A water information R & D alliance between the Bureau of Meteorology and CSIRO's Water for a Healthy Country Flagship

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Water Information
DATA › INFORMATION › INSIGHT

Evaluation of AWRA-L, WaterDyn and CABLE

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Session 3: How well can we trust our models, and how can we be sure?

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Propositions

- The simplest model that explains the observations is necessarily the best model.☑
- All models are wrong, but some are still useful. ☑
- The models are not the main problem, it is the quality of the data and assumptions that go into them. ☑
- Much more effort is needed to objectively assess the performance of alternative models. ☑ ☑ ☑
- We need to stop calibrating our models, it leads to a false sense of security.☒
- In circumstances where calibration is essential for a model to be useful, we should just use an empirical model (for example, based on data mining or Bayesian methods). ☑ ☒
- We cannot know whether to trust our models. Therefore multi-model ensembles should be standard operational practice, not just a research endeavour. ☒
- In the absence of quantitative knowledge of model inter-dependence, ensemble methods are meaningless. ☒.
- Inappropriate values for unconstrained parameters (through calibration or assumption) should remove any trust in predictive ability. ☑
- Talking about 'physically-based' models is meaningless when there is not enough data to construct an empirical model. ☑

Motivation: Which model(s) can we use for retrospective runoff, soil moisture, ET, recharge reporting?

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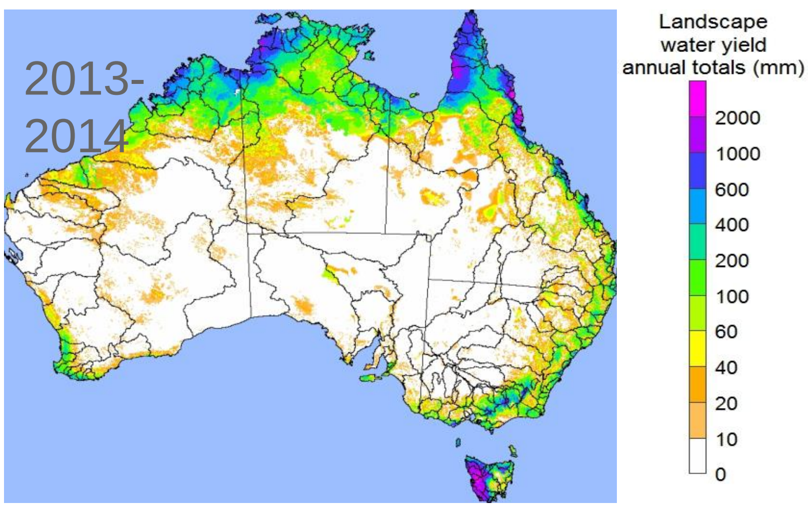
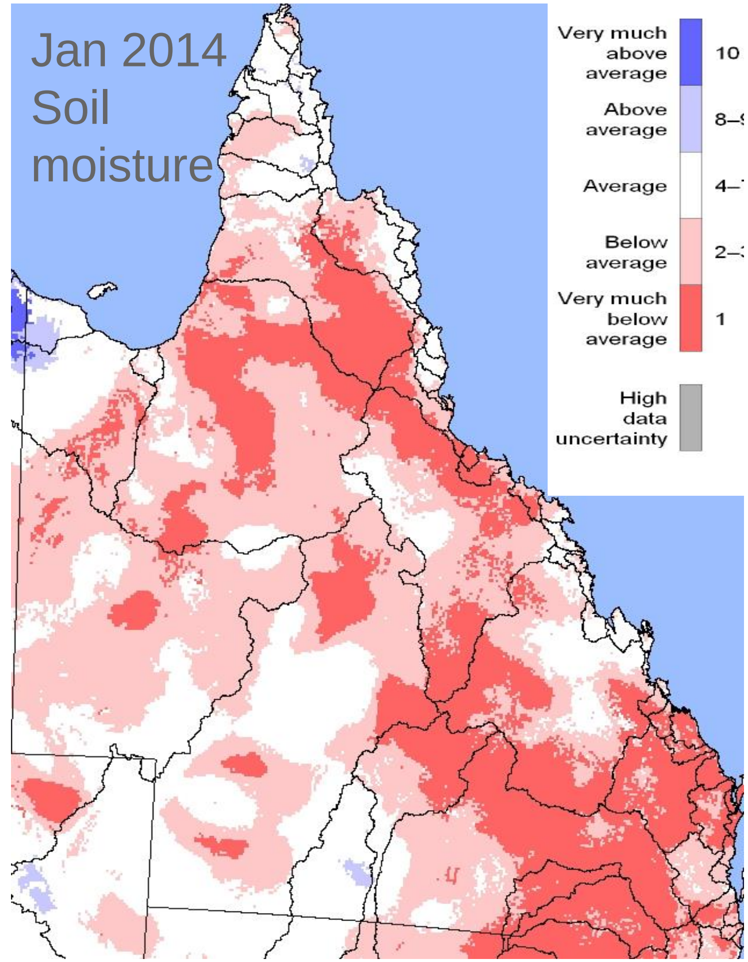
BoM reports on water:

