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Present-day intra-plate deformation of the Eurasian plate

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We build on the results of two recent, yet independent, studies. In the first (Warners-Ruckstuhl et al., 2013) the forces on, and stresses within the Eurasian plate were established. In the second (Tesauro et al., 2012) the distribution of mechanically strong and weak parts of the Eurasian plate was found. The aim of our work is to predict lithospheric deformation of the Eurasian plate and to compare it with observations. This constitutes a test of both the force/stress results and of the strength results. Specific questions are to which extent stresses localize in specific regions and whether micro-plates as identified by geodesists arise naturally from the results.

Importantly, Warners-Ruckstuhl et al. (2013) found an ensemble of mechanically consistent force models based on plate interaction forces, lithospheric body forces and convective tractions. Each of these force sets is in mechanical equilibrium. A subset drives Eurasia in the observed direction of absolute motion and generates a stress field in a homogeneous elastic plate that fits observed horizontal stress directions to first order. Deformation models constitute a further test and a possibility to discriminate between the remaining force sets.

Following Tesauro et al. (2012) we assume five different compositions for the upper and lower crust. We use their geotherms and crustal thickness maps to estimate vertical distributions of strength at any location within the Eurasian plate. Based on the assumption that horizontal strain rates do not vary with depth allows us to estimate the vertically averaged viscosity of each point. We include major active faults in our mechanical model.

We compare our results with GPS velocities, InSAR, seismic, and paleomagnetic observations, which capture present-day and long-term deformation. We discuss various causes for differences.