Use of evaporation and streamflow data in hydrological model calibration

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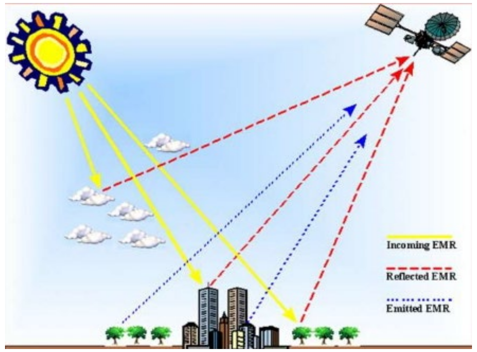
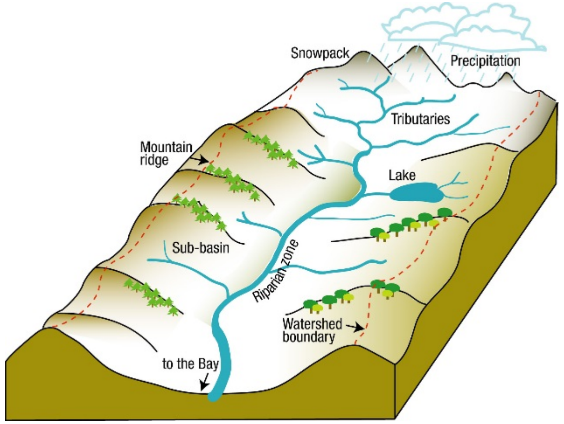
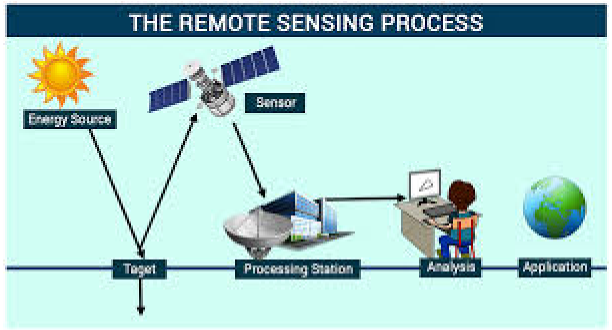


Background

- The conventional method of hydrological model calibration is based on observed streamflow data at catchment outlets.

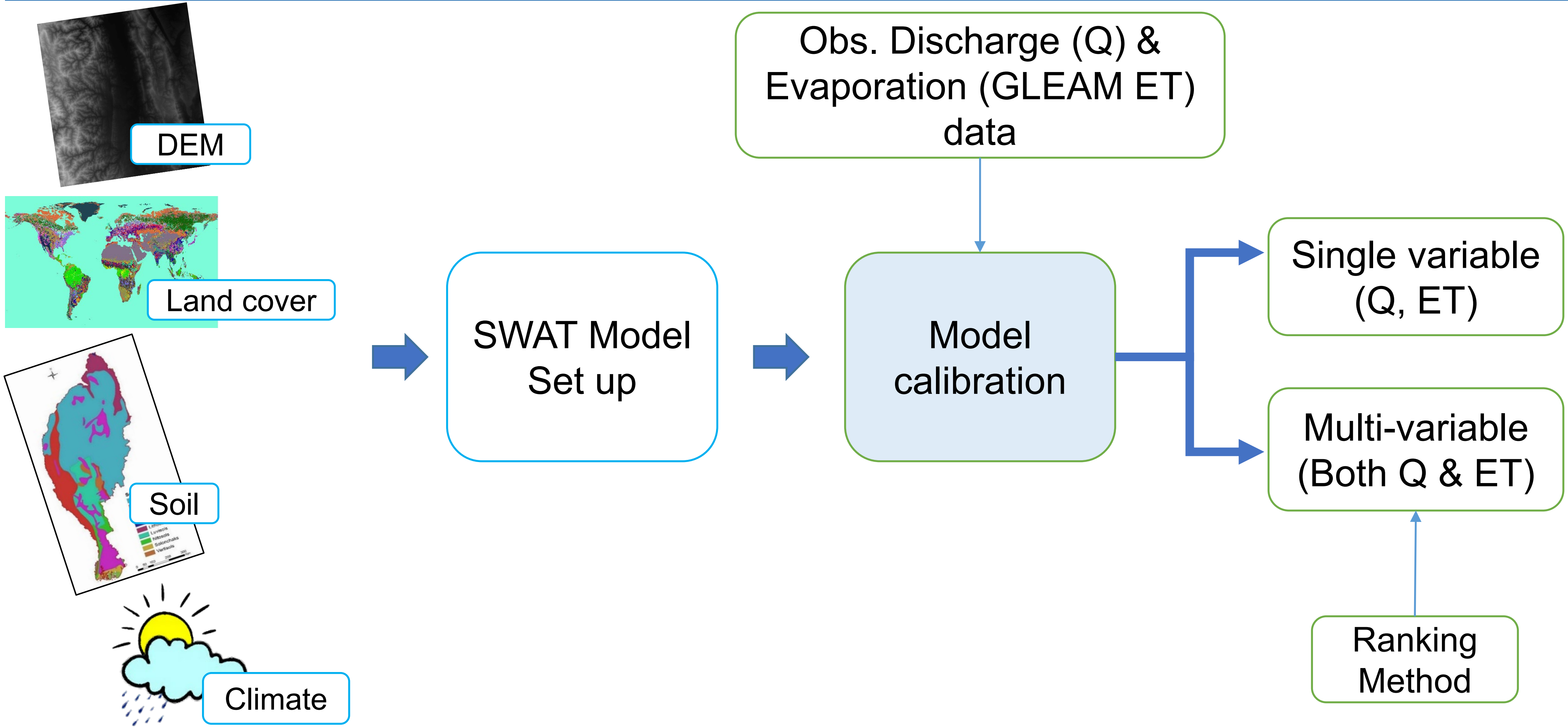
- Nowadays, availability of remote sensing based evaporation data provides additional dataset for hydrological model calibration.





