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The role of hydro-geomorphic feedbacks, fire and vegetation on present and long-term sediment flux in a northern Australian tropical river system

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Monsoonal rainforest in the Australian tropical Top End is patchy and has been found to be associated with rivers and upwelling groundwater, which indicates strong links to hydrologic and geomorphic conditions. Riverine monsoonal rainforests are important ecosystems for fire control, biodiversity, tourism and the aboriginal heritage of the region. While their present distribution is well known, very little data exists on past spatial and temporal dynamics of these ecosystems, or their medium- to longer-term controls. Several factors have been suggested to control riverine rainforest extend in the Top End such as fires, and/or hydroclimatic (droughts). A recent study finds an additional geomorphic control induced by alluvial knickpoint migration. This process initiate eco-hydro-geomorphic feedbacks which in combination with frequent fire events causes the destruction of the wet monsoon forest. In addition, the incision going along with these knickpoints exposes stratigraphic sequences of alternating soils and floodplain sediments. These sequences provide valuable archives for the reconstruction of longer-term (i) floodplain sedimentary dynamics, (ii) local vegetation history, or (iii) catchment-wide fire histories and thus provide the opportunity to combine annual up to millennial time scales. The quaternary study shows that a $\sim$ 4000 year lasting phase of aggradation was recently disrupted by a phase of channel incision and floodplain erosion. The aggradational phase (0.8 cm/year) includes phases of soil development and sand deposition, which we interpret based on the collected data as similar to present conditions. Minor erosional events, likely linked to fire, disturbed the wet monsoon forest, but did not destabilize the ecosystem, a finding that diverges from current paradigms. In contrast, the recently observed phase of incision, which is likely similar to the past phase of major erosion $\sim$ 4000 years ago, changes hydro-geomorphic conditions and causes wide-spread erosion and lowering of the macro-channel surface. This study hence provides first evidence for a tropical cut-and-fill river system, which seem to depend on similar conditions than its semi-arid counterpart, however one major difference is that the here described river system is perennial. We also argue that shallow groundwater plays a major role in the evolution of cut-and-fill river systems, but was mostly overlooked in the past. Finally, we interpret that phases of biotic and abiotic processes control not only alternate with each other, but also depend on each other in the long-term, and we conclude that such eco-hydro-geomorphic feedbacks over shorter and longer time-scales need to first be understood, before interpreting fluvial archives with regards to climate, fire or human induced change.