A System for Hydrological Ensemble Forecasting (SCHEF) for Australia

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HEPEX 10th Anniversary Workshop

24 June 2014

WATER FOR A HEALTHY COUNTRY FLAGSHIP
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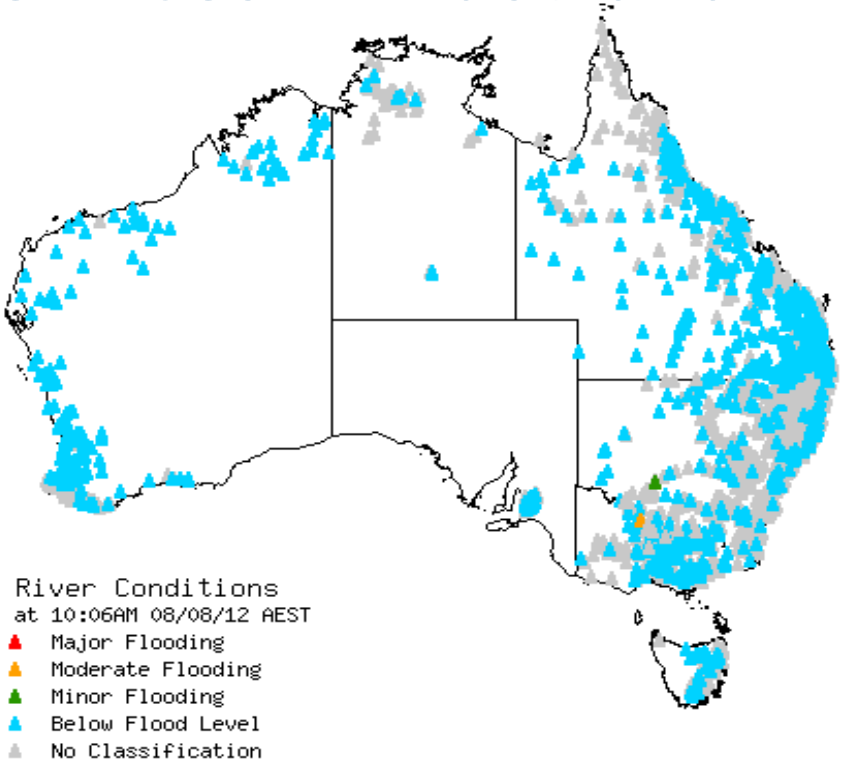
Short-term forecasting services in Australia

- Existing forecasting services
  - Forecast flood events
  - Event models
  - Limited use of Numerical Weather Predictions (NWP)
  - Labour intensive
- Desired forecasting services
  - Forecast out to 7-10 days
  - Continuous hydrological modelling
  - Routine use of Australian NWP model output
  - Quantify forecast uncertainty



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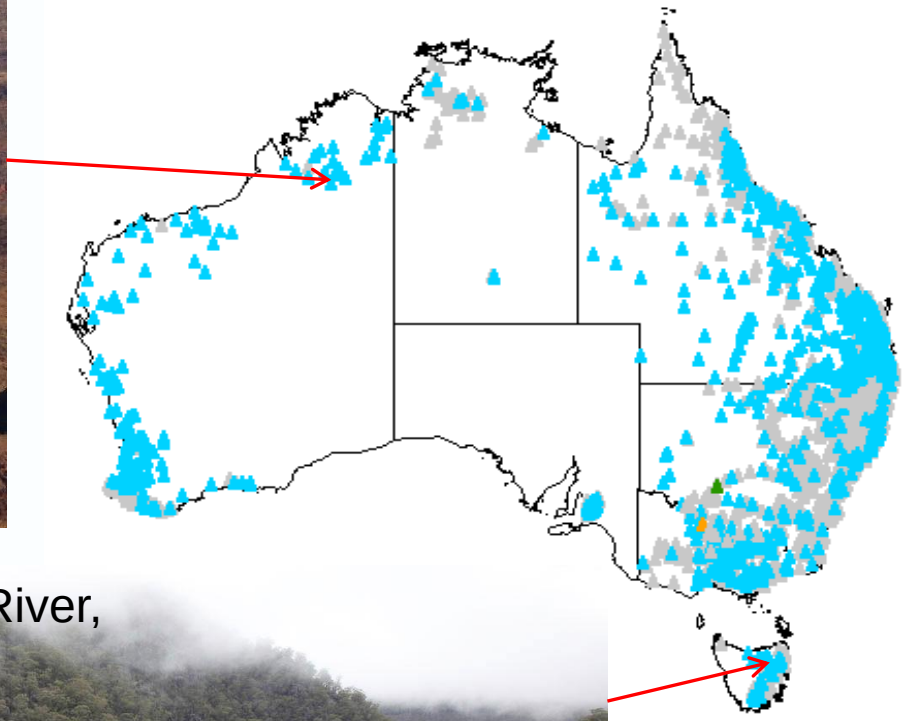
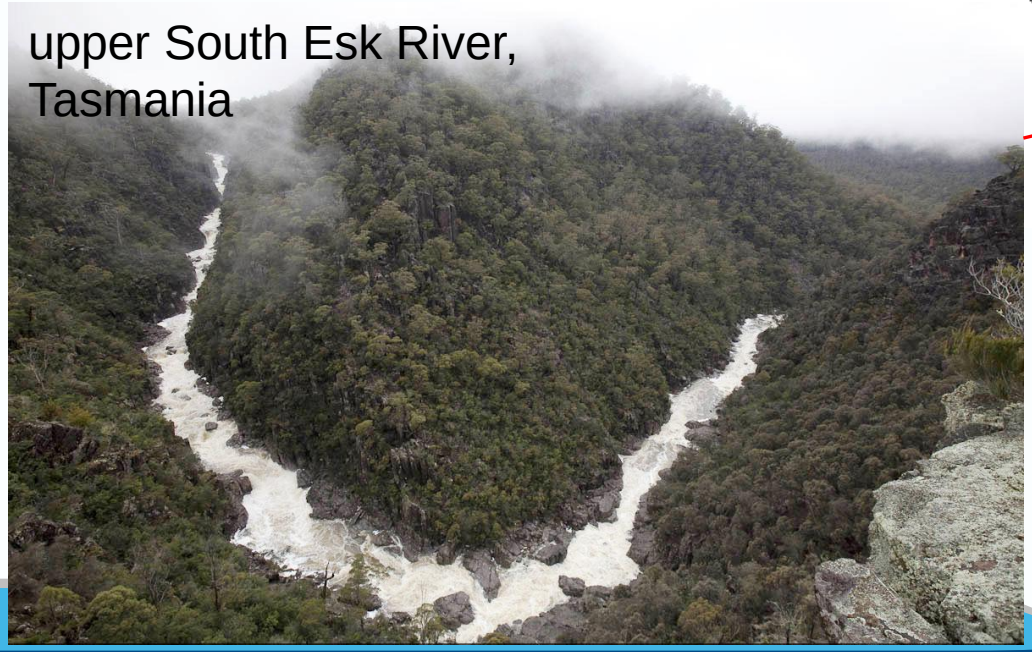
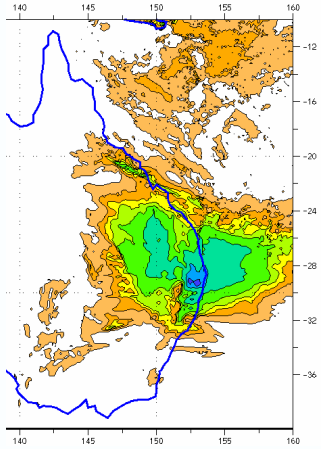
Ord River,
Western Australia



