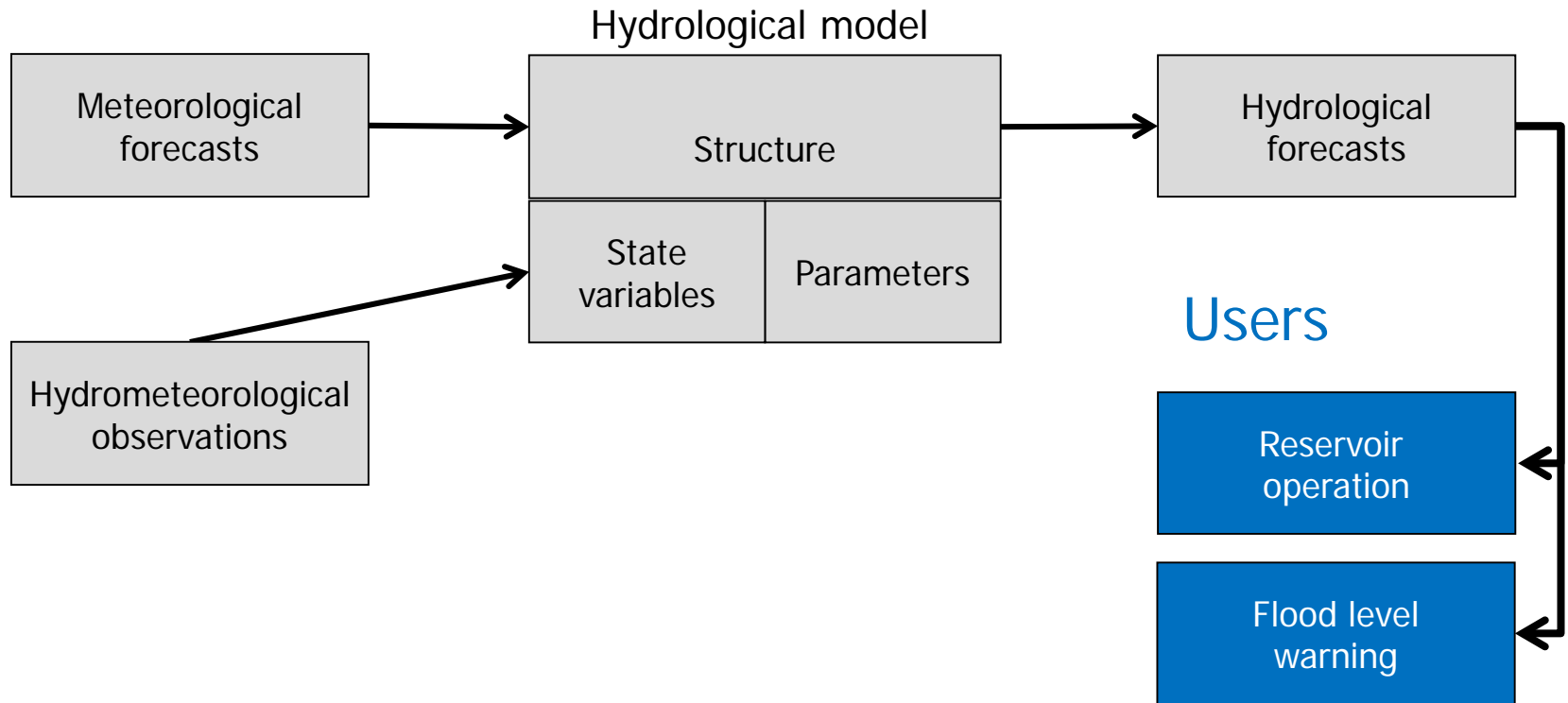
Hydrological ensemble forecasting

- General objective
 - To dynamically reduce and quantify uncertainty
- An operational framework accounting for
 - Meteorological forecasting uncertainty
 - Initial (watershed) uncertainty
 - Structural (hydrological) uncertainty
- Verification targets
 - Low bias
 - Reliability
 - Skill

