Geophysical Research Abstracts
Vol. 13, EGU2011-13855, 2011
EGU General Assembly 2011

Erosional feedback between mountain and foreland: Effects on internal system dynamics and the response to climate change

Emilie Pepin, Sébastien Carretier, and Gérard Herail
LMTG-Observatoire Midi-Pyrénées, 14 av.Edouard Belin, 31400 Toulouse, France

The existence of strong sedimentary feedback or "teleconnections" between mountain and foreland has been suggested by recent geomorphological studies. Even if it is assumed that the foreland is essentially controlling mountain base level and the mountain provides incoming sediment fluxes to the foreland, feedback effects on sedimentary dynamics throughout the system are still not well understood.
We carried out a numerical study, using the landscape evolution model CIDRE to provide improved feedback interpretations that focus on a mountain-foreland system. Mountainous regions correspond to an uplifted block and foreland regions are formed over an initial horizontal surface. In a previous work we showed that strong entrenchment affecting both foreland and mountain occur in this system without any climatic or tectonic changes. The two necessary conditions for this kind of entrenchment are: a significant transport threshold (critical shear stress); and a downstream boundary condition corresponding to a transversal river. These results have addressed the important need to evaluate internal dynamics within a mountain-foreland system in order to link landscape shape with past external changes.
Based on this previous result, we first detail the autogenic entrenchment propagation through the whole system. The entrenchments propagate from the fan apex both upstream to mountain divides and downstream to the fan base at different rates. Noteworthy, it highlights that an erosional signal could propagate simultaneously towards source and sink.
Secondly, we evaluate the strength of interconnection between mountain and foreland and focus on the mean sediment effluxes from the mountain during entrenchment development. It appears that the strength of feedback between source and sink is dependent on the size of the foreland. Mountain erosion is increasingly controlled by foreland dynamics if the foreland is large.
Finally, we study the interaction between external forcing (in particular climate change) and internal system dynamics. A simple climatic change is applied to the mountain section and the entire system response is observed. Due to internal teleconnections, the mountain-foreland system could develop simple or complex responses in terms of time and sedimentary signals. The system response is directly dependent on the amplitude of climatic change perturbations.
These results demonstrate how fundamental the feedbacks between source and sink are in term of internal sedimentary dynamics and system response to external change.