EGU22-1692
https://doi.org/10.5194/egusphere-egu22-1692
EGU General Assembly 2022

Slow-slip events destabilize upper-plate and trigger large-magnitude earthquake at the western-end of the Hellenic Subduction System

Vasiliki Mouslopoulou[1], Vasso Saltogianni[2], Gian Maria Bocchini[3], Simone Cesca[2], Jonathan Bedford[2], Armin Dielforder[2], Onno Oncken[2], Michael Gianniou[4], and Gesa Petersen[2]

[1]National Observatory of Athens, Institute of Geodynamics, Athens, Greece,
[2]GFZ Helmholtz Centre Potsdam, German Research Centre for Geosciences, Telegrafenberg 14473 Potsdam, Germany
[3]Ruhr University of Bochum, Institute of Geology, Mineralogy and Geophysics, Germany
[4]University of West Attica, Athens, 12243, Greece

Slow slip events (SSEs) in subduction zones can precede large-magnitude earthquakes and may therefore serve as precursor indicators, but the triggering of earthquakes by slow slip remains poorly understood. Here we report on a multidisciplinary dataset that captures a synergy of slow slip events, earthquake swarms and fault-interactions during the ~5 years leading up to the 2018 Mw 6.9 Zakynthos Earthquake at the western termination of the Hellenic Subduction System (HSS). We find that this long-lasting preparatory phase was initiated by a slow-slip event that released, over a period of 4-months, aseismic slip equivalent to a ~Mw 6.4 earthquake on the Hellenic plate-interface. This SSE, which is the first to be reported in the HSS, was associated with mild Coulomb failure stress changes (≤3 kPa) that were nevertheless sufficient to destabilize faults in the overriding plate. Tectonic instability was evidenced by a prolonged (~4 years) period of suppressed b-values (<1), an associated increase in upper-plate seismicity rates on discrete thrust, normal and strike-slip faults, including an earthquake swarm in the epicentral area of the Mw 6.9 earthquake, and another episode of slow-slip immediately preceding the Zakynthos mainshock. We show that this second SSE in 2018 caused stress changes up to 25 kPa in the epicentral area immediately prior to the mainshock, affecting a highly overpressured and mechanically weak forearc, whose state of stress fluctuated between horizontal deviatoric compression and tension during the years preceding the Zakynthos Earthquake. We conclude that this configuration facilitated episodes of aseismic and seismic deformation that ultimately triggered the Zakynthos Earthquake and may characterise other subduction zones globally.