On 24th and 26th September 2019, two earthquakes of Mw=4.5 and Mw=5.6 respectively took place in the Marmara Sea. They were associated with the Central Marmara segment of the North Anatolian Fault Zone, which is pinpointed by several investigators as the most likely segment to rupture in the near future giving way to an earthquake larger than M7.0. Both events were felt widely in the region. The Mw=5.6 event, in particular, led to a number of building damages in Istanbul, which were larger than expected in number and severity. There are several strong motion networks in operation in and around Istanbul. We have compiled a data set of recordings obtained at the stations of the Istanbul Earthquake Rapid Response and Early Warning operated by the Department of Earthquake Engineering of Bogazici University and of the National Strong Motion Network operated by AFAD. It consists of 148 three component recordings, in total. 444 records in the data set, after correction, were analyzed to estimate the source parameters of these events, such as corner frequency, source duration, radius and rupture area, average source dislocation and stress drop. Duration characteristics of two earthquakes were analyzed first by considering P-wave and S-wave onsets and then, focusing on S-wave and significant durations. PGAs, PGVs and SAs were calculated and compared with three commonly used ground motion prediction models (i.e Boore et al., 2014; Akkar et al., 2014 and Kale et al., 2015). Finally frequency-dependent Q models were estimated using the data set and their validity was discussed by comparing with previously developed models.