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

“A work in progress”

Willem Vervoort

w.vervoort@usyd.edu.au

McCaughey Senior Lecturer

Hydrology Research Laboratory

Faculty of Agriculture, Food & Natural Resources

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

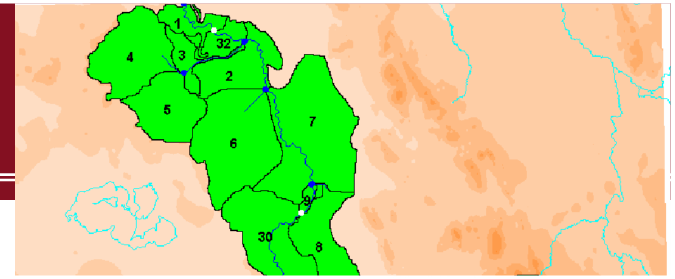
Semi-arid Hydrology

- 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

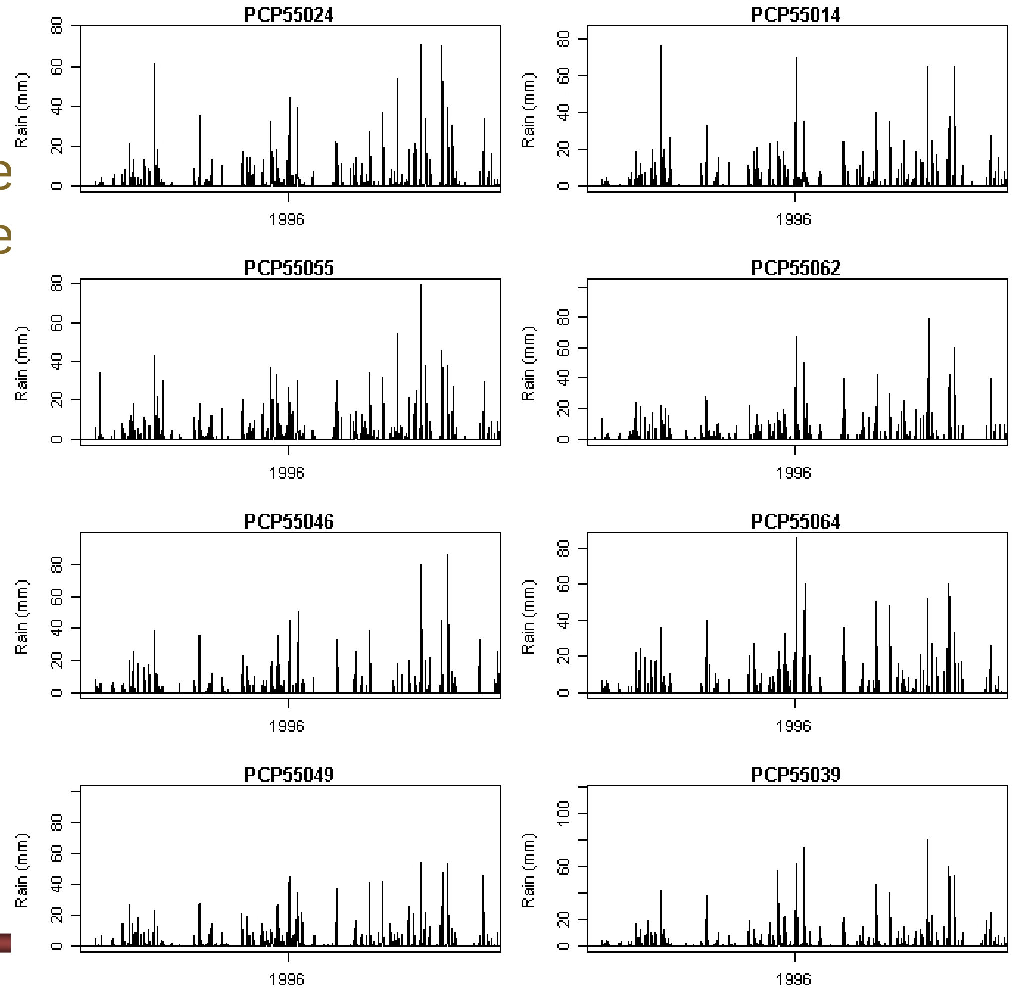
Salinity and water sharing

- Key issues for Australia's food bowl: The Murray Darling Basin (~1 mln km^2)
- 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