This study illustrates the model performance in Single-variable and multi-variable calibration using evaporation (ET) and streamflow (Q) data.

Approach to model calibration



Study Area

Chindwin River Basin

- Location: Mostly in Myanmar
  Small part of India

  Located in North-western part of Myanmar

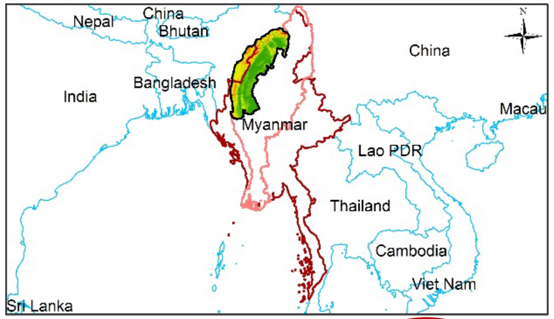
- Total area: 111,000 Km^2

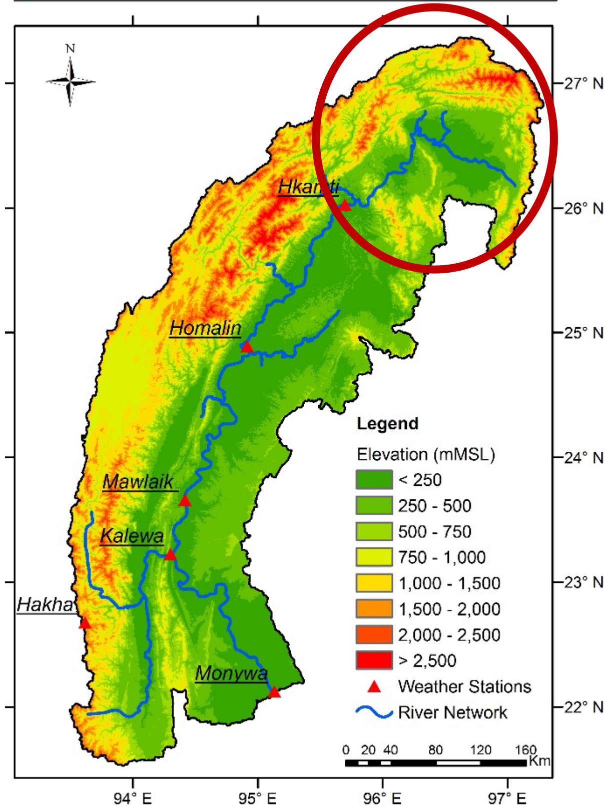
- Main River: Chindwin
  Main tributary of Irrawaddy River

