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Vegetation Patterns and Degradation Thresholds in the Mulga Landscapes of Australia

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Drylands are often characterised by a spatially heterogeneous vegetation cover forming mosaics of patches dense vegetation within bare soil. This 'patterned' or 'patchy' vegetation cover is sensitive to human pressures. Previous work suggests that within these landscapes there is a critical vegetation cover threshold below which the landscape functionality is lost. This threshold behaviour is tightly linked to the overland flow redistribution and an increase in hydrologic connectivity that induces loss of resources (i.e. leakiness). In fact, disturbances (such as wildfire, overgrazing or harvesting activities) can disrupt the spatial structure of vegetation, increase landscape hydrologic connectivity, trigger erosion and produce a substantial loss of water. All these effects affect ecosystem functionality.

Here we present the results of exploring the impact of degradation processes induced by vegetation disturbances (mainly grazing) on ecosystem functionality and connectivity in semiarid landscapes with various types of vegetation patterns. The sites are carefully selected in Mulga landscapes bioregion (New South Wales, Queensland) and in sites of Northern Territory in Australia, which display similar vegetation characteristics but with different vegetation patterns and good quality rainfall information. The analysis of vegetation patterns is derived from high resolution remote sensing images (IKONOS, QuickBird, Pleiades). Using MODIS NDVI and local precipitation data, we compute rainfall use efficiency and precipitation marginal response in order to assess the ecosystem functionality. We use vegetation binary maps and digital elevation models to estimate mean Flowlength as an indicator of structural hydrologic connectivity. We compare the trends for several sites with varying vegetation patterns (i.e. banded versus spotted patterns). Our results show that disturbances increase hydrologic connectivity and suggest threshold behaviour that affects landscape functionality. Though this threshold behaviour is found in all sites, the plots in higher rainfall landscapes with banded vegetation patterns show evidence of higher resilience. We will also present some preliminary modelling results that complement this analysis and capture the coevolution of vegetation and landforms (erosion), leading to this type of threshold behaviour.