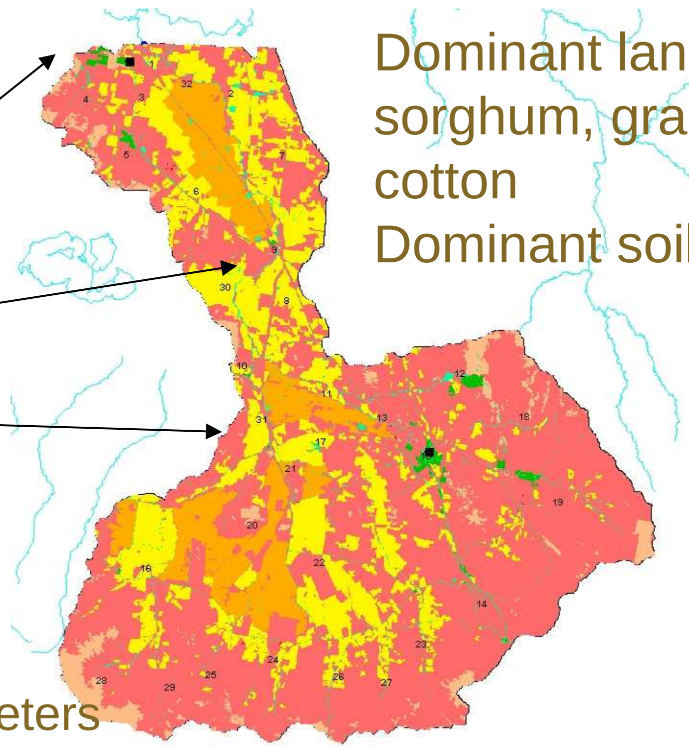
Australia:
Data poor, large spaces
Mooki catchment relative
DEM, soils map, landuse



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

SWAT 2000 used for Mooki catchment: 4500 km^2

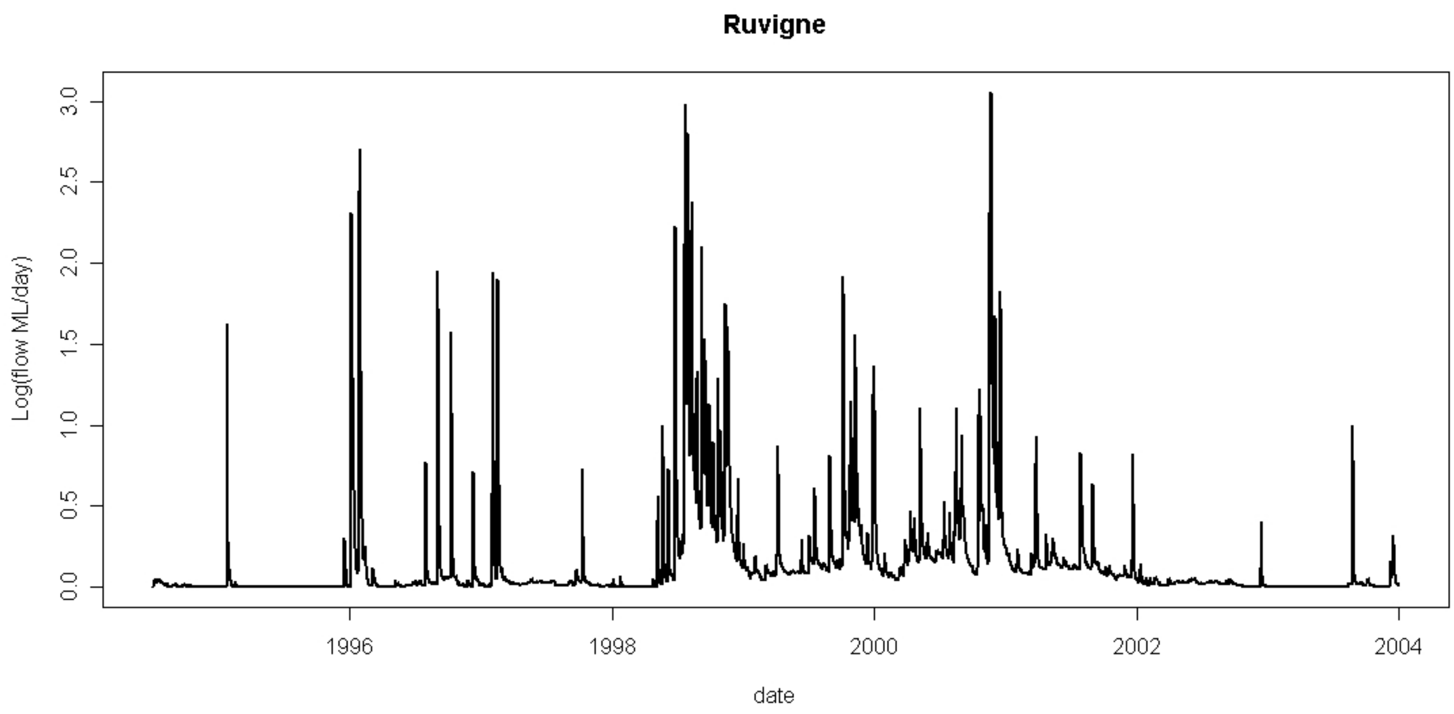
Three gauging stations with
10 years of data
- Ruvigne
- Breeza
- Caroona



