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Interaction of ENSO-driven flood variability and anthropogenic changes driving river channel evolution: Corryong Creek, Australia

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River channels are highly responsive to climatic forcing, particularly in terms of changes in flow regime. Variability in precipitation can directly alter channel dimensions via erosion and deposition, particularly in response to prolonged droughts or extreme floods, but also alter channel stability through changes in catchment and riparian vegetation, which create complex feedback mechanisms which can reinforce relatively modest climate changes. In Australia, short-term hydrological precipitation is largely driven by changes to the El Nino-Southern Oscillation cycle. A body of research also suggests that river channels respond to longer term (40-50 year) alternating flood and drought dominated regimes. In this study, we determine the role of climate forcing in controlling the channel shape and stability of Corryong Creek, a dynamic gravel-bed river in southeast Australia, using a range of climate, hydrological, geomorphological and historic data. Corryong Creek is highly response to ENSO scale hydrological variability, with a distinct pattern of channel narrowing and stabilisation by vegetation during El Nino periods, and significant, often catastrophic widening during La Nina phases, usually associated with a rapid succession of high magnitude floods. There is no evidence of longer flood or drought dominated regimes, either statistically, in the hydrological record, or in terms of a geomorphological signature. Major bushfires (which have occurred in 1939 and 2003) occur during or toward the end of dry phases, but produce a short live increase in flood erosion, due to increased runoff and the destruction of riparian vegetation. However, long-term (100 year) changes have been heavily mediated by anthropogenic activities. The most dramatic change to the channel is a significant reduction in sinuosity, which occurred rapidly in the early to mid 20th century, associated with clearing of all floodplain and riparian vegetation, and major clearing of the lower hillslopes. The instability triggered by this period of rapid erosion was countered by extensive planting of willows and widespread river stabilistation works. In almost all cases, attempts to stabilise the channel lead to further localised erosion. The net effect of this combined history of natural and anthropogenic changes is a complex landscape in which the response to modern flooding, such as that which occurred in 2010, is highly variable across the catchment, with reaches often being more, or less, stable than models of riverbank erosion suggest, due to the complex legacy of events which have historically shaped the channel.