



## **Evaluating uncertainties in the simulated soil carbon in China using a nonlinear method**

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In this study, we explored the maximal uncertainties in the simulated soil carbon in part of China to climate change, including variations in climatology and climate variability, under the condition of global warming. A conditional nonlinear optimal perturbation (CNOP) approach was employed to discuss the above issue to a CNOP-type temperature or precipitation perturbation using the Lund-Potsdam-Jena (LPJ) model. These uncertainties in the simulated soil carbon were compared with those caused by a linear temperature or precipitation perturbation. The key difference between the CNOP-type and the linear perturbations was whether the perturbations brought the variation in the temperature or the precipitation variability in comparison with the reference temperature or the precipitation variability. The model results demonstrated that the uncertainties in the simulated soil carbon resulted from the CNOP-type and linear temperature perturbations in south of the study region, which was corresponding to part of South China, had different variations. In the part of South China, the soil carbon was augmented because of the CNOP-type temperature perturbations, and the variation in the soil carbon because of the linear temperature perturbations was minor. In northeast of the study region, which was corresponding to part of Northeast China, the soil carbon increased, whereas the soil carbon decreased in north of the study region, which was corresponding to part of North China and is located in arid and semi-arid regions in China, due to two kinds of temperature changes. The uncertainties in the simulated soil carbon caused by the two types of precipitation perturbations were similar. In the arid and semi-arid regions, the soil carbon increased due to the two types of precipitation perturbations. This research implies that the variation in temperature variability plays a crucial role in the uncertainties in the simulated soil carbon and its components in the study region.