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Can spatial patterns function as generic indicators of regime shifts?

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Understanding how ecosystems respond to climate change is amongst the most urgent present-day challenges in environmental science. While transitions in ecosystem properties may be smooth, concern has risen that a broad range of ecosystems may occur as ‘regime shifts’. In regime shifts, only minor climatic perturbations may trigger large, abrupt, and irreversible changes in ecosystems. Moreover, due to the complex non-linear dynamics, these shifts are particularly hard to predict.

An increasing body of literature suggests that changes of spatial patterns of vegetation may function as ‘early warning signals’ to predict impending critical transitions in systems with patterned vegetation. Theoretical model simulations suggest that spatial resilience indicators may exist that can be generically applied to a broad range of ecosystems, ranging from semi-arid tiger bush to subarctic peatlands. Yet, before universal application, these generic spatial indicators require empirical verification.

This work aims to determine the applicability of generic spatial resilience indicators in the Kenyan Serengeti-Mara savannah ecosystem using remote sensing. Remotely sensed precipitation is related to generic spatial resilience indicators, derived from classified vegetation maps and Sentinel 2-baed NDVI. Our results reveal that, for classified vegetation maps, spatial skewness and spatial variance, two generic resilience indicators, are statistically related to mean vegetation cover. As a consequence, their additional value compared to monitoring mean cover be questioned. Our results thus have important implications for the applicability of generic spatial resilience indicators.