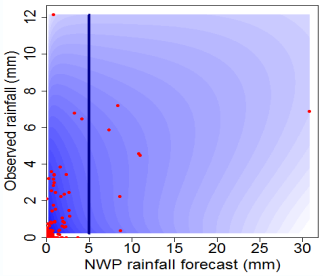

upper South Esk River,
Tasmania

SCHEF

ACCESS-G NWP rainfall forecast



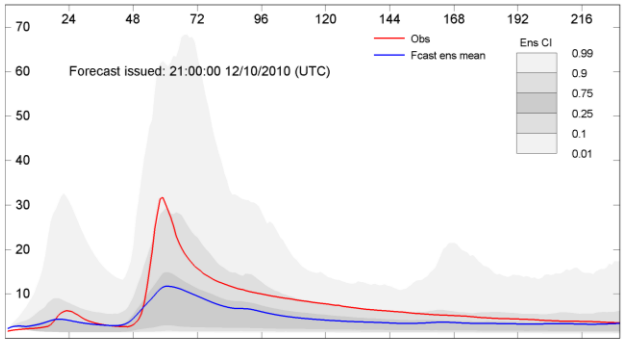
Rainfall forecast post-processing



Hydrological model

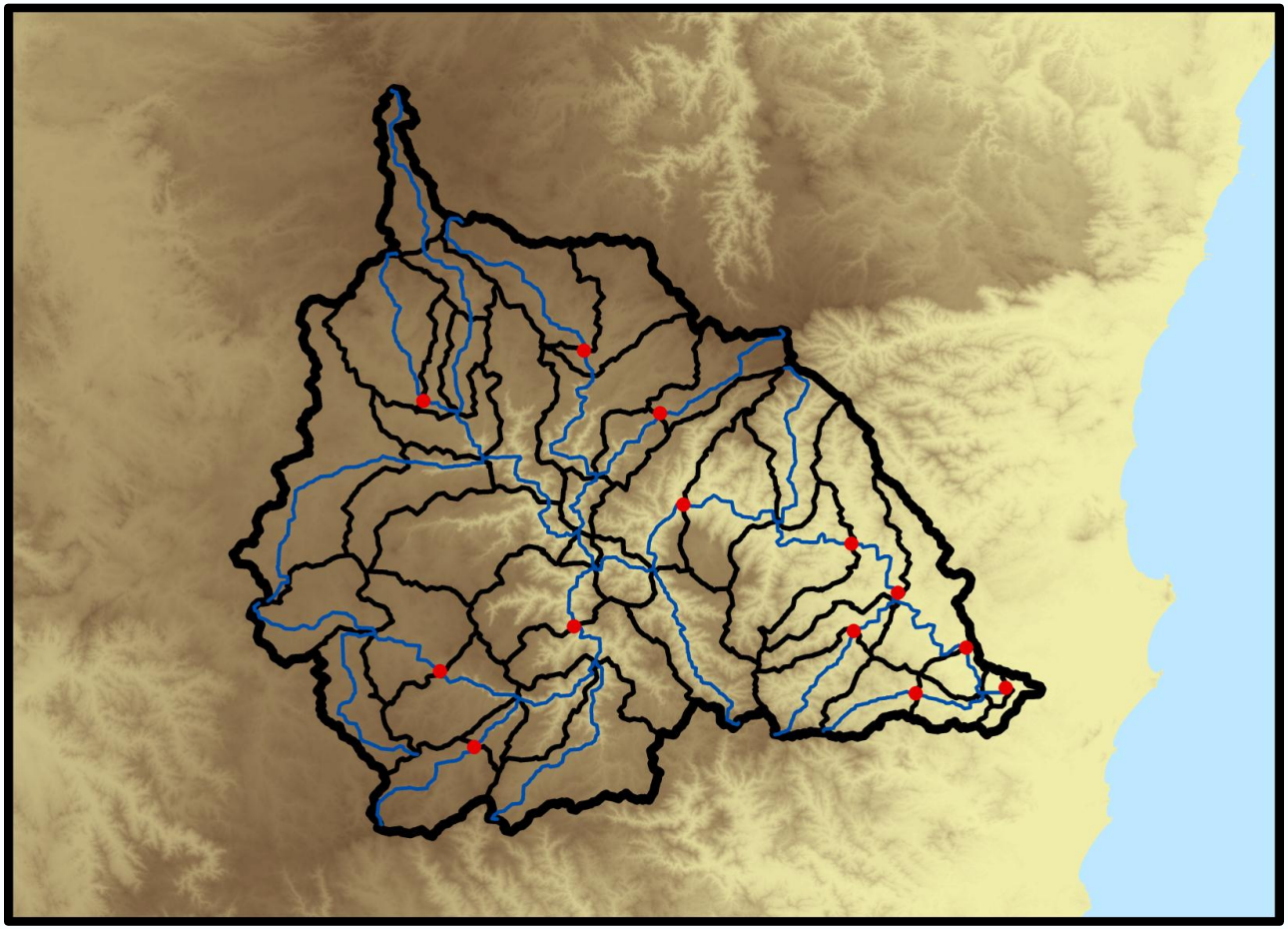
Real-time flows

9-day ensemble flow forecast



Hydrological modelling

- Semi-distributed
- GR4H & Muskingum routing
- Error model updates forecast

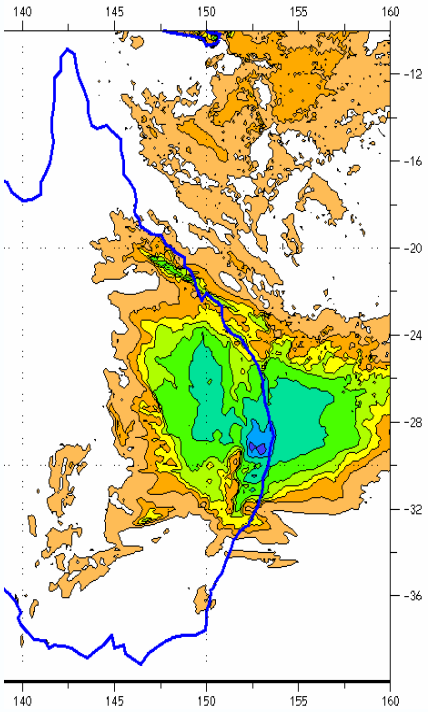


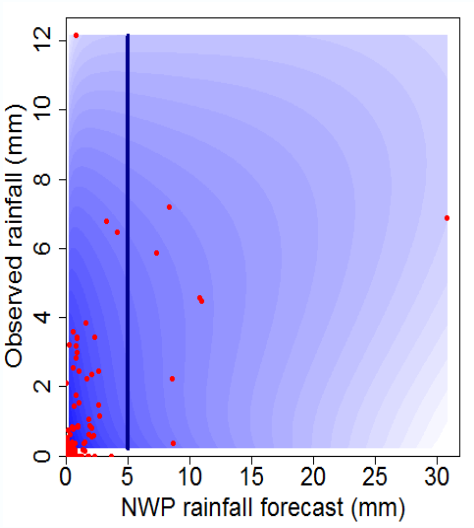
Post-processing NWP rainfall

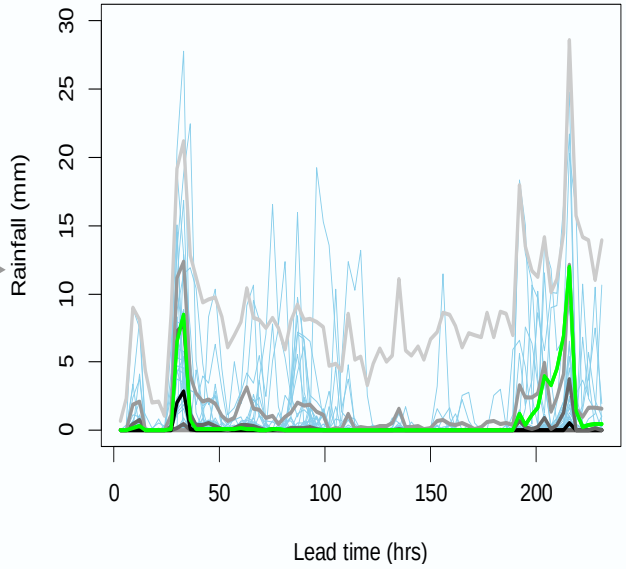
Deterministic ACCESS-G rainfall forecast

Rainfall bias-correction and ensemble generation

Ensemble rainfall forecast







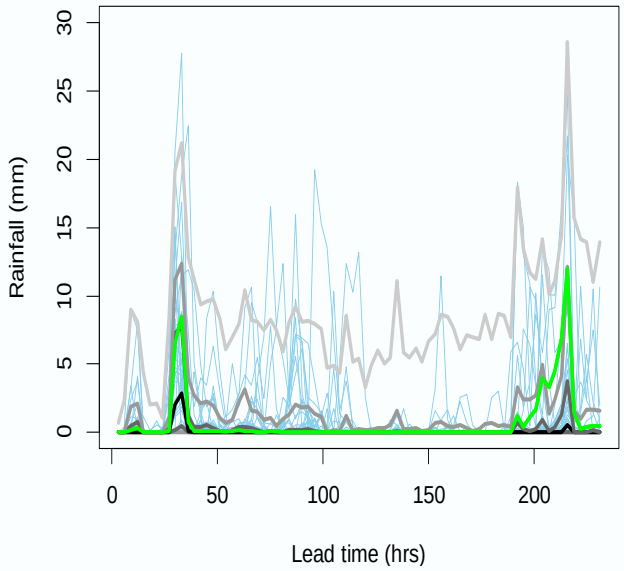
Rainfall post-processing - Robertson et al. (2013) *HESS*
Data transformation - Wang et al. (2012) *WRR*

Handling Zero values – Wang & Robertson (2011) *WRR*
BJP – Wang et al. (2009) *WRR*
Schaake shuffle – Clarke et al. (2004) *J. Hydrometeorol.*

Post-processing NWP rainfall

- Forecasts are unbiased at all lead times and locations
- Non-linear conditional bias is corrected
- Zero rainfall days
- Uncertainty reliably quantified