Dominant landuses: wheat, sorghum, grazing, irrigated cotton
Dominant soils: Vertosols

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

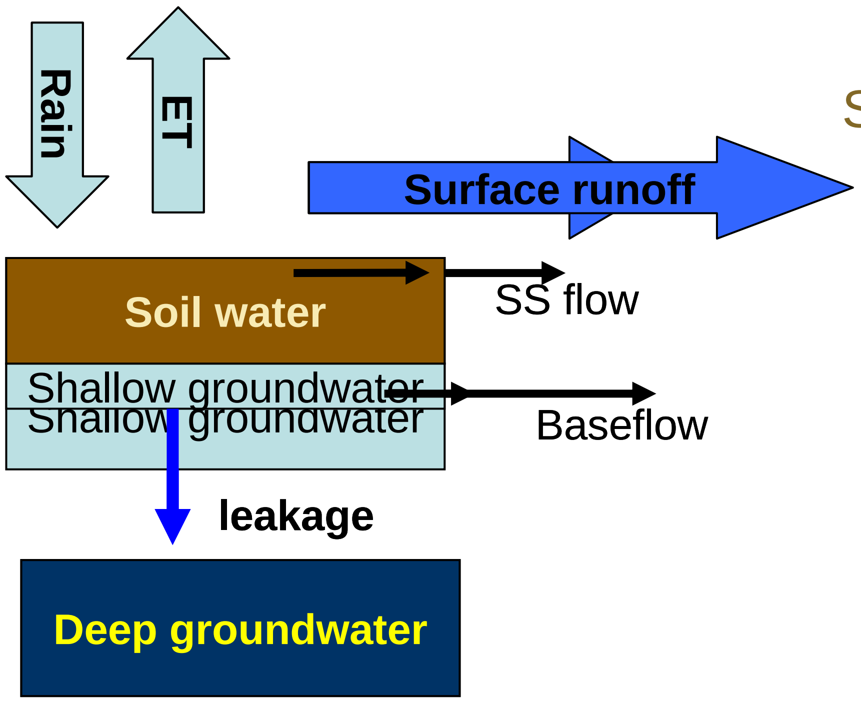
Connected System?