An example

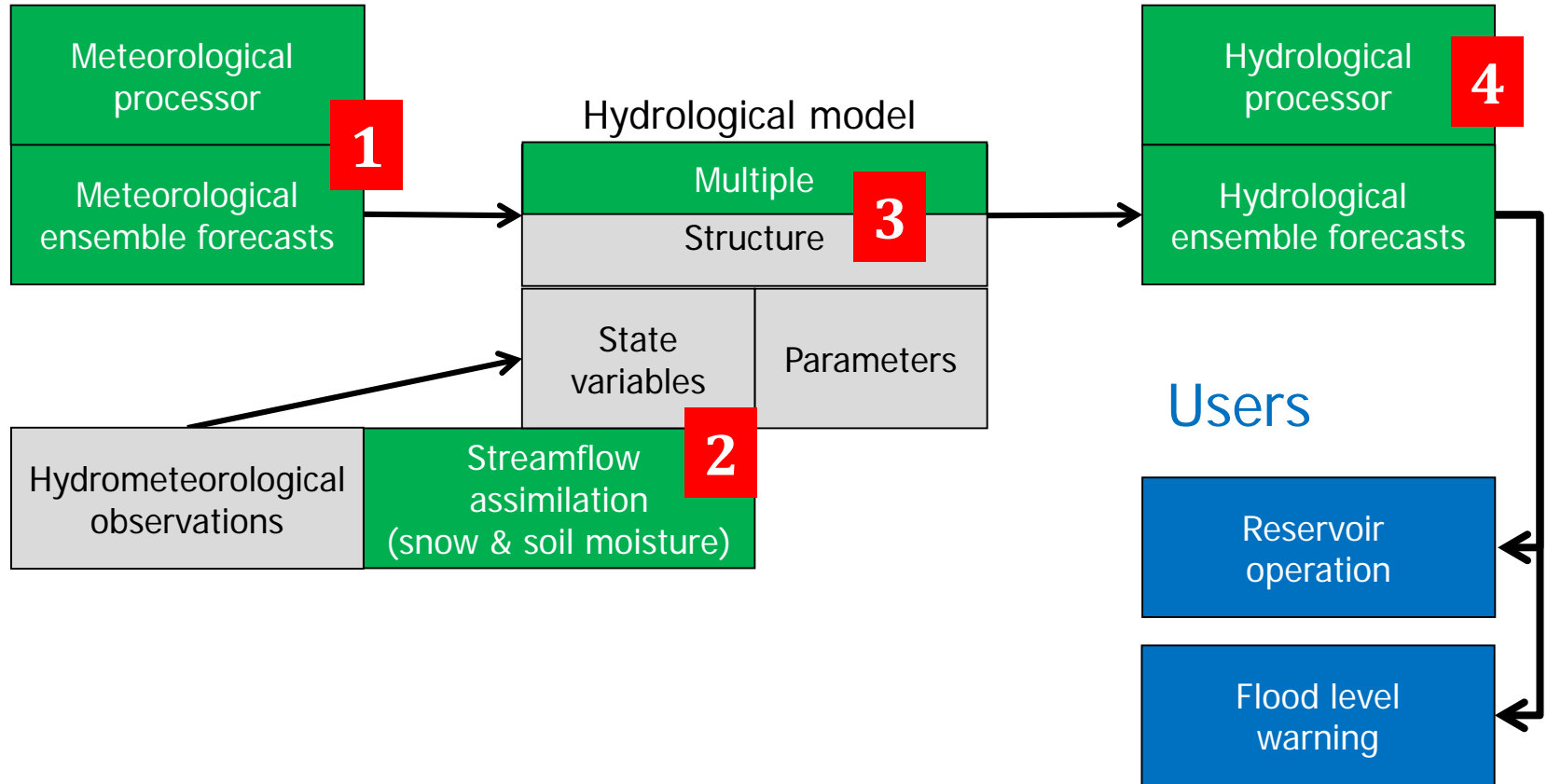


Deterministic framework



Probabilistic framework

Reduce and quantify uncertainty



FloodNet - Theme 2

- Hydrological ensemble forecasts
 - Single hydrological model
 - Multiple hydrological model
 - Meteorological ensemble forecasts post-processing
- Users oriented developments
 - Flood level warning
 - Real-time reservoir operation

Some earlier questionings

- A** What is the value of meteorological ensemble forecasts ?
- B** What is the value of probabilistic streamflow assimilation ?
- C** What is the value of multiple model hydrological ensemble forecasting ?