Ensemble rainfall forecast



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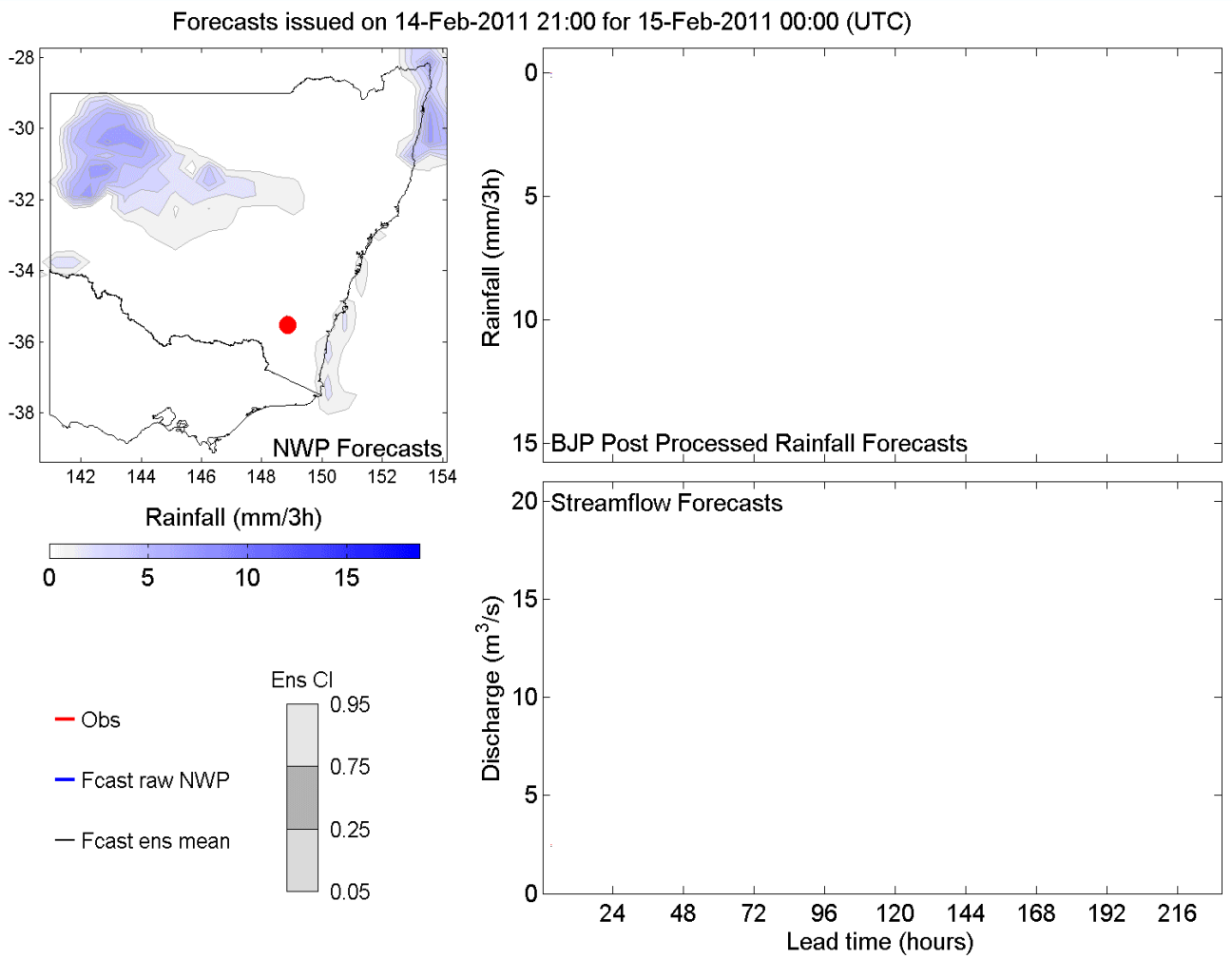
Putting the system together



