



The University of Sydney



Uncertainties in calibrating SWAT for a semi-arid catchment in NSW (Australia)

“A work in progress”

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Calibration and catchment models

- Large catchment scale models are used extensively for management scenarios
- Calibration is used to match observed to predicted data
- Implies background conceptual model
 - Calibration is non-unique
- Impacts subsequent management scenario

Semi-arid Hydrology

- Semi-arid and arid rivers have high flow variability
- Many no-flow days
- Lateral flows, valley/bank storage
- Dynamic transmission losses
- Difficult to predict/model

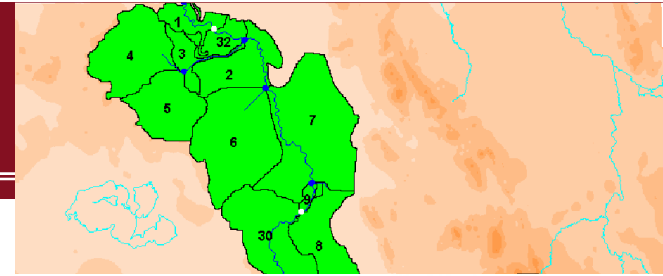


Salinity and water sharing

- Key issues for Australia's food bowl: The Murray Darling Basin (~1 mln km²)
- Salinity levels have been rising in rivers
- Continued extraction of water for irrigation
- Mooki catchment has been recognised as an area prone to salinisation in earlier work

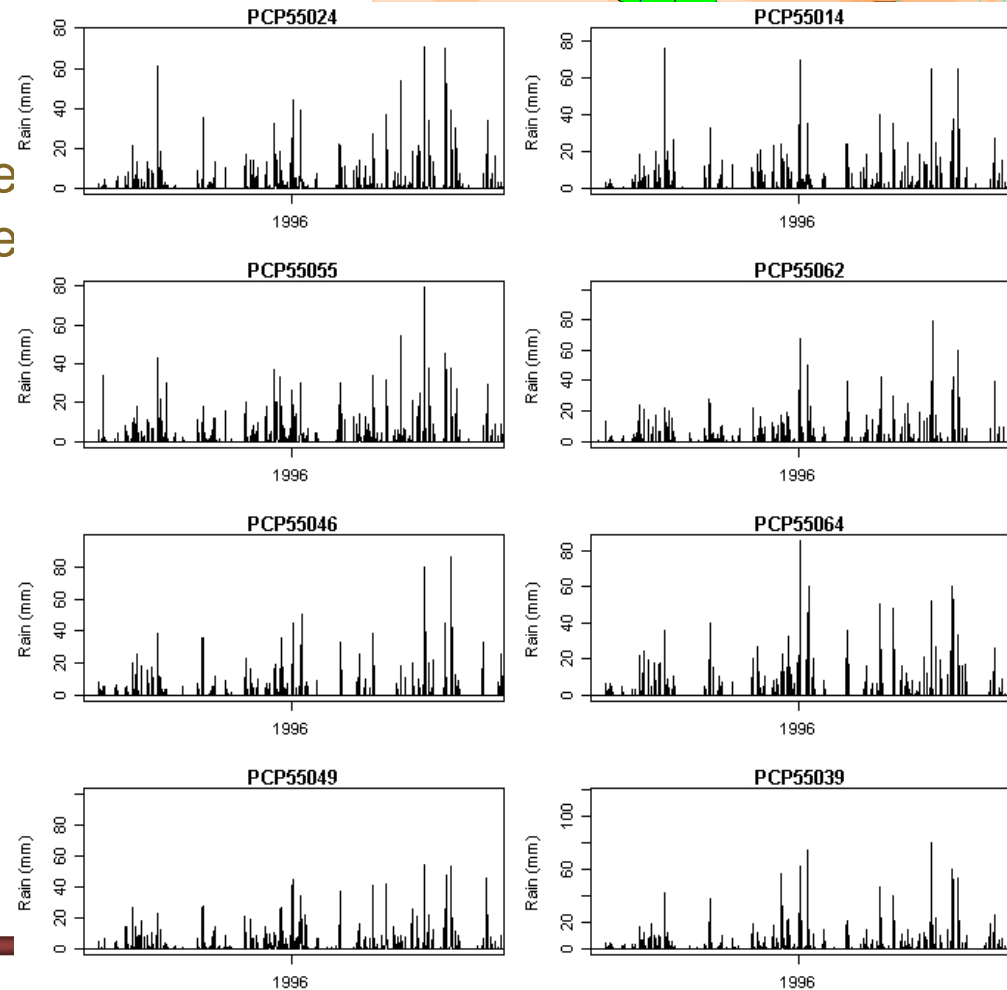


Source: wikipedia.org



Australia:
Data poor, large spaces
Mooki catchment relative
DEM, soils map, landuse

Rainfall: 550 mm/year
But highly variable
spatial and temporal!

