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Judgement of the relatively sensitive and important physical parameters with an intermediate complexity vegetation model

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The parameters errors in numerical models are an important source of the uncertainty in the simulation and prediction of weather and climate event. However, it is costly to reduce all parameters errors in the numerical models through observation data. A new theoretical framework is advanced to determine the most sensitive and important parameters among all parameters. In the study, it is explored how to identify the most sensitive and important physical parameters to implement the key part of the theoretical framework using a numerical model. A Lund-Potsdam-Jena (LPJ) dynamic global vegetation model, which is regarded as an example and could describe land process of a weather and climate numerical model, is employed to validate the key part of the theoretical framework. To find the most sensitive and important parameters, the approach of conditional nonlinear optimal perturbation (CNOP) is applied because the approach could consider the nonlinear interaction among parameters. It was found that the most important subset of parameters in the arid and semi-arid regions China was different to those in northern, northeastern and southern China. The results imply that the nonlinear interaction among parameters plays a key role in the uncertainty of numerical simulation in arid and semi-arid regions of China. The uncertainties in the numerical simulation were reduced considerably through reducing the errors of the subset of relatively more sensitive and important parameters compared to other types of parameter errors in these regions. The results based on the LPJ model demonstrate that our approach not only offers a new route to identify relatively more sensitive and important physical parameters, but also that it is viable to then apply “target observations” to reduce the uncertainties in model parameters.