Forecast Evaluation

Forecast Performance

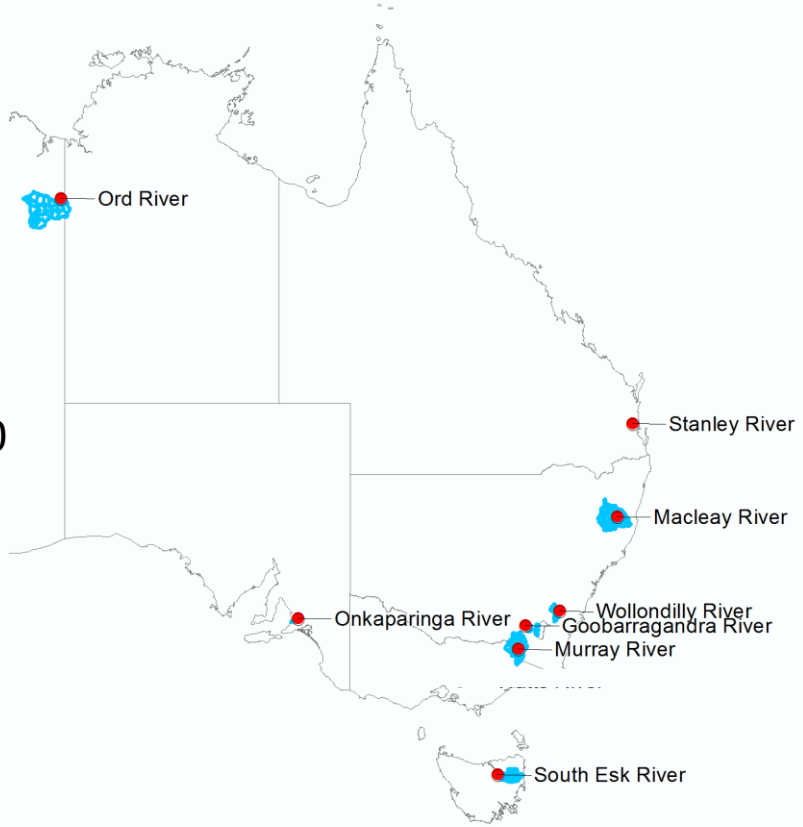
- Skill
- Reliability

System evaluated at time steps of 1, 3, 6 and 24 hours

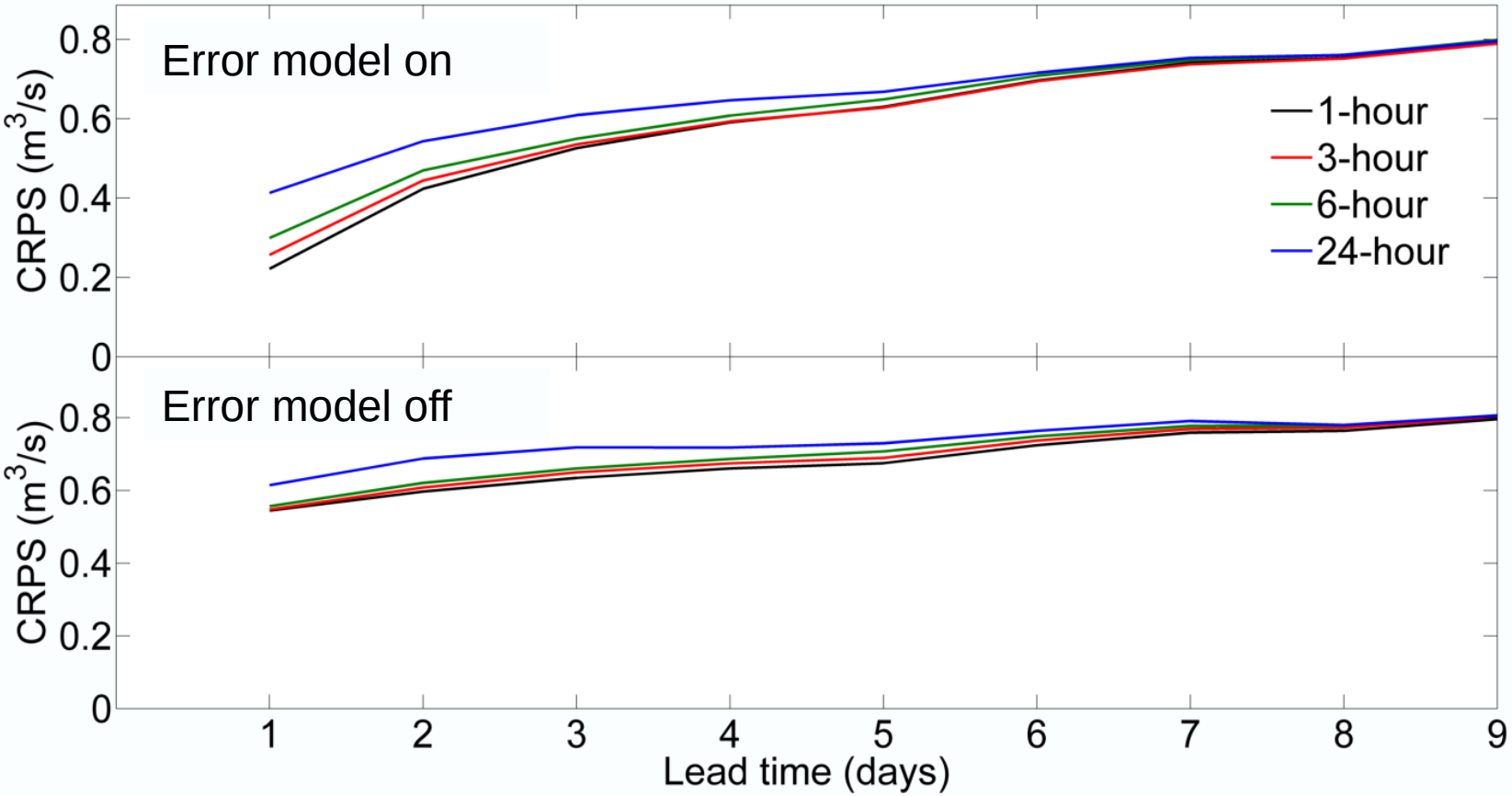
- Comparisons of 24 hr average flow

9 catchments over the period of Aug 2010 – Apr 2012

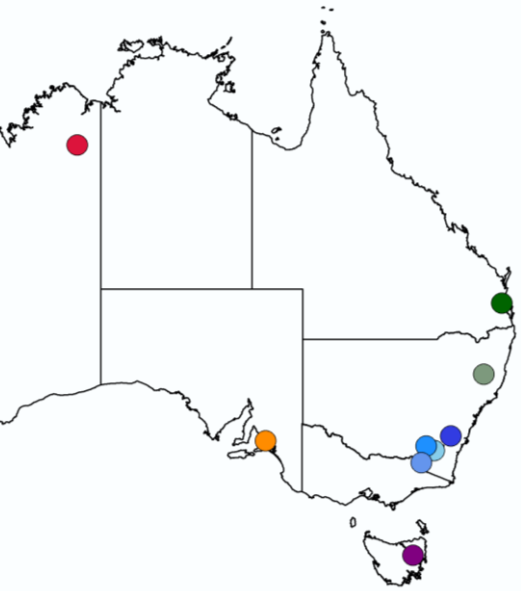
- Hydrological model calibrated to data prior to 2010
- Rainfall post-processing leave-one-month-out cross validation

