EGU22-2995
https://doi.org/10.5194/egusphere-egu22-2995
EGU General Assembly 2022

Valley width as a metric to explore lateral erosion in mountain landscapes

Fiona Clubb[1], Eliot Weir[1,2], and Simon Mudd[2]
[1]Department of Geography, Durham University, Durham, UK (fiona.j.clubb@durham.ac.uk)
[2]School of GeoSciences, University of Edinburgh, Edinburgh, UK (simon.m.mudd@ed.ac.uk)

Mountainous landscapes often contain sediment-filled valleys that control ecosystem diversity, flood hazard, and the distribution of human populations. Various mechanisms have been proposed to control the spatial distribution and width of valley floors, including climatic, tectonic and lithologic drivers. Attributing one of these drivers to observed valley floor widths has been hindered by a lack of reproducible, automated valley extraction methods that allow continuous measurements of valley floor width at regional scales. We have developed a new method for measuring valley floor width in mountain landscapes from digital elevation models (DEMs). This method first identifies valley floors based on thresholds of slope and elevation compared to the modern channel and uses these valley floors to extract valley centrelines. It then measures valley floor width orthogonal to the centreline at each pixel along the channel. The result is a continuous measurement of valley floor width at every pixel along the valley, allowing us to constrain how valley floor width changes downstream.

We demonstrate the ability of our method to accurately extract valley floor widths by comparing with independent Quaternary fluvial deposit maps from sites in the UK and the USA. We find that our method extracts similar downstream patterns of valley floor width to the independent datasets in each site. The method works best in confined valley settings and will not work in unconfined valleys where the valley walls are not easily distinguished from the valley floor. We then test current models of lateral erosion by exploring the relationship between valley floor width and drainage area in the Appalachian Plateau, USA, selected because of its tectonic quiescence and relatively homogeneous lithology. We find that an exponent relating width and drainage area (c_v= 0.3 ± 0.06) is remarkably similar across the region and across spatial scales, suggesting that valley floor width evolution is driven by a combination of both valley wall undercutting and wall erosion in the Appalachian Plateau. Finally, we suggest that, similar to common metrics used to explore vertical incision across mountain regions, continuous observations of valley width have the potential to act as a network-scale metric of lateral fluvial response to external forcing.