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Exploring seasonal variation characters on the net primary production by conditional nonlinear optimal perturbation in China

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In this study, we use the approach of conditional nonlinear optimal perturbation (CNOP) to investigate the seasonal variations in the net primary production (NPP) due to nonlinear temperature and precipitation perturbations in China. A state-of-the-art Lund-Potsdam-Jena (LPJ) model is applied. The CNOP-type temperature or precipitation perturbation leads to interannual variations in comparison with the original temperature or precipitation condition. The seasonal variations in the NPP caused by the CNOP-type perturbation are compared with those by the linear type perturbation without interannual variations. The model results show that in North China and Northeast China, there are similar variation characters caused by the CNOP-type and linear type temperature perturbations during four seasons. In South China, the variations are analogous in spring and summer. However, in South China, the NPP caused by the CNOP-type temperature perturbation increases in autumn and winter, the variation in the NPP caused by the linear type temperature perturbation is minor. A possible reason is that the CNOP-type temperature perturbation restrains the autotrophic respiration in South China, while the linear type temperature perturbation fails within the LPJ model. There are similar results about the seasonal variations due to different types of precipitation perturbation. The numerical results suggest that the CNOP approach is a potential tool to explore the seasonal variations on the terrestrial ecosystem.