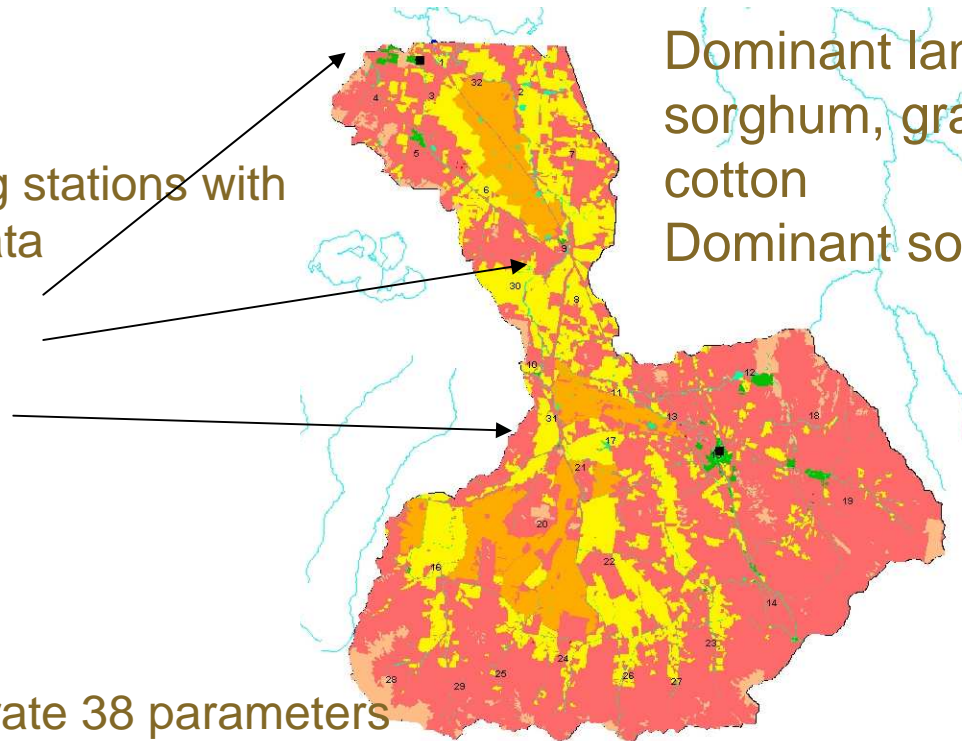




SWAT 2000 used for Mooki catchment: 4500 km²

Three gauging stations with
10 years of data

- Ruvigne
- Breeza
- Caroona



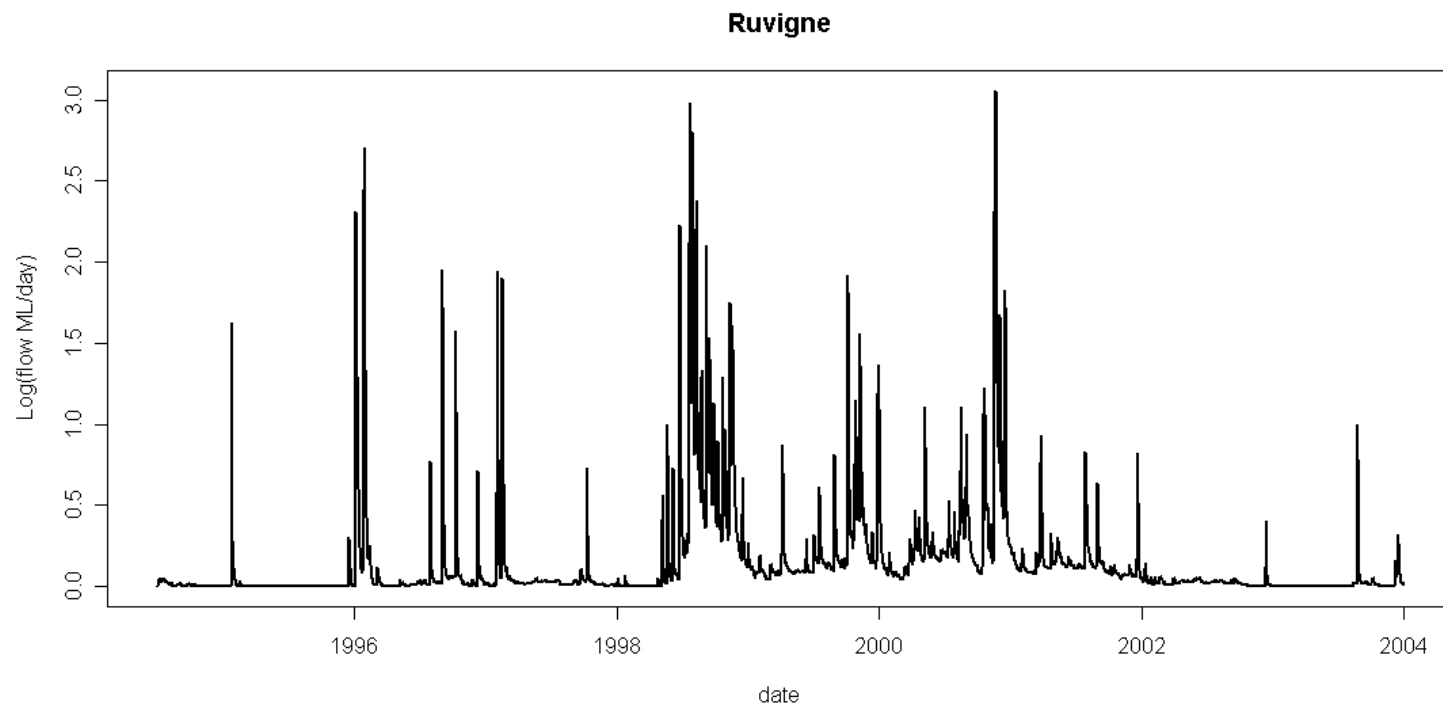
Dominant landuses: wheat,
