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# Modeling of nonlinear crustal block-and-fault dynamics and earthquake simulations in the Caucasus region

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The Caucasus region is a part of ongoing collision of the Arabian and Eurasian plates, where moderate to strong earthquakes caused significant losses of lives and likelihood in the past. Employing the results of the morphostructural analysis and active faults in the region to delineate crustal blocks, and the geodetic observations on crustal movements, we develop a model of block-and-fault dynamics introducing nonlinear rheology of fault zones, and simulate earthquakes in the region. A set of numerical experiments has been performed to answer the following questions: (i) how crustal blocks react to the Arabian plate motion and to movements of the lower crust in the Caucasus; (ii) how earthquakes cluster in the system of major regional faults and generate strong seismicity; (iii) how the focal mechanisms of model events are related to the mechanisms of observed earthquakes; and (iv) how rheological properties of the fault zones influence the earthquake clustering and fault slip rates. The modeling results confirm that the contemporary crustal dynamics and seismicity pattern in the Caucasus are determined by the north-northeastern motion of the Arabian plate relative to Eurasia and the movement of the lower crust overlain by the upper crustal rigid blocks. Variations in the rheological properties of the fault zones and/or of the lower crust influence the displacement rates of the crustal blocks and hence fault slip rates. Clustering of earthquakes can be considered as a consequence of the dynamics of the block-and-fault structure in the region. The number and maximum magnitude of synthetic earthquakes change with the variations in the movements of the crustal blocks and in the rheological properties of the lower crust and the fault zones. The earthquake simulations in the Caucasus region will help to assess seismic hazard using recorded, historical, and simulated events.