Tracking Adjustments in Fan and Floodplain Storage in a Braided Channel Following Major Sedimentary Disturbance, East Cape, NZ

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Abstract:
We use a sediment budget model to elucidate the complex nature of fan and floodplain evolution over annual and decadal timescales following major disturbances.

The East Cape Context

The Tapuaeroa River (326 km² catchment area) is a major tributary of the Waipapa River, it joins the Mata River to form one of the largest river systems in New Zealand's East Coast Region (1,582 km² in total). The gravelly river is wide and braided, due primarily to a continuing surplus of coarse sediment. Landsliding in the headwaters drives a remarkable regime of sediment transfer. The river has one of the highest suspended sediment concentrations in New Zealand [1]. Rapanapariki Stream (Fig 1), in particular, is recovering from a significant sediment loading following the passage of Cyclone Bella in 1988. Material in temporary storage within this valley will continue to feed the fan at its terminus, and open meanders of the Tapuaeroa. The study area covers a 12 km reach of river that has shown dramatic response to widespread gullying and landslides in the tributary heads.

A sediment budget model is developed to elucidate the complex nature of fan and floodplain evolution over annual and decadal timescales following major disturbances.

Project Aims:
- Quantify changes to mainstem channel sediment stores in the span of one year.
- Determine the nature of tributary fan sediment transfer and evolve connections between the mainstem and tributaries.

Methods
- A fixed-wing UAV (Trimble UX3; Figure 2) with a 12MP Sony NEX-5T camera flown at a height of roughly 80 m along 12 km of river.
- Two high-resolution Structure-from-Motion surveys were carried out along a 12 km length stream corridor.
- There is significant, focused erosion at distal fan edges, and the peaks of sediment deposition in Figure 4 attest to the strong influence of former channel bounds. This has important implications for sediment budget assessment, since the abandonment and refilling of channels accounts for a significant proportion of the annual budget, particularly in the lower part of the study area.

Conclusions
Two high-resolution Structure-from-Motion surveys were carried out along a 12 km length braided river floodplain. The pattern of erosion and deposition is consistent with the historical trend, and provides a detailed picture of the up-channel and very active system. Unsubmerged topography under ~0.5 m of water is not resolved in the surveys, which introduces a key element of uncertainty. Most cut and fill can be attributed to channel erosion and fills; trimming of lateral fans is highlighted as a key sediment source.

Perspective
The results from the 2015-2016 surveys demonstrate the immense potential for monitoring river change and establishing an annual sediment budget. The difference map provides a minimum estimate of change, since numerous bedload transport events have occurred in the 1-year interval, but we assume that most of the load is captured within the 12-km river corridor.

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References