sorghum, grazing, irrigated
cotton

Dominant soils: Vertosols

PEST to calibrate 38 parameters
Partly tied using PAR2PAR
Other parameters estimated from data



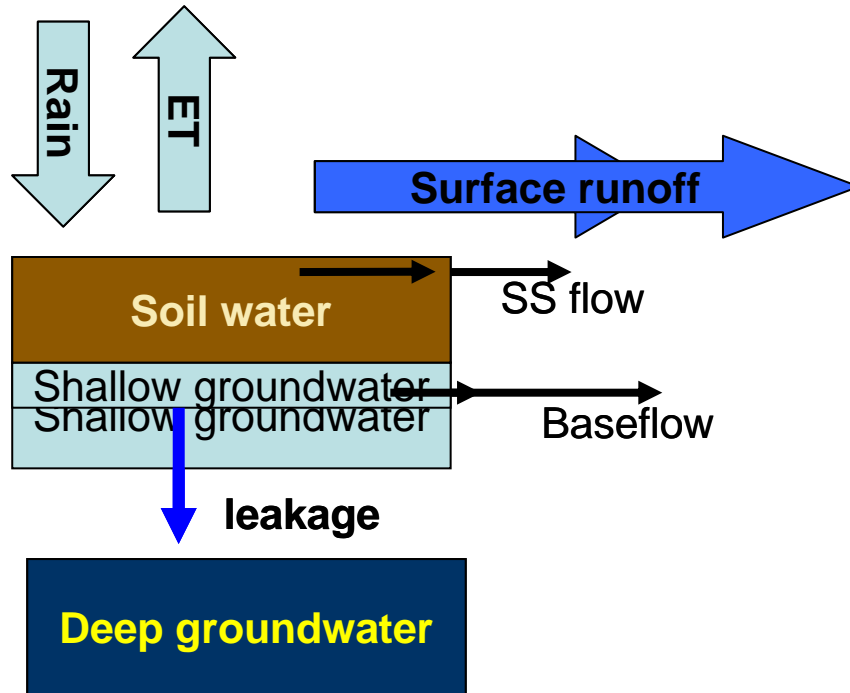
Connected System?





