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Numerical modeling of the relationships between erosion-sedimentation processes and neotectonic structures

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The coupling between tectonics and surface processes has been demonstrated theoretically and through numerical and analogue modeling.

The basic arrangement of the present model is a bi-dimensional grid of points (x, y). Each point contains values of elevation (z), erodability and precipitation. For a better correlation with the nature an aleatory "noise" is introduced to the spatial components (x, y, z). The system allows to design an initial regional slope in some direction and to apply tectonic perturbations simulating neotectonic folds growing in piedmont environments. The algorithm used to fold the surface is fault parallel flow and for each step the grid is "deformed" at the shortening rate. The erodability was adjusted using actual denudation rates measurements for Andean (and mainly erosive) fluvial basins. Flexural subsidence is calculated putting in the center of the growing fold the maximum charge and calculating the effect for each grid point using a cosine equation. This equation take into account that as the fold grows the charge is increases and the peripheral bulge migrates towards the fold.

Each step in the main subroutine comprises a sequence of modules. In the first module the zones with tectonic perturbations are determined, the shortening rate is applied and the spatial values (x, y, z) are recalculated. In the next module each grid point is evaluated to determine its path of maximum slope. Following this path the system calculates the eroding capacity for each path point (Qe) and the quantity of charge (Qi). If Qe exceeds Qi then the river erodes its substratum, and if Qi exceeds Qe then

the excess of charge (Qi – Qe) is deposited. These procedures continue until the last point of the path is reached and is repeated for each path calculated.

The eroding pattern in the growing anticline is similar to some analogue models and natural examples. The sediment thickness around the growing fold becomes greater in its vicinity and decreases with the distance. This thickness distribution is similar to the pattern founded in alluvial fans. These results are in agreement with previous works and become this modeling platform in an interesting tool to study de interaction between deformation, erosion and sedimentation.