Improving hydrological model performance by incorporating dynamic variability of parameters

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Background

- The parameters of the model, representing the various physical processes in the watershed, exhibit high seasonal variability
- Disaggregation of the time period and its separate calibration led to improved model performance
- Recombining the best performing discrete periods resulted in better predictions during dry times

Limitations:

- Inadequate physical representation of the hydrological processes on the transition days, while recombining
- The daily variations in soil saturation levels is not accounted effectively
- Static parameter set for a given period may not reflect the watershed hydrology

Research Question

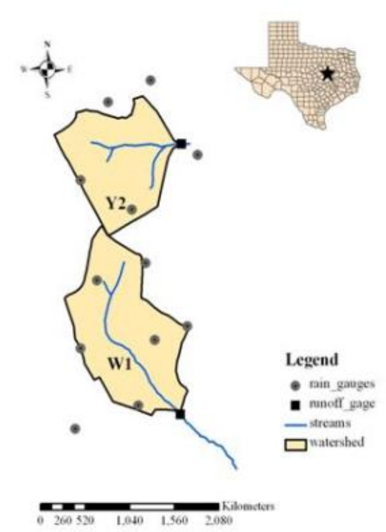
- Can we improve the model simulations if the model parameters are updated along the simulation period by accounting the daily soil moisture conditions?

Research Objective

- To develop a methodology for dynamic updating of parameters based on the prevailing soil moisture conditions

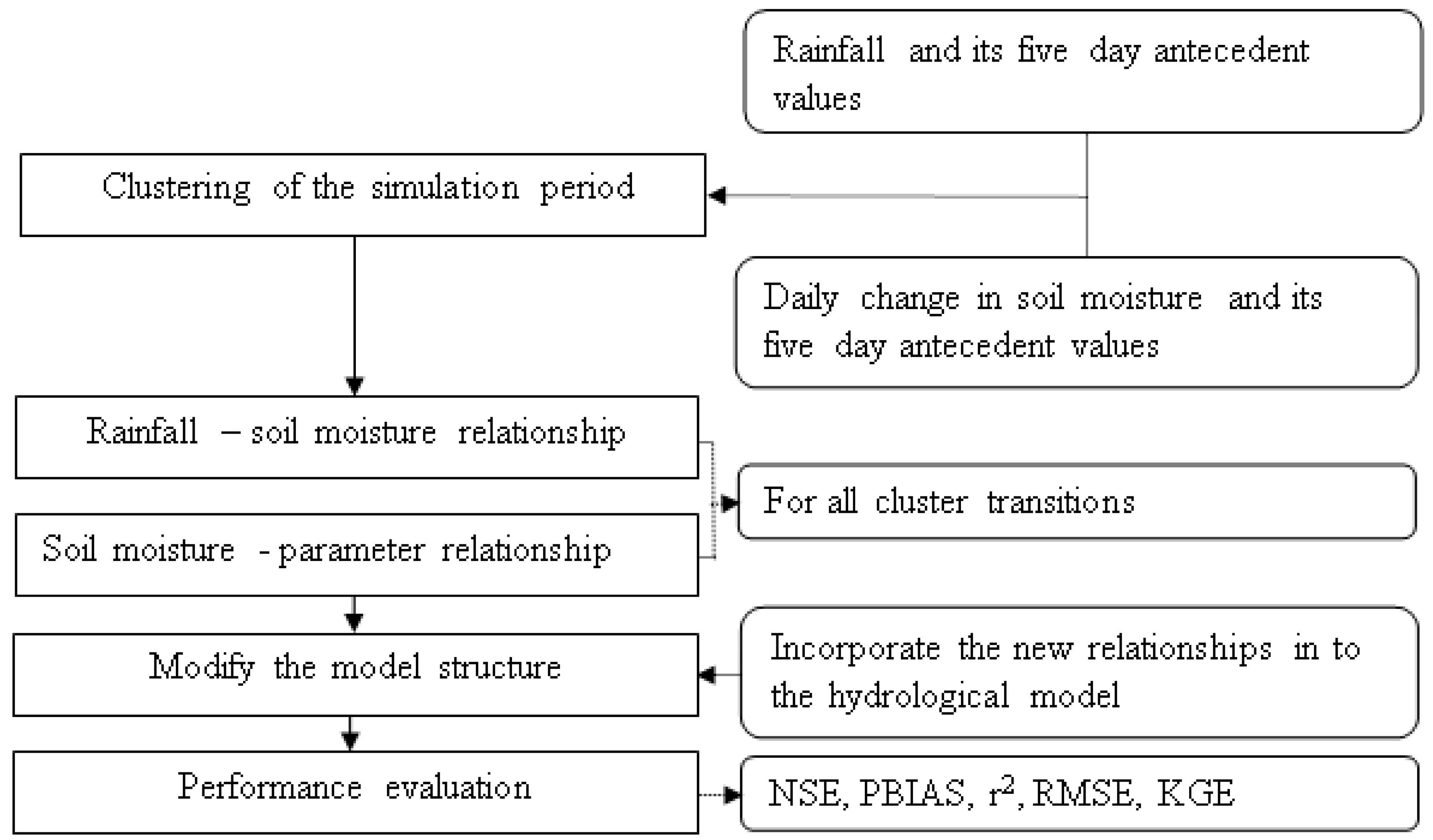
Study area and tools used

- Riesel watersheds W1(70.4 ha) and Y2 (53.4 ha) , TX, USA
- Model set up for 25 years (1991-2015); initial 3 years warm-up
- Grid based distributed hydrologic model with six parameters developed by Vema et al., (2017).
- Gustafson – Kessel (GK) clustering algorithm



