Co-seismic deformation and preliminary fault model of the M6.4 Durres (Albania) Nov. 26, 2019 earthquake, based on space geodesy observations

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We report the mapping the co-seismic deformation in the coastal region of Durres (Albania) following the \( M_w = 6.4 \) shallow earthquake on Nov. 26, 2019, 02:54 UTC. The tectonics of western and northern Albania is characterised by on-going compression due to collision between Eurasian and Adriatic plates. Crustal deformation is characterised by shortening directed at NNE-SSW to E-W orientation. We analysed co-seismic interferograms of the Sentinel-1 (ESA) satellites (ascending orbit; relative orbit 175, slice numbers 14 & 15) and GPS observations (30-s interval) recorded at two stations (DUR2 and TIR2). The raw GPS data were processed with the GIPSY-OASIS II software, using the Precise Point Positioning (PPP) methodology with Final JPL products, to obtain daily static solutions defined in ITRF14. The coseismic offsets were computed as differences between the mean positions, respectively 5 days before and after the earthquake day. Uncertainties associated with the displacements were calculated by propagating the errors in GPS solutions. For DUR2 the displacement is significant in all three components (East=-1.3 cm, North=-2.1 cm, Up= +1.4 cm), while for TIR2 seems reasonable (0.4 cm on the horizontal components) but within the error bar. The SAR images were processed by the open-source SNAP software and they were obtained on Nov. 14, 2019 20:59 UTC (master scene) and on Nov. 26, 2019 16:31 UTC (slave scene). Each frame (slice) was processed independently and the wrapped phase was mosaicked in order to reveal the full deformation extent. The InSAR fringe pattern shows a 45-km long, NW-SE arrangement of three (3) fringes with a maximum LOS displacement of about +8.4 cm near the village Hamallaj (15 km NE of Durres). Assuming a half-space elastic model with uniform slip along a rectangular fault surface, the source of the ground deformation was inverted using the available geodetic data (GNSS and InSAR). The mean scatter value between data and the model is 2.4 mm. The inversion modelling indicates that the 2019 Durres (Albania) earthquakes ruptured a low-angle fault (24 km long by 9 km wide) dipping 23° towards east with the fault plane top at 16 km. The geodetic fault-model is in agreement with published moment tensor solutions showing a NNW-SSE fault plane (for example the USGS solution has attributes 337°/27°/91°; strike/dip-angle/rake angle). This
geometry is compatible with a blind thrust fault that may root on the main basal thrust i.e. along the main Ionian thrust front that separates Adria-Apulia from Eurasia.

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