- Avg. Annual Rf: 770 mm – 3900 mm

- Avg. Annual Temp: 21^{o}C

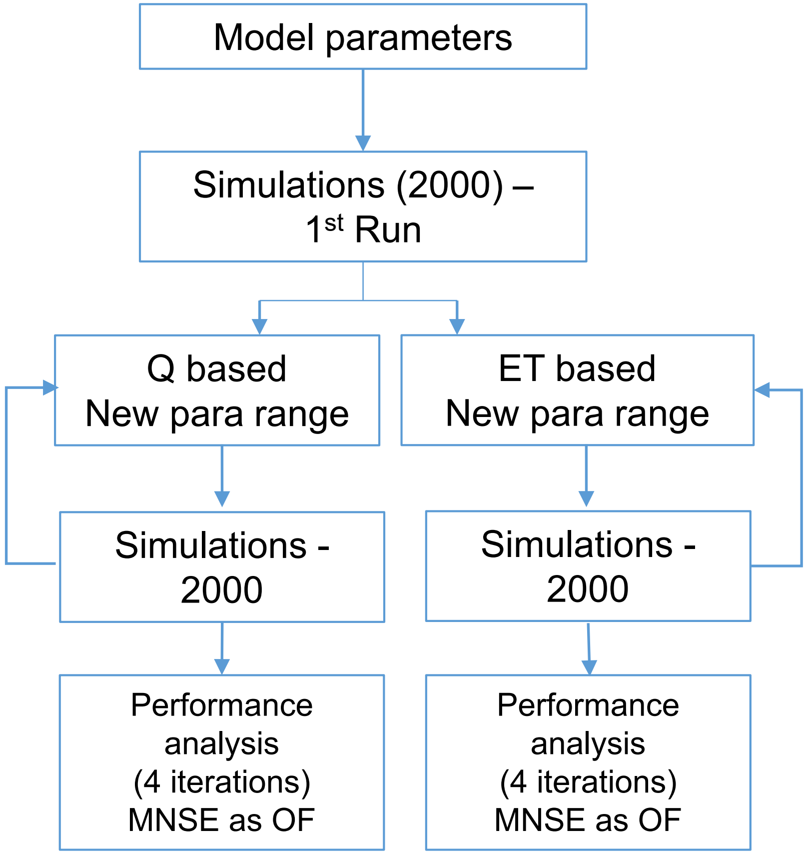
- Land cover: Mostly forest



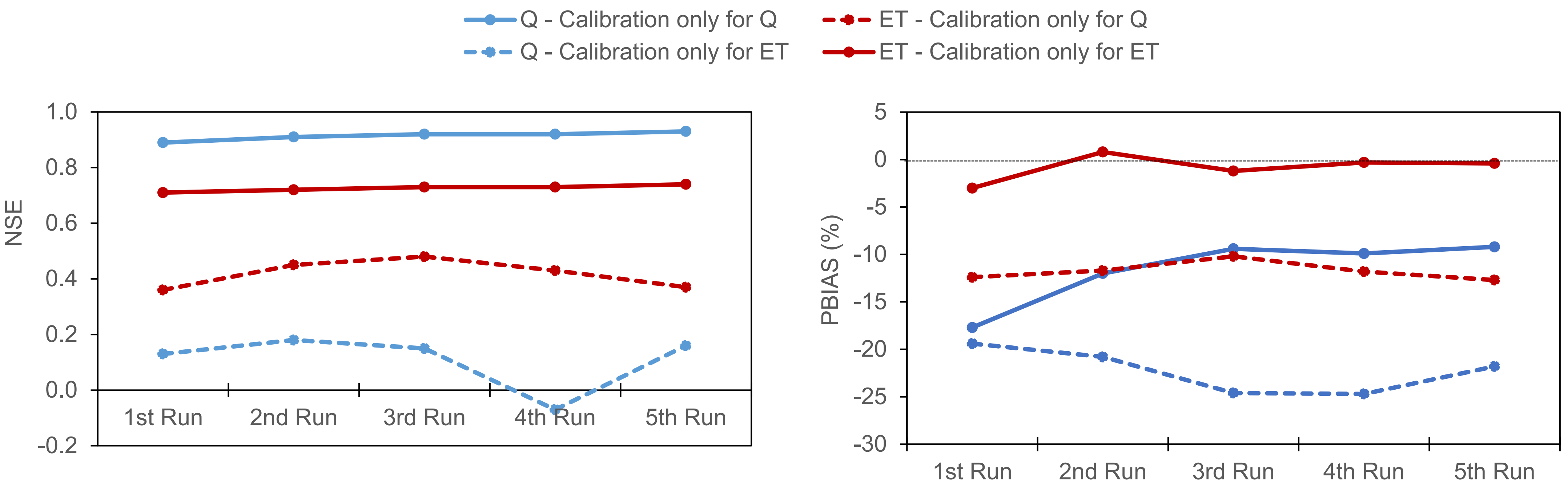


Approach to model calibration with ET & Q

Single variable calibration



Single variable calibration



Calibration with only Q improves the model performance with respect to Q estimates, but with a poor performance with respect to ET estimates and vice versa.