- availability
- Use: National Water Account
  - see www.bom.gov.au/water/nwa/2013/
- current situation





Model possibilities

Others: rainfall-runoff models, empirical methods, etc

	WaterDyn (AWAP)	CABLE-SLI	AWRA-L
Reference	Raupach et al (2009)	Wang et al (2011) Haverd et al (2013)	Viney et al (2014)
Developer	CSIRO/BOM/BRS	CSIRO/BOM +	CSIRO/BOM (WIRADA)
Purpose	Monitoring terrestrial water balance	Landsurface scheme for ACCESS	Water reporting and monitoring
Soil layers (spatially varying properties)	2 (depth, saturated volumetric water content)	10 (saturated hydraulic conductivity, field cap, etc etc)	3 (sat. hydraulic conductivity, % AWC)
Calibration	Parameter sensitivity to 6 catchments in Murrumbidgee	Calibration to derived ET (50 catchments) and flux tower data	Streamflow over ~300 catchments

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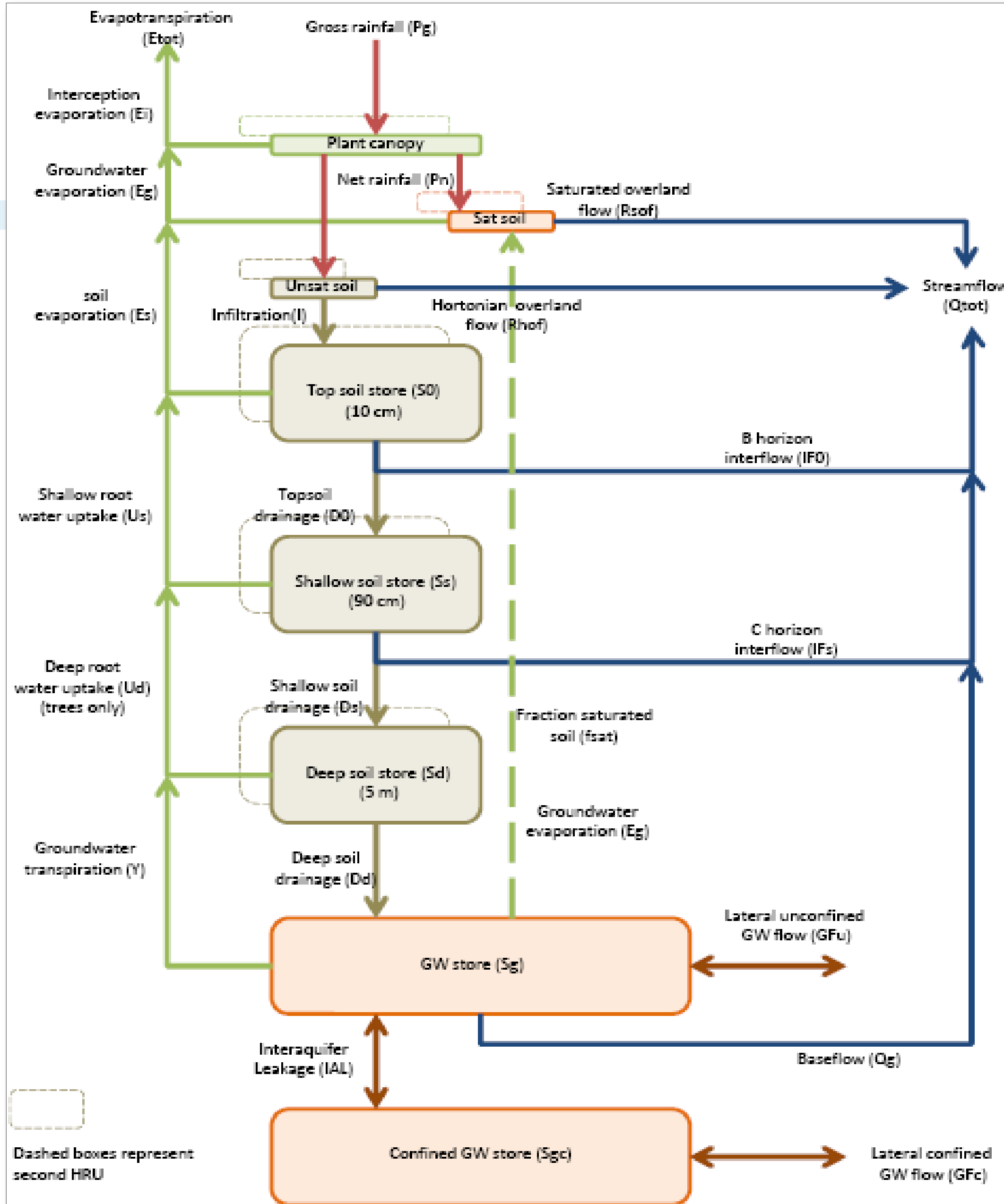
AWRA-L conceptual structure



