Geophysical Research Abstracts
Vol. 20, EGU2018-5998, 2018
EGU General Assembly 2018

Tectonics vs. eustasy: fluvial terraces, channel profiles, and hillslopes at the Mendocino Triple Junction, California

Fiona Clubb (1), Simon Mudd (2), Martin Hurst (3), and Stuart Grieve (4)

(1) Institute of Earth and Environmental Science, University of Potsdam, Potsdam-Golm, Germany (clubb@uni-potsdam.de), (2) School of GeoSciences, University of Edinburgh, Edinburgh, UK, (3) School of Geographical and Earth Sciences, University of Glasgow, Glasgow, UK, (4) Research IT Services, University College London, London, UK

An important challenge within earth surface research is linking the dynamics of surface processes to those occurring at depth within the Earth. Tectonic plate motion, and the resulting change in land surface elevation, has been shown to have a fundamental impact on landscape morphology. Therefore, linking landscape form with uplift rates can provide potential insight into deep earth processes from topography alone. Many studies focus on fluvial networks as a window into tectonic processes, as river channels often undergo some combination of gradient, width, or depth adjustment in response to tectonic uplift, as well as forming strath and fill terraces. However, the rest of the landscape also responds to transient signals through modification of hillslope gradient and ridgetop curvature, providing additional opportunities for extracting tectonic information from topography. Although many studies have analysed these signatures independently, none to our knowledge have combined the analysis of river profiles, hillslopes, and fluvial terraces to investigate the timescale of landscape response to tectonic forcing.

Here we perform topographic analysis of channel profiles, terraces, hillslopes, and hilltops across a series of catchments at the Mendocino Triple Junction in Northern California. These catchments are characterised by orders of magnitude differences in tectonic uplift rates from north to south. We combine this topographic analysis with compiled terrace dates and erosion rate data from previous studies, and find that terraces can be separated into eustatic terraces, which have a shallower gradient than that of the modern channel, and tectonic terraces, which are steeper and at higher elevation. Channel profiles and hilltops also show clear signals of transience within basins, which we link to the influence of eustasy. Our results suggest that, even in landscapes with high rates of tectonic uplift rates, fluvial and hillslope sediment transport processes respond rapidly to changes in sea-level. This raises important implications for linking channel steepness to uplift rates in areas undergoing eustatic base-level adjustment or temporal climatic variability, and suggests that topographic data can be used to constrain timescales of sediment transport both in rivers and on hillslopes.