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BAYESIAN MERGING OF LARGE SCALE AND LOCAL SCALE HYDROLOGICAL FORECASTS

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Environment and Climate Change Canada

Environnement et Changement climatique Canada

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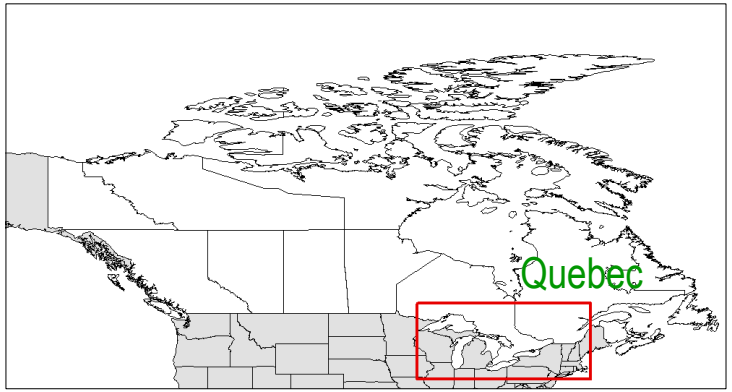
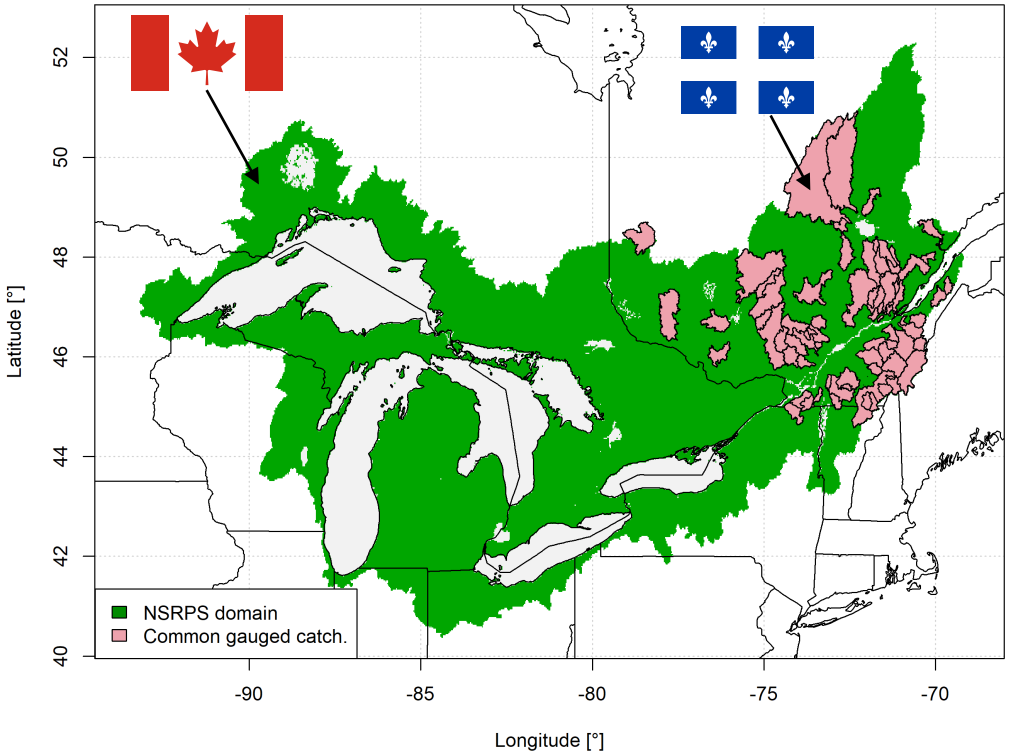
COEXISTENCE OF LARGE SCALE AND LOCAL FORECASTS





COEXISTENCE OF LARGE SCALE AND LOCAL FORECASTS

	SPH	NSRPS
Organization	MELCC (Quebec) 	ECCC (Canada) 
Meteo. forcings	ECCC regional forecasting system	
Hydrological model	HYDROTEL	SVS + WatRoute
Emission time	06 UTC-5	00 and 12 UTC
Lead time	3h0, 6h, 9h, ..., 5d	1h, 2h, 3h, ..., 6d
Nature	Dressed deterministic	Deterministic
Data assimilation	Manual, expert judgment	None
Spatial resolution	28 035 river reaches	1km x 1km grid
Availability	Since January 1st, 2019	Since March 12, 2019

