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A unified seismicity catalogue for the Sea of Marmara Region, Turkey, and subsequent studies regarding repeating earthquakes and the local stress-field

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The North Anatolian Fault Zone (NAFZ) in the Sea of Marmara, Turkey, is likely to host a major earthquake (magnitude $M > 7$) in the coming decades. This exposes one of Europe's largest metropolitan areas, Istanbul, to substantial risk. Our study contributes to the description of the seismotectonic setting in the area, a prerequisite for a comprehensive seismic hazard assessment.

As the extended water body in the area has inhibited continuous seismic near-fault recordings, this long term study covering a decade of seismic activity (2006–2016) aggregates different land based, permanent seismic networks for joint analysis including the two largest, national seismic networks. With such optimized azimuthal coverage and a consistent waveform-processing scheme which involves automatized timing (picking) and iterative inversion of seismic P- and S-wave onsets, a refined earthquake catalogue with 6812 hypocentre locations is obtained. Newly calculated moment magnitudes indicate completeness down to $M_c = 2.1$. On the basis of this new catalogue we present results from a search for highly similar earthquakes (repeaters) and from a segmented investigation of the stress-field where waveform cross-correlation and direct inversion of first-motion polarities are the employed methods, respectively.

The earthquake distribution distinguishes the northern branch of the NAFZ as the more active fault strand and spares several aseismic patches there. The latter are interpreted as locked fault segments where their contours are further sharpened by a catalogue of 4407 relatively relocated earthquakes. Repeating earthquakes in the western half of the Sea of Marmara indicate that the fault segments there accommodate the far-field deformation by partial creep. For the same fault segment the stress-field inversion indicates a normal faulting regime.

Adjacent, in the east and west offshore the Ganos Mountains and the Princes' Islands, respectively, it is framed by strike-slip regimes. This spatial variation of the orientation of the largest and intermediate principal stresses as well as most of the newly calculated single focal mechanisms are in agreement with large scale transtension. It is found for other seismically active areas off the northern fault branch too and it is characterized by a least compressive principal stress that has almost constant N35°E trend on average and a subhorizontal plunge.

The transtensional setting with a combination of normal and strike-slip stress regimes implies that both faulting types could be involved during the expected major earthquake. Its nucleation seems more likely within locked fault patches and less likely at segments displaying creep. As the latter are situated on the farer end of the fault zone, the hazard from a rupture directed towards Istanbul is relaxed.