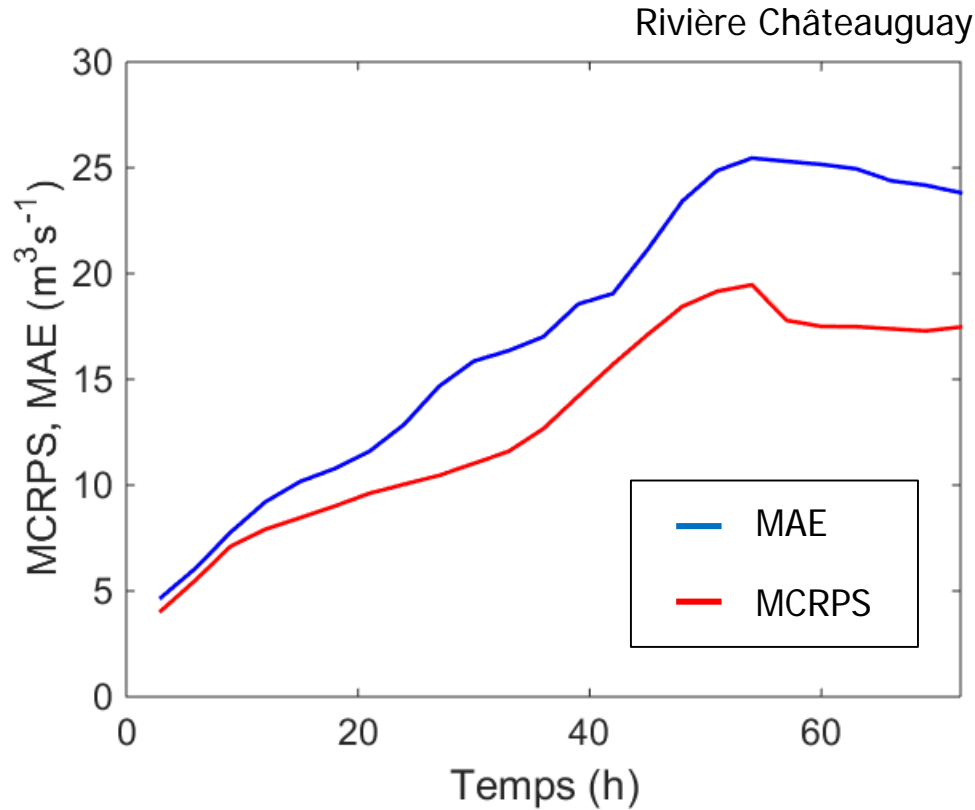
A What is the value of meteorological ensemble forecasts ?

