EGU2017-14782: Comparison of Bayesian Joint Inference versus Model Conditional Processor approaches for quantification of hydrological uncertainty

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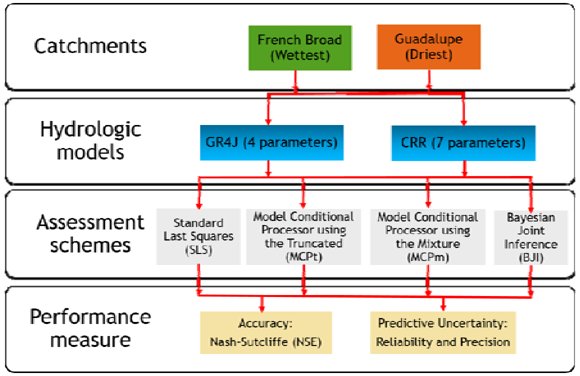
1. INTRODUCTION

- More work needs to be done on quantifying predictive uncertainty to support decision making in water management (Gupta et al. 2014).
- To enhance the reliability and resilience of water resources systems, water management agencies need to work towards improved methods for better incorporating the predictive uncertainty (Kasiviswanathan et al. 2017).

2. METHODS

Empirical analysis are carried out using daily data from two catchments from the Model Intercomparison Experiment (MOPEX) data set using two conceptual rainfall-runoff models, GR4J and CRR. In addition, we used four uncertainty assessment schemes: model conditional processor using the truncated Normal distribution (MCPt) (Coccia & Todini 2011), model conditional processor using the Gaussian mixture (MCPm), Bayesian joint inference (BJI) (Schoups & Vrugt 2010; Hernández-López & Francés 2017) and SLS (figure 1).

Figure 1. Schematic representation of the experimental design.



3. RESULTS

Table 1. Summary of the accuracy and reliability index to quantifying predictive uncertainty.

Performance Measure	French Broad (Wettest)								Guadalupe (Driest)							
	GR4J				CRR				GR4J				CRR			
	SLS	MCPt	MCPm	BJI	SLS	MCPt	MCPm	BJI	SLS	MCPt	MCPm	BJI	SLS	MCPt	MCPm	BJI
NSE E[q/qs]	0.87	0.88	0.92	0.80	0.90	0.90	0.94	0.91	0.46	0.36	0.52	0.40	0.46	0.41	0.40	0.39
Reliability	0.81	0.98	0.97	0.88	0.79	0.96	0.98	0.96	0.65	0.91	0.97	0.89	0.66	0.87	0.97	0.91
Precision	3.13	4.70	6.03	4.40	3.68	5.05	6.46	3.94	0.54	1.34	2.11	1.37	0.55	1.22	3.16	1.51

Figure 2. Transformed observed daily streamflow data against transformed predictions for GR4J model on the Guadalupe River catchment. Representation of the truncated normal joint distribution obtained applying the MCPt (left). Representation of the Normal space obtained applying the MCPm (right).

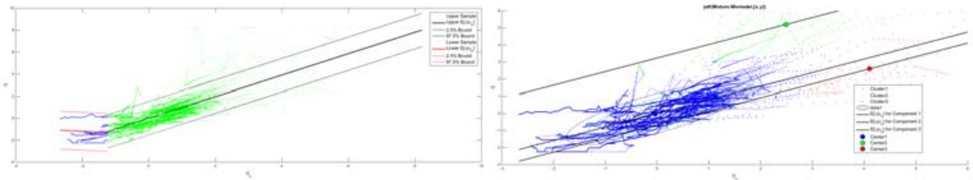
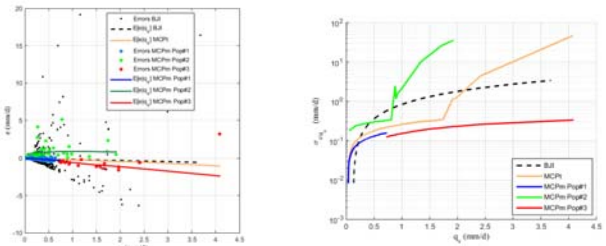
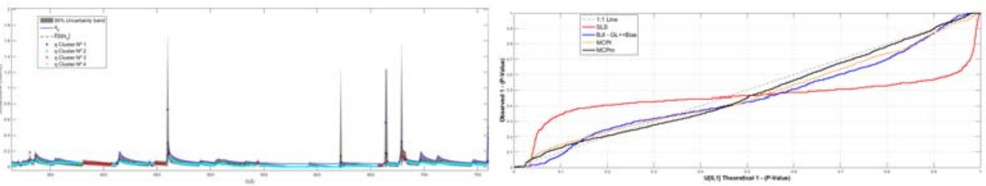


Figure 3. Errors structure comparison between MCP approaches and BJI. Error bias law (left). Error standard deviations law (right).



The MCP approach assumes correct calibration of hydrological models to estimate the predictive uncertainty. While BJI with generalized error model allow estimates parameters and predictive uncertainty at the same time.

Figure 4. Predictive uncertainty for GR4J model on the Guadalupe River catchment. Time series of observations (dots) and 95% total prediction uncertainty bands (left). PP-Plots of the predictive distribution for all performed (right).



4. CONCLUSIONS

- Results demonstrate that the predictive distribution are more accurate and reliable after model conditional processor using the Gaussian mixture (MCPm).
- Bayesian joint inference (BJI) has acceptable performance because the hypothesized error model is not the most suitable for the analyzed case study.
- The model conditional processor (MCP) approach provide more insight into the error structure.

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