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Some thoughts on the roles of bedrock channel width and sinuosity in landscape dynamics

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Landscapes can respond to climate change and tectonic forcing in many ways. The response of the fluvial system is often evaluated by examining slope-area relationships derived from DEM data. Interpretation of slope-area trends and deviations from them are generally couched in a "stream-power model" context that makes very strong assumptions about hydraulic geometry and channel morphology. In reality, changes in channel width and sinuosity can absorb the effects of changing boundary conditions much more quickly than a river profile can steepen. We study the effects of dynamically adapting hydraulic geometry and sinuosity using simple models of bedrock channel flow and erosion. We combine model experiments with DEM and remote-sensing studies of river morphology in fast eroding, rapidly adapting mountain environments such as the western North Pacific. Our model results show that bedrock channel cross-sectional geometry takes time to adapt to climate change, which means that many slope-area analyses are likely to contain lag artefacts inherited from past climate regimes. We explore the relative speed of sinuosity development and its importance for slope adjustment, both at the reach scale and the orogen scale. We conclude with a discussion of the implication for landscape dynamics.