

Improving the predictability of streamflow for hydropower production in Canada using S2S ensemble meteorological forecasts

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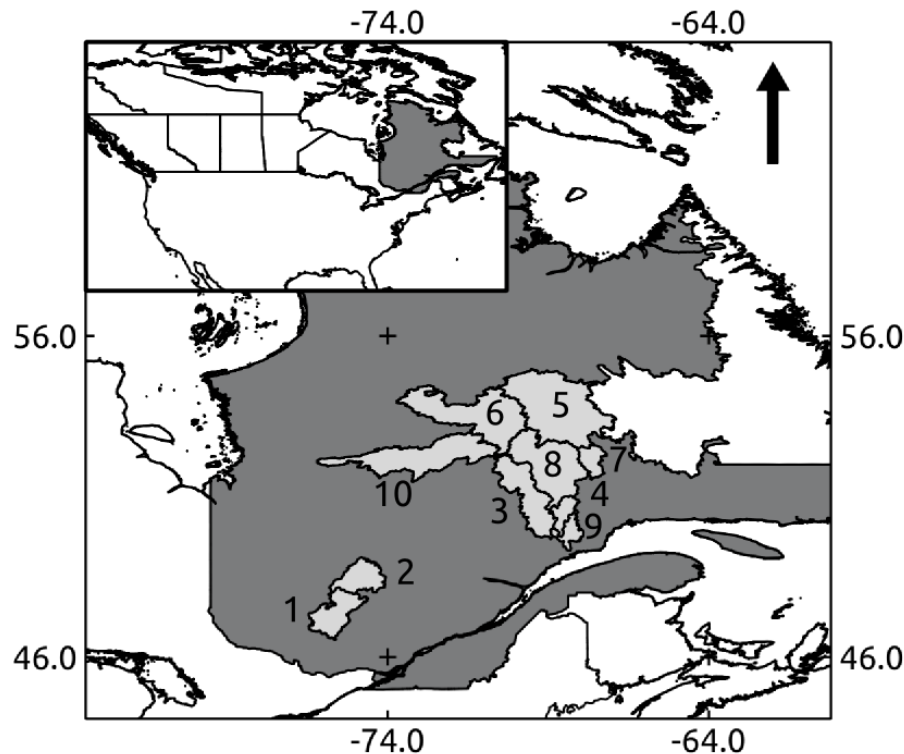
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**Hydro
Québec**
Institut de recherche

HYDRO ELECTRICITY IN QUÉBEC

- ❑ Hydro power represents 99% of total energy produced by Hydro-Québec
- ❑ 10 main reservoirs
- ❑ Approx. 10 000 MW on the 35 000 MW installed ^[1]
- ❑ Strong hydrological cycle



Watersheds' name :

- | | | |
|---------------------------|-----------------|---------------|
| 1 - Baskatong | 2 - Gouin | 3 - Outardes |
| 4 - Manic 3 | 5 - Caniapiscau | 6 - La Grande |
| 7 - Petit Lac Manicouagan | 8 - Manic 5 | 9 - Manic 2 |
| 10 - Eastmain 1 | | |

PERFORMANCE OF ECMWF SYSTEM4

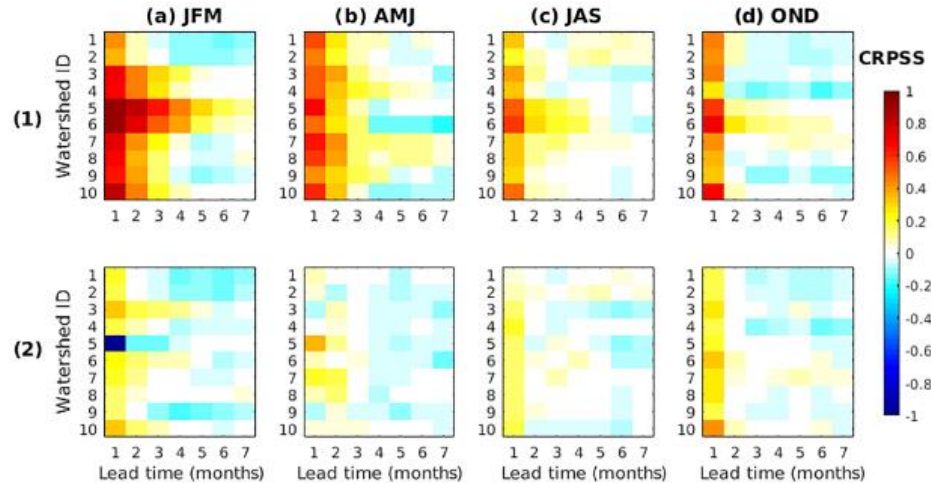


Figure 5. CRPSS of ensemble forecasts of monthly inflow volume for reservoirs, produced by corr-DSP compared to (1) sim-HSP and (2) ESP. CRPSSs are shown by watershed, season and lead time. [2]

