THE 1933 KOS EARTHQUAKE: A PRELIMINARY STUDY
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Introduction. The island of Kos and the Turkish coast near Bodrum were shaken on July 21, 2017 by a shallow earthquake of Mw 6.6, with a focal depth of about 10 km. Its epicentre was located offshore NE of the island. The seismogenic source is a segment 16 km long of an E-W striking and south dipping (38°) fault located east of Kos, a westward extension of the Akyaka-Gökova fault in Muğla province (Fig. 1). Information on this earthquake is found in Sözbilir et al. (2017), AFAD report (2017) and Lekkas et al. (2017).

The earthquake is responsible for the loss of life of two tourists and 10 injured, as well as severe damage to the old buildings in the historic centre of Kos town, failures and subsidence to the town port and slight damage to a number of recent structures. Secondary effects were slope failures, land and coastal subsidence, liquefaction phenomena and a small tsunami that struck the port.

In the past the area was shaken by few known earthquakes, the main of those happened in 1493 (Mw 6.9) and 1933 (Mw 6.5). The first one is known from the studies of Guidoboni and Comastri (2005), for which we have seven macroseismic data points.

The one of 23 April, 1933 took place in a time-window when the Dodecanese was under Italian administration, with Rhodes as capital, and shook an area already damaged by the great, 1926 Rhodes earthquake. Fig. 2 shows a sketch of the early epicentral location attempts by of the
National Observatory of Athens, the Director of which, N. Kritikos, provided to the newspaper and mentioned that there are two candidate epicentres (stars in the map; he mentioned that the most probable is the northern one, in Kerameikos gulf).

Magnitude and epicentral location are known from several sources including Ambraseys (2001), Papazachos and Papazachou (2003), Kalafat et al. (2011), Storchak et al. (2013), Makropoulos et al. (2012) and the SHEEC catalogue (Gruenthal et al., 2013), which is based on Makropoulos et al. (2012) for that area. The relevant parameters are given in Tab. 1:
The locations and the M values look very similar: some disagreement may concern the depth.

Damage in the island was heavy: the city of Kos was partly destroyed. The earthquake was also damaging in the nearby Turkish mainland (Datcha peninsula) and less severe in Nysiros, Leros and Rhodes; It was also felt in Simi, Kalymnos and as far away as Santorini. The death toll was less than 200 persons in total. Papazchos and Papazachou (2003) supply a short description. Fig. 3 shows a view of the Old City of Kos after the earthquake.

<table>
<thead>
<tr>
<th>Source</th>
<th>Latitude</th>
<th>Longitude</th>
<th>Depth (km)</th>
<th>Mw</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambraseys (2001)</td>
<td>36.75</td>
<td>27.20</td>
<td>40</td>
<td>6.46  (Ms)</td>
</tr>
<tr>
<td>Papazchos and Papazachou (2003)</td>
<td>36.80</td>
<td>27.30</td>
<td>normal</td>
<td>6.6</td>
</tr>
<tr>
<td>Kalafat et al. (2011)</td>
<td>36.77</td>
<td>27.29</td>
<td>30</td>
<td>6.2</td>
</tr>
<tr>
<td>Makropoulos et al. (2012)</td>
<td>36.76</td>
<td>27.17</td>
<td>44</td>
<td>6.5</td>
</tr>
<tr>
<td>Gruenthal et al. (2013)</td>
<td>36.760</td>
<td>27.170</td>
<td>44</td>
<td>6.5   (0.3)</td>
</tr>
<tr>
<td>Storchak et al. (2013)</td>
<td>36.751</td>
<td>27.292</td>
<td>15</td>
<td>6.32  (0.2)</td>
</tr>
<tr>
<td>Kadirioğlu et al. (2017)</td>
<td>36.77</td>
<td>27.29</td>
<td>30</td>
<td>6.4   (Ms)</td>
</tr>
</tbody>
</table>

Although the location of that earthquake apparently looks similar to the one of the 2017 event, it would be important to understand whether the source of the 1933 earthquake is the same or it is another segment of the same fault. The particular historical context and the proximity of the Turkish territory, requires investigation in varied repositories, and this stimulated the collaboration between Greece, Turkey and Italy.

**Investigation: Sources, archives.** The main source of information should be the “Archivio del Dodecaneso”, handed back to Greece when Dodecanese was assigned to Greece in 1947. It is currently stored in the Rhodes State Archives, which contain most of the documents of the Italian Administration. Dodecanese was rather independent from Italy: the Governor reported to
Rome but not as frequently as one could imagine. A preliminary search revealed the existence of some folders dedicated to the earthquake, which are to be investigated in detail. Some archives in Rome, mostly military ones, contain correspondences with Rhodes. A map reporting the damage distribution in the capital is to be found at the local archive of Kos.

In Turkey, we have the correspondence of the local governors with the Ministry of Internal Affairs on the effects of the events and the associated relief measures (source: archives of Earthquake Department of Prime Ministry Disaster and Emergency Management Presidency – AFAD). It reports damage from a number of villages, including slight damage in Bodrum and rockfalls in the nearby mountains. It recalls that the area of Datça (old name Dadya) was shaken by a previous earthquake on August 9, 1932, Mw 5.4.

**Newspapers. Greece.** Newspapers in Greece (among them “Akropolis”, “Ethnos”, “Estia”) as well as the local Dodecanese report extensively on the earthquake. Most of them mainly focus on the large death toll, the medical care of the injured and the ruined town. The main issue in Greece concerned the management of this crisis by the Italian administration. Newspapers reporting earthquake news come from the areas of Athens, Piraeus, Samos, Chios, Drama, Thessaloniki, Heraklion and Rhodes, starting from April 25, 1933. As for the Kos island, besides the damage in Kos city, the villages Antimacheia and Asfendiou were completely destroyed, while Kardamaina and Kermetes were severely damaged. Several houses in Pyli, Kefalos, Asomato and Lagoudi were destroyed. Nisyros also suffered by the earthquake. Serious extended damage. Hundreds of houses collapsed or became uninhabitable: 138 houses destroyed, others suffered negligible damage. Rockfalls were reported from the volcano of the island.

**Italy.** Some information is found in “Corriere della Sera” and “La Stampa”, although not very useful for our purposes. Il “Messaggero di Rodi” supplies more detailed information, although mostly referring to the city of Kos.

**Turkey.** Earthquake news are found in the “Cumhuriyet” newspaper. The issue of April 26, 1933 gives information with percentage of damaged buildings for a number of villages on the coastal area (Karaköy, Kızlan, Hızırşah, Emecik, Eşme and Yaka. Yazı was half demolished; Cumah village was half collapsed and half badly damaged. In Bodrum the walls of two mosques, one military building, two huts, one coffeehouse and 14 houses were cracked. Some chimneys and roofs fell down. The earthquake was strongly felt in Muğla.

**Macroseismic data.** The “Bollettino Sismico of the Regio Ufficio di Meteorologia e Geofisica”, section “Macrosismi”, had a subsection devoted to the “Italian Colonies”. While for the 1926 earthquake it supplies some information, including how that earthquake was felt in Italy, for the 1933 we have just one line “Coo, Egeo, intensity IX).

**Preliminary results and conclusion.** The so far available data allow to assess macroseismic intensity to at least 30 localities, from which location and Mw can be computed. The investigation of the material contained in the main repositories is still in progress.

**Acknowledgments** The material from AFAD archives has been kindly compiled and provided to us by MSc. Geological Engineer Mr. Cenk Erkmen. We are grateful for his contribution.

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