1 Deterministic vs Global probabilistic

2 Naïve output updating

3 Hydrotel

4 None

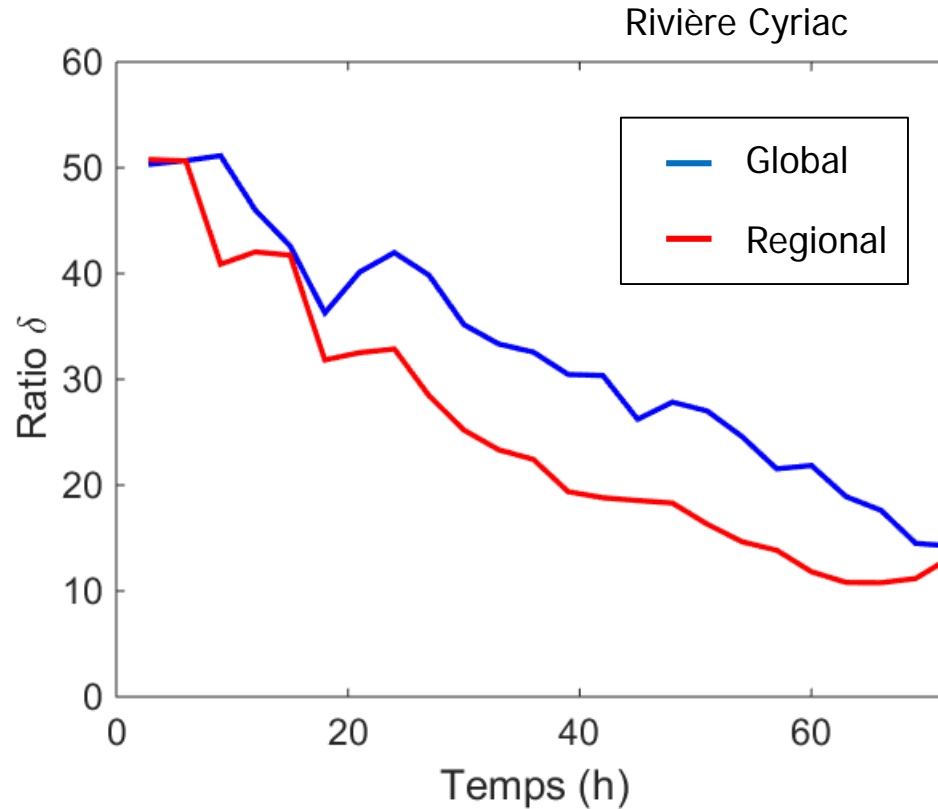


1 Global vs Regional

2 Manual

3 Hydrotel

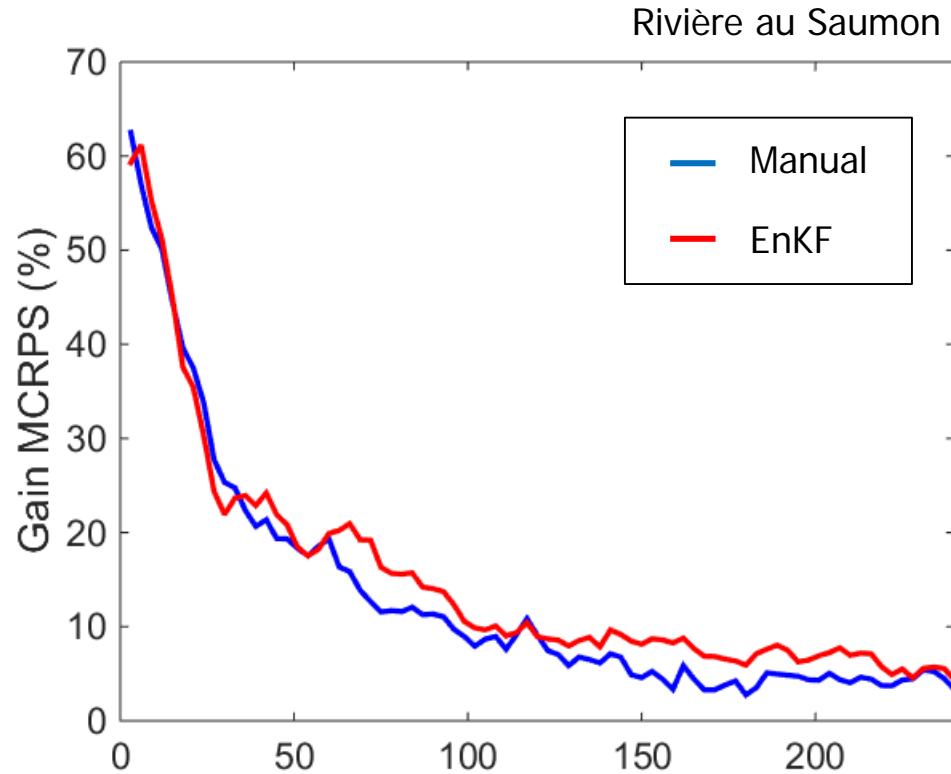
4 None



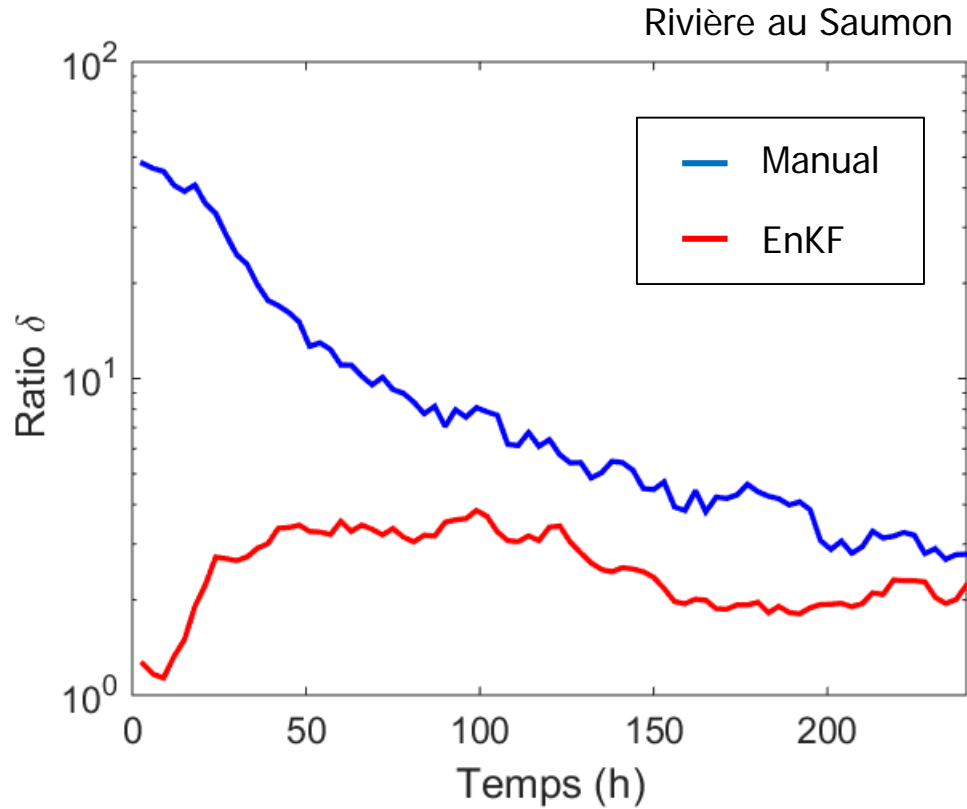
Abaza M, Anctil F, Fortin V, Turcotte R. **2013**. A comparison of the Canadian global and regional meteorological ensemble prediction systems for short-term hydrological forecasting. *Monthly Weather Review*, 141, 3462-3472. Corrigendum. *Monthly Weather Review* 142, 2561-2562.

B What is the value of probabilistic streamflow assimilation ?