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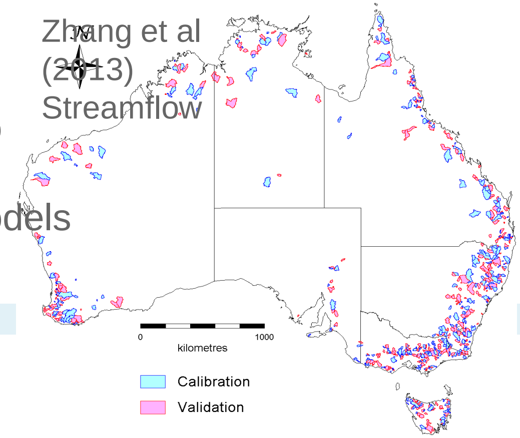
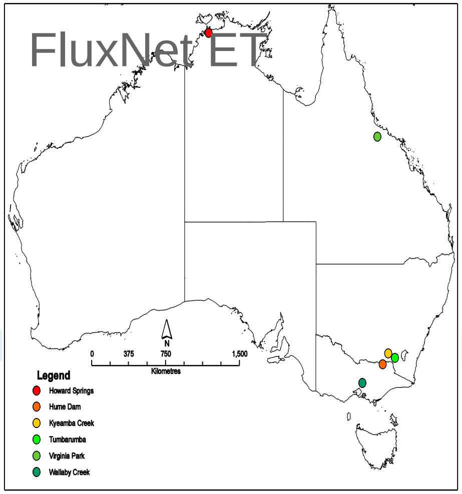
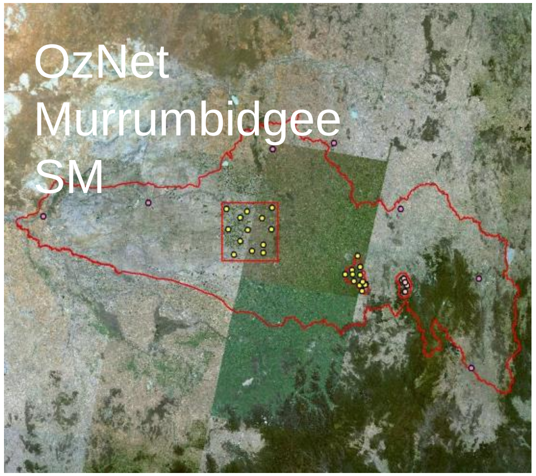
What to do?

