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Do you want Seamless Subseasonal Streamflow Forecasts? Ask MuTHRE!

Mark Thyer[1], David McInerney[1], Dmitri Kavetski[1], Richard Laugesen[2], Narendra Tuteja[2], and George Kuczera[3]

[1]University of Adelaide, School of Civil, Env and Mining Engineering, Adelaide, Australia (mark.thyer@adelaide.edu.au)
[2]Bureau of Meteorology, Canberra, ACT, Australia
[3]School of Engineering, University of Newcastle, Callaghan, NSW, Australia

Sub-seasonal streamflow forecasts (with lead times of 1-30 days) provide valuable information for many consequential water resource management decisions, including reservoir operation to meet environmental flow and irrigation demands, issuance of early flood warnings, and others. A key aim is to produce “seamless” forecasts, with high quality performance across the full range of lead times and time scales.

This presentation introduces the ***Multi-Temporal Hydrological Residual Error model (MuTHRE)*** to address the challenge of obtaining “seamless” sub-seasonal forecasts, i.e., daily forecasts with consistent high-quality performance over multiple lead times (1-30 days) and aggregation scales (daily to monthly).

The model is designed to overcome common errors in streamflow forecasts:

- Seasonality
- Dynamic biases due to hydrological non-stationarity
- Extreme errors poorly represented by the common Gaussian distribution.

The model is evaluated comprehensively over 11 catchments in the Murray-Darling Basin, Australia, using multiple performance metrics to scrutinize forecast reliability, sharpness and bias, across a range of lead times, months and years, at daily and monthly time scales.

The MuTHRE model provides ”high” improvements, in terms of reliability for

- Short lead times (up to 10 days), due to representing non-Gaussian errors
- Stratified by month, due to representing seasonality in hydrological errors
- Dry years, due to representing dynamic biases in hydrological errors.

Forecast performance also improved in terms of sharpness, volumetric bias and CRPS skill score; Importantly, improvements are consistent across multiple time scales (daily and monthly).

This study highlights the benefits of modelling multiple temporal characteristics of hydrological errors, and demonstrates the power of the MuTHRE model for producing seamless sub-seasonal streamflow forecasts that can be utilized for a wide range of applications.