BAYESIAN MERGING

$$p(\theta|y) = \frac{p(\theta)p(y|\theta)}{p(y)}$$

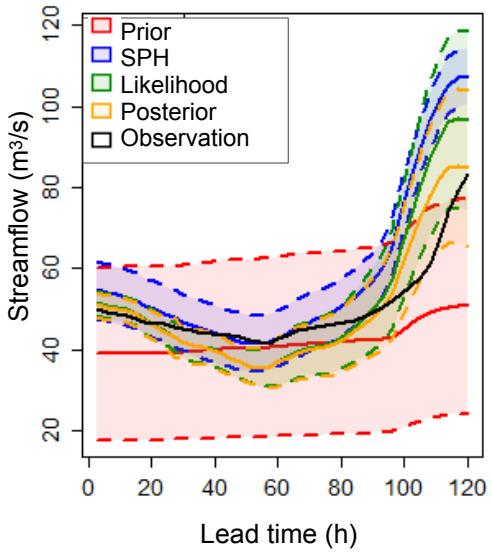
- θ is the **future normalized** streamflow
- y is the **normalized forecasted** streamflow
- $p(\theta)$ is the streamflow probability distribution before any forecasting: the prior knowledge to be updated.
- $p(y)$ is the forecast probability distribution. New information used for updating.
- $p(y|\theta)$ is the distribution of y, conditional to θ. It measures how the forecast is distributed around the actual streamflow. It is the likelihood function.
- $p(\theta|y)$ is the distribution of θ, conditional to y. It is the updated distribution of the actual streamflow: the **posterior** knowledge.

TESTING DIFFERENT PRIOR DISTRIBUTIONS

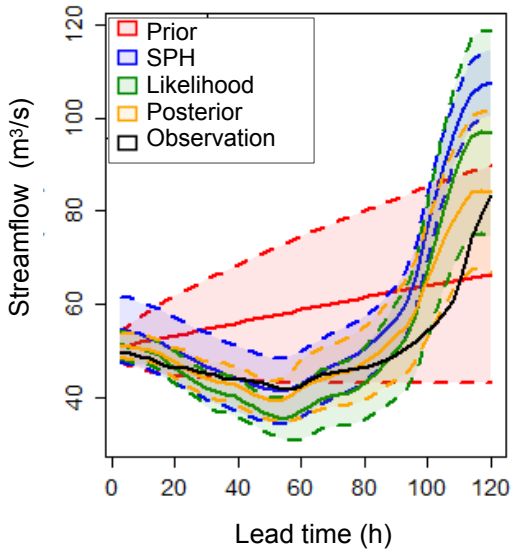
Example for the La Malbaie River (1 707 km^2).