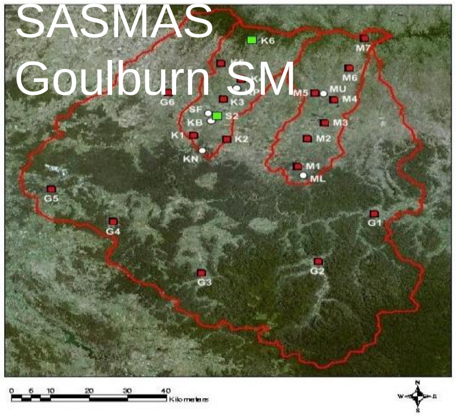
Much more effort is needed to objectively assess the performance of alternative models

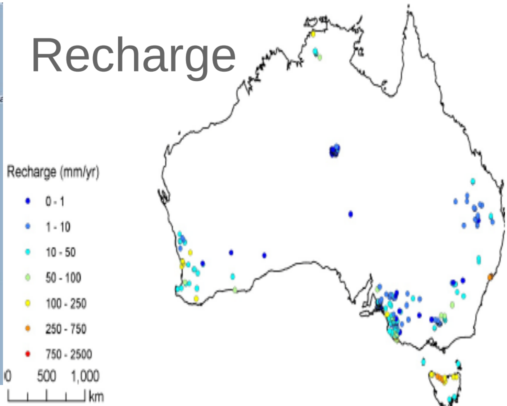
- **Catchment evaluation**
  - **Streamflow** – 780 unimpaired catchments (Zhang et al, 2013)
  - **ET** [CMRS, SLS] (Guerschman et al, 2009, Van Niel et al, 2012)
  - **Soil moisture** [AMSR-E, ASCAT] – Renzullo et al (2014)
- **Point testing**
  - **ET** – FluxNet towers http://www.ozflux.org.au (King et al, 2011), Jason Beringer
  - **Soil moisture** –
    - Murrumbidgee OzNet http://www.oznet.org.au/ Smith et al (2012)
    - SASMAS (Rüdiger et al, 2007)
    - CosmOz http://cosmoz.csiro.au/cosmoz/
  - **Recharge** - Crosbie et al (2011), Peeters et al (2011)
- **Benchmarking system:** Warren (2012) ++











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Streamflow: Unimpaired catchments

We need to stop calibrating our models, it leads to a false sense of security.

Cal

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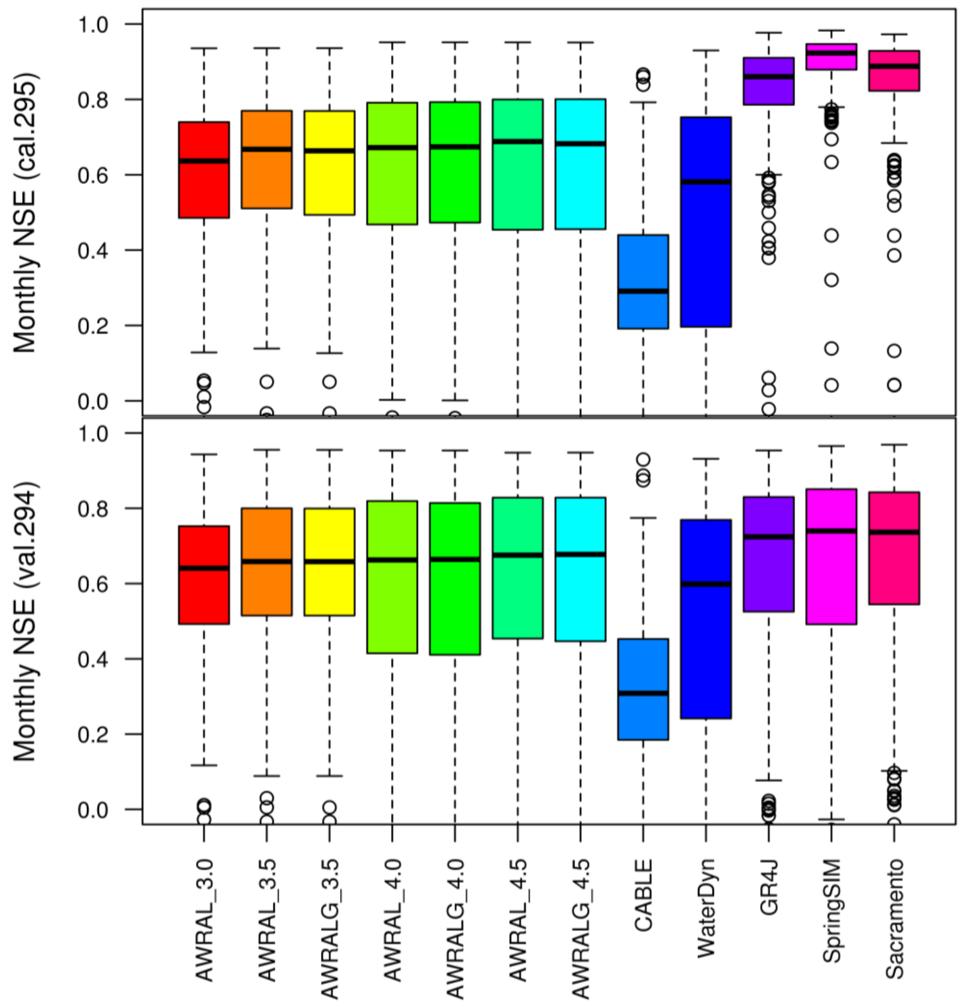

