Can Continental Models Convey Useful Seasonal Hydrologic Information at the Catchment Scale?

Louise Crochemore[1], Maria-Helena Ramos[2], Ilias Pechlivanidis[1]

(1) SMHI, Research and Development / Hydrology (Sweden) (2) INRAE, UR HYCAR, Antony, France

Motivation

- Many seasonal hydroclimate services are flourishing at the continental scales: how can these services be successfully used in local (catchment-based) applications?

Hydrological models

- **European scale:** E-HYPE continentally-calibrated process-based model used in European services
- **French scale:** GR6J catchment-specific parsimonious model used operationally in France

Meteorological forcing

- **Hydro-GFD** Corrected reanalysis of precipitation and temperature based on ERA-Interim
- **ECMWF System 4** Dynamic meteorological seasonal forecasts, bias adjusted against HydroGFD

Catchment set

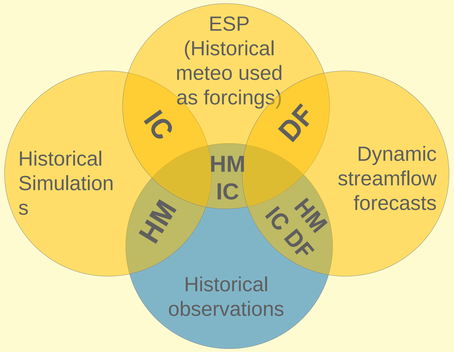
- **11 catchments in France**

For more details

Crochemore, L., Ramos, M.-H. and Pechlivanidis, I. G.: Can Continental Models Convey Useful Seasonal Hydrologic Information at the Catchment Scale?, Water Resources Research, 56(2), e2019WR025700, doi:10.1029/2019WR025700, 2020.

How can we disentangle model uncertainty (structural, parameter, input) in hydrological prediction? (related to UPH 20)

► **Targeted skill assessment** to isolate the components of the forecasting chain and allow an analysis, for a specific location, of the sources of seasonal forecasting skill



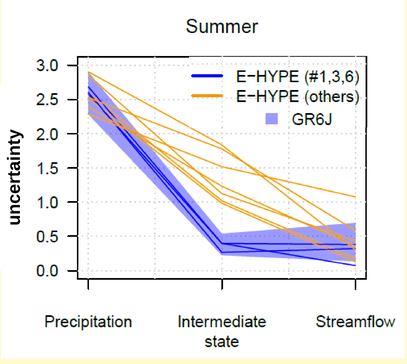
Skill assessment framework

Observation-based ensemble
Model-based ensembles

Components of the forecasting chain:
HM: Hydrological model
IC : Forecast initialisation
DF: Dynamic meteorological forcings

► **Uncertainty varies with hydrological variable and model structure**

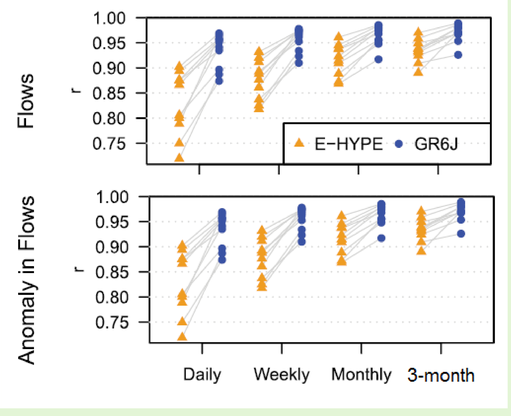
- The largest part of uncertainty comes from input forcing (here, precipitation)
- This uncertainty is filtered by the hydrological models and results in reduced uncertainty in streamflow
- Parameter and structure uncertainty are responsible for large differences in uncertainty in internal model states: differences are observed between the two models and for E-HYPE among catchments



How can the (un)certainty of continental models in hydrological predictions be communicated to decision makers and the general public? (related to UPH 21)

Hydroclimatic services can provide accurate predictions at the catchment scale for:

► **Long-term averages** (accumulations over several months)
► **Anomalies in flows** (changes relative to normal conditions)
► **Flows below or above normal conditions** (with respect to model climatology)



Model performance (correlation) for two statistics of temporal aggregated flows. Within each aggregation, for the same catchment, GR6J and E-HYPE performance are linked with a straight line.
Source: Fig. 6 in Crochemore et al. (2020)

- These statistics can be computed in the 'model world': the forecast is interpreted against the model climatology.
- However, such statistics will only convey accurate information if time dynamics are correctly represented by the large-scale model.

Also:

- When evaluating seasonal forecasts against observations, the local catchment setup (GR6J) performs better than the continental one (E-HYPE).
- However, when models are evaluated against their own climatology, the continental setup can sometime outperform the local setup.

Contact: louise.crochemore@smhi.se