



The Destructive Earthquake (Mw6.4) of 26 November 2019 in Albania: a First Report

Gerasimos Papadopoulos¹, Apostolos Agalos², Panayotis Carydis³, Efthimios Lekkas⁴, Spyridon Mavroulis⁴, and Ioanna Triantafyllou

¹International Society for the Prevention & Mitigation of Natural Hazards, 10681 Athens, Greece
(gerassimospapadopoulos2@gmail.com)

²Institute of Geodynamics, National Observatory of Athens, 11810 Athens, Greece

³Laboratory for Earthquake Engineering, National Technical University of Athens, Panagouli str. 5α, 14562, Athens, Greece

⁴Department of Dynamic, Tectonic and Applied Geology, Faculty of Geology and Geoenvironment, National & Kapodistrian University of Athens, Athens 15784, Greece

On 26 November 2019 an Mw6.4 earthquake ruptured along the Adriatic coast of Albania causing extensive destruction, mainly in Durrës city and Thumanë town, claiming 51 human lives. Maximum intensity in both areas reached the level of VIII-IX. On 21 September 2019 a strong foreshock (Mw5.6) occurred at nearly the same epicenter causing considerable damage. Fault-plane solutions of the main shock showed reverse faulting striking NW-SE and likely dipping to east indicated by the regional tectonics. In the long-term sense the earthquake has not been a surprise since the area experienced destructive earthquakes in the past as well. We present observations collected during a post-event field survey as well as a seismic source model of the main shock. Apart from the strong motion and amplification phenomena due to loose soil conditions and soil liquefaction, the severe building damage is attributed to the synergy of several other factors including poor workmanship and construction quality, ageing of materials, impact of the September 21st earthquake and pre-existing stress on buildings suffering differential displacements due to soft soil conditions in their foundations. A finite fault model was developed from the inversion of 30 teleseismic P-wave records following the methodology by Hartzell and Heaton (1983, 1986). The hypocenter was manually located offshore but close to Durrës at depth of ~22 km using the NLLoc procedure and the Ak135 velocity model based on 71 seismic phases at distances ≤ 550 km. Based on this solution a rectangular fault was assumed of 29 km in length with a depth ranging from 15 to 27 km which is large enough to describe successfully the slip for an earthquake of $M_w=6.4$. A kinematic parameterization of the earthquake fault was used to identify the space-time distribution of slip. Synthetics were calculated for each cell in which the fault is divided and are compared with the recorded data during an inversion producing the solution vector, i.e. the slip for each cell. Strike of 345° and dip of 22° were found to better fit the data. The rake vector was allowed to vary within the range from 65° to 155° permitting up-dip and possible left lateral strike-slip movement of the hanging wall domain relatively to the footwall. Rupture velocity was allowed to vary from 2.4 km/s to 3.6 km/s, the best fit found for 2.6 km/s. The heterogeneous spatial slip distribution obtained shows a complex rupture process with maximum

slip at the source of ~1.5 m with the rake vector at that point being of 115° but an arithmetic mean of the rake for the cells with significant slip over 10 cm is 99°. This implies that the thrust component is the one that played the important role in the rupture process. Significant values of slip were also found in a second patch in the northern area of the fault at depths from 19 to 26 km. The total duration of rupture was nearly 16 s, while the total seismic moment released was $M_0=5.0 \times 10^{18}$ N*m, corresponding to $M_w=6.4$.