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Stressed landscape evolution

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Landscapes – simulated or natural – exhibit various textures. Some appear gentle and smooth, while others show off sharp edges, steep descents or roughness. Erosion controls the sculpting of landscapes. Bedrock and material are eroded where weakened or unconfined. Analogous models have us speculate that stress controls might impact landscape evolution across scales. A first order control behind this is the landscape's internal stress state or strength. The internal stress state or strength is a result of the geometry, material properties, gravity and geodynamic stresses. Depending on the mode, orientation and magnitude of internal stress can have a strengthening or toughening effect on the rock, which can retard erosion. We expect emergent effects from the tectonic/regional to the local/topographic stress field on erosion rates and landforms. We use experimentally constrained equations to explore the consequences of stress-strengthening on landscape evolution. Within a numerical landscape evolution modelling framework, FastScape, we test these variations in erosion due to the stress field by modulating the erodibility factor K as a function of the simulated internal stress. We observe the local effects on erosion rates and compare where in a fluvial or diffusion driven landscapes the implemented stress control has a dominant effect.