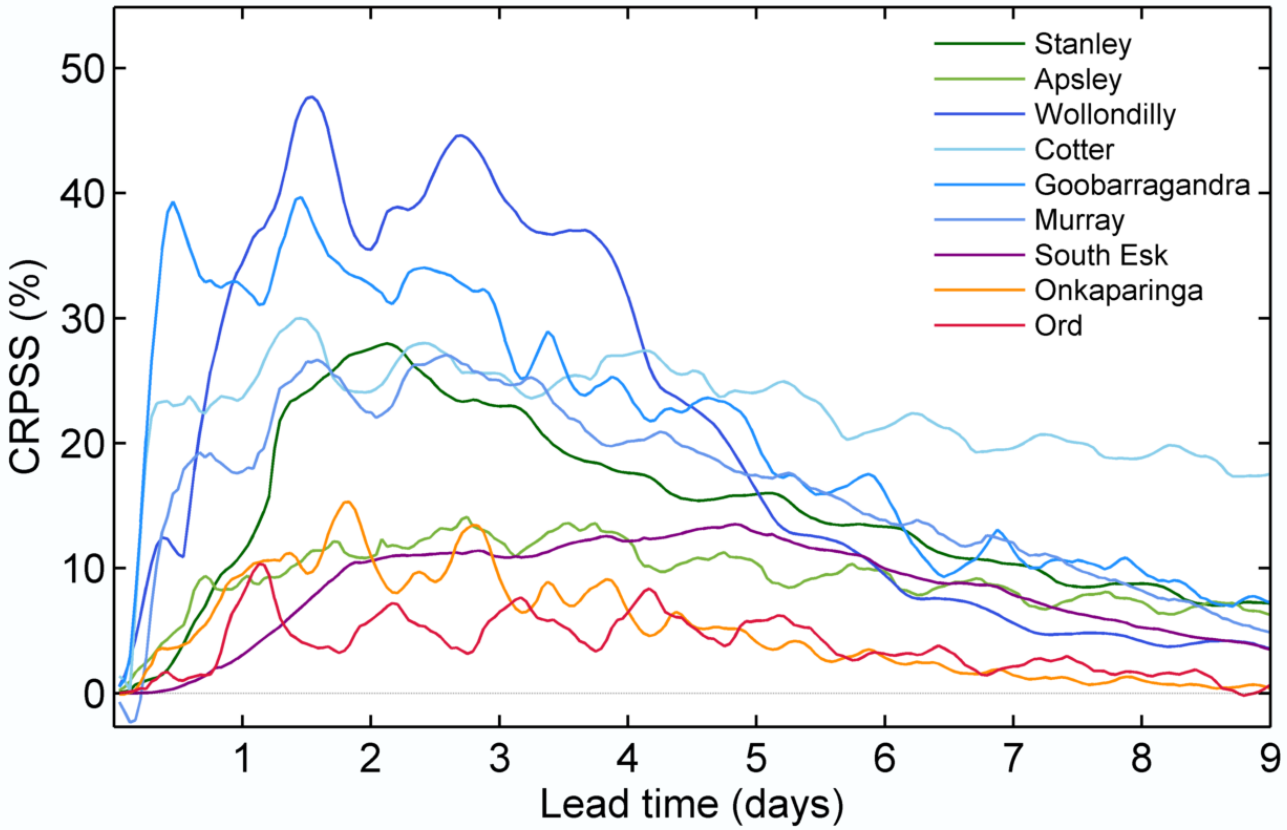


Impact of modelling time step – Cotter River

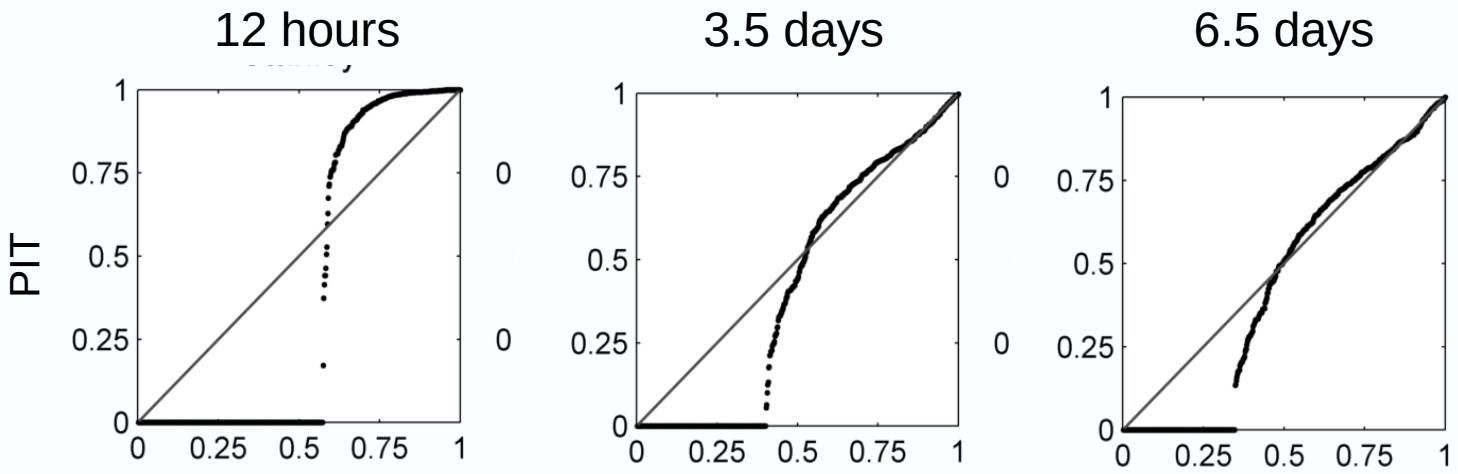


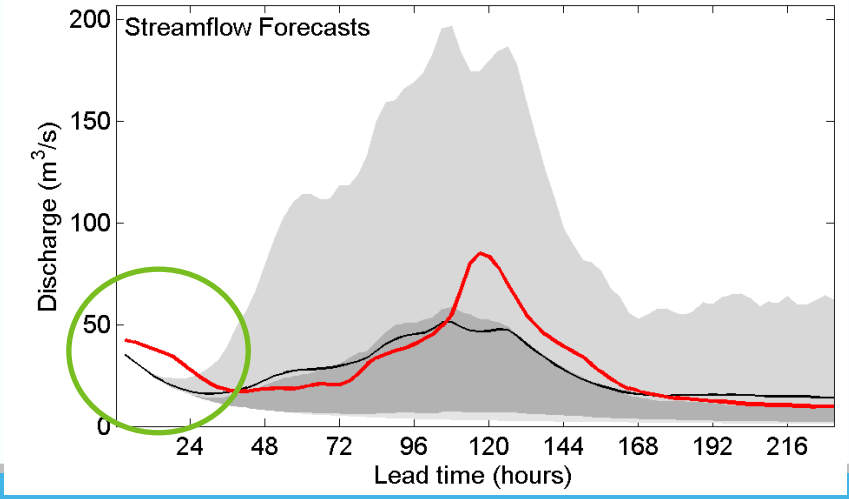
Model skill – Continuous Ranked Probability Skill Score



