



Gully erosion processes and hillslope connectivity in savanna rangelands tributary to the Great Barrier Reef

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Gully erosion is a globally significant land degradation phenomenon and a major issue in dry-tropical savanna rangelands tributary to the Great Barrier Reef, Australia. Limited understanding of the hydrological and geomorphological processes involved in gully initiation and expansion constrain effective management. This study elucidates key hydrogeomorphic processes driving hillslope gully erosion in the Upper Burdekin catchment, north-east Queensland. Analysis of ultra-high resolution (0.01 m) DEMs of four gully systems, derived from repeat ground-based Structure-from-Motion with Multi-View Stereo photogrammetry surveys, reveal spatial patterns of gully geomorphic change over two wet seasons (2016-2018). Most erosion occurs at the gully head, primarily through mass wasting processes. Mapping of fine-scale hydrological flow pathways and the Index of Connectivity of gullied catchments, using very high resolution (0.1 m) DEMs derived from an unmanned aircraft system (UAS), identifies critical areas of flow accumulation. The point at which modelled flow pathways enter the gully correspond to areas of greatest geomorphic change. While primarily topographically driven, flow pathways are strongly influenced by cattle trails, roads, and areas of low ground cover. Annual rainfall is dominated by a small number of typically short-duration, high-intensity storms. During these periods of intense rainfall, runoff is delivered rapidly to gullies via infiltration-excess (Hortonian) overland flow. This study provides valuable new insights into key gully erosion processes and demonstrates how low-cost UAS and ground-based platforms can be used to aid in the modelling and management of hillslope gully systems.