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

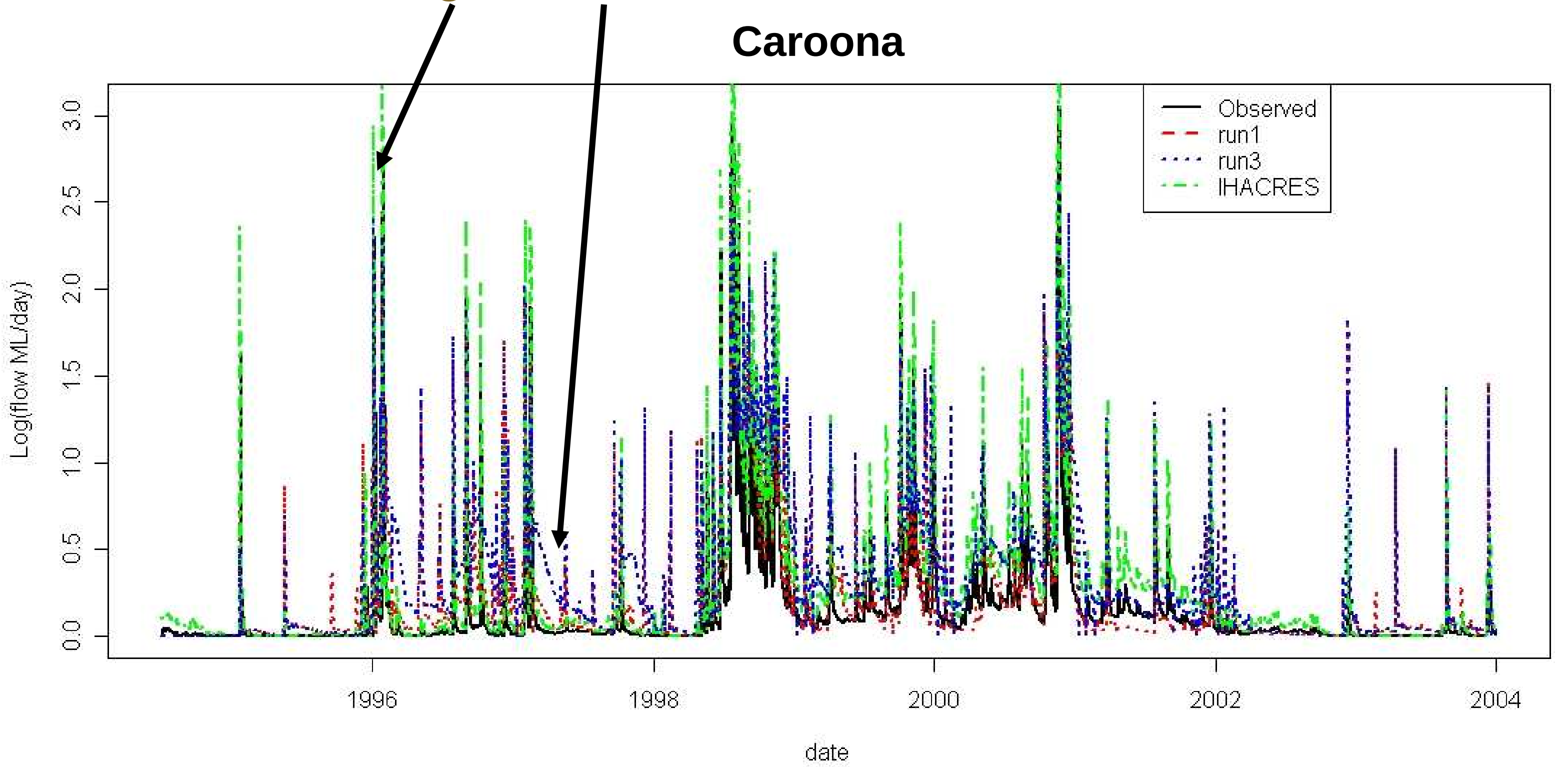
Run	SHALLST	RCHRG_DP	REVAPMIN	GWQMN	ESCO
Run 1	500	0.5	200	500	0.95
Run 2	500	0.01	500	Calibrated	0.95
Run 3	500	0.1	500	Calibrated	0.95
Run 4	1	0.1	10	1	0.95
Run 5	500	0.1	*510*, Calibrated, tied to GWQMN	*500*, Calibrated	0.001
Run 6	500	0.25	*510*, Calibrated, tied to GWQMN	*500*, Calibrated	0.95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