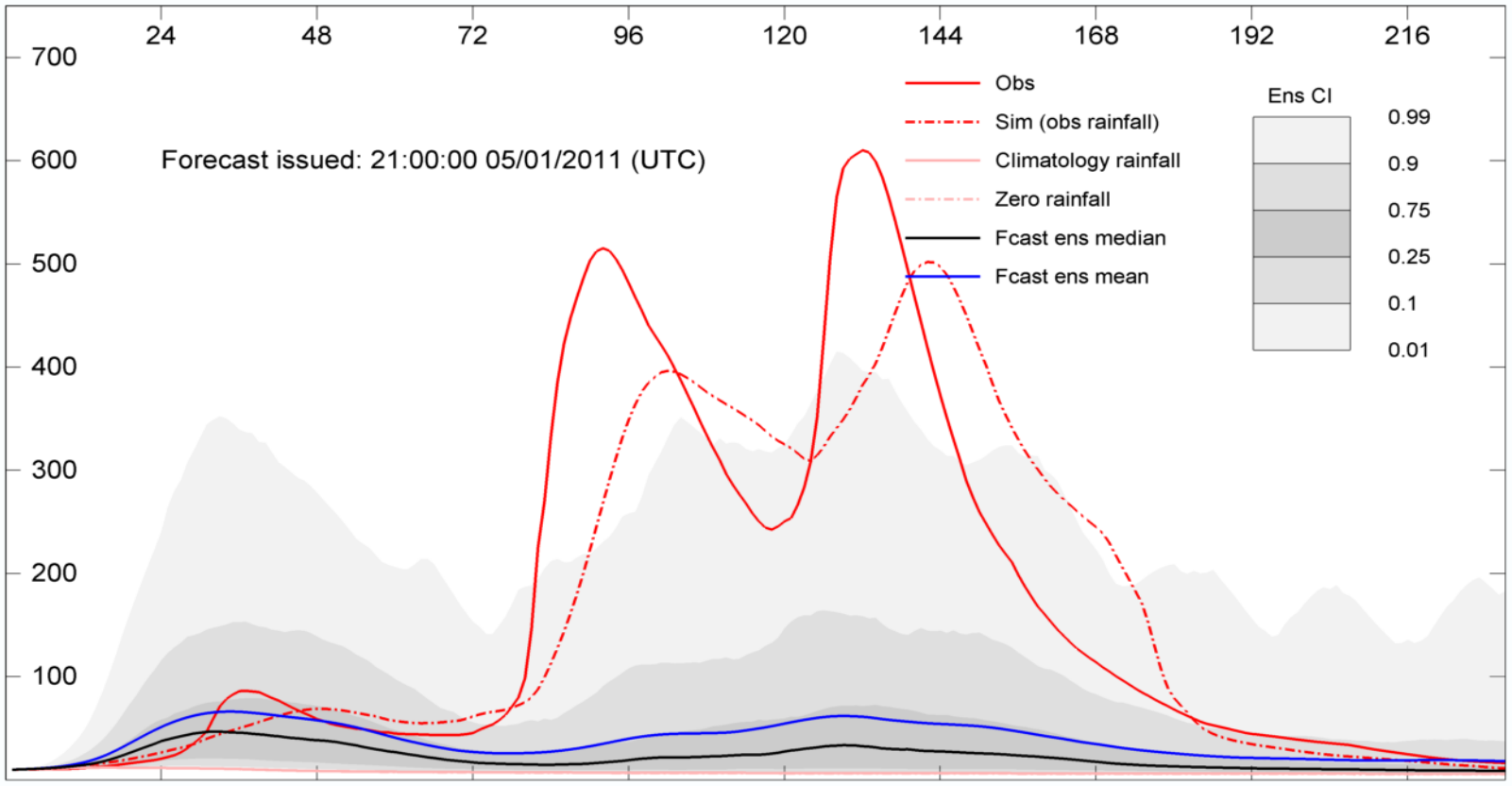


Ensemble reliability – Stanley River





Room for improvement – rainfall forecasts



Summary and future directions

- Ensemble forecasting is now possible, but not yet operational
- Need to account for hydrological uncertainty for better reliability
- Including more rainfall forecasts will improve skill