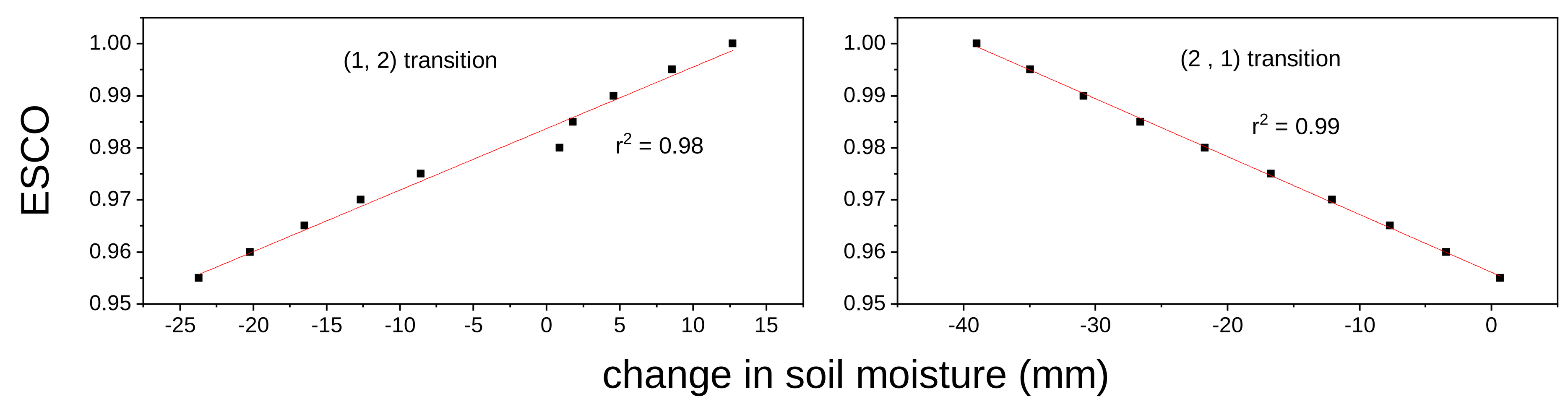
Source: Lan Zhang & V.P. Singh., 2012

Methodology



Flowchart of the proposed methodology

- **GK Clustering** : 12 dimensional data set is used. Unique clustering pattern with no repetitions along the simulation period is obtained. The parameter(s) is updated when the forthcoming day changes from one cluster to another. W1 was clustered into two and Y2 into three clusters
- Parameter **ESCO** is selected for dynamic updating
- Relationships are developed for linking the parameter with soil moisture for different cluster transitions



- Incorporation of the relationship into the model structure and evaluate the performance

