Geophysical Research Abstracts
Vol. 20, EGU2018-14660, 2018
EGU General Assembly 2018

The role of landslides in mobilising organic carbon from the biosphere in the Southern Alps, New Zealand

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Landslides can erode large amounts of particulate organic carbon (POC) over short periods of time, and can play an important role in the carbon cycle at regional scales. Landslides are triggered by storms and earthquakes and thus link changes in climate and tectonics to biogeochemical cycles. Their deposits may protect POC mobilised from the biosphere from oxidation and act as short-term CO_2sinks. However, these deposits are susceptible to further erosion, which can deliver POC to rivers. This POC can then be transported to sedimentary basins, such as lakes and oceans, which act as longer term carbon sinks. Therefore, understanding the fate of POC post-landsliding is crucial for inferring the consequences of landsliding on the carbon cycle. It is also important to constrain the source of the carbon, with only biospheric POC, as opposed to rock-derived sources of POC, acting to potentially sequester CO_2 from the modern day atmosphere. While landslide erosion and transport of POC has been studied over large spatial areas in river catchments, we have a poor understanding of the detailed transport pathways of POC from hillslopes to landslide deposits and ultimately to river networks.

This research addresses this gap by quantifying the mass of POC eroded by ten individual landslides in the Southern Alps, New Zealand, and determining the effectiveness of individual landslides in routing POC from the biosphere. We collected 191 soil samples from landslide deposits, river bed sediments, and undisturbed soil profiles, and quantified total organic carbon content and stable isotope ratios (δ^{13}C and δ^{15}N) using an elemental analyser coupled to isotope mass spectrometer (EA-IRMS). The POC removed by each landslide is determined as a function of elevation based on the organic carbon content of the undisturbed soil profiles and by using time series of satellite imagery to estimate the scar area. These values are compared to the mass of POC in landslide deposits to quantify its retention. We also assess the possible sources of and pathways taken by POC post-landsliding using δ^{13}C and δ^{15}N as geochemical tracers. This study builds on our current understanding of carbon dynamics within landslides by helping to determine the factors that control the fate of eroded POC, and to evaluate the impacts of using simple spatially-averaged assumptions about carbon content and landslide sediment delivery.