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Quantitative modelling of crustal block-and-fault dynamics and seismicity in the Tibet-Himalayan region

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The Tibet-Himalayan plateau has resulted mainly from the continuous Indian and Eurasian plate convergence following their initial collision at about 55 million years ago. Earthquakes occur along large strike-slip faults in response to the convergence. To understand the basic features of the regional seismicity and its dependence on the crustal structure and dynamics, we develop a model of crustal block-and-fault interaction and stress release. A model domain is composed of twelve rigid blocks separated by fault planes. These crustal blocks interact between themselves and with the underlying viscous lower crust. The set of the blocks moves as a consequence of prescribed motion of the model boundary. As the blocks are perfectly rigid, all deformation takes place in the fault zones. The interaction of blocks along the fault planes is viscous-elastic (normal state) as long as the ratio of the normal stress to shear stress magnitude remains below a certain strength level. When the critical level is exceeded in some part of a fault plane, a stress-drop (earthquake) occurs causing also failures in some other parts of the fault planes. Immediately after the earthquake the affected parts of the fault planes are in a state of creep. This state differs from the normal state because of a faster growth of inelastic displacements lasting until the stress falls below a prescribed level.

We analyse the tectonic driving forces based on the spatial distribution of synthetic seismicity, the clustering of earthquakes in the model, and the dependence of the oc-

currence of large earthquakes on a motion of crustal blocks. Also we study the effects of small changes in a direction of the Indian plate movement with respect to the Eurasian plate on the distribution of seismicity and changes in rates of the crustal block movements. The model predicts the rates of the crustal block movements consistent with GPS observations and the occurrence of large earthquakes along the Himalayan seismic belt.