# MuTHRE model for high quality daily subseasonal streamflow forecasts

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**Aim:** *Produce daily subseasonal (0-30 day) streamflow forecasts with high quality performance for a range of lead times and time scales (daily to monthly)*
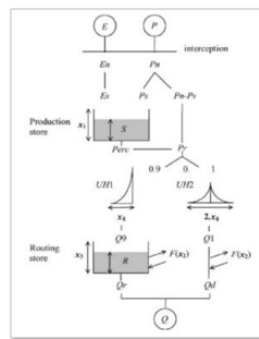
## MuTHRE: Multi-temporal hydrological residual error model

Represents temporally-varying features of hydrological errors
- **Seasonality:** Errors vary systematically by month
- **Dynamic Biases:** Errors vary yearly, due to non-stationarity
- **Extreme errors:** Occasional very large errors, poorly represented by common Gaussian distribution



MuTHRE Model
- Heteroscedasticity
- Dynamic Biases
- Seasonality
- Persistence
- Mixed Gaussian for extreme errors
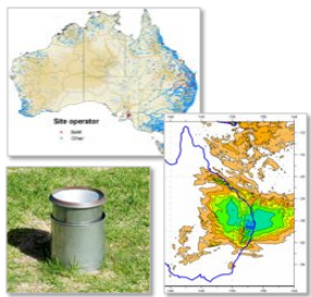
**Daily Rainfall Forecasts** (ACCESS-S + Rainfall Post-Processing)

**Daily Rainfall->Streamflow using rainfall-runoff modelling**
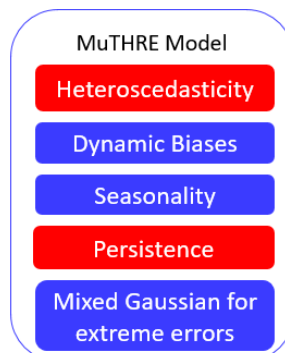
**Post-processing of daily streamflow forecasts using probabilistic residual error models**
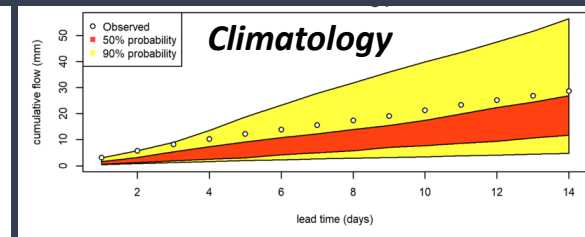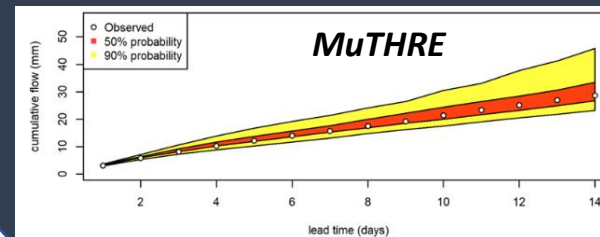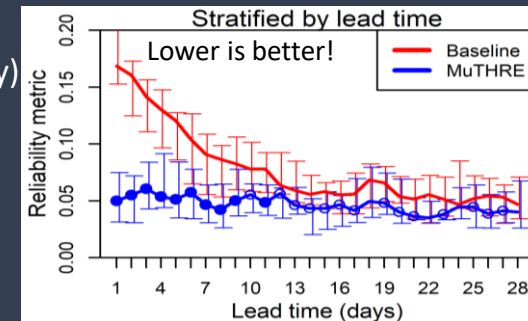
## Case study

- 11 catchments from Murray Darling Basin in SE Australia
- GR4J daily rainfall-runoff model
- ACCESS-S rainfall forecasts with post-processing
- Performance evaluated using multiple metrics, stratifications and aggregation time scales
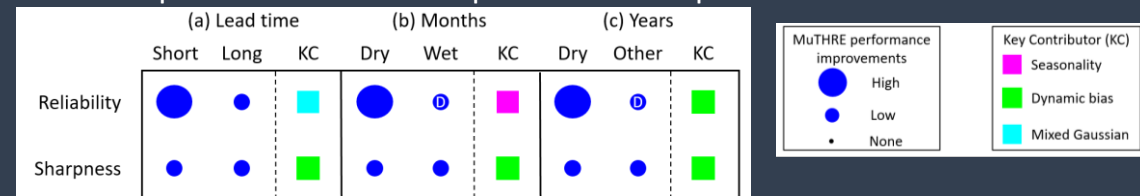- Compare to baseline model (without new components)
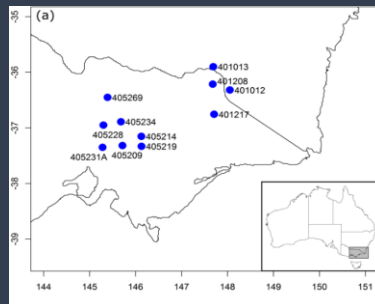


## Key outcome 1

- MuTHRE provides consistent high forecast quality for range of time scales (daily-monthly)
- Large improvements in reliability for short lead times (see right), dry months and drought years
- Far sharper than climatology: ~30% of climatology for 1-3 days lead (see below)



Stratified by lead time — Lower is better! — Baseline / MuTHRE — Reliability metric / Lead time (days)

*MuTHRE*

*Climatology*

## Key outcome 2

- Each component of MuTHRE improves forecast performance

|  | (a) Lead time | | | (b) Months | | | (c) Years | | |
|---|---|---|---|---|---|---|---|---|---|
|  | Short | Long | KC | Dry | Wet | KC | Dry | Other | KC |
| Reliability | ● | ● |  | ● | ● |  | ● | ● |  |
| Sharpness | ● | ● |  | ● | ● |  | ● | ● |  |

MuTHRE performance improvements: High / Low / None

Key Contributor (KC): Seasonality / Dynamic bias / Mixed Gaussian

- E.g. improvements in reliability: extreme errors key for short lead times, seasonality for dry months, dynamic biases for dry years

## Benefits

- Step-change in use of forecasts – easily integrates into river models
- Independent of hydro. model/rainfall forecasts, utilizing future advances in both

Further details: McInerney, D., Thyer, M., Kavetski, D., Laugesen, R., Tuteja, N., & Kuczera, G. (2020). Multi-temporal hydrological residual error modeling for seamless subseasonal streamflow