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Hydrologic Connectivity: a Framework to Understand Threshold Behaviour in Semi-Arid Landscapes.

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Anthropogenic activities and climate change are imposing an unprecedented pressure on arid and semi-arid ecosystems, where shortage of water can trigger shifts in landscapes' structures and function leading to degradation and desertification. Hydrological connectivity is a useful framework for understanding water redistribution and scaling issues associated to runoff and sediment production, since human and/or natural disturbances alter the surface water availability and pathways increasing/decreasing connectivity. In this presentation, 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. In doing so, we draw particular attention to the analysis of co-evolution of system structures and function, and how they drive threshold behaviour leading to desertification and degradation. We first analyse the case of semi-arid rangelands, where feedbacks between decline in vegetation density and landscape erosion reinforces degradation processes driven by changes in connectivity until a threshold is crossed above which the return to a functional system is unlikely. We then focus on semi-arid wetlands, where decreases in water volumes promotes dryland vegetation encroachment that changes drainage conditions and connectivity potentially reinforcing redistribution of flow paths to other wetland areas. 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.