Global desert expansion over the 21st century: patterns, predictors and signals

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Abstract

Desert expansions can cause tremendous losses to human well-being. However, the process of shifting from the non-desert state to the desert state, a representation of a system regime shift, remains unclear on the global scale. Clarifying the underpinning pattern, predictors and signals of this process is of great value in advancing understanding of both ecosystem resilience and sustainable developments. Here, we combine the climate classification map and long-term observational land cover data to assess the global desert distribution and its changes from 2000 to 2019. The identified desert areas cover approximately 7.53% of the global land in the past two decades. Only approximately 16.03% of these deserts shows expanding trends, especially in countries such as Tunisia, Tajikistan and Peru. After assessing 26 climatic, ecological and socioeconomic factors that could potentially modify desert expansion rates, vegetation cover diversity was identified as the strongest predictor in both hot and cold deserts, followed by cattle density in hot deserts and desert size in cold deserts. In addition, pronounced high fluctuation in satellite vegetation productivity and flickering between land cover states could serve as two signals for desert conversion and fast expansion, respectively. Our results provide not only a long-term overview of global desert changing patterns but also possible guidance for constraining desert expansion.

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