Station	Ruvigne		Breeza		Caroona	
Model run	NSE	r^2	NSE	r^2	NSE	r^2
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



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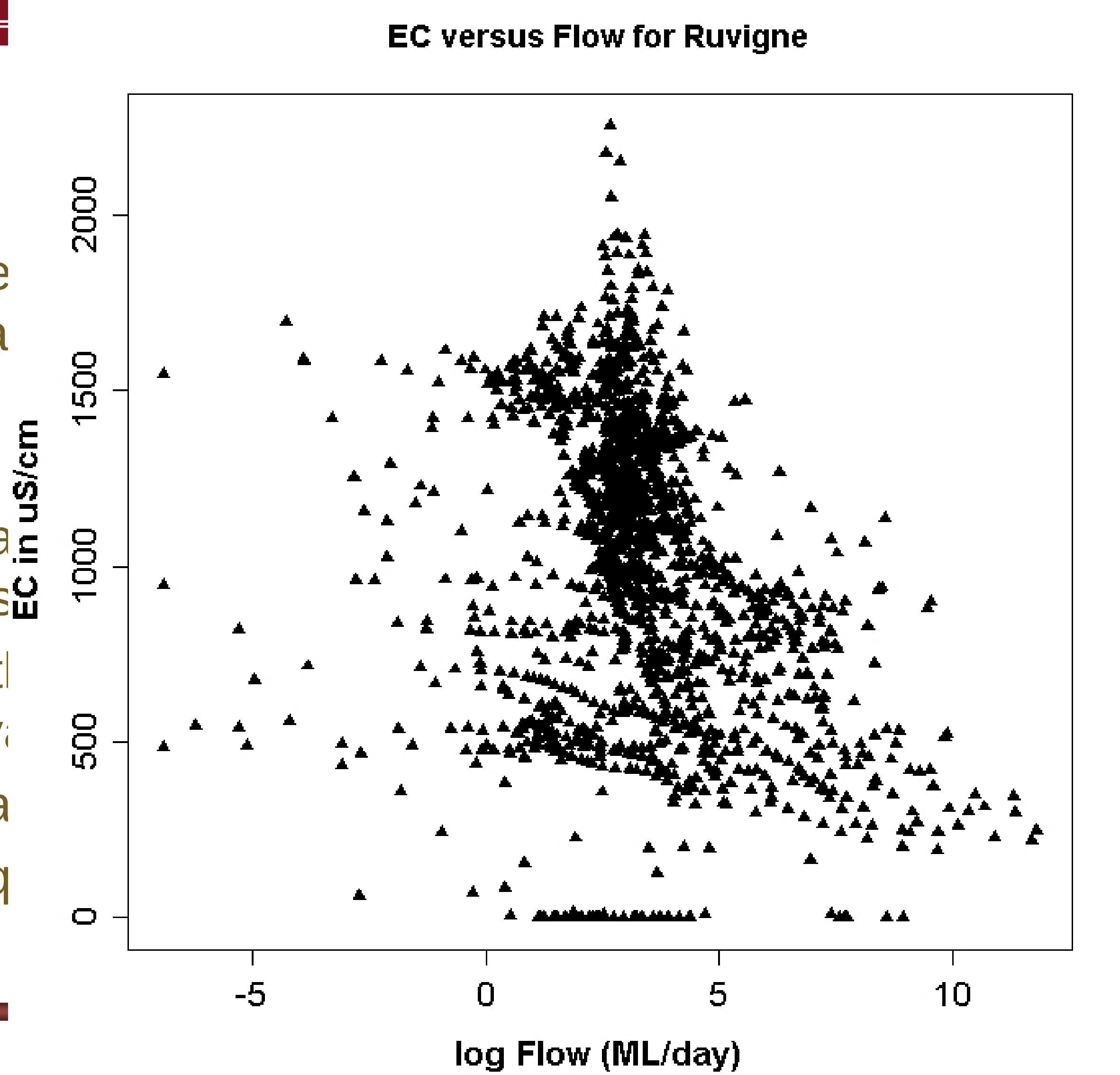

