Geophysical Research Abstracts
Vol. 17, EGU2015-1065, 2015
EGU General Assembly 2015
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A framework for the verification of process dynamics with temporal parameter sensitivity analysis

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To ensure reliable results of a hydrological model for decision-making and case studies, it is essential that the applied model reproduces the hydrological processes adequately. The process dynamic is investigated by a model structure diagnosis which provides temporal sensitivities of the corresponding model parameter. For this, the temporal dynamics of parameter sensitivity are used to describe the dominance of parameters for each time step. The parameter dominance is then related to the corresponding hydrological process by assuming that the temporal parameter sensitivity represents the modelled hydrological process. For a reliable model application it has to be verified that the modelled hydrological processes match the expectations of the real-world. This verification of proper process dynamic is analysed with a model structure diagnosis.
We demonstrate such verifications with a model diagnosis framework which distinguishes between a verification of single model components and of the overall model behaviour. We apply the analysis of temporal dynamics of parameter sensitivity on a modified groundwater component of a hydrological model to evaluate the appropriateness of these structural modifications. The results of the single analysis for the modified component show that the behaviour for the parameters of the analysed component is consistent with the idea of the model structure modifications. Additionally, the appropriate simulation of all relevant hydrological processes is verified as the temporal dynamics of parameter sensitivities represent these processes according to the expectations. Thus, we conclude that temporal dynamics of parameter sensitivity are helpful for verifying hydrological models, which were modified to overcome structural model errors.