A shifting 'river of sand': the profound response of the dryland Warrego River, eastern Australia, to Holocene hydroclimatic change

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Project outline

Understanding how rivers respond to extrinsic forcing (e.g. hydroclimatic change) is increasingly important given concerns surrounding the changes to climate projected for the coming decades and beyond. However, disentangling changes brought about by extrinsic forcing and those brought about by intrinsic fluvial dynamics can be difficult. A long-term perspective on dryland river development can improve our understanding of fluvial responses to extrinsic forcing and the associated thresholds that influence river behaviour. The Warrego River is a dryland river in the northern Murray-Darling Basin. Little is known about its geomorphology and late Quaternary evolution, however large palaeochannels preserved on the floodplain that have a significantly different morphology to the modern river may provide insight into threshold responses of rivers to changing hydroclimatic conditions. The main aims of this project were to: 1) characterise the hydrology and geomorphology of the modern Warrego River, and 2) to determine the age of large palaeochannels adjacent to the modern river and to characterise their palaeohydrology and geomorphology.

2017 Fieldwork

The BSG postgraduate grant provided critical funding to help support an 11-day fieldtrip to the Warrego River in southwest Queensland and northwest New South Wales, Australia. The aim of this fieldwork was to undertake topographic surveys of the Warrego River and to collect samples for optically stimulated luminescence (OSL) dating from large palaeochannels on the Warrego floodplain. Thirteen river channel surveys were undertaken on the Warrego River, spaced roughly evenly along the ~500 km between Charleville in the middle-upper catchment and Toorale where the Warrego joins the Darling River. These surveys provide an indication of the downstream trends in modern channel characteristics, bankfull discharge and stream power. OSL samples taken from auger holes in scroll ridges of large palaeochannels (named Burrenbilla and Coongoola) provide the timing of fluvial activity along these palaeochannels which are significantly larger than the modern Warrego River.

Key findings

Combination of hydroclimatic datasets, satellite imagery, field surveys, and OSL dating demonstrates that the Warrego River has undergone profound hydrological and geomorphological changes during the Holocene (Figure 1). During the early to mid-Holocene between ~8 – 5 ka, the Warrego River was characterised by large (~160 m wide), high energy (~10 W m^{-2}), sinuous meandering channels that were actively laterally migrating. These channels were supported by persistent La Niña conditions in the Pacific Ocean which brought increased rainfall over eastern and northern Australia and the Warrego catchment. After ~5 ka, increased frequency and intensity of El Niño events resulted in an increase in aridity over eastern Australia. A reduction in discharge and stream power and the associated increase in hydrological variability triggered a dramatic change in river behaviour to its current form. The modern Warrego River is much smaller (<50 m wide), lower energy (<4 W m^{-2}), with straighter channels that periodically cease to flow and typically do not maintain continuous channels to the Darling River confluence.

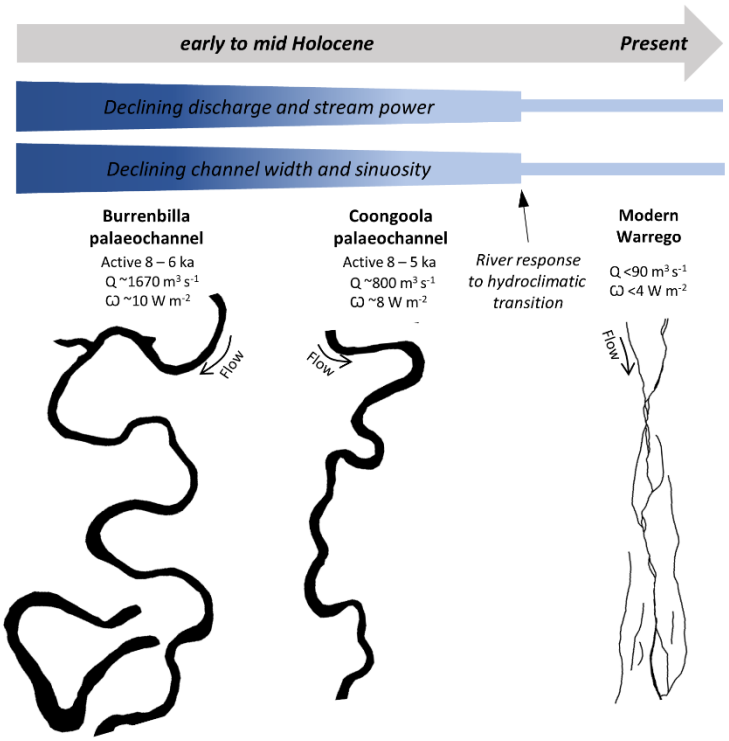

Figure 1 Summary of changes to the Warrego River during the mid-late Holocene (Larkin et al., 2020).

Larkin Z, Ralph T, Tooth S, Duller G, 2020. A shifting 'river of sand'; the profound response of Australia's Warrego River to Holocene hydroclimatic change, *Geomorphology*, in press.