1. AWRA-L performs better due to calibration and conceptual structure
2. Locally calibrated rainfall runoff models provide benchmark
3. AWRA-L is close to locally calibrated models in validation

Viney, N.R., Vaze, J., Wang, B., Zhang, Y., Yang, A., Vleeshouwer, J., Ramchurn, A. and Frost, A., 2014. Intercomparison of methods for regionalising rainfall-runoff model predictions over large domains, Hydrology and Water Resources Symposium 2014. Engineers Australia, Perth, pp. 970-977

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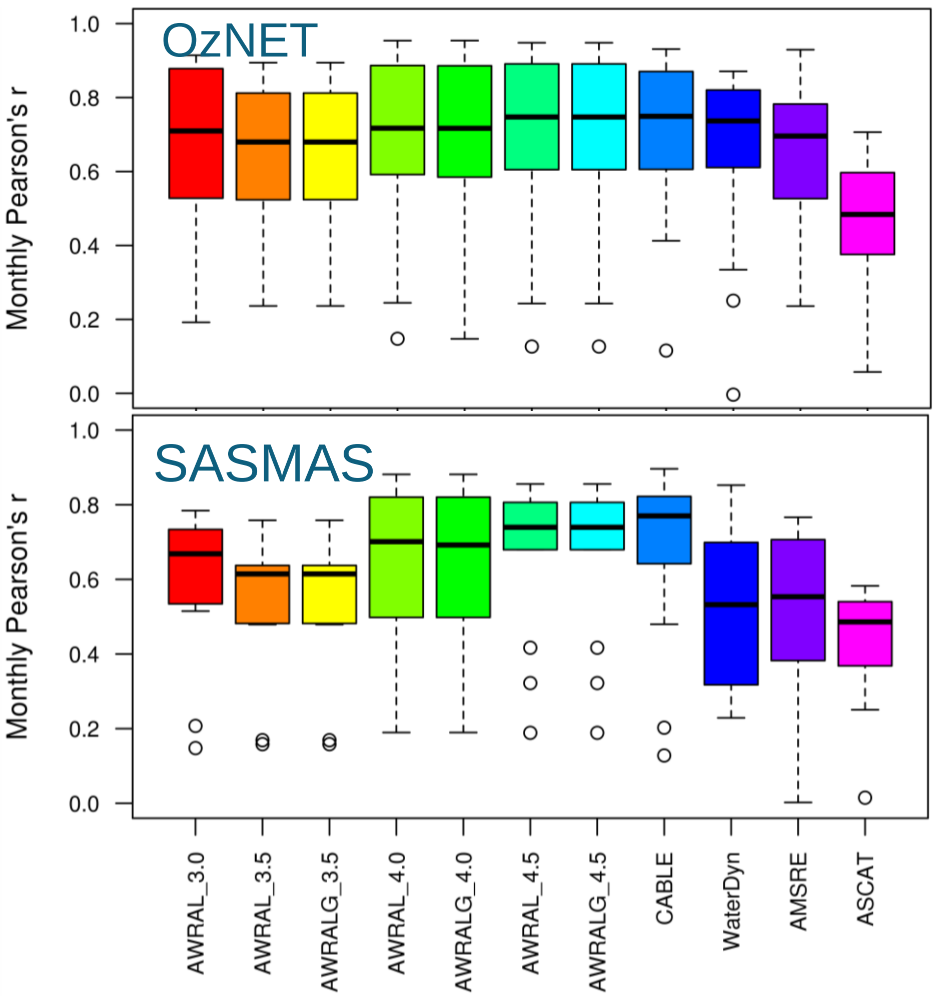
Soil moisture