Objective

- Compare the performance of System4 with SEAS5 and ECMWF S2S database for time delays 1 to 30 days.

METHODOLOGY

Forecasting system	Lead-time (days)	Number of forecasts (1995-2014)	Members
S2S ECMWF [3]	46	1719	5 or 11
System4 [4]	215	240	15 or 51
SEAS5 [5]	215	240	25
ESP [6]	As needed	As needed	64

Meteorological forecasts

S2S ECMWF
System4 ECMWF
SEAS5 ECMWF

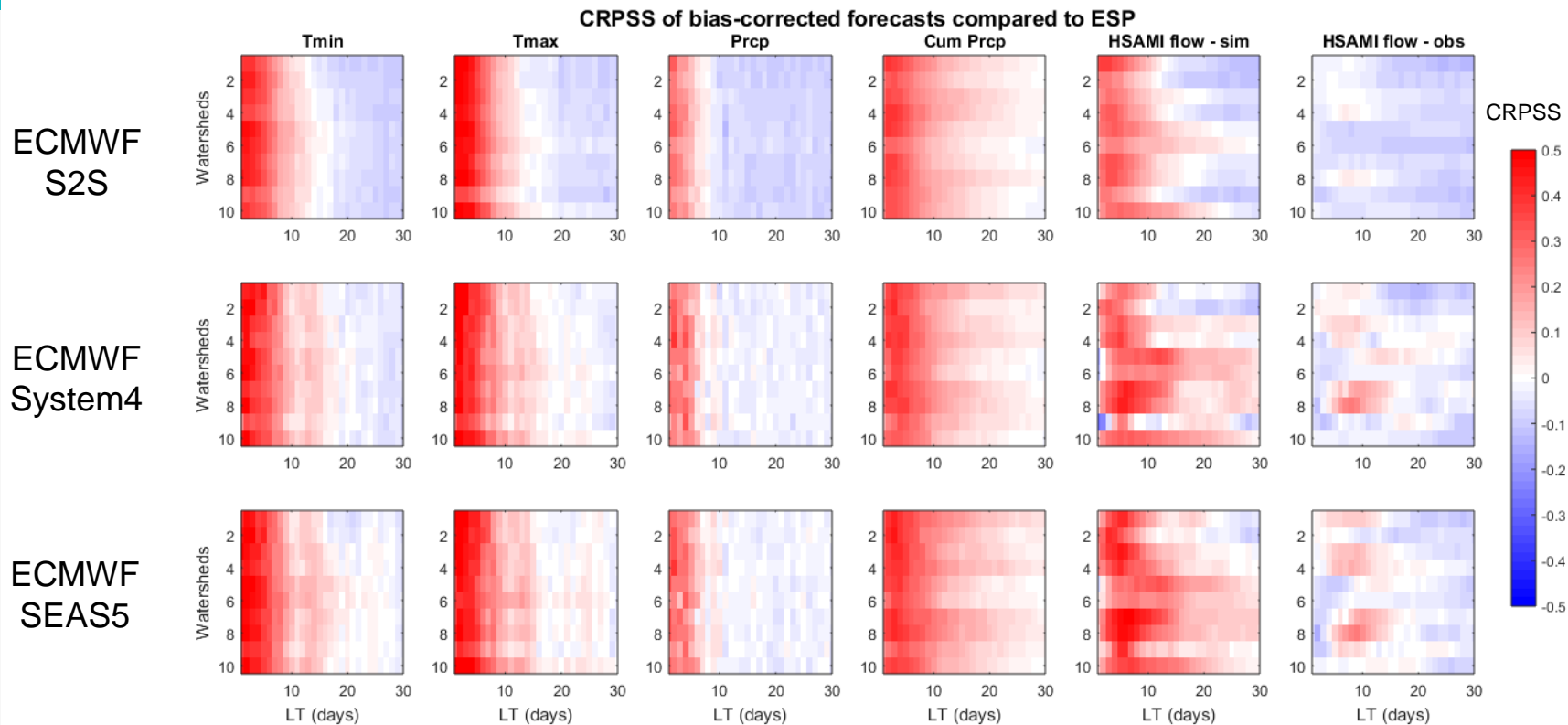
- Temporal and spatial aggregation
- Bias characterisation and correction by Linear Scaling [7]

