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Applications of a hydro-geomorphic (dis)connectivity framework to study vegetation transitions in semiarid ecosystems.

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Changes in hydro-geomorphic connectivity have been previously linked to catastrophic shifts in landscape structures and function leading to irreversible degradation. Here we present evidence and new observations to better understand the link between connectivity of water and sediments and possible phase transitions for the case of semiarid ecosystems at the catchment and hillslope scales. We first focus on rangelands, where coevolving vegetation and landform structures lead to a distinct connectivity pattern responsible for the healthy functioning of the system. Positive feedbacks, triggered by disturbances in vegetation, water or sediment structures can alter the hydro-geomorphic connectivity leading to degradation. Our results for rangelands in Australia, from both simulations and observations, suggest that an increase in connectivity beyond a threshold may lead to irreversible degradation, meaning that the system return to a functional state is unlikely without extensive management interventions. We also analyse the case of semi-arid floodplain wetlands of the Murray-Darling Basin, where we observe that dis-connectivity during droughts promote terrestrial vegetation encroachment and degradation. Simulations and observations also indicate the presence of thresholds beyond which the recovery of the system is unlikely without interventions.