Profile (0-90cm)



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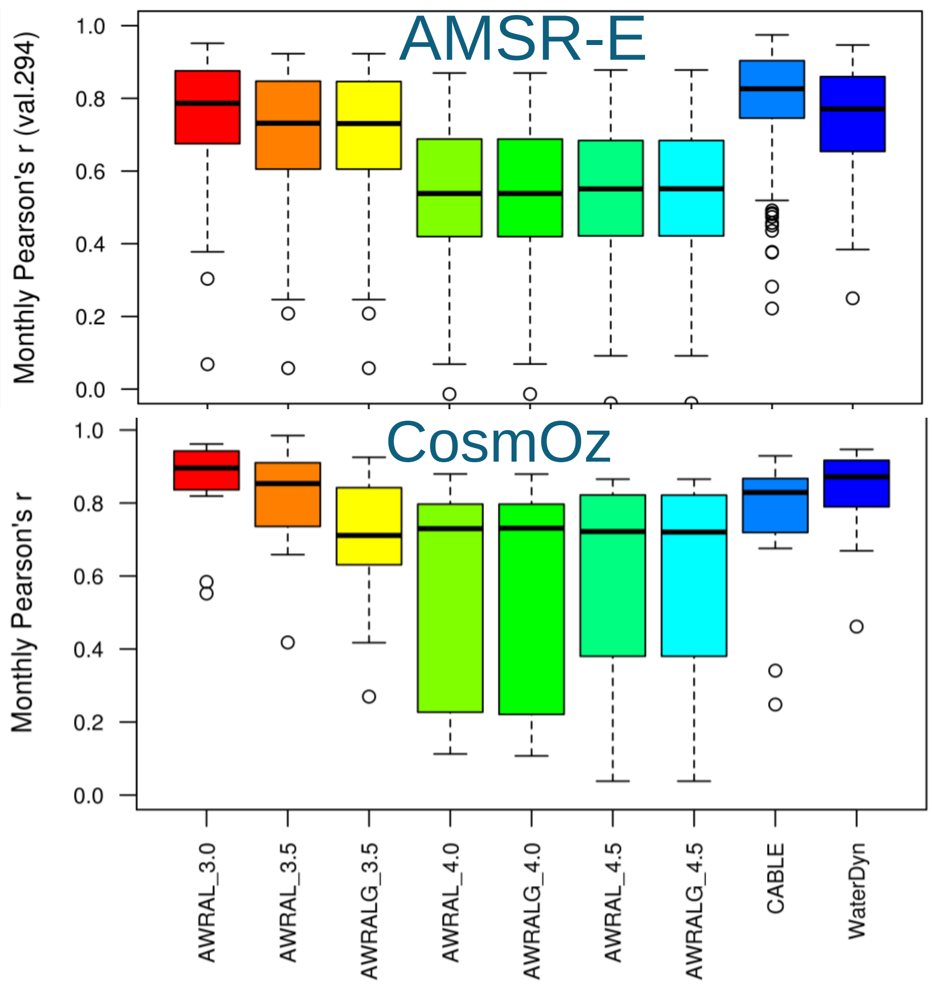
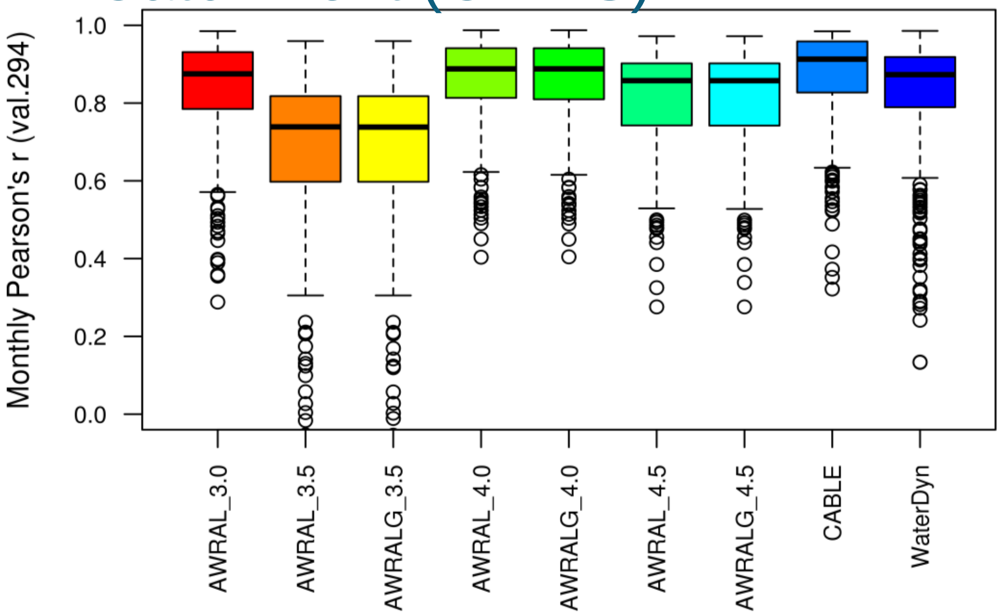