Hydrological model HSAMI [8]

Verification – Sim and obs

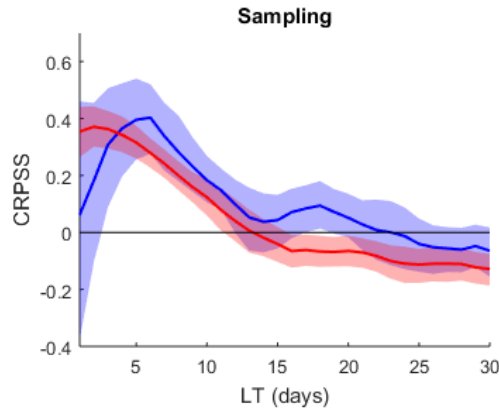
- CRPSS [9]
- Reliability diagram

CRPSS - General performance

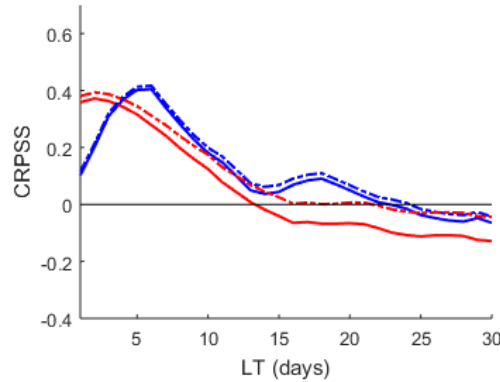


CRPSS – Sources of uncertainty

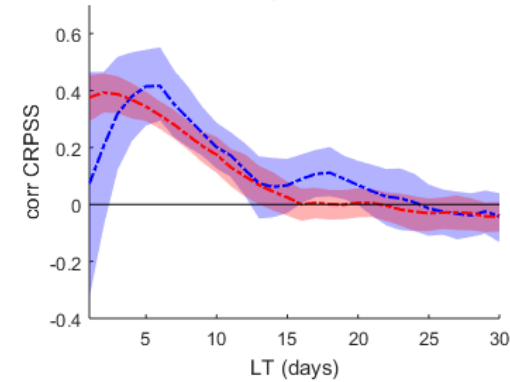
Baskatong



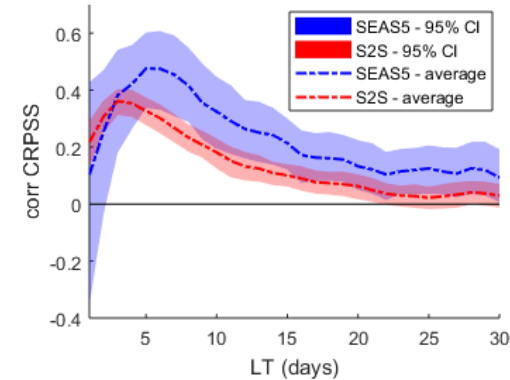
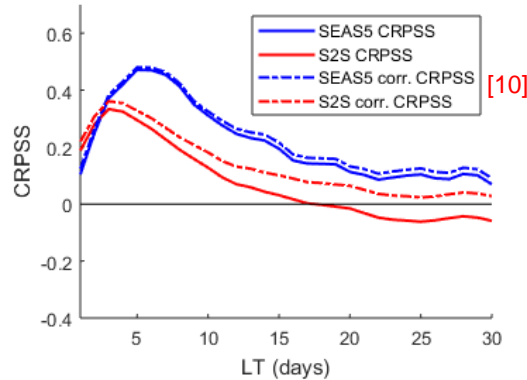
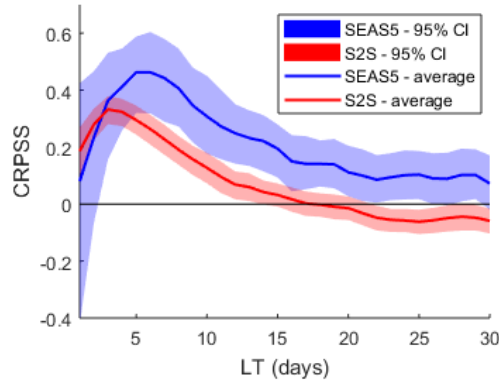
Streamflow CRPSS - Uncertainty
(Bias corrected forecasts vs ESP for simulated observations)



