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Modeling surface velocities in the Southern and Eastern Alps by finite dislocations at crustal depths

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The indentation of the Adria plate into the Southern and Eastern Alps is an ongoing collisional process accompanied by seismicity, uplift and lateral escape. We attempt a first 3D quantitative description of the process by combining GPS and structural data with an elastic dislocation model. Horizontal velocities of 75 Austrian and Italian permanent GPS stations in the Eastern and Southern Alps serve as boundary condition on the free surface of an elastic half space containing six rectangular faults, each with an uniform slip rate. Using the Okada (1985) algorithm, and taking into account the structural setting of the area and the geographic distribution of the velocity data, the geometry of the rectangular faults and the slip rate vector are constrained by least squares. We find that the surface velocities of the order of some mm/yr require slips at crustal depth ranging for 1 to 5 cm/yr, with rake mostly reverse, occasionally transpressional. The horizontal gradient of the moment rate associated to each rectangular fault positively correlates with seismicity. The regional stress pattern computed from fault plane solutions agrees with the principal directions of our rectangular fault planes. The model, although constrained by horizontal velocities only, predicts a pattern of vertical motion which qualitatively agrees with known phenomena such as the uplift in the Tauern and subsidence in the Po Plain, of the order of up to few mm/yr.