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The 25th October, 2018 Zakynthos Earthquake

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The geodynamic regime in western Greece manifested by intense seismic activity results from the convergence between the African and Eurasian lithospheric plates (e.g. Armijo *et al.*, 1992), while the westward motion of the Turkish plate imposes an important contribution (e.g., Armijo et al., 1996). The region hosts both continental collision to the north and oceanic slab subduction to the south; these features are connected by the right-lateral Cephalonia Transform Fault (CTF). Active tectonics involves all types of faulting. Reverse and strike-slip faulting characterize the interplate type of deformation (Papadimitriou et al., 2006; 2012; Kassaras et al., 2016), while normal and strike-slip faulting prevails in intraplate regions (Kassaras et al., 2014a, 2014b), forming pull-apart basins (King et al., 1993) and the rapidly spreading Corinth Rift (Kapetanidis & Papadimitriou, 2011; Kapetanidis et al., 2015). GPS measurements demonstrate rapid deformation to the south (~35 mm·yr^{-1}) and a slower one of the order 5–8 mm·yr^{-1} in NW Greece (Chousianitis *et al.*, 2015). Deformation across the area of Western Greece is mainly accommodated within the accretionary sediments comprising the external Paxi, Gavrovo and Ionian geotectonic units, escarped from the African margin and colliding against the un-deformed Eurasian hinterland (e.g. Royden and Papanikolaou, 2011).

Zakynthos Island is located at the front of the present-day Hellenic Trench, which is formed along the convergent zone of the plate boundaries between the subducting oceanic lithosphere of Tethys and the overriding Eurasian plate. The high level of seismic activity in the area is the result of the intense crustal deformation in the Central Ionian Sea, which leads to the occurrence of moderate to strong events. The most recent events include the November 18th, 1997 (Mw=6.5) earthquake, SW of Zakynthos Island, the December 2nd, 2002 (Mw= 5.5) earthquake, a sequence of earthquakes on October 2005 (Mw=5.6) and April 2006 (Mw=5.5–5.7) south of Zakynthos, the June 8th, 2008 (Mw= 6.4) Andravida earthquake, the January 26th, 2014 (Mw= 6.1) Paliki earthquake and the November 17th, 2016 (Mw= 6.4) Lefkas earthquake.

A strong earthquake of moment magnitude Mw=6.8 occurred on 25 October 2018, ~50 km to the SW of Zakynthos Island, causing some damage in the municipality of Zakynthos and on the islands of Strofades. This event was one of the largest that have occurred in the vicinity of Zakynthos Island since 1983. It was strongly felt in Western Greece but also in other parts of the Greek mainland. More than 4,000 aftershocks were located in the framework of this study. The aftershock zone covers a region about 60-70 km long in a N110°E direction and ~80 km towards N20°E.

In this work we attempt to highlight the nature and dynamics of the earthquake sequence, the driving forces that acted during its evolution and potential consequences of its occurrence on the regional hazard. To this aim, a comprehensive dataset of recordings from the Hellenic Unified Seismological Network (HUSN) and the Hellenic Strong Motion Network (HSMN; Theodulidis et al. 2004) was compiled and the following tasks were carried out: (a) determination of precise hypocentral locations employing a custom velocity model, followed by double-difference relocation, (b) spatiotemporal analysis of the sequence, (c) regional moment tensor inversion for the determination of the source parameters of the mainshock and the larger events, (d) inversion of focal mechanisms to investigate the local stress-field distribution and (e) computation of Coulomb stress transfer to identify regions and receiver faults that were loaded with additional stress.

After the manual determination of P- and S-wave phase arrivals, a dataset of 900 best located earthquakes, between 26 October and 30 November 2018, was compiled and a local velocity model was obtained using a travel-time residual and location errors minimization method (e.g. Kissling et al., 1994). Locations were recalculated with the new model and relocated with the use of a double-difference algorithm. The spatial distribution of epicenters revealed several distinct clusters, some of which are in general agreement with the geometry of known mapped faults and compatible with the strike of Quaternary faults.

Regional moment tensor inversion revealed a focal mechanism with a strike of N16°E, a dip of 25° and a rake of 166°. Most of the determined focal mechanisms of the sequence followed this trend. Nevertheless, the largest aftershock displayed strike-slip characteristics. In addition, focal mechanisms, including events of past activity (Kassaras et al., 2016), were inverted to determine the regional stress field (Hardebeck and Michael, 2006). A complex stress field in the broader area of Central Ionian Sea, related to both thrust and strike-slip faulting was revealed.

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