- 1 Global
- 2 Manual vs EnKF
- 3 Hydrotel
- 4 None



- 1 Global
- 2 Manual vs EnKF
- 3 Hydrotel
- 4 None



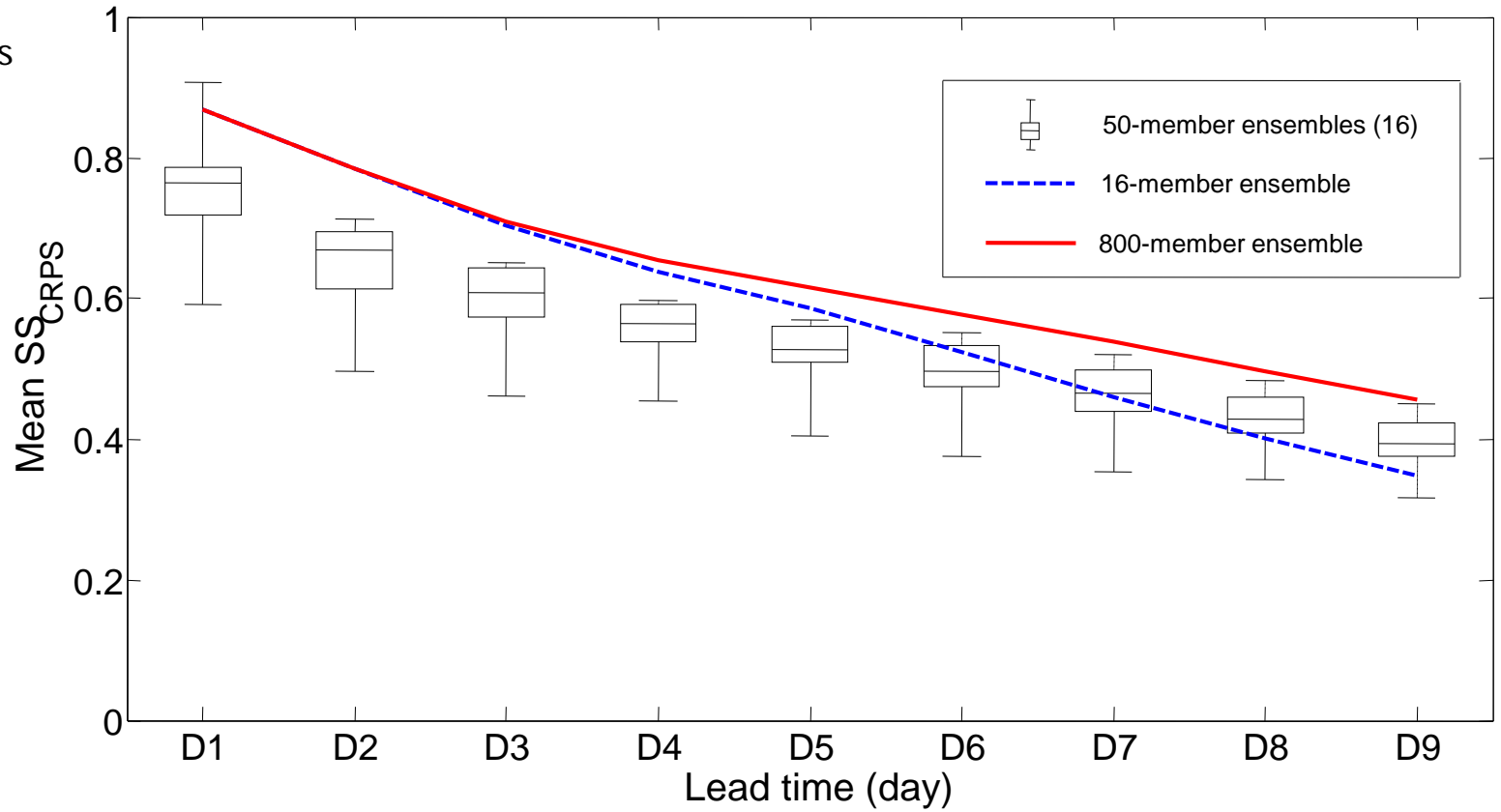
C What is the value of multiple model hydrological ensemble forecasting ?