Approach to model calibration with ET & Q

Single variable calibration

Model parameters

Simulations (2000) – 1st Run

Q based
New para range

ET based
New para range

Simulations - 2000

Simulations - 2000

Performance analysis
(4 iterations)
MNSE as OF

Performance analysis
(4 iterations)
MNSE as OF

Combine the total simulations of each iteration
(18,000 simulations)

Multi-variable calibration

Performance of Q and ET
(18,000 simulations)

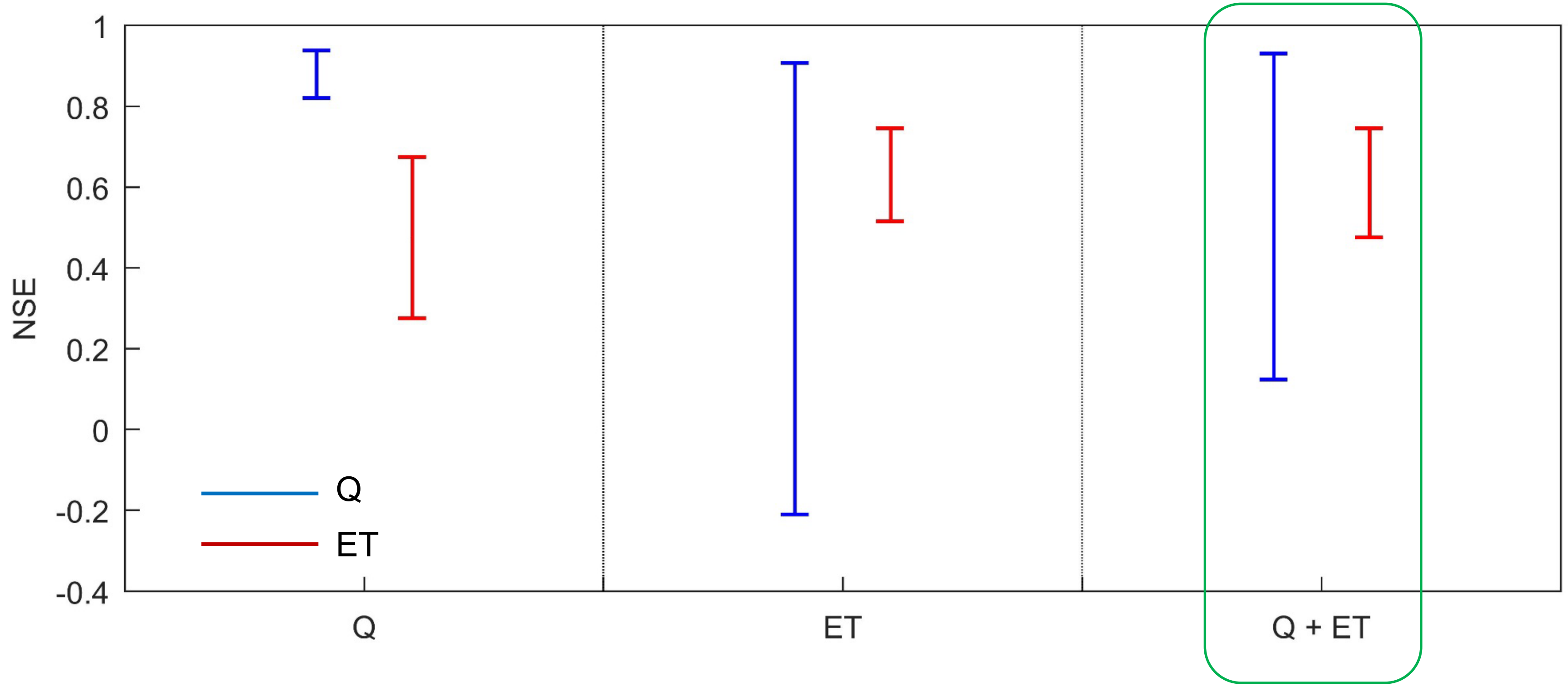
Ranking Method

$$P_r^i = \frac{(N+1) - R_r^i}{N};$$

Extracted from
(Finger et al., 2011)