Forecasts issued on May 12 2020 at 6 UTC

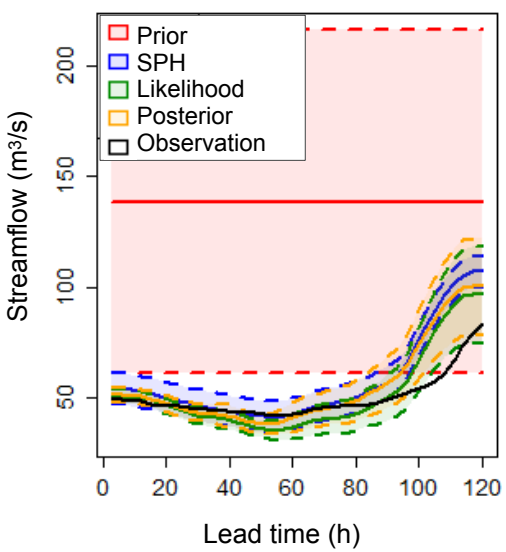
NSRPS prior



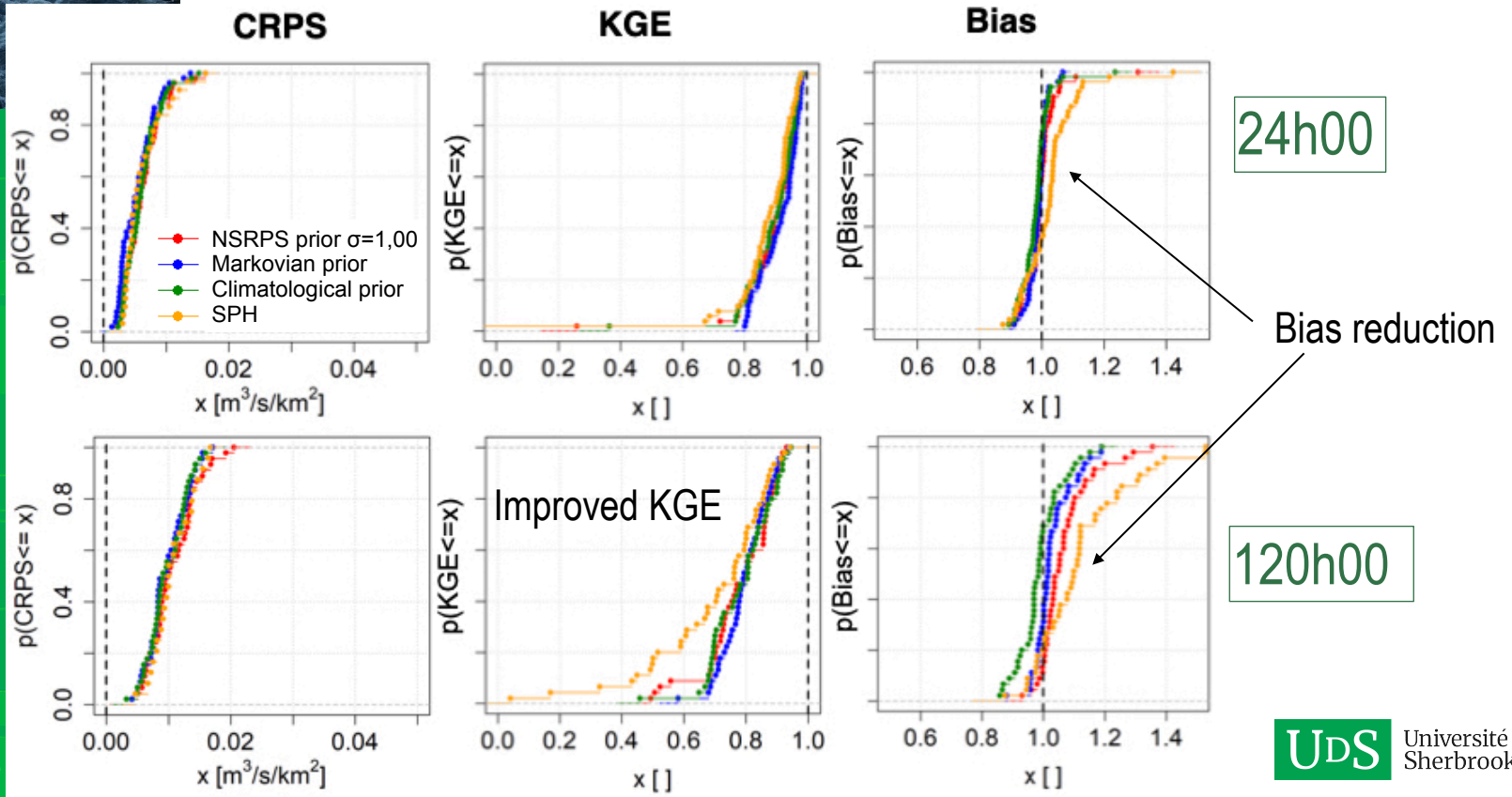
Markovian prior



Climatological prior



POSTERIOR DISTRIBUTION AT GAUGED SITES



CONCLUSION

- The proposed merging technique is efficient: merged forecasts remain at least as good as the raw local forecasts, with reduced bias.

- Limitations:
  - The study period is very short.
  - One forecasting system is individually much more skillful than the other.
  - Both systems are fed by approximately the same meteorological forecasts, so the information brought by the second forecasting system is not entirely new.