For example

- High connectivity deep and shallow groundwater
- High capillary rise
- Result is no baseflow
- Or:
 - Low connectivity
 - Low capillary rise
 - Result is high baseflow



SWAT conceptual model

But, relative magnitude of arrows and buckets is important for economic modelling and water quality



Parameters calibrated

Curvenumbers	10 different soil and landuses
REVAP	4 subcatchments
Transmission K, Mannings n	4 subcatchments
GW threshold	4 subcatchments
EPCO	ET damping in soil, 10 soils

Based on SENSAN analysis in PEST

Also calibrated the CMD version of IHACRES (Croke and Jakeman 2004) with only 6 parameters to the data at each of the stations (max simplification)



Conceptual models

Run	SHALLST	RCHRG_DP	REVAPMIN	GWQMN	ESCO
Run 1	500	0.5	200	500	0.95
Run 2	500	0.01	500	Calibrated	0.95
Run 3	500	0.1	500	Calibrated	0.95
Run 4	1	0.1	10	1	0.95
Run 5	500	0.1	510, Calibrated, tied to GWQMN	500, Calibrated	0.001
Run 6	500	0.25	510, Calibrated, tied to GWQMN	500, Calibrated	0.95
Run 7	500	0.25	300, Calibrated, tied to GWQMN	600, Calibrated	0.95



Station	Ruvigne		Breeza		Caroona	
	NSE	r^2	NSE	r^2	NSE	r^2
Model run						
run 1	0.25	0.52	0.26	0.37	0.16	0.38
run 2	0.12	0.48	0.34	0.48	0.34	0.44
run 3	0.09	0.54	0.35	0.49	0.40	0.55
run 4	-0.13	0.46	0.24	0.44	0.17	0.46
run 5	-0.10	0.47	0.23	0.43	0.23	0.48
run 6	-0.24	0.38	0.15	0.42	0.14	0.44
run 7	-0.11	0.49	0.28	0.48	0.29	0.53
IHACRES	0.40	0.40	0.38	0.38	0.39	0.39

