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Fast and efficient methods to couple channel erosion and hillslope processes

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Efficient and stable methods have been recently developed to solve the stream power equation and compute the evolution of fluvial landforms (Braun and Willett, 2013). We have developed new algorithms to couple in an almost equally efficient and stable manner this equation with those governing the rate of production and transport of sediment from the hillslopes into the channels. We have also included the effect of the sedimentary load on the erosional and transport efficiency of river channels, as well as transport/erosional thresholds without perturbing the overall efficiency of the method. Using this new numerical tool, we show the complex behaviour of a coupled system where fluvial incision and transport interact with hillslope processes to predict the evolution of landforms in a variety of uplift (tectonic) environments. We also compute age distributions as a function of drainage area and show how they can be used as constrains on the various erosional and transport parameters.

Braun, J. and Willett, S.D., 2013. A very efficient O(n), implicit and parallel method to solve the stream power equation governing fluvial incision and landscape evolution. Geomorphology, v. 180-181, pp. 170-179.