Sampling + Members

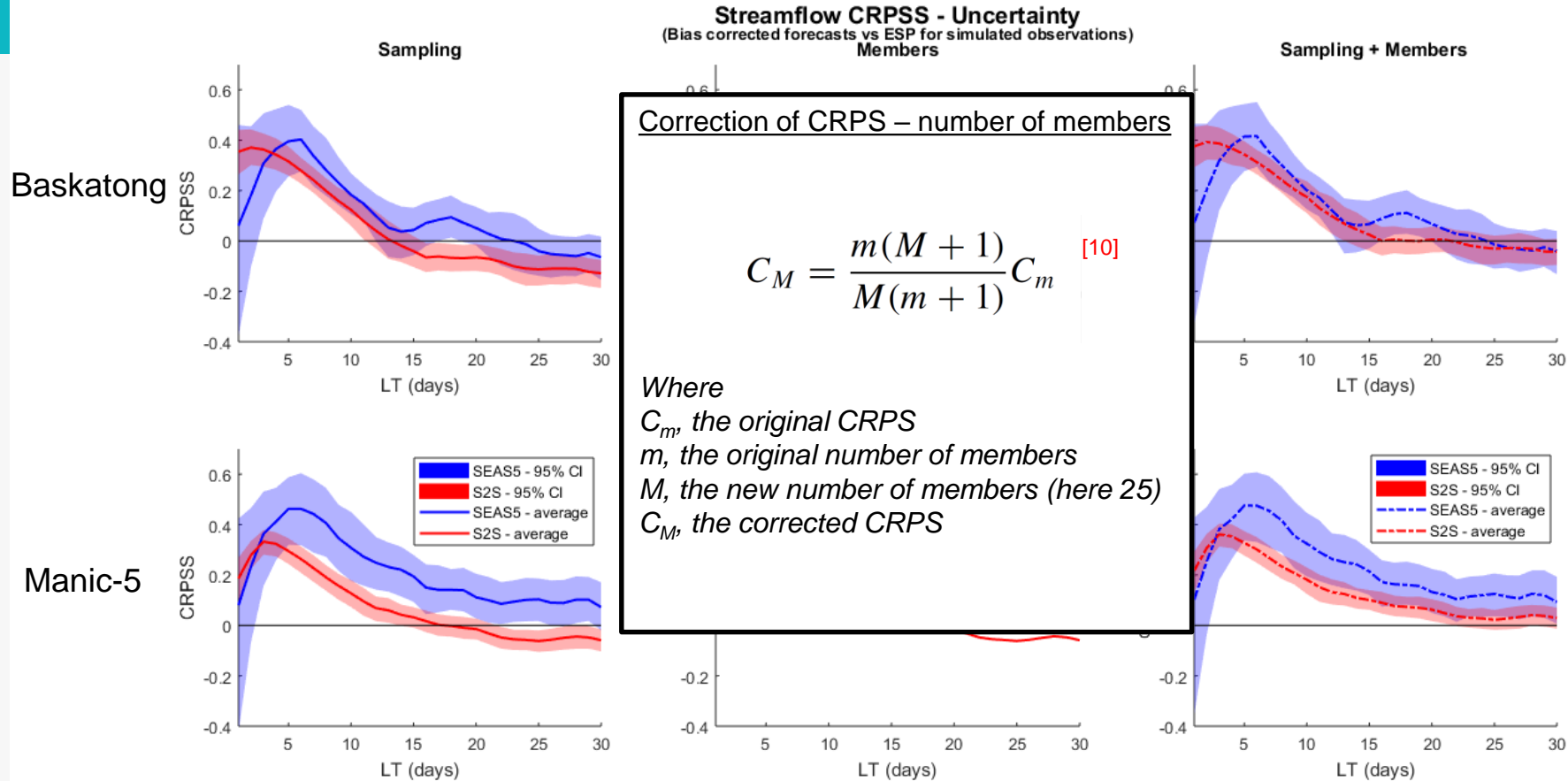


Manic-5



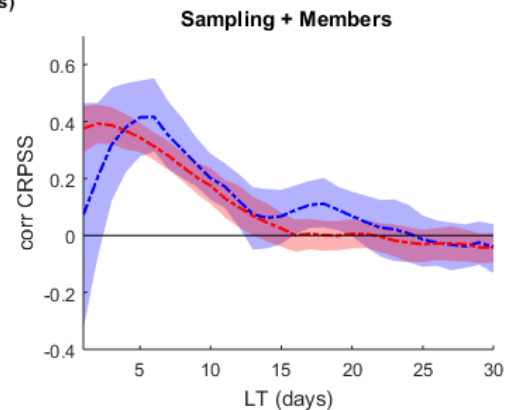
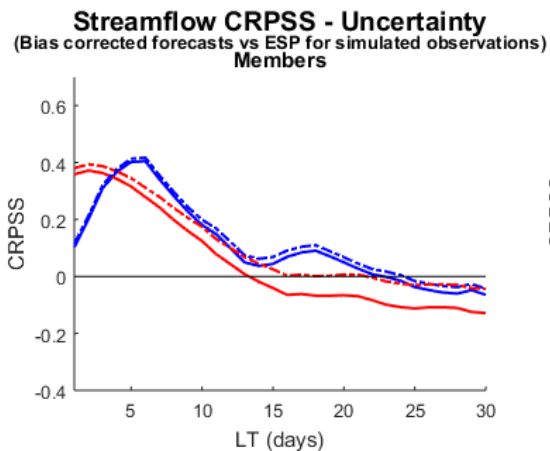
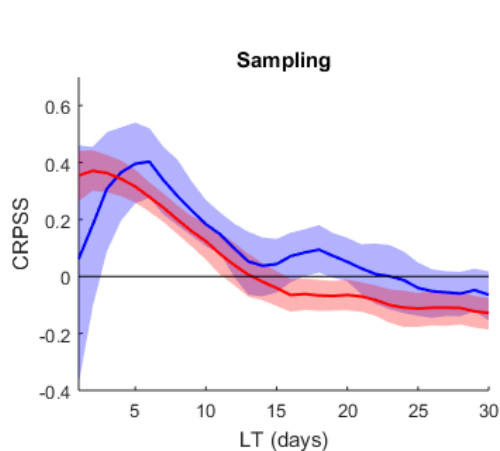
