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Spatial variations of slip and creep rates along the Dead Sea Fault and the Carmel-Gilboa Fault System

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Crustal deformation and seismic activity in the Levant is mainly related to the interplate Dead Sea Fault (DSF) and the intraplate Carmel-Gilboa Fault System (CGFS). In this study we analyze the interseismic deformation along these fault systems using 23 years of GPS measurements obtained from 209 campaign and 60 continuous stations. This GPS dataset is the longest record and the densest dataset for the DSF and the Levant region. We use this dataset to investigate the spatial variations of slip and creep rates along the southern and central sections of the DSF and the CGFS. Our inversion model results indicate that part of the tectonic motion is transferred from the DSF to the CGFS. We find that the left-lateral strike-slip motion along the DSF decreases in a rate of 0.9±0.4 mm/yr, from 4.8±0.3 mm/yr south to the intersection with the CGFS, to 3.9±0.4 mm/yr north to this intersection. Along the CGFS the left-lateral strike-slip motion ranges between ~0.3-0.5 mm/yr and the extension rate between ~0.6-0.7 mm/yr, indicating a total slip rate vector of 0.8±0.4 mm/yr in the DSF direction, in agreement with the reduction of slip rate along the DSF near the intersection with the CGFS. Shallow creep is found along the southern and central sections of the Dead Sea basin and the northern Jordan Valley section of the DSF, with creep rates of 3.4±0.4 and 2.3±0.4 mm/yr, respectively. These creeping sections were identified as areas with thick salt layers at the shallow subsurface. We suggest that shallow creep behavior along the DSF is govern by the presence and mechanical properties of the salt layers, which probably allows plastic deformation and the transition to velocity strengthening at the shallow subsurface and promotes creep.