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Near-fault seismic monitoring reveals the long-lasting activation of a local fault in the Marmara region controlled by slow slip

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Recent laboratory and field observations show that fault seismic and aseismic slip may occur concurrently. Here, we combine microseismicity recordings from a temporary near-fault seismic network (SMARTnet) and borehole strainmeter data from the eastern Marmara region in NW Turkey to track seismic and aseismic deformation around the hypocentral region of a M_W 4.5 earthquake that occurred in 2018. The strainmeter data show a clear strain signal transient starting at the time of the M_W 4.5 event and lasting for about 150 days. We study about 1,200 microseismic events following the mainshock within and beyond the mainshock fault rupture. The temporal distribution of the seismicity reveals a strong temporal clustering, including four semi-periodic seismic sequences each containing more than 50 events in two days. Two seismic sequences occurred during the strain transient showing different characteristics compared to two sequences occurring afterwards. Seismicity occurring during the transient displayed typical characteristics driven by aseismic slip, such as the activation of a broader region from the mainshock, and the absence of a clear mainshock in each sequence. Seismic sequences occurring after the transient correspond to typical mainshock-aftershock sequences and activated a region closer to the original M_W 4.5 mainshock. We suggