Geophysical Research Abstracts
Vol. 17, EGU2015-5178, 2015
EGU General Assembly 2015

Maximising diagnostic information by relating temporal variations in parameter sensitivity to different segments of the flow duration curve

Björn Guse (1), Matthias Pfannerstill (1), Michael Strauch (2), Dominik Reusser (3), Martin Volk (2), and Nicola Fohrer (1)

(1) Christian-Albrechts-University of Kiel, Institute for Natural Resource Conservation, Department of Hydrology and Water Resources Management, Kiel, Germany (bguse@hydrology.uni-kiel.de, (2) UFZ-Helmholtz Centre for Environmental Research, Department of Computational Landscape Ecology, Leipzig, Germany, (3) Potsdam Institute for Climate Impact Research, Potsdam, Germany

Parameter sensitivity analysis is a well-known method to detect the most relevant parameters to reproduce the modelled discharge. In contrast to classical approaches, a temporally resolved analysis provides daily sensitivities and detects dominant model parameters for each time step. Relating the dominant parameters to the corresponding processes enables the investigation of the process relevance in a high temporal resolution and thus, improves the understanding of the dominant processes in the model structure. For this, we used a Fourier Amplitude Sensitivity Test (FAST) which is efficient compared to other sensitivity test by requiring only a small number of 315 model runs for nine model parameters.

In order to maximize the diagnostically relevant information with low computational demand, the interpretation of the temporal resolved parameter analysis is extended by extracting additional information. We present a model framework consisting of three steps, which was applied to a lowland and a upland catchment in Germany to check its plausibility in two hydrological contrasting catchments. The results of one temporal sensitivity analysis are used in an efficient way to provide three different visualization types with a different focus and aggregation levels.

In a first step, the temporal dynamic is analysed in a high resolution with daily time series of parameter sensitivities (TEDPAS). TEDPAS detects the temporal variations in dominant model parameters. Secondly, these results are related to the flow duration curve (FDC) (TEDPAS-FDC) to identify parameter dominances in relation to discharge magnitudes. TEDPAS-FDC emphasizes that high sensitivities of model parameters are related to certain discharges. These relationships are explained by looking at the role of the parameters in the model concept. Thirdly, the parameter sensitivities are monthly averaged and investigated separately for five segments of the FDC (TEDPAS-FDC PATTERN) to detect typical monthly process patterns. The joined analysis of monthly averaged sensitivities for all parameters provides an efficient way to identify temporal variations of parameter sensitivities. For each FDC segment, a typical sequence of parameter dominances is derived. The results of TEDPAS-FDC PATTERN show that the groundwater parameters control the discharge dynamic in the lowland catchment. By contrast, the dominances of fast and slow runoff components change in the upland catchment during the year for different discharge magnitudes. Thus, TEDPAS-FDC PATTERN leads to a clear and easily interpretable visualization of temporal patterns, capturing efficiently the typical characteristics of the study catchments.

The relation of temporal parameter sensitivity analysis with discharge magnitudes under consideration of the seasonal dynamics in these three model diagnostic methods leads to a profound overall impression of the hydrological dynamics during the year. Due to the improved understanding of temporal dynamics for the investigated model parameters, the role of model parameters are easily identified and can be constrained in model calibrations.