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Factors controlling the interaction between tectonics and surface processes in convergent orogens: insight from analogue and numerical models

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Convergent orogens are the best places on Earth for studying the interaction between surface processes and tectonics. They display the highest surface uplift rates and in turn are more likely affected by erosion. The balance between tectonics and erosion is responsible for many aspects in the evolution of a mountain belt. Despite the growth of analysis techniques, our understanding is still limited by the impossibility to observe these processes through their entire evolution. In particular, understanding how single parameters affect the system is necessary to unravel the nature of these multiple-interrelated processes.

Here we propose a new series of analogue models reproducing a simplified and scaled natural convergent orogenic system, to investigate the evolution of landscapes in which both tectonics and erosion/sedimentation are present. The growth of the orogenic wedge is driven by a rigid plate pushing the rear of the model. Deformed brittle granular material is a mixture of silica powder, glass microbeads and PVC powder. This mixture allows for the observation of both deforming structures and geomorphic features. Erosion is simulated by a water sprinkler system, providing a fine mist as precipitation which collects into simulated rivers, shaping the landscape. The model therefore allows observing the interaction between tectonics and surface processes. We analyze the model evolution monitoring oblique-view with cameras and top-view with a laser scanner. The latter is useful for measuring the mass balance between input fluxes (tectonics) and output fluxes (erosion) and in fulfilling a proper parametric study on the cause-effect relationship. The effect of different parameters on landscape evolution (e.g., precipitation rate, convergence velocity) is investigated systematically.

Our preliminary results analyze the relationship between single parameters and their effect on the models, allowing a proper definition of the role played in the landscape evolution. We also set up a benchmark with numerical models using DACI3ELVIS code in the same tectonic setting.

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