



Quantitative assessment of ecosystem vulnerability to global warming: methodology and application in China

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Understanding how ecosystem vulnerability in response to climate change is generated and distributed is an important topic; however, quantitative assessments of the vulnerability process remain relatively rare. The Intergovernmental Panel on Climate Change (IPCC) regards ecosystem vulnerability as sensitivity or susceptibility to harm, lacking the capacity to cope and adapt. Sensitivity refers to the degree to which the ecosystem could be affected by climatic factors, whereas adaptability is considered a measure to maintain a stable system. Through analysis of the concept of vulnerability, we propose a response-based quantitative method to assess ecosystem vulnerability, integrating the concepts of sensitivity and adaptability. This method was applied to assess ecosystem vulnerability in China from 1981 to 2050. The results indicated that vulnerability would develop in nearly 30% of the terrestrial ecosystems of China. Vulnerability would be severe in the desert and grassland ecosystems, distributed mainly in the Tianshan Mountain and the Inner Mongolia Plateau. As the effects of sensitivity and adaptability differ, obvious regional differences exist between the ecosystem vulnerability zones in China. For example, the effects of climate warming would be severe in the Loess Plateau, with vulnerability caused mainly by high sensitivity, whereas vulnerability in the subtropical region would be caused mainly by low adaptability. Compared with previous research, our method emphasizes the critical role of adaptability, which enhances the scientificity and reasonableness of assessing ecosystem vulnerability, and enriches the methodology adopted under the IPCC framework. However, as we did not consider fully the autonomous adaptation mechanism in ecosystem vulnerability, this aspect should be combined with other factors in future study.