Hidden tectonic shortening: a numerical model of coupled erosion and deformation at plateau margin

Andrey Babeyko[1], **Stephan Sobolev**[2]**and Tim Vietor**[2]

[1] *Institut fuer Meteorologie und Geophysik, J.W.Goethe Universitaet Frankfurt, Germany*
[2] *GeoForschungsZentrum Potsdam, Germany*

The idea that high fluvial erosion rates at the plateau rim can influence the dynamic behavior of the plateau/foreland system is directly tested with our thermo-mechanical 2D parallel lagrangian explicit material-point code LAPEX-2D. The code incorporates highly nonlinear visco-elasto-plastic rheology as well as surface processes in form of fluvial and landsliding erosion. Model setup represents converging plateau/foreland system.

At low erosion rates tectonic shortening is unevenly distributed among the plateau and the foreland, depending on their relative effective stiffness, which is a function of thermal history, lithology and height of the plateau. In contrast, when the erosion rate is high, such as in areas with monsoon climate, the overall tectonic shortening could be almost completely hidden by a single exhumational shear zone at the plateau rim. In this case the apparent tectonic shortening might strongly underestimate the real one. Our numerical experiments suggest a way to estimate the amount of hidden shortening based on two observables: denudation and convergent rates. Thus, high denudation rates in Hymalayas may be responsible for more than 50 percent of hidden shortening.

High erosion and exhumation rates at the plateau margin have an overal dynamic weakening effect in the converging plateau/foreland system. Mass removal through the erosion process may, to a large part, compensate tectonic influx into the plateau and, thus, effectively prevent further uplift of the plateau. If this occurs, resistance of the convergent system to shortening will not increase with time.