1 Global ECMWF

2 Simple output

3 16 models

4 None

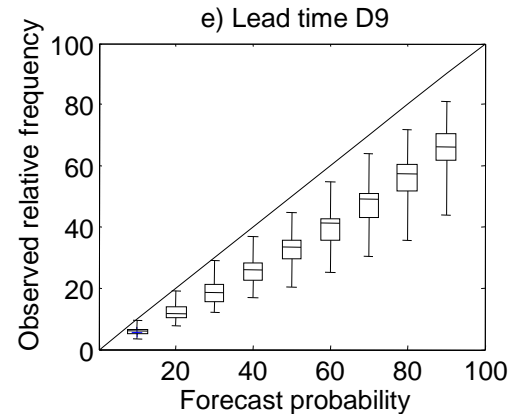
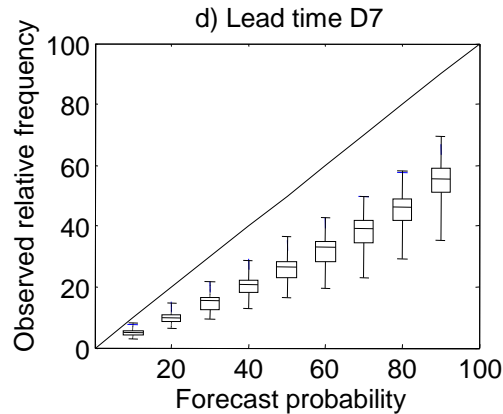
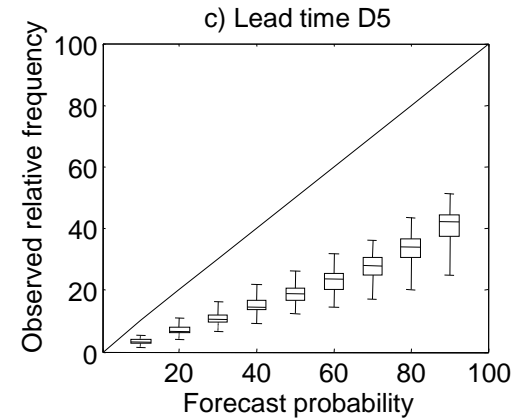
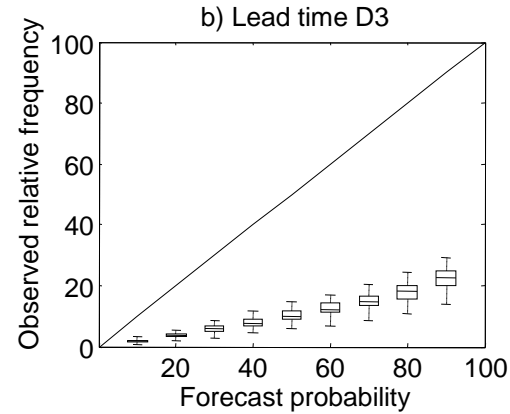
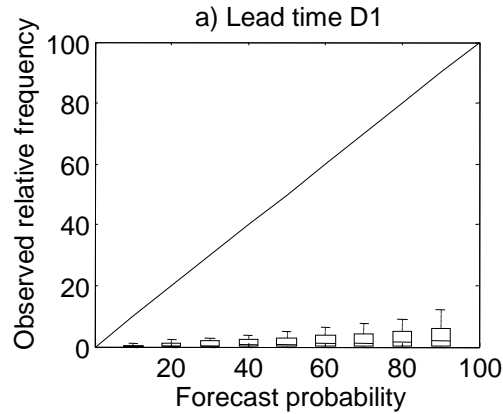


1 Global ECMWF

2 Simple output

3 16 models

4 None



50-member ensembles (16)