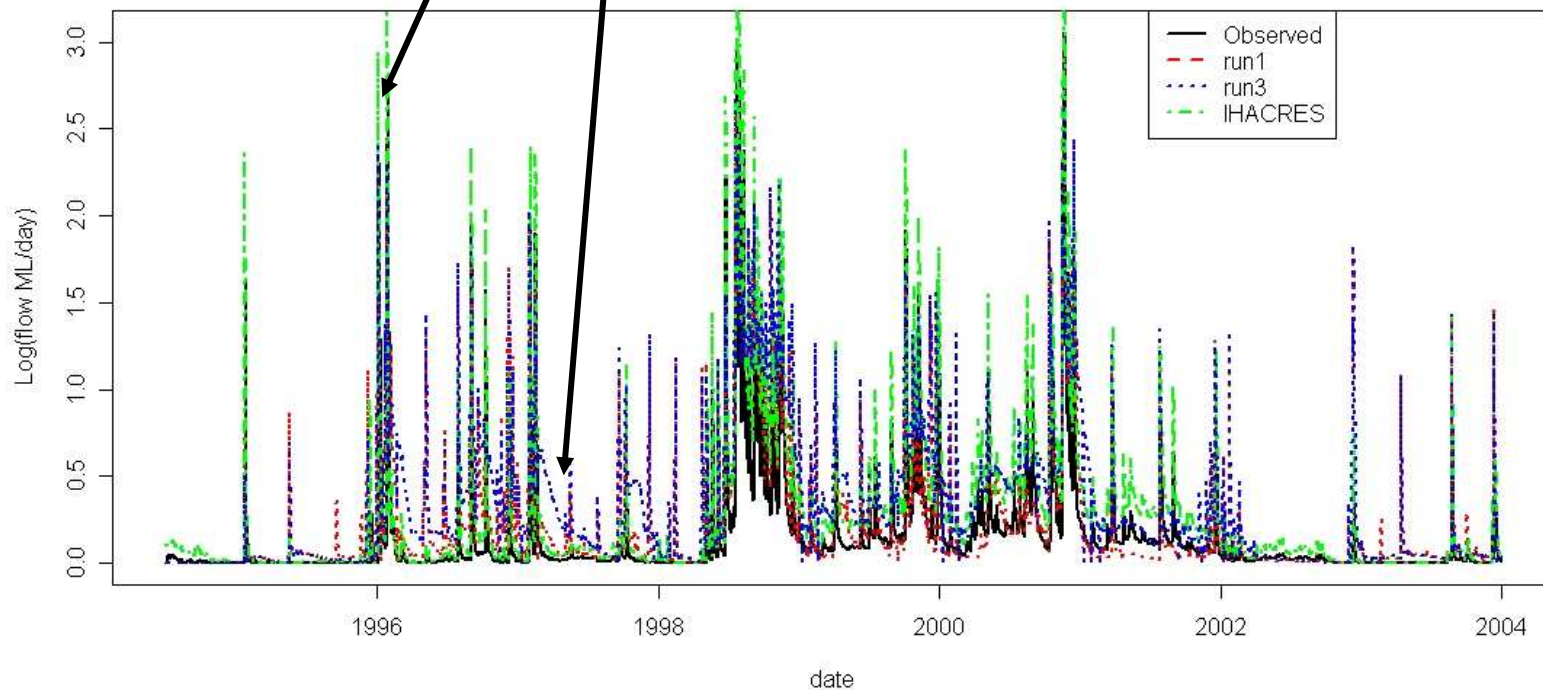


Clear differences in flow. Both peak and baseflow
But similar calibrations

Extraction for irrigation?