Multi-variable calibration

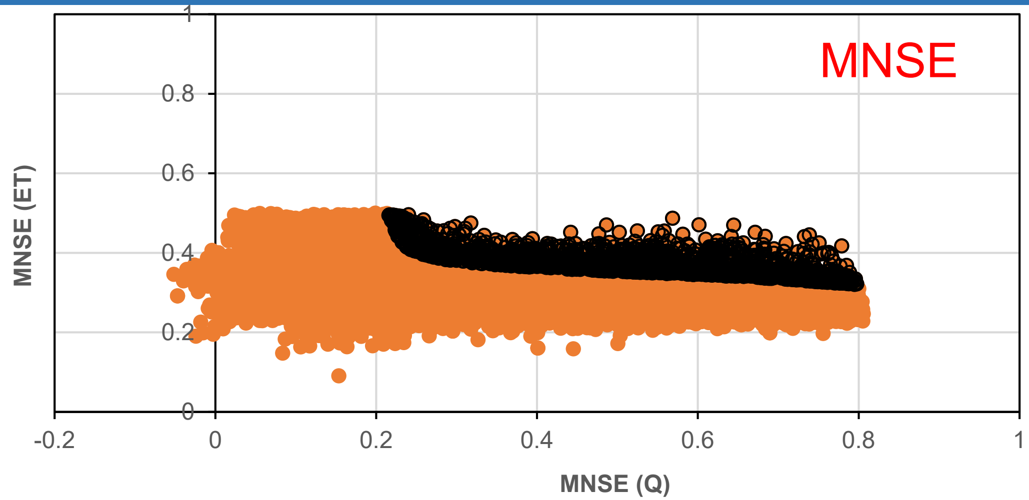
Taking the threshold as 90th percentile of ranking value out of 18000 simulations

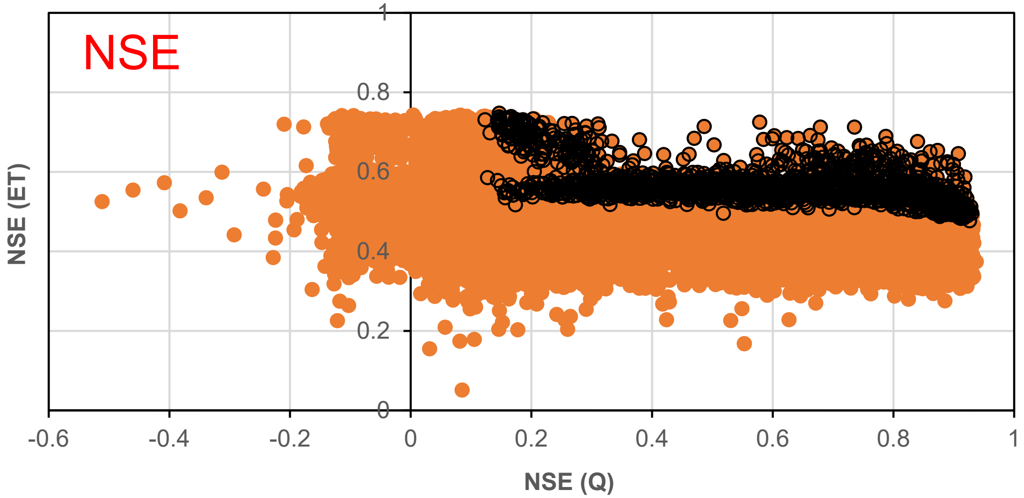


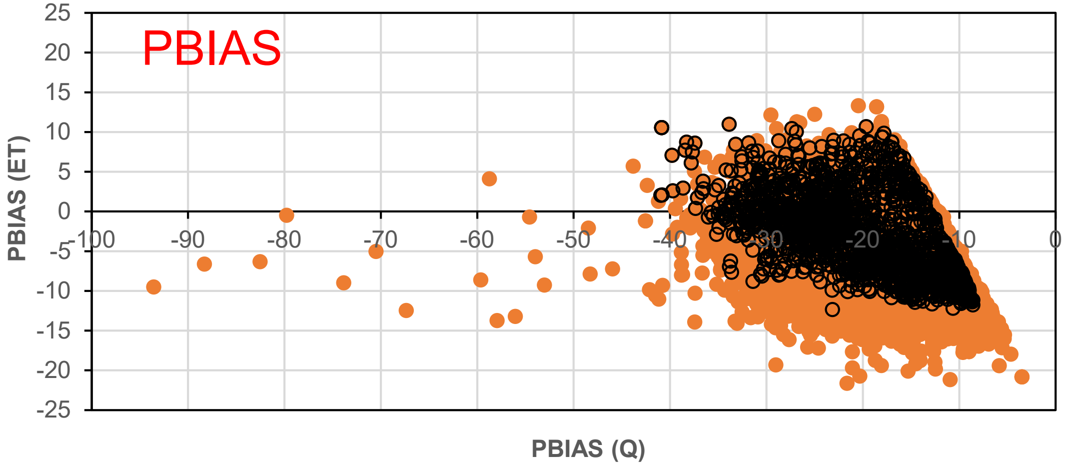
Calibration only with ET results in high variability of Q performance.