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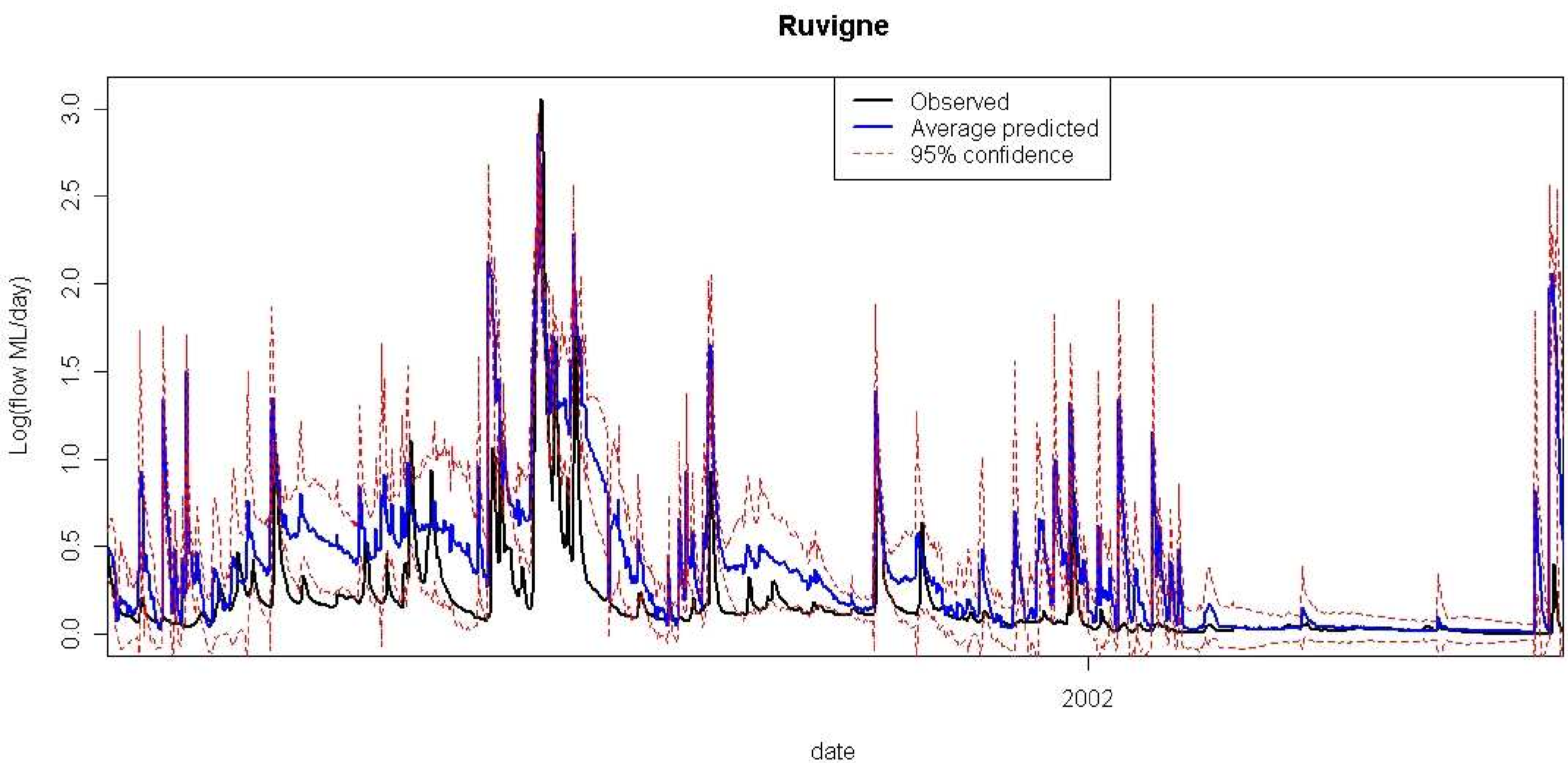
  –
- Ca
  dis
- Ot ... very
  av
- Va ... ught
- Eq ... w for
  all

Equifinality



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?