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Hydrological Connectivity: A Useful framework to identify degradation thresholds in semiarid landscapes.

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Over the last few years, the concept of hydrological connectivity has emerged as a useful framework to quantify how changes in water redistribution and sediment production may lead to land degradation. Here, we illustrate the use of the connectivity framework for several examples of dryland systems that are analysed at a variety of spatial and temporal scales using both modelling approaches and remote sensing data analysis. We show that hydrological connectivity is particularly useful in drylands where human and/or natural disturbances can alter the surface water availability and pathways, and therefore the system connectivity. In doing so, we also focus on the analysis of co-evolution of system structures and function, and how they may drive threshold behaviour leading to desertification. We apply the framework to different dryland systems, starting with the analysis of semi-arid rangelands, where feedbacks between the decline in vegetation density and landscape erosion reinforces degradation processes driven by changes in connectivity. We then focus on semi-arid floodplain wetlands, where decreases in water volumes promote terrestrial vegetation encroachment that changes drainage conditions and connectivity, potentially reinforcing redistribution of flow paths to other wetland areas. In both cases, crossing a system threshold might lead to degradation in which the return to a functional system is unlikely. The examples presented highlight the need to incorporate a co-evolutionary framework for the analysis of changing connectivity patterns and the emergence of thresholds in arid and semi-arid systems. This framework can be used for the identification of early warning indicators of transitions from healthy to degraded states, which are useful for management applications.