Sensitivity Analysis and Parameter Estimation of a Land Surface Model: SIB2

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Background and Aim: As Land Surface Models (LSMs) have become more complex, the number of parameters that must be estimated has significantly increased. This paper represents the utility of applying multi-criteria methods to parameter sensitivity analysis in order to evaluate and improve the ability of Simple Biosphere Model (SIB2) to simulate the land surface energy and water balance, and the temperature and water content of the soil. It is important to find sensitive parameters in order to reduce parameter dimensionality and model calibration costs.
Methods: A multi-criteria algorithm, Multi-Objective Generalized Sensitivity Analysis (MOGSA), was used to investigate the parameter sensitivity of the SIB2 model at Lindenberg reference site located in the Europe. The Shuffled Complex Evolution (SCE-UA) and the Shuffled Complex Evolution Metropolis (MOSCEM-UA) algorithms developed at the University of Arizona were used for single and multi-objective minimization cases respectively for estimation of some sensitive soil-vegetation related parameters.
Results: The Sensitivity analysis of the SIB2 shows that most of sensitive parameters are related to soil thermal and hydraulic properties. The MOGSA is very useful method to specify sensitive model parameters. The MOSCEM-UA is more effective than the SCE-UA approach for parameter estimation and improvement of model performance.
Discussion and Conclusions: Multi-criteria methods for parameter sensitivity analysis and the SCE-UA and the MOSCEM-UA algorithms are efficient, effective, robust and easy to use with modern land surface schemes and hydro-meteorological models. Through the appropriate estimation of sensitive model parameters, it is possible to improve model performance.
Suggestions The source code of the SCE-UA and the MOSCEM-UA algorithms is available on the website of the University of Arizona. These advanced approaches can be applied for calibration of hydrological models in basins with enough observed or satellite data.