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Inter-seismic and co-seismic surface deformation deduced from space geodetic observations

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Inter-seismic surface deformation models are of prime importance for understanding the dynamics causing deformation and in seismic hazard analysis, while the co-seismic surface deformation field provides important information on the complexity of an earthquake and the crustal properties, as well as on the relaxation of the long-term deformation field during an earthquake. To model the surface deformation field I adopt the method of Spakman and Nyst (EPSL 203, 2002), which resolves the velocity (displacement) field and the motion (slip) on the fault simultaneaously. The novel implementation of fault motion is particularly important for the purely kinematic estimation of co-seismic surface deformation. I will show the model solutions and my analysis for the south-western US deformation zone (SWUSDZ) and for the august 17 1999 Izmit, Turkey earthquake.

The model for the SWUSDZ shows fault motion consistent with aseismic creep measurements. The eastern California shear zone is found to act as a distinct fault zone bounded by rigid blocks. Similarly, the San Jacinto and southern San Andreas faults act as bounding faults of a fault zone. A moment deficit analysis of our model shows significant accumulation of moment deficit between 1973 and 2000 corresponding to a maximum earthquake of Mw=6.1-6.3.

The surface deformation field of the August 17 1999 Izmit, Turkey earthquake is based on a combination of GPS and InSAR data. The strain field portrays four distinct quadrants reflecting the earthquake focal mechanism. The transition between the quadrants is not focussed on the epicenter but shifted. The shift is the result of a two-stage rupture process caused by the step-over features in the fault geometry. Further, I identified two consecutive sources inducing progressive rupture east- and westwards.