

A review of the November 26th 2019 Durrës, Albania earthquake M_w 6.4

Преглед на земетресението от 26-ти ноември 2019 г. M_w 6.4 в Дурес, Албания

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Brief description of the November 26 2019 event

On November 26, 2019 an earthquake occurred in the Adriatic Sea off the coast of Albania (Fig. 1). It took the lives of 51 people and left about 3000 injured, as well as destruction of many buildings. Even though the earthquake did not cause casualties in other countries outside of Albania, there is information that it was felt in Bulgaria in the stories of buildings. The epicenter is situated 17 km North of Durrës and 35 km from the capital of Albania – Tirana. The earthquake is shallow – 22 km with magnitude M_w 6.4 (Papadopoulos et al., 2020a) estimated the maximum earthquake intensity in the range VIII–IX. Liquefaction occurred in some areas in the vicinity of Durrës.

Geological setting and historical data

The Adriatic collision zone is the most active seismic region in Albania which originates the variety of earthquake’s mechanisms (McKenzie, 1972). In addition, the African Plate shifts towards the Eurasia Plate by 4–10 mm annually and results in strong earthquakes mainly in Turkey, Greece, Albania, and Southern Italy (Ormeni et al., 2020). Focal mechanism of the 26th November’s earthquake showed thrust faulting striking NW-SE and likely dipping to east (Papadopoulos et al., 2020b).

Historical data point out that this is a highly active seismic zone and more than once during the past strong earthquakes have demolished the city of Durrës. The earliest data of an earthquake in that region dates back to 346 AD (Galadini, Gal-

li, 2004). In 1267 and 1273 historical data would suggest that a large number of people were killed and almost the whole city was destroyed. More recently, a destructive earthquake M_w 7.1 occurred on April 15, 1979, leaving 129 deaths (Benetatos, Kiratzi, 2006). The epicenter (19.2° E, 42.1° N) is estimated near the border of Albania and Montenegro, close to 2019’s earthquake location (Papazachos et al., 1998).

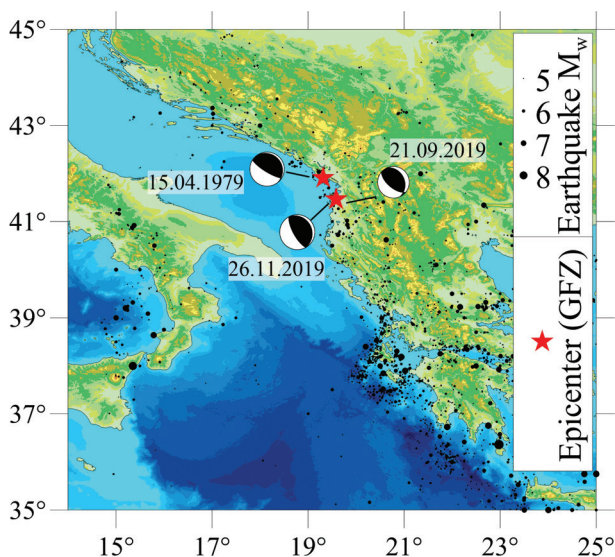


Fig. 1. Epicenters of the Durrës earthquake M_w 6.4 in November 2019, the foreshock M_w 5.6 in September 2019 and the one in 1979 $M_w=7.1$. Black solid circles indicate the seismicity in the region for the period 1900–2020 (ISC) for $M>5$. Focal mechanisms are presented as beach balls inserted in the map.

Table 1. Earthquakes characteristics

Origin Time UTC	M_w	Lat (°N)	Lon (°E)	Depth* (km)	Strike (ϕ , °)	Dip (δ , °)	Rake (λ , °)	FM** author
2014-04-21 21:25:30	4.6	41.79	19.25	10.0f	142 350	52 41	72 112	ROM
2014-05-20 00:59:20	5.0	40.94	19.81	19.6	68 337	84 72	18 174	ISC
2014-05-20 04:43:26	4.6	40.92	19.86	10.0f	63 331	74 82	8 163	MED_RCMT
2018-07-04 09:01:08	4.9	41.4	19.53	23.5	153 325	52 38	95 84	NEIC
2018-07-04 09:08:58	4.2	41.53	19.45	26.6	13 108	62 81	170 28	MED_RCMT
2018-07-04 11:24:20	4.4	41.48	19.53	21.2	9 107	53 79	167 38	MED_RCMT
2018-07-05 22:49:02	4.3	41.48	19.57	23.0	149 344	55 36	82 102	MED_RCMT
2019-09-21 14:04:27	5.6	41.37	19.45	21.5	130 336	62 31	77 112	GCMT
2019-11-26 02:54:11	6.4	41.38	19.47	22.0	151 335	72 18	89 94	GFZ
2019-11-26 06:08:22	5.4	41.58	19.33	21.5	146 319	47 43	95 84	NEIC
2019-11-26 13:05:01	4.9	41.58	19.51	23.5	134 358	65 33	67 129	NEIC
2019-11-27 14:45:27	5.3	41.56	19.35	17.5	166 334	63 28	95 80	NEIC
2019-11-28 10:25:06	4.5	41.46	19.45	30.8	163 336	63 27	93 84	GCMT

*f, fixed depth; **FM, focal mechanism; authors: Istituto Nazionale di Geofisica e Vulcanologia (ROM); International Seismological Centre (ISC); MedNet Regional Centroid – Moment Tensors (MED_RCMT); National Earthquake Information Center (NEIC); the Global CMT Project (GCMT); Helmholtz Centre Potsdam (GFZ); German Research Centre For Geosciences (GFZ).

Foreshocks and aftershocks activity

This main shock is preceded by a foreshock with magnitude M_w 5.6, which occurred 2 months prior to the main earthquake, which left 108 people injured and 120 buildings destroyed. Seven other smaller foreshocks are observed, the highest magnitude of which is M_w 4.4. All of these foreshocks occurred in the rupture zone. Less than four hours after the main earthquake the strongest aftershock occurred with a magnitude of M_w 5.4.

It is noteworthy that this is not the only case in which in that region an earthquake occurs preceded and followed by a number of foreshocks and aftershocks, which have magnitude close the one of the main shock. In January 2020, an earthquake M_w 5.1 occurred in the same place. It was preceded and followed by foreshocks and aftershocks ranging from 4.1 to 4.4. The year prior to the 6.4 earthquake, in July 2018, a smaller shock with magnitude M_w 4.9 occurred in that same location. It as well was followed by aftershocks all of which have epicenters with almost the exact same coordinates as the main earthquake and magnitudes ranging from 4.2 to 4.4.

In May of 2014, in the same place an earthquake occurred. The main shock's magnitude was M_w 5.0 and it was again preceded and followed by two earthquakes with magnitude of M_w 4.6.

Discussion

All of the mentioned earthquakes and their accompanying foreshocks and aftershocks are shallow and the difference in time between the main earthquake and the aftershock and foreshocks could be anywhere from a few hours to a few months. No correlation between the magnitude of the main shocks and their closeness in occurrence with the foreshocks and aftershocks is observed. Nevertheless, the focal mechanism of the event from 1979 is very similar to the one of November 26, 2019. The upper mentioned earthquakes and associated mechanisms are all shown in Table 1, as the epicenter's location is taken from *CSEM*. The main shocks are bolded.

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