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The (un)balance between tectonic and erosion in analog accretionary wedges

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In convergent systems, tectonics, erosion, and sedimentation control orogenic evolution. The nature of the interaction between these factors is still to be unraveled, because of their complex feedback that goes through different time and spatial scales. Here, we try to bind tectonics, erosion, and sedimentation by running laboratory-scale coupled analog models of landscape evolution, in which both tectonic forcing and surface processes are modeled, trying to unravel the nature of these multiple-interrelated processes. The analog apparatus consists of a rectangular box filled with a water-saturated granular material. The deformation is imposed by the movement of a rigid piston (backstop), while surface processes are triggered by simulated rainfall and runoff. We systematically vary the convergence velocity and the rainfall rate, testing how different boundary conditions affect the balance between tectonics and surface processes and the onset of steady-state configurations. We measure the competition between input fluxes (tectonics) and output fluxes (erosion) of material. The results show how analog models never achieve a steady-state configuration in which tectonic rates are perfectly balanced by erosion rates. Tectonics add more material to the accretionary wedge than is removed by erosion (about 2-5 times more). Still, erosional fluxes seem to reach an equilibrium with the applied tectonic flux. The foreland is always overfilled with sediments, and we argued how the storage of sediments in front of a wedge can strongly divert the orogenic system from the "classical" steady state configuration. This work analyzes which are the main differences between analog and theoretical models and if/how the results coming from analog models can be exportable when interpreting natural landscape morphologies and force balance.