[10]

CRPSS – Sources of uncertainty

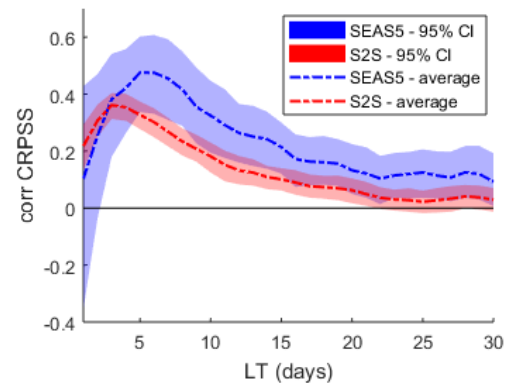
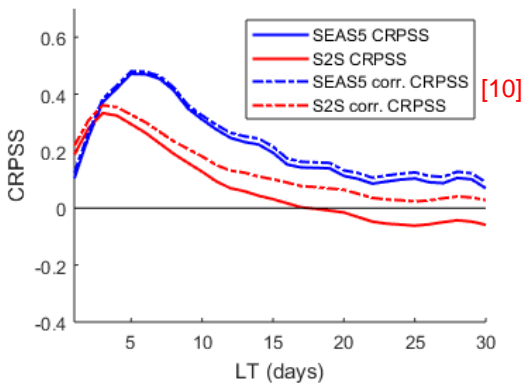
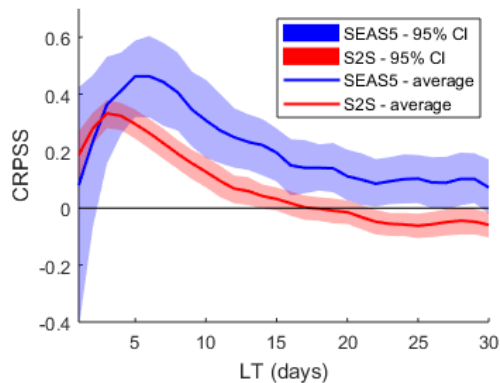


