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Characterizing deformation processes along the Psathopyrgos fault, western Gulf of Corinth through InSAR and GNSS time-series analysis

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This study investigates the kinematic behavior and deformation patterns of the Psathopyrgos normal fault in the Western Gulf of Corinth (GoC) using space geodetic techniques such as InSAR and GNSS time-series analysis. The Psathopyrgos fault is the main onshore tectonic structure of the north-dipping fault system and is located near the western tip of GoC (Tsimi et al. 2007). The crustal extension across the Corinth rift increases from east to west and reaches its maximum value in the western GoC where the Psathopyrgos fault is located. Our analysis covers the period from 2016 to 2022 and leverages LiCSBAS, an open-source package, for InSAR time series analysis with the N-SBAS method. We combine our InSAR results with GNSS velocities in order to obtain a more accurate estimation of the deformation field. Through the InSAR time-series analysis, the E-W fault trace of the Psathopyrgos fault was mapped in detail as the ground motion pattern is affected by the long-term displacement of the fault. An offset across the fault trace was detected in the LOS position time series. The Up-Down component of InSAR confirms the LOS findings thus indicating a mainly vertical component of motion and shows an average velocity offset of 4.5 mm/yr between the two blocks across the fault, i.e., the footwall and the hanging-wall. This geodetic evidence confirms the creeping behavior of the fault. The E-W cross-sections of the InSAR velocity data also show contrasting patterns of motion. The E-W component of InSAR reveals a right-lateral slip along the western segment of the fault. An additional finding was provided by the examination of the time-series of the pixels that are located on the hanging wall of the Psathopyrgos fault. These pixels include offsets related to possible co-seismic or passive slip of Psathopyrgos fault because of the 17 February 2021 M5.3 offshore earthquake (Zahradnik et al. 2022). The offset in the time-series was about 0.01 m. The geodetic data indicate a possible surface rupture or passive slip along the Psathopyrgos fault plane, together with continuous motion that could relate to migration of fluids and aseismic creep. These new findings suggest a combination of slip history including fault rupture, aseismic creep, and fluid migration, thus, contributing to a better understanding of the interseismic and co-seismic dynamics of the Psathopyrgos active fault.

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