Behaviour of high and low flows

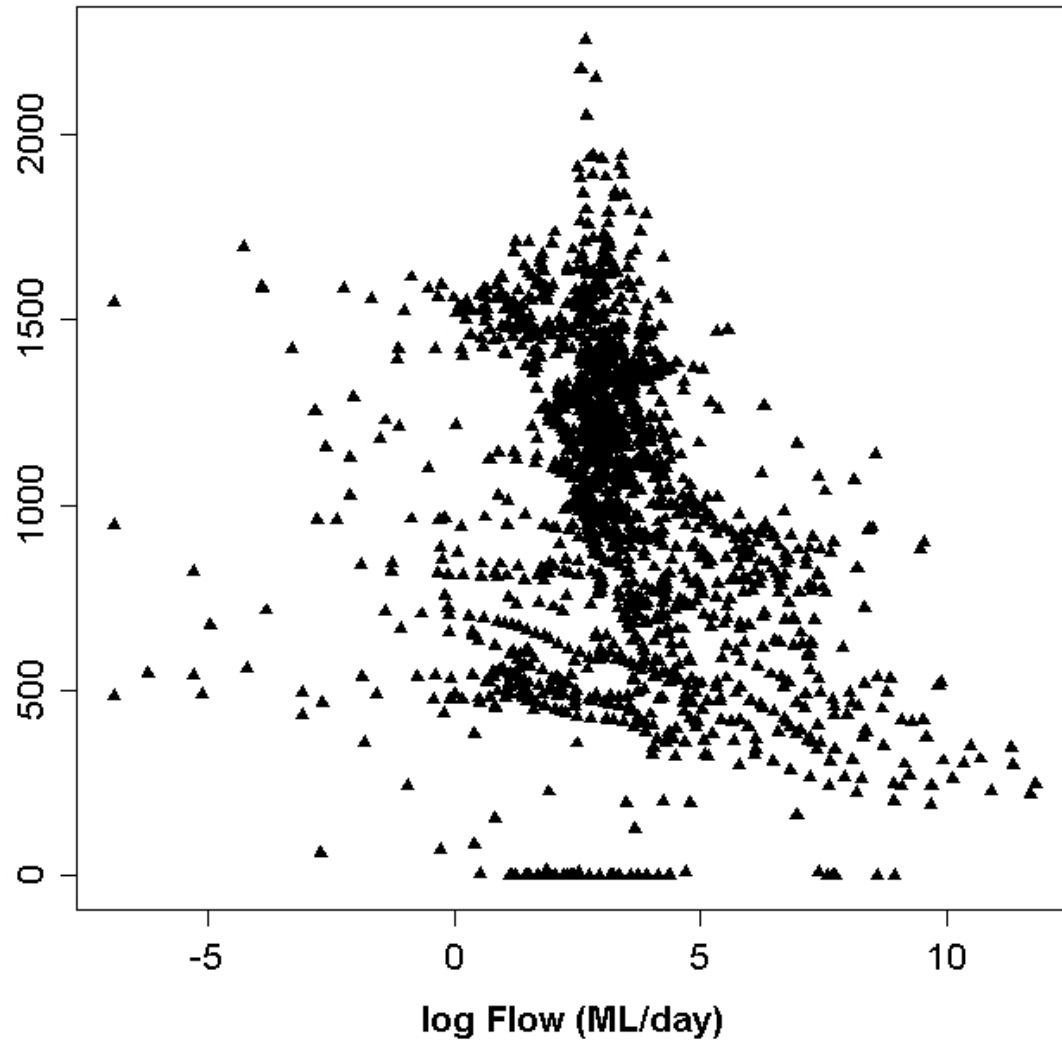
Carroona





EC versus Flow for Ruvigne

- Se
- tra
-
-
- Ca
- dis
- Otl
- av
- Va
- Eq
- all



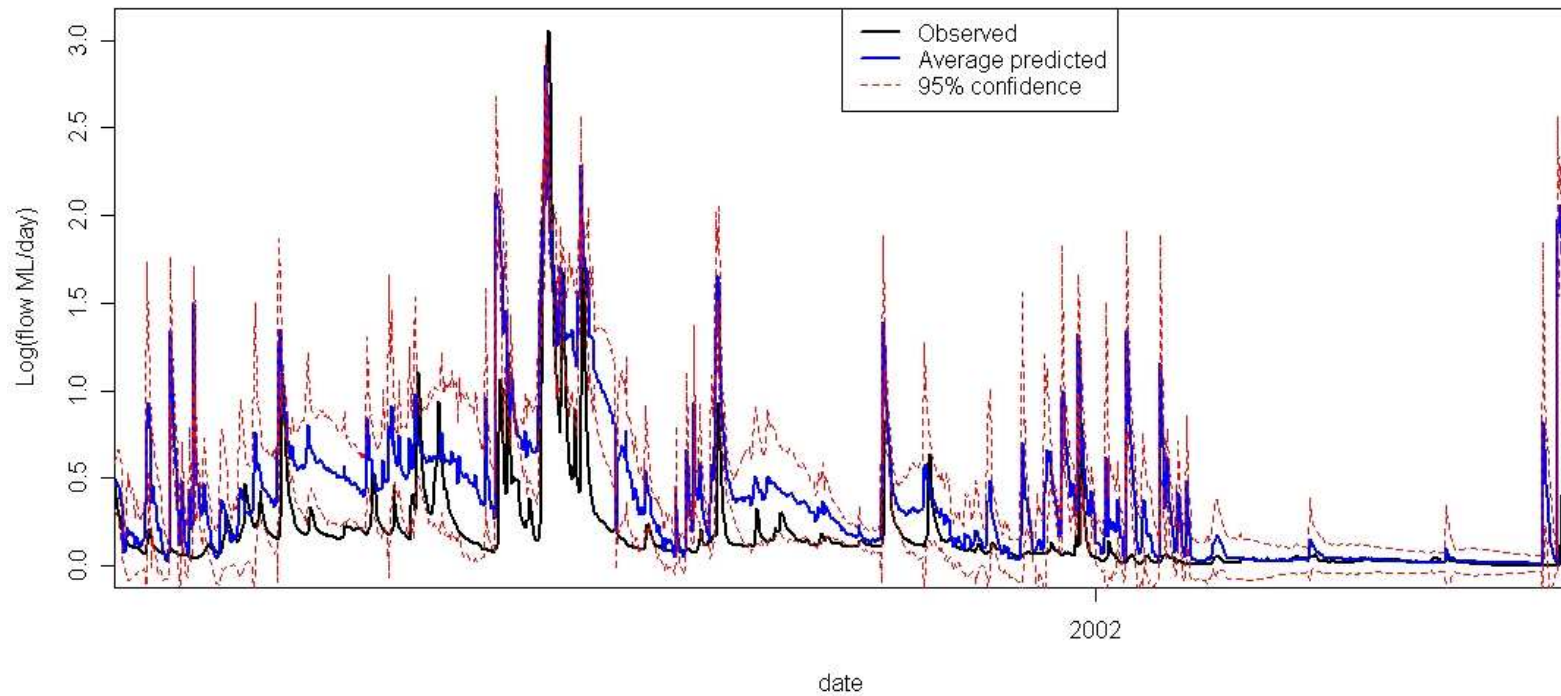
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Equifinality

Ruvigne





Further discussion

- Care should be taken when interpreting the results of a “calibrated” catchment model:
 - Conceptual model drives calibration direction due to interdependence of parameters
 - If conceptual model is unknown or uncertain, how do we interpret results?
 - Bayesian averaging? And include in calibration
- Calibrate on monthly values?