Uncertainty in a monthly water balance model using the generalized likelihood uncertainty estimation methodology

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Abstract

Hydrological models are simplified representations of natural processes and subject to errors. Uncertainty bounds are a commonly used way to assess the impact of an input or model architecture uncertainty in model outputs. Different sets of parameters could have equally robust goodness-of-fit indicators, which is known as Equifinality. We assessed the outputs from a lumped conceptual hydrological model to an agricultural watershed in central Chile under strong interannual variability (coefficient of variability of 25%) by using the Equifinality concept and uncertainty bounds. The simulation period ran from January 1999 to December 2006. Equifinality and uncertainty bounds from GLUE methodology (Generalized Likelihood Uncertainty Estimation) were used to identify parameter sets as potential representations of the system. The aim of this paper is to exploit the use of uncertainty bounds to differentiate behavioural parameter sets in a simple hydrological model. Then, we analyze the presence of equifinality in order to improve the identification of relevant hydrological processes. The water balance model for Chillan River exhibits, at a first stage, equifinality. However, it was possible to narrow the range for the parameters and eventually identify a set of parameters representing the behaviour of the watershed (a behavioural model) in agreement with observational and soft data (calculation of areal precipitation over the watershed using an isohyetal map). The mean width of the uncertainty bound around the predicted runoff for the simulation period decreased from 50 to 20 m3s(-1) after fixing the parameter controlling the areal precipitation over the watershed. This decrement is equivalent to decreasing the ratio between simulated and observed discharge from 5.2 to 2.5. Despite the criticisms against the GLUE methodology, such as the lack of statistical formality, it is identified as a useful tool assisting the modeller with the identification of critical parameters.

Keywords

Author Keywords: Monthly water balance; Uncertainty; Generalized likelihood uncertainty estimation methodology

KeyWords Plus: GLUE METHODOLOGY; EQUIFINALITY; PREDICTION; INCOHERENCE; CALIBRATION; SIMULATION