Multi-variable calibration – Q+ET

Simulations passes the 90th percentile threshold limits







Approach to model calibration with ET & Q

Single variable calibration

Model parameters

Simulations (2000) – 1st Run

Q based
New para range

ET based
New para range

Simulations - 2000

Simulations - 2000

Performance analysis
(4 iterations)
MNSE as OF

Performance analysis
(4 iterations)
MNSE as OF

Combine the total simulations of each iteration

Multi-variable calibration

Performance of Q and ET
(4000x5 simulations)

Ranking Method

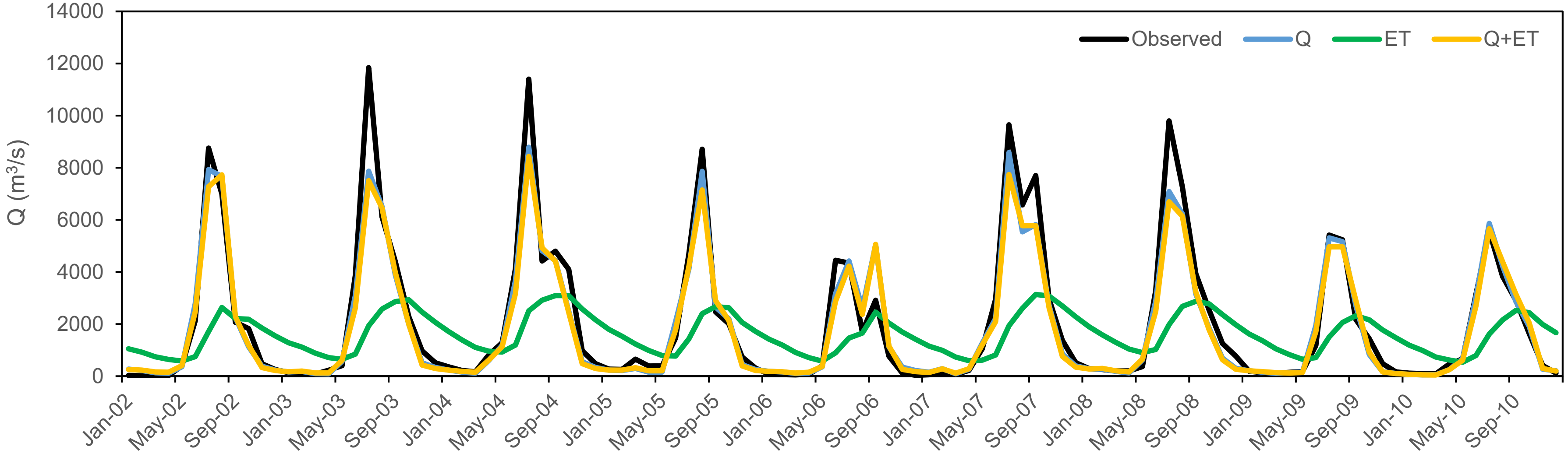
$$P_r^i = \frac{(N+1) - R_r^i}{N}$$

Extracted from
Finger et al., 2011)