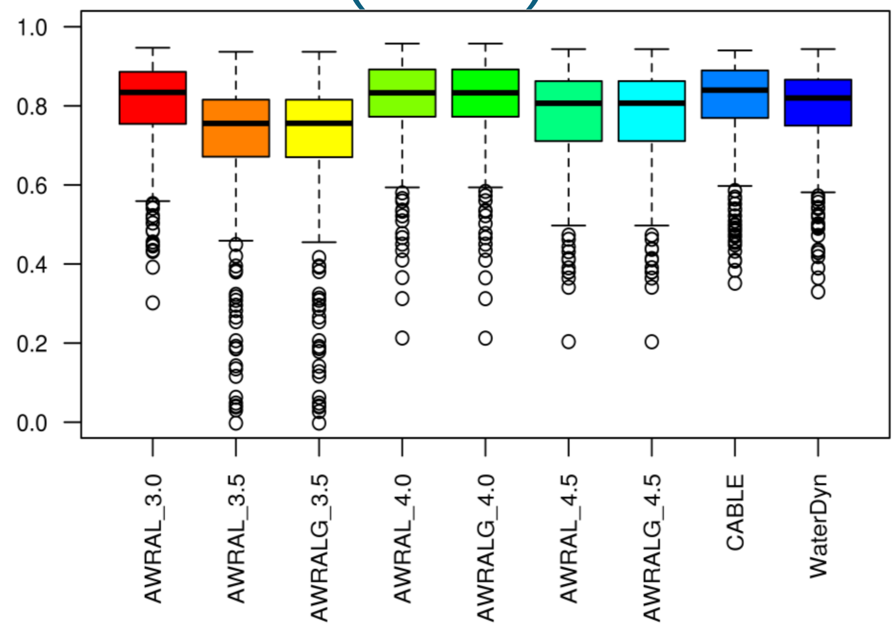
ET

In circumstances where calibration is essential for a model to be useful, we should just use an empirical model (for example, based on data mining or Bayesian methods). ☑ ☒

Catchment (CMRS)



Catchment (SLST)



Site (Flux)

Site	L 3.0	L 3.5	LG 3.5	L 4.0	LG 4.0	L 4.5	LG 4.5	CMRS	SLST	CABLE	WaterDyn
Tumbarumba	0.89	0.76	0.76	0.93	0.93	0.9	0.9	0.94	0.92	0.94	0.91
Howard.Springs	0.87	0.9	0.9	0.75	0.75	0.76	0.76	0.77	0.77	0.84	0.87
Wallaby.Creek	0.86	0.78	0.78	0.87	0.87	0.87	0.87	0.86	0.89	0.82	0.8
Kyeamba	0.93	0.89	0.89	0.89	0.89	0.93	0.93	0.98	0.93	0.96	0.94
Virginia.Park	0.88	0.91	0.91	0.92	0.92	0.94	0.94	0.96	0.89	0.94	0.88
Hume.Dam	0.12	0.18	0.18	0.25	0.25	0.2	0.2	0.38	0.5	0.32	0.11

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How well can we trust our models?

- Hydrological assessment not undertaken routinely
  - Especially for variables other than streamflow
- Operational/community comparison and demonstration of models ….through PALS?
  - standard tests against published unimpaired catchment and point data
- Objective assessment is hard
  - different forcing data, calibration techniques, scales, soil store depths, purposes of models etc
  - **First step:** set up system for ongoing benchmarking and use as analogue check that model is fit for intended purpose

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Thanks