Geophysical Research Abstracts
Vol. 13, EGU2011-5213, 2011
EGU General Assembly 2011

Investigating nonlinear variations in the soil carbon by the Lund-Potsdam-Jena model in China

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In this study, the approach of conditional nonlinear optimal perturbation (CNOP) is employed to discuss the nonlinear variations in the soil carbon owing to nonlinear temperature and precipitation perturbations in China using the Lund-Potsdam-Jena (LPJ) model. The variations are compared with those caused by linear temperature and precipitation perturbations. The model results show that there are similar characters about the variations in the soil carbon due to two types of temperature perturbation in Northeast and North China. In Northeast China, the soil carbon increases, and in North China, the soil carbon decreases, especially in the arid and semi-arid regions. However, in South China, the soil carbon is augmented due to the CNOP-type temperature perturbation, and the variation in the soil carbon due to the linear temperature perturbation is minor. In terms of three components of the soil carbon in the LPJ model: fast decomposing soil carbon, slow decomposing soil carbon and litter in the below ground, their variations are different due to two types of temperature perturbation. The reduction in litter in the below ground may be main reason about the decreasing of the soil carbon in arid and semi-arid regions. The major difference derived from two types of temperature perturbation in South China may lie in the variations in fast decomposing soil carbon. The variations in the soil carbon caused by the two types of precipitation perturbation are similar. The researches imply that the CNOP approach is a potential tool to reveal the nonlinear response of the soil carbon to climate change.