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EXTRA

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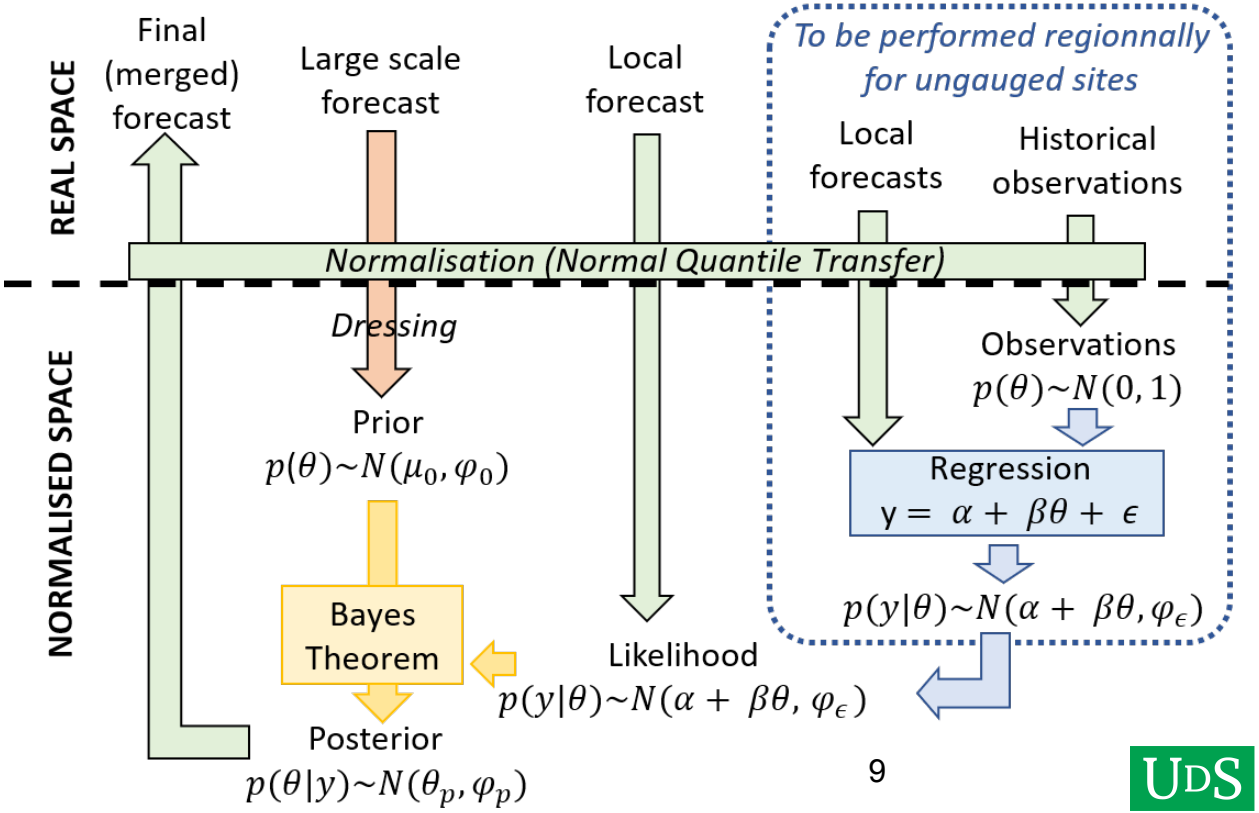
REAL SPACE
NORMALISED SPACE
Final (merged) forecast
Large scale forecast
Local forecast
To be performed regionnally for ungauged sites
Local forecasts
Historical observations
Normalisation (Normal Quantile Transfer)
Dressing
Observations
$p(\theta) \sim N(0,1)$
Prior
$p(\theta) \sim N(\mu_0, \varphi_0)$
Regression
$y = \alpha + \beta\theta + \epsilon$
$p(y|\theta) \sim N(\alpha + \beta\theta, \varphi_\epsilon)$
Bayes Theorem
Likelihood
$p(y|\theta) \sim N(\alpha + \beta\theta, \varphi_\epsilon)$
Posterior
$p(\theta|y) \sim N(\theta_p, \varphi_p)$

MAIN CHARACTERISTICS OF THE 2 SYSTEMS