90th percentile of each Q and ET

Multi-variable calibration

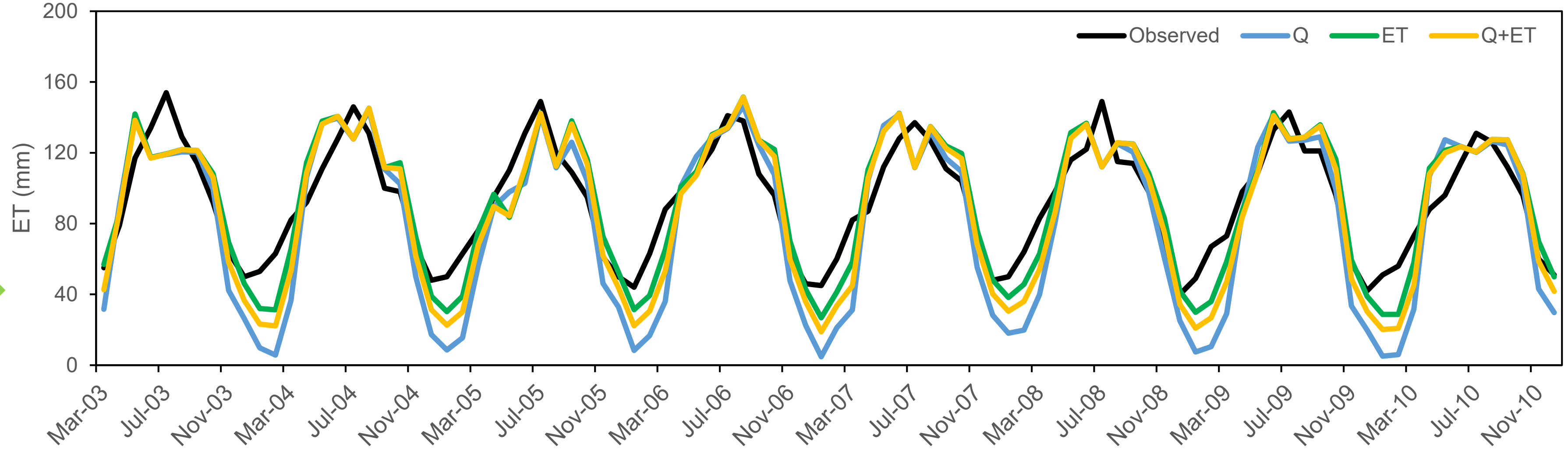
Evaluation Criteria for OF (MNSE)	Q		ET	
	min	max	min	max
	NSE			
Ranking overall MNSE	0.12	0.93	0.48	0.75
90th percentile of MNSE for each Q and ET	0.82	0.91	0.57	0.68
	PBIAS (%)			
Ranking overall MNSE	-40.9	-8.6	-12.3	11.0
90th percentile of MNSE for each Q and ET	-18.6	-10.8	-6.6	6.9



