Seismic hazard evaluation in western Turkey

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Western Turkey has a long history in destructive earthquakes that have killed thousands of people and caused the collapse of buildings and monuments. The area is bounded to the north by the North Anatolian Fault (NAF) and the Ganos Fault System. The NAF is one of the longest active right lateral strike–slip systems nearly 1500 km in length extending from eastern Turkey, through the Marmara Sea where it bifurcates. Along its northern branch, the Ganos Fault System consists the most significant tectonic element controlling the tectonic evolution of the area. The western termination of this fault system is in Gulf of Saros, which is a neotectonic basin with ENE trending depression placed at the northeastern part of the Aegean Sea, where the North Aegean Trough (NAT) is developed. The dextral strike–slip motion of NAF is translated into Aegean where it additionally accommodates the rapid N–S extension of the back arc Aegean region. The Anatolian and Aegean are considered as two separate microplates, as recent geodetic information combined with seismological data reveals. Western Turkey between the two is under N–S extension since Late Oligocene.

Recently, the earthquakes of Izmit on 17 August 1999 (M_w=7.4) and Düzce (M_w=7.2) on 12 November 1999, which occurred in neighboring fault segments along the NAF, were catastrophic for this part of our study area. It has been documented, from studies related to the NAF and the Aegean, that changes in the stress field due to the coseismic displacement of the stronger events influence the occurrence of the next events of comparable size by advancing their occurrence time and delimiting their occurrence place. In the present study the evolution of the stress field since the beginning of the 20th century in the territory of western Turkey is examined, in an attempt to testify if the history of cumulative changes in stress can explain the spatial and temporal occurrence patterns of large earthquakes in the eastern Aegean Sea and western Turkey. Coulomb stress changes are calculated assuming that earthquakes can be modeled as static dislocations in an elastic half–space, and taking into account both the coseismic slip in large ($M \geq 6.5$) earthquakes and the slow tectonic stress buildup along the major fault segments. The stress change calculations were preformed for strike–slip and normal faults and in each stage of the evolutionary model the stress field is calculated according to the strike, dip, and rake of the next large event, whose triggering is inspected. The geometry of the major faults in the study area is assessed and the long–term slip rates on them were defined based on existed information. Thus, the identification of known active faults that are currently in areas where the cumulative changes of Coulomb stress are positive can bring about new insight on the assessment of future seismic hazards.