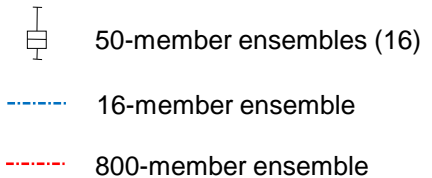
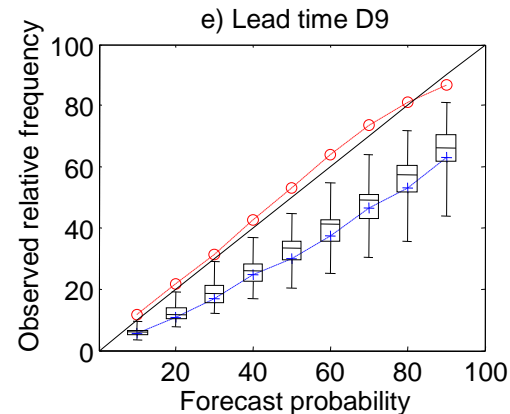
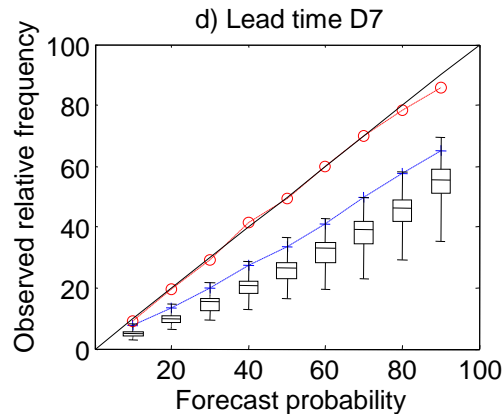
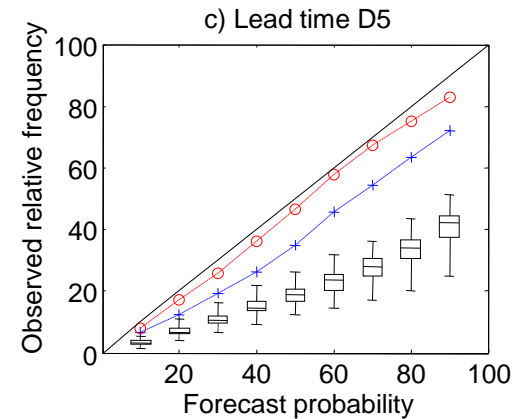
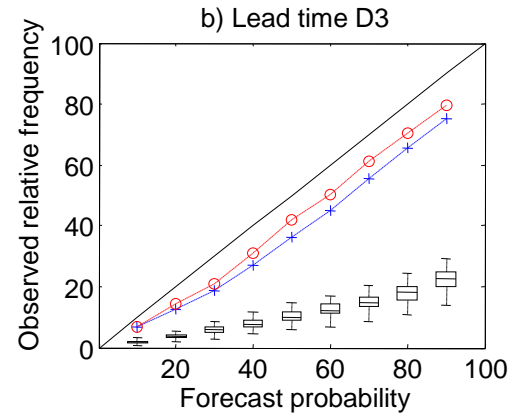
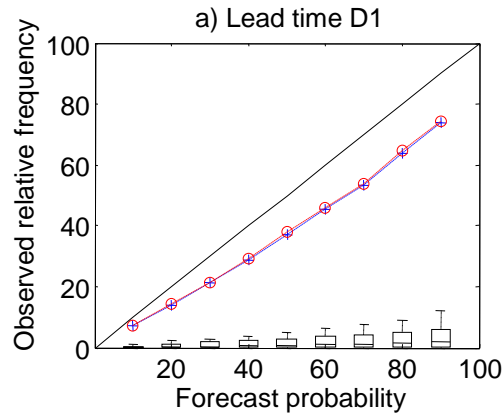
Velázquez JA, Anctil F, Ramos MH, Perrin C. **2011**. Can a multi-model approach improve hydrological ensemble forecasting? A study on 29 French catchments using 16 hydrological model structures. *Advances in Geosciences*, 29, 33-42.

1 Global ECMWF

2 Simple output

3 16 models

4 None



Velázquez JA, Anctil F, Ramos MH, Perrin C. **2011**. Can a multi-model approach improve hydrological ensemble forecasting? A study on 29 French catchments using 16 hydrological model structures. *Advances in Geosciences*, 29, 33-42.

Take home message

- It is operationally feasible to dynamically reduce and quantify uncertainty
- We seek refining operational frameworks accounting for
 - Meteorological forecasting uncertainty
 - Initial (watershed) uncertainty
 - Structural (hydrological) uncertainty
- and attaining
 - A lower bias
 - A Reliable predictive distribution



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