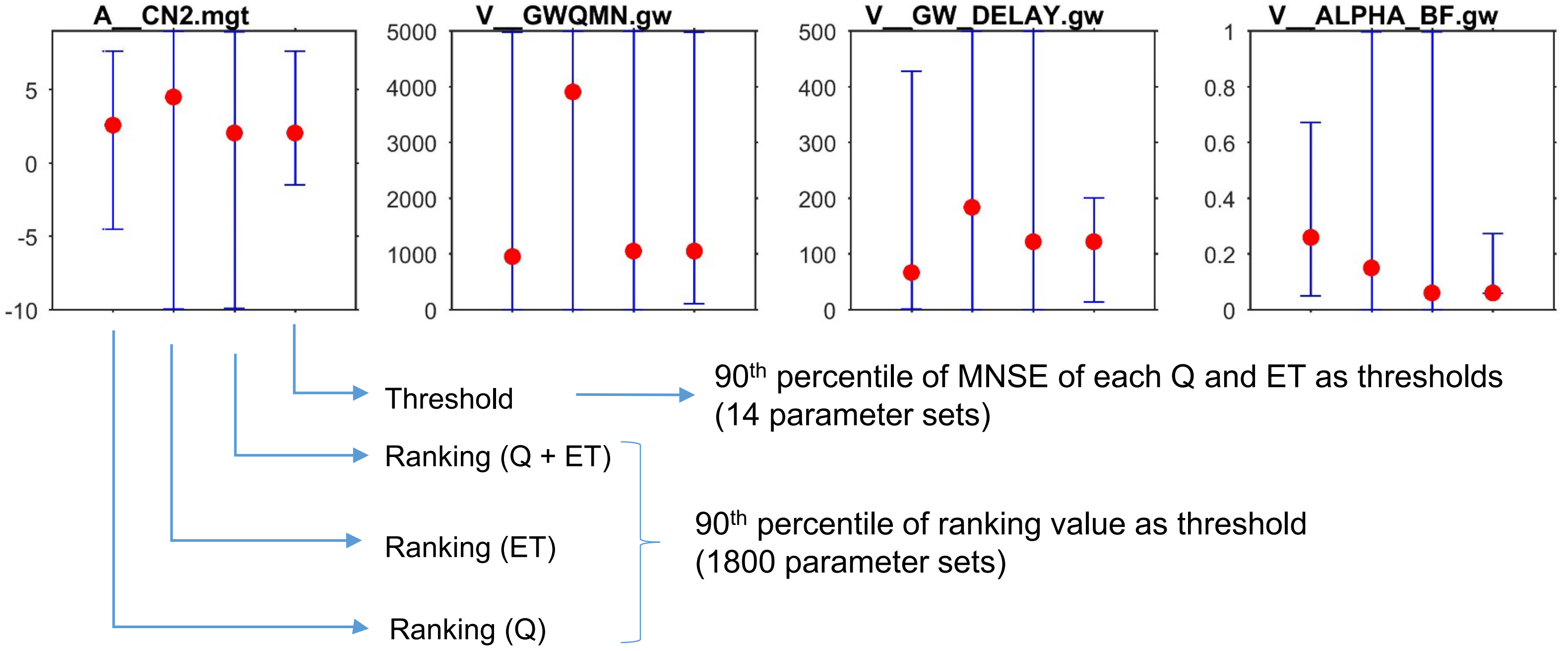
Best Simulations

Discharge

ET



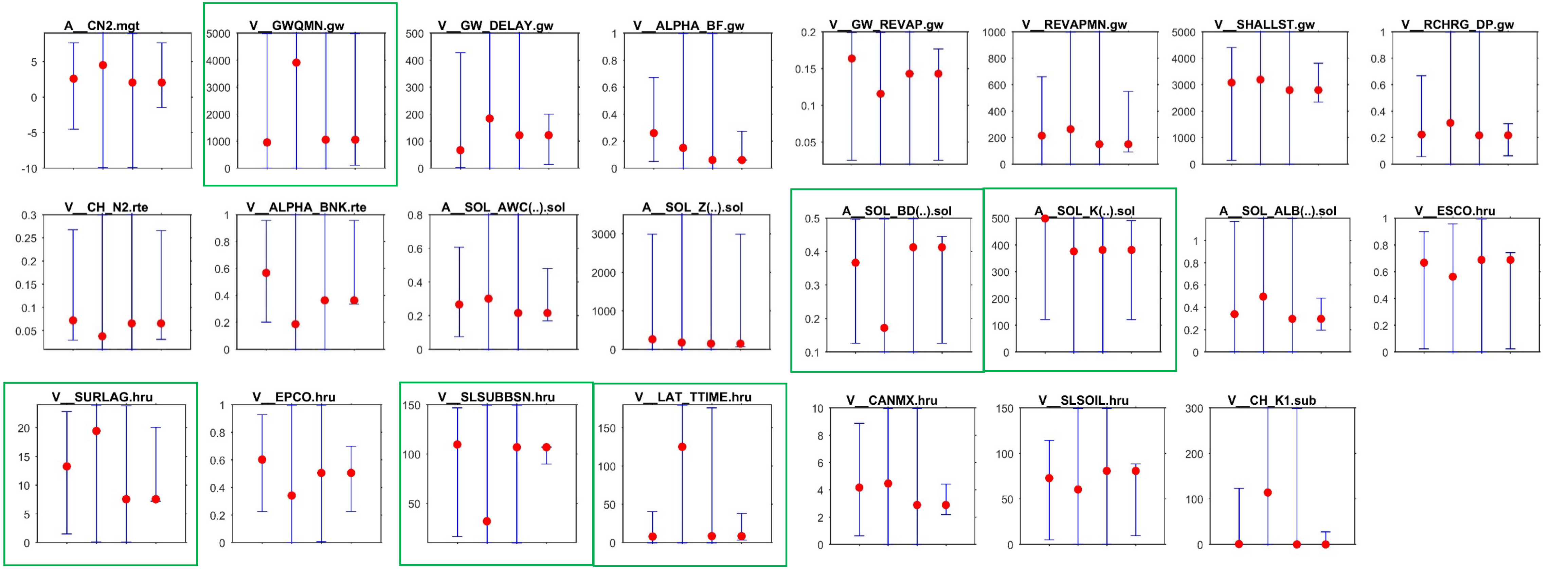
Parameter Space



90th percentile of MNSE of each Q and ET as thresholds (14 parameter sets)

90th percentile of ranking value as threshold (1800 parameter sets)

Parameter Space



No clear pattern emerges to correlate the ranges of the estimated parameters and with evaluation techniques.
Evaluation based on ranking of Q results in minimum parameter space compared to the other three criteria.

Conclusions

- Calibration with only Q improves the model performance with respect to Q estimates, but may be a poor performance respect to ET estimates and vice versa.
- With multi-variable calibration, reasonably good performances can be achieved for both variables (Q and ET).
- Initial thresholds can avoid the presence of low performance of one variable in overall model performance.
- The uncertainty affecting the estimated parameters and their range of variability change when applying different evaluation criteria.

THANK YOU