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Investigation of Connectivity Thresholds Associated with Severe Degradation along a Rainfall Gradient in Australia

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Dryland vegetation is very sensitive to climatic and anthropogenic pressures and prone to critical degradation thresholds which make rehabilitation efforts considerably difficult. In many dryland areas of Australia, the spatial structure of vegetation is tightly linked to overland flow redistribution through feedback mechanisms that are likely to exhibit this type of threshold behaviour. Disturbances can trigger erosion and substantial water losses by increasing landscape hydrological connectivity and damaging ecosystem function.

In this study, we combine remote sensing observations with a modelling approach to analyse changes in ecosystem connectivity and the existence of threshold behaviour along a precipitation gradient in selected sites of the Mulga Lands Bioregion in Australia (250mm to 490mm annual average rainfall). Vegetation patterns are derived from high resolution remote sensing images, and Rainfall Use Efficiency estimated from precipitation data and MODIS vegetation indices for several plots across along this gradient. These data is used to model the evolution of landform and vegetation in order to analytically investigate the processes and possible triggering mechanisms for threshold behaviour. We find that disturbances can substantially increase the connectivity above a threshold that leads to severe degradation determined by loss of productivity and landscape functionality (e.g. rainwater use efficiency of the landscapes). However, both observations and modelling results suggest that sites with higher rainfall are more resilient to changes in surface connectivity, even if these changes are quite profound. The implications for ecosystem resilience and land management strategies are briefly discussed.