Examining erosion in New Zealand over millennial timescales using in-situ 10Be and 14C

Duna Roda-Boluda\textsuperscript{1}, Taylor Schilgen\textsuperscript{1}, Maarten Lupker\textsuperscript{2}, Wittmann Hella\textsuperscript{1}, Prancevic Jeff\textsuperscript{3}, Tofelde Stefanie\textsuperscript{4}, and Bufe Aaron\textsuperscript{1}

\textsuperscript{1}GFZ Potsdam, Geomorphology, Potsdam, Germany (roda@gfz-potsdam.de)
\textsuperscript{2}ETH Zurich, Zurich, Switzerland
\textsuperscript{3}University of California Berkeley, Berkeley, United States
\textsuperscript{4}University of Potsdam, Potsdam, Germany

Landslides are the major erosional process in many orogens, and one of the most sensitive erosional process to tectonic and climatic perturbations. However, it remains extremely difficult to constrain long-term or past rates of landslide activity, and hence their contribution to long-term landscape evolution and catchment sediment fluxes, because the physical records of landsliding are often removed in $<10^2$ yrs. Here, we use the in-situ $^{10}\text{Be}$ and in-situ $^{14}\text{C}$ concentrations of recent landslide deposits and catchments from the Fiordland and the Southern Alps of New Zealand to: (a) estimate landslide frequencies over $10^3-10^4$ yr timescales, which we compare against landslide inventories mapped from air photos ($<10^2$ yrs) to estimate changes in landslide activity, (b) quantify catchment-averaged erosion rates, and landslide's contribution to those erosional fluxes, and (c) test whether paired $^{14}\text{C}/^{10}\text{Be}$ measurements can be used to trace erosional depth-provenance and identify transient erosion rate changes. We show that $^{10}\text{Be}$ concentrations on landslide deposits can be used to estimate landslide recurrence intervals and frequency over $10^3$ yr timescales, and that $^{14}\text{C}/^{10}\text{Be}$ ratios reflect the depth-provenance of sediment, and possibly transient changes in erosion rates. The comparison of our $^{10}\text{Be}$-based long-term landslide frequencies with short-term published inventories suggests that landslide frequencies have increased towards the present by up to an order of magnitude. We compare sediment fluxes inferred from these long- and short-term landslide inventories with sediment flux estimates derived from $^{10}\text{Be}$ catchment-averaged erosion rates, which allows us to examine fluctuations in erosion rate estimates from $10^1$ to $10^3$ yrs timescales.