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Comparison of the GLUE and DREAM methods for estimating cultivar parameters for a maize crop model

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Abstract: Process-based crop models are popular scientific tools to study the impacts of environment, variety and management decisions on crop growth. Some cultivar parameters in crop models cannot be measured directly and need to be estimated. In this research, two Bayesian methods, namely the generalized likelihood uncertainty estimation (GLUE) and Differential Evolution Adaptive Metropolis (DREAM) algorithm, were used to estimate the parameters of the maize module of the Agricultural Productions Systems sIMulator (APSIM-Maize) for the first time. Six cultivar parameters of APSIM-Maize were estimated using GLUE and DREAM, respectively. Both the GLUE and DREAM methods were able to give accurate simulations of yield in the theoretical evaluation. But in the real-world evaluation, the GLUE method performed better than DREAM method in both the calibration and validation period. The posterior density distributions of variety parameters obtained by DREAM were more sharp and narrow than those obtained by GLUE, and the standard deviations were much smaller. For the simulated yield uncertainty, the 95% confidence intervals calculated by GLUE were wider than DREAM method. The performance of DREAM was not stable. Using DREAM method, some estimated parameters were close to the initially defined “true parameter values”. But some other parameters (e.g. photoperiod_slope) had very large biases to “true parameter value”. For the GLUE method, all estimated parameters had relative stable biases to “true parameter value”. These results suggested that the GLUE method is more suitable for estimating varieties parameters of APSIM-Maize than the DREAM method.

***Keywords**:* APSIM; GLUE; DREAM; maize