- Deterministic continuous hydrological forecast service for 11 catchments now a pilot service
- Ensemble streamflow forecast service to be implemented in the near future


Abercrombie River

Thank you

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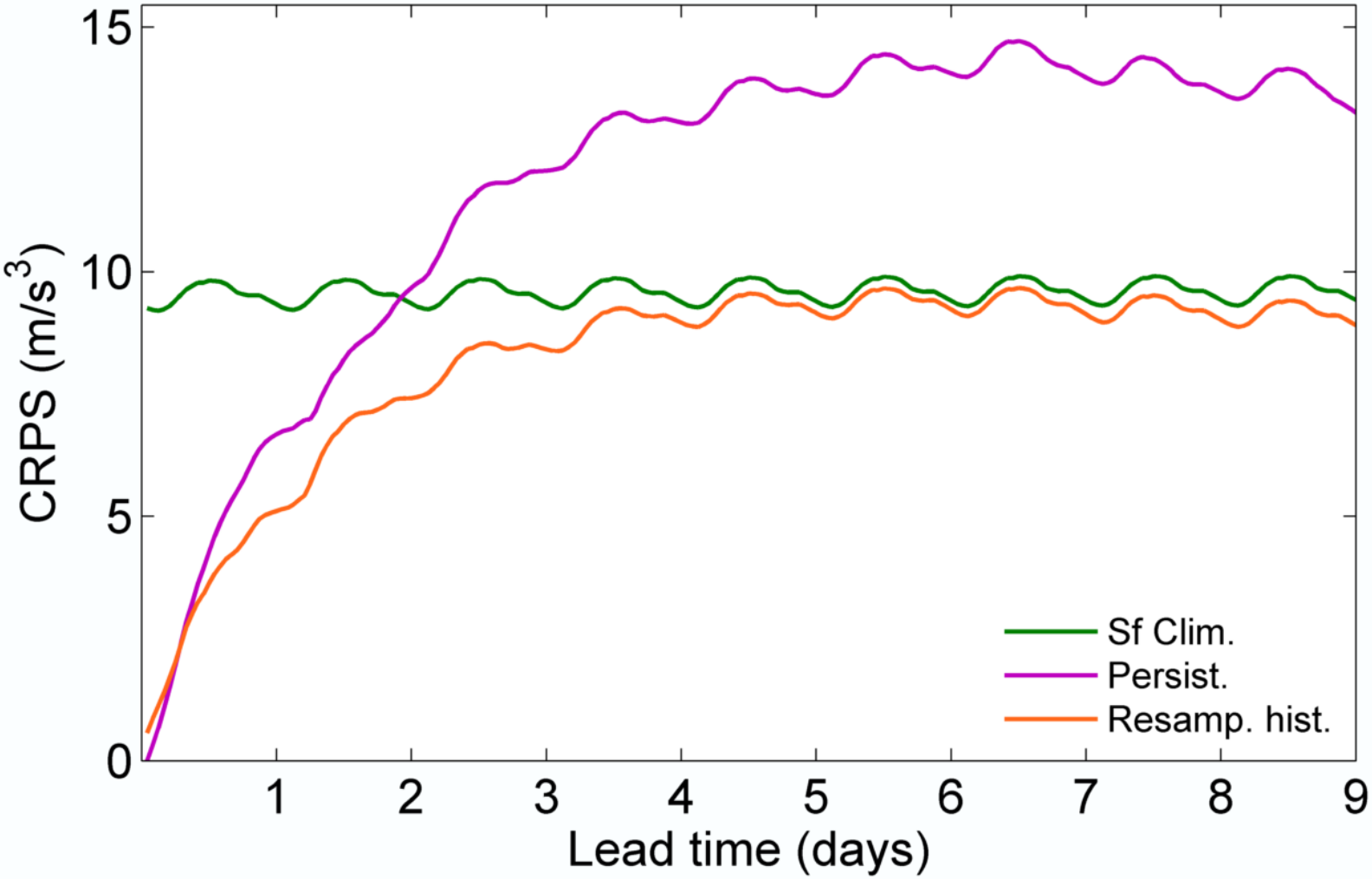
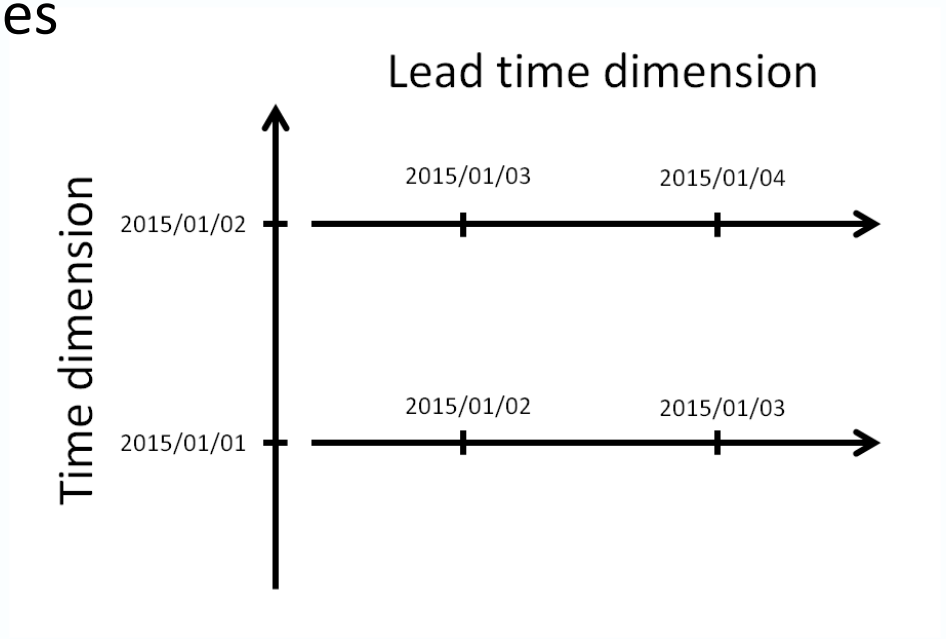
Choosing a reference forecast