CRPSS – Sources of uncertainty

Baskatong

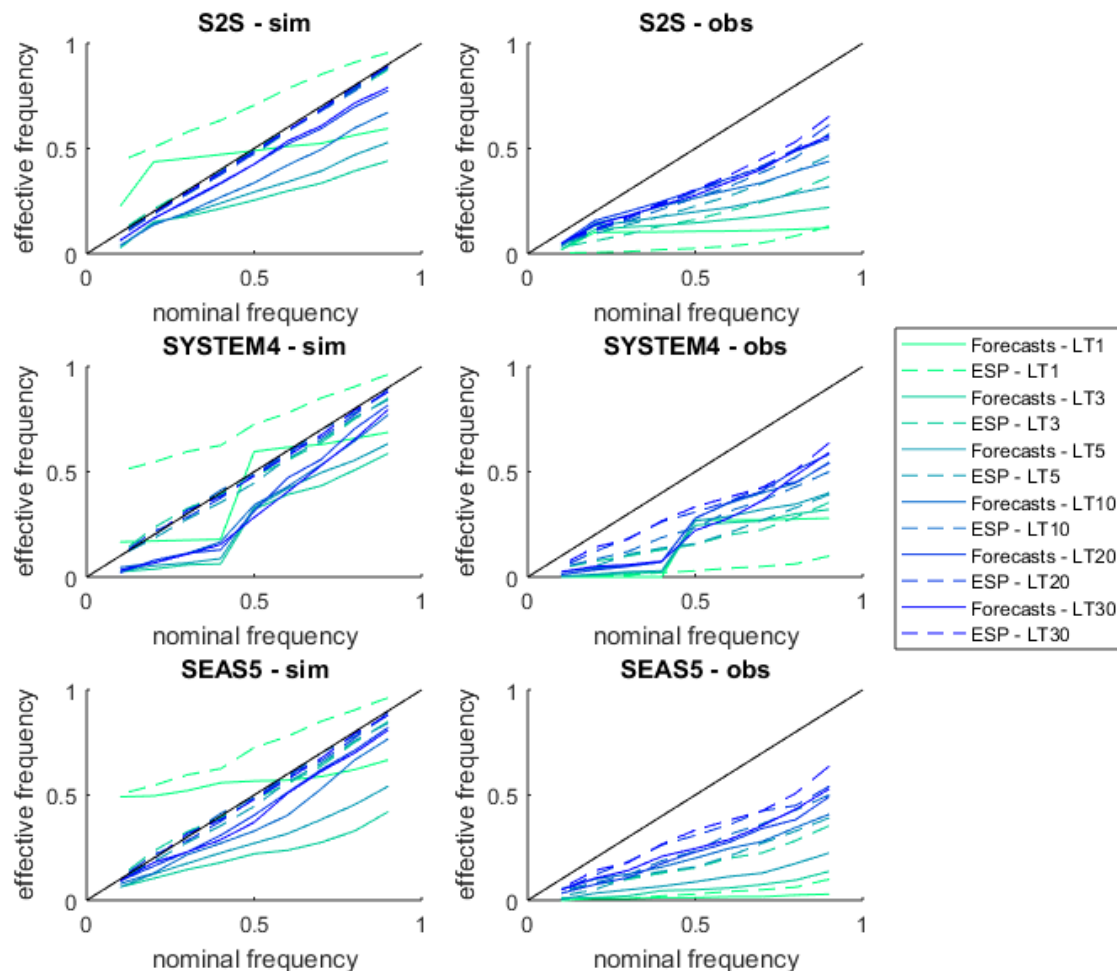


Manic-5



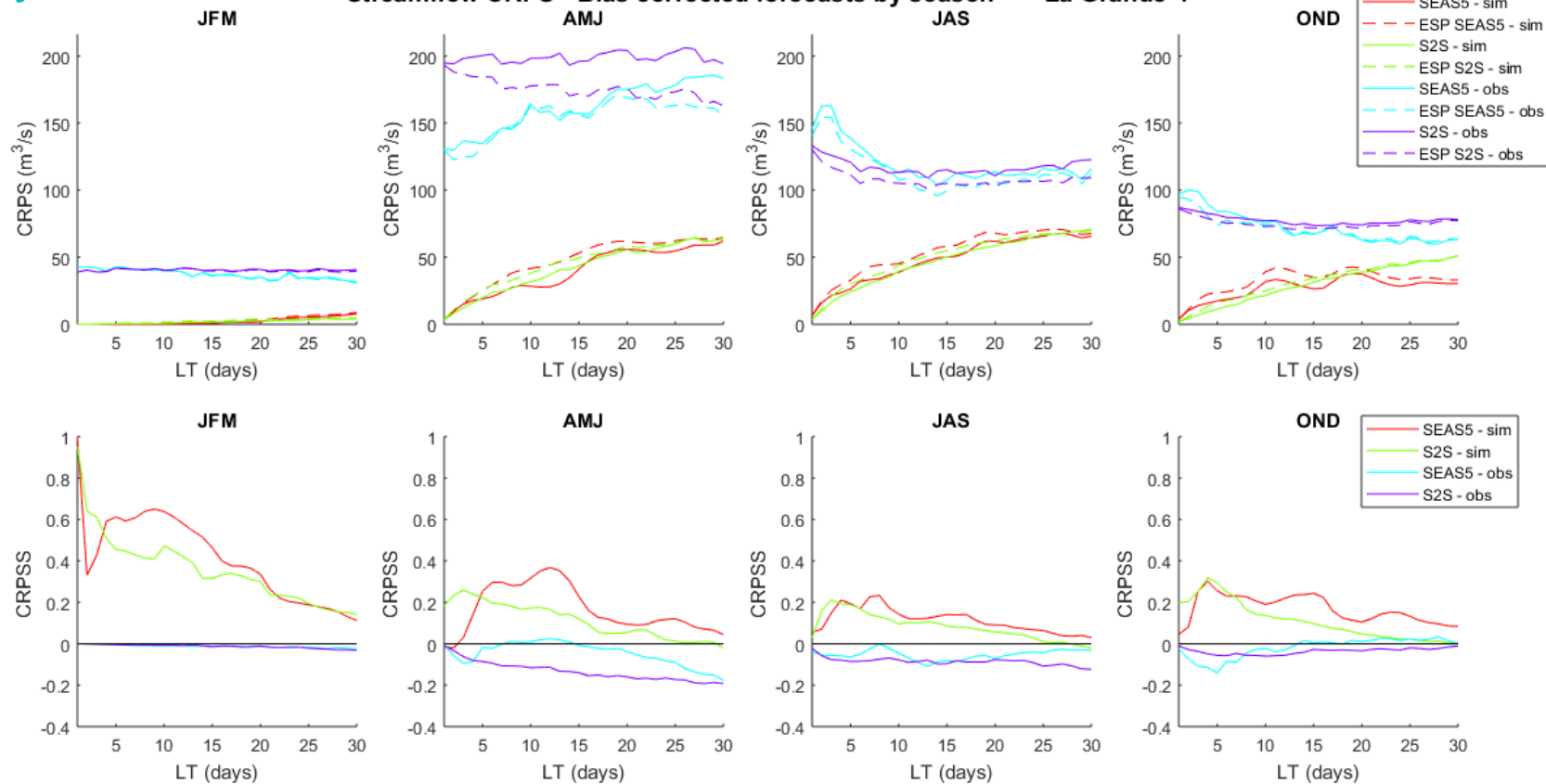
RELIABILITY DIAGRAM – Manic 5

- ESP is more reliable than dynamical forecasts
- Limited reliability when compared with observations even for ESP

