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PS-InSAR velocity field along the eastern section of the North Anatolian Fault: implications for loading and release of interseismic strain along strike-slip faults

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Fault segmentation has long been thought to control the release of interseismic strain by acting as asperities or/and barriers. However how the secular strain accumulates along such segmented faults, particularly around the segment boundaries, remains unknown since GPS is generally too sparse for determining the pattern of strain accumulation at a kilometer scale, and conventional Interferometric InSAR measurements are often heavily hampered by atmospheric effects. Here we use, together with the GPS, the Persistent Scatterer SAR interferometry (PS-InSAR) technique with the Envisat and ERS SAR data acquired on three neighboring and overlapping descending tracks to map interseismic strain accumulation along a ∼225 km-long, NW-SE trending section of the North Anatolian fault that ruptured during the 1939, 1942 and 1943 earthquakes. The technique we used in this study provides a line-of-sight velocity map of the region with an unprecedented spatial resolution and accuracy which, together with the maps of earthquake surface ruptures, shed light on the style of continental deformation and the relationship between loading and release of interseismic strain along segmented continental strike-slip faults. Modeling of the PS-InSAR velocity field reveals a linear and concentrated trough-going shear zone with an over-all slip rate of 20±3 mm/y below an unexpectedly shallow locking depth of 5-9 km. This supports the thick lithosphere model in which continental strike-slip faults are thought to extend as discrete narrow features through the entire crusts. Fault segmentation observed on the surface is therefore likely inherited from heterogeneities in the upper crust that either preexist or/and develop during the propagation of the fault. They guide dynamic rupture propagation and thus persist over a long period of time surviving thousands of earthquake cycles.