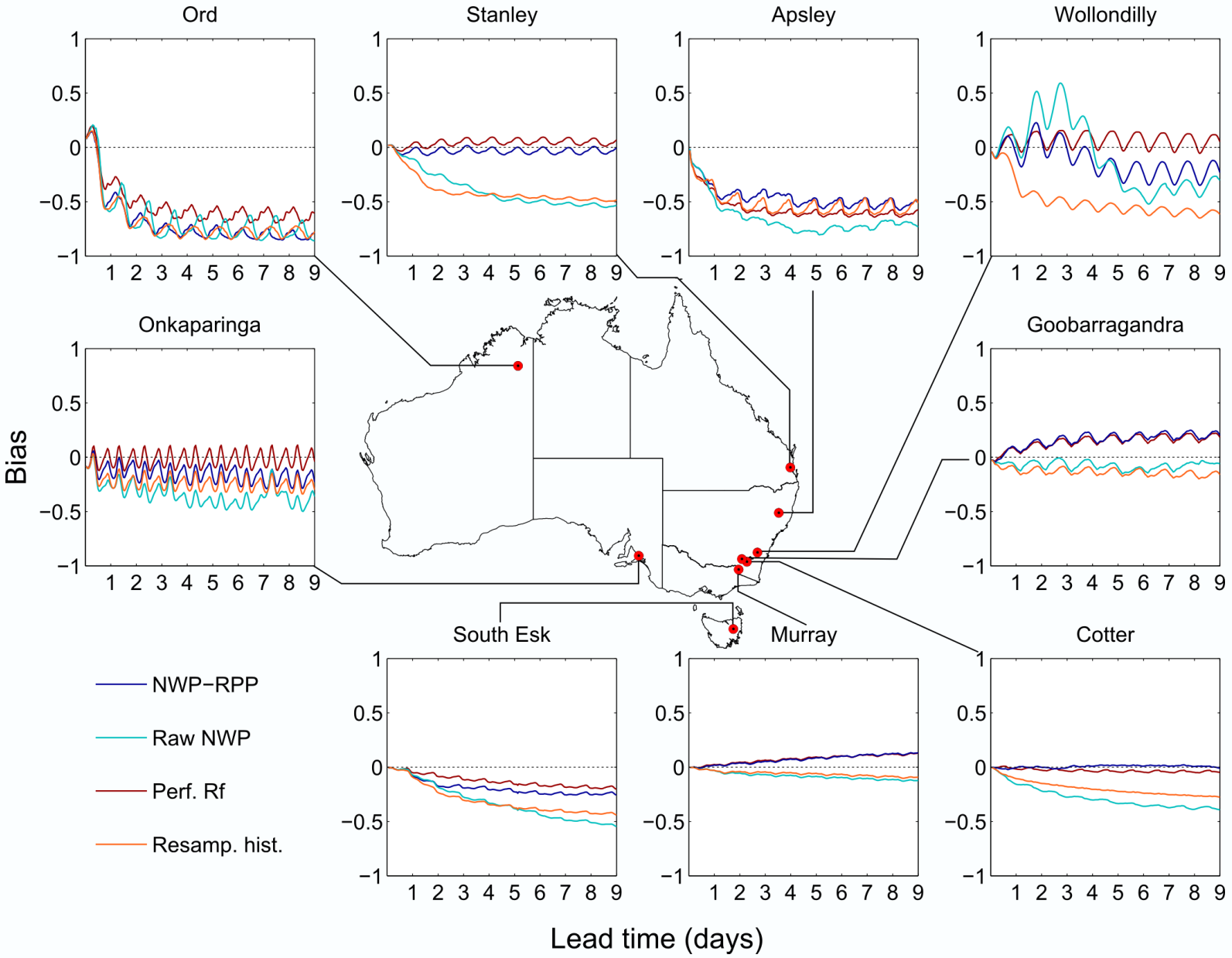


Software and Data formats

- Modules of SCHEF developed in Fortran
- For operational forecasts, modules called by Delft-FEWS
- Data is all stored in netCDF files including dimensions:
  - Time
  - Ensemble member
  - Lead Time



Bias


Ord
Stanley
Apsley
Wollondilly
Onkaparinga
Goobarragandra
South Esk
Murray
Cotter
Bias
Lead time (days)
NWP−RPP
Raw NWP
Perf. Rf
Resamp. hist.

Ensemble reliability – Stanley River