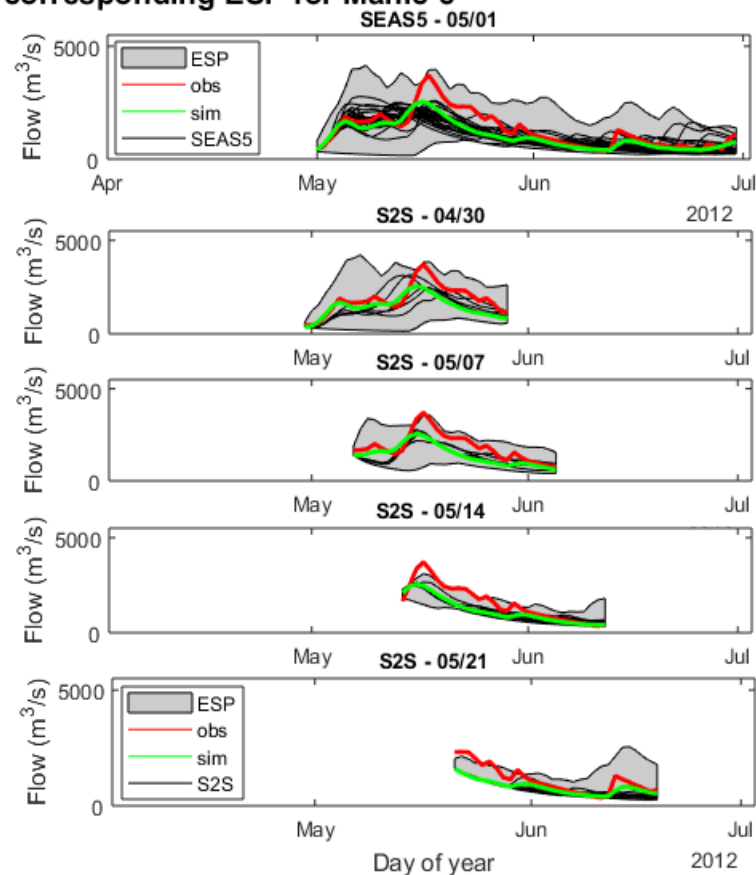
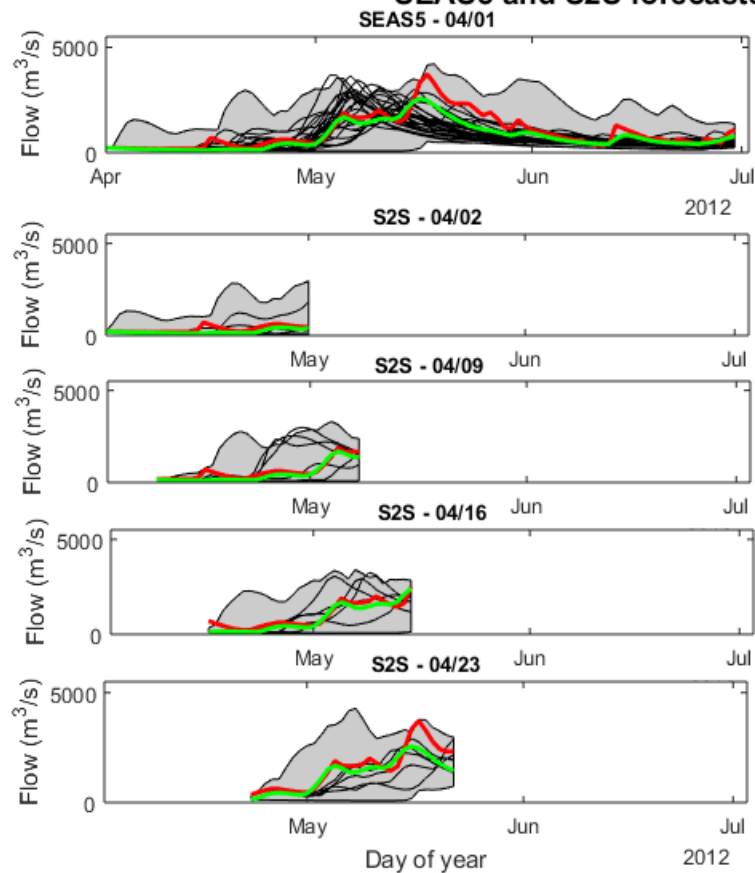


CRPS by SEASON

Streamflow CRPS - Bias corrected forecasts by season - La Grande-4



SEAS5 and S2S forecasts and corresponding ESP for Manic-5



DISCUSSIONS and CONCLUSION

- ❑ Potential for dynamical s2s forecasts to replace ESP in hydrology for the 1st 30 days depending on season and watersheds
- ❑ Improvement of hydrological modeling (data assimilation, model structure and calibration, post-processing)
- ❑ Difficulty to have a fair comparison between different forecasting systems (sampling, ensemble size, issue dates) to determine the best product to use

Next steps

- **SEAMLESS** – multi model
- **VALUE** - reservoir management model



THANK YOU!

Any questions?

You can find me at

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REFERENCES AND CREDITS

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