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Surface processes control on orogenic evolution: inferences from 3D coupled numerical models and observations from the India-Eurasia collision zone

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The inherent links between tectonics, surface processes and climatic variations have long since been recognised as the main drivers for the evolution of orogens. Oceanic and continental subduction and collision processes lead to distinct topographic signals. Simultaneously, different climatic forcing factors and denudation rates substantially modify the style of deformation leading to different stress and thermal fields, strain localisation and even deep mantle evolution. An ideal area where the above-mentioned processes and their connections can be studied is the India-Eurasia collision zone.

Understanding the complex interplay between tectonics, erosion, sediment transportation and deposition requires the coupled application of thermo-mechanical and surface processes modelling techniques. To this aim, we used a 3D coupled numerical modelling approach. The influence of different plate convergence, erosion and sedimentation rates has been tested by the thermo-mechanical code I3ELVIS (Gerya and Yuen, 2007) coupled to the diffusion-advection based (FDSPM) surface processes model.

We show preliminary results to demonstrate that the diffusion-advection erosion implementation has significant effects on local and regional mass redistribution and topographic evolution within narrow, curved, high orogens such as the Himalayas and their syntaxes, where erosion is a dominant forcing factor. We also discuss possible implications from different erosion/sedimentation implementations such as DAC (Ueda et al., 2015; Goren et al., 2014) in combination with the reference thermo-mechanical model to analyse changes in orogenic development as a consequence of different erosional processes in more detail.

References:

Gerya, T. V., & Yuen, D. A. (2007). Robust characteristics method for modelling multiphase visco-elasto-plastic thermo-mechanical problems. Physics of the Earth and Planetary Interiors, 163(1-4), 83-105.
Ueda, K., Willett, S. D., Gerya, T., & Ruh, J. (2015). Geomorphological–thermo-mechanical modeling: Application to orogenic wedge dynamics. Tectonophysics, 659, 12-30.
Goren, L., Willett, S. D., Herman, F., & Braun, J. (2014). Coupled numerical–analytical approach to

landscape evolution modeling. Earth Surface Processes and Landforms, 39(4), 522-545.