

## **Hillslope failure and paraglacial reworking of sediments in response to glacier retreat, Fox Valley, New Zealand.**

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Climate and glacier fluctuations influence sediment supply to glacier forelands, which in turn influences down-valley hazards to infrastructure and tourism within glacier forelands. At Fox Glacier, one of New Zealand's most iconic and popular glaciers, rapid retreat has initiated a range of hillslope and valley floor responses, that present a cascade of hazards and changes that need to be carefully managed. Fox Glacier has retreated many kilometres historically, with ~2.6 km of retreat since the mid-20th century, and a phase of rapid retreat of 50-340 m per year since 2009. To study the system response to past and ongoing glacial retreat at the Fox valley, morphological changes are being observed using time-lapse photography and the annual collection of high-resolution digital elevation models (DEMs) and orthophoto mosaics. The DEMs are being produced using Structure from Motion photogrammetry from UAV/RPAS and helicopter platforms, and are being used, along with manual ground surveying, to produce ground surface change models (DoDs; DEMs of Difference) and sediment budgets for the valley. Results from time-lapse photography and DoDs show that glacial retreat has initiated destabilisation and (mostly chronic) mass movement of surficial glacial sediments on the valley slopes near the glacier terminus. Alluvial fans farther down valley are actively growing, reworking glacial and landslide sediments from tributary catchments. These paraglacial sediments being delivered to the proglacial river from the glacier terminus and alluvial fans are driving aggradation of the valley floor of decimetres to metres per year and maintaining a highly dynamic braid plain. Valley floor changes also include the melting of buried dead ice, which are causing localised subsidence at the carpark and one of the alluvial fans. The unstable slopes and active debris fans, aggrading and highly active river channel, ground subsidence, add to the spectacle but also the hazards of the Fox valley, and require constant attention from land managers and tourism providers.