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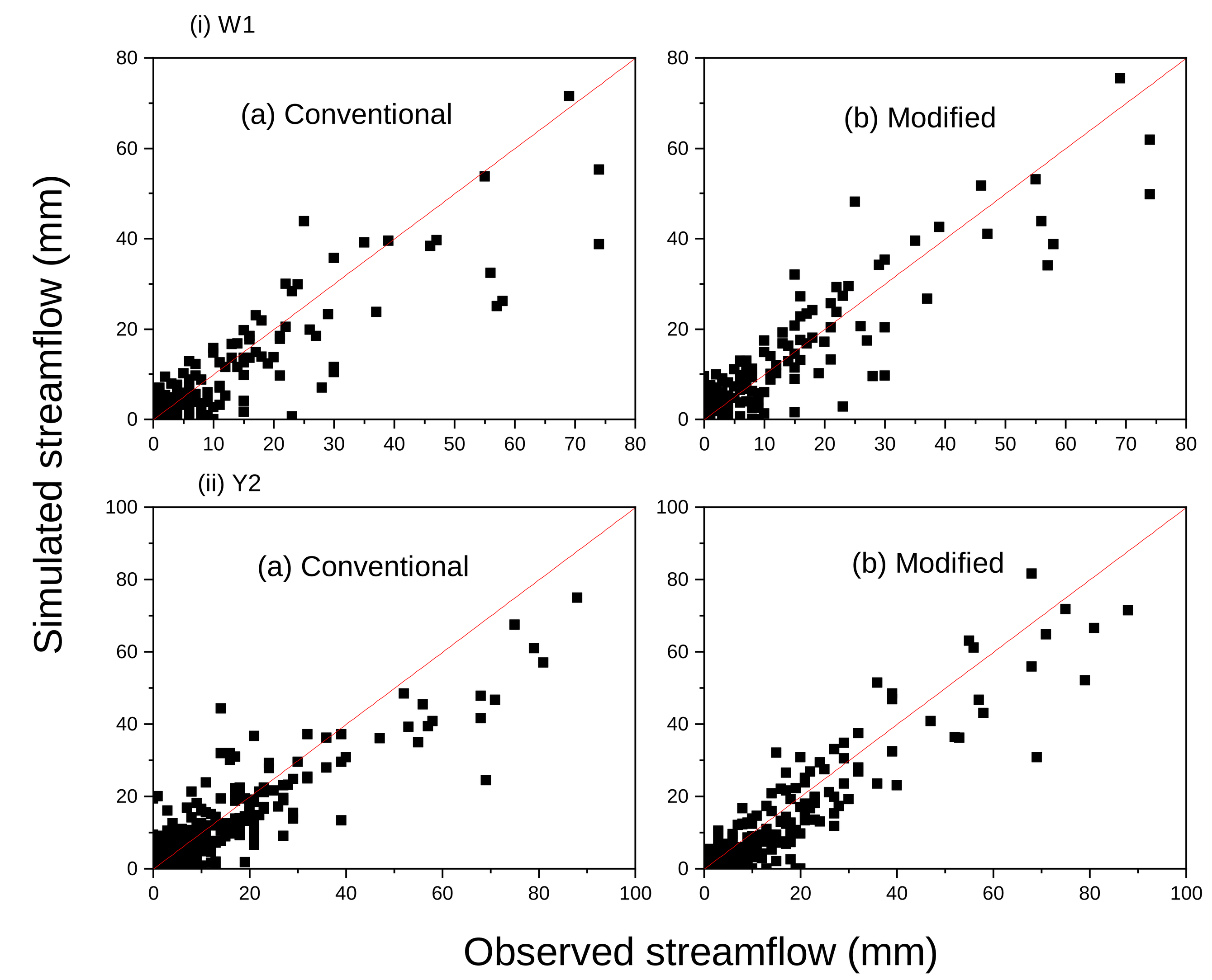
Results

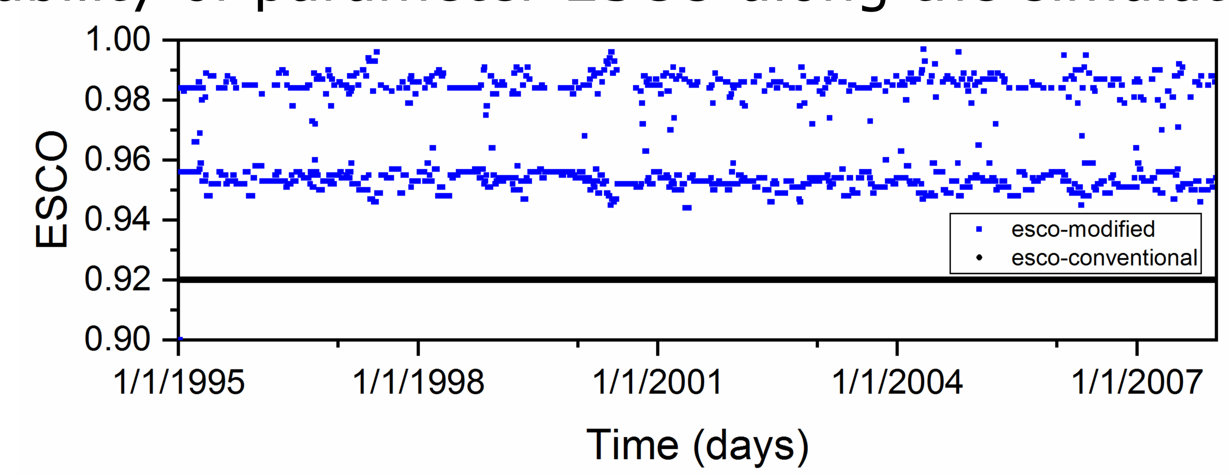
- Performance of the uncalibrated model

		NSE	RMSE (mm)	r^2	PBIAS(%)
Riesel W1	Modified	0.85	1.33	0.86	26.19
	Conventional	0.83	1.39	0.84	-10.06
Riesel Y2	Modified	0.88	1.30	0.89	-29.20
	Conventional	0.84	1.52	0.85	-13.98

Conventional: static parameter set



- Variability of parameter ESCO along the simulation



Conclusions

- The developed methodology is able to simulate the streamflow well
- The variability of the parameter ESCO is dependent on the soil moisture conditions

Vema, V., Sudheer, K.P., Chaubey, I., 2017. Development of a hydrological model for simulation of runoff from catchments unbounded by ridge lines. J. Hydrol. 551, 423–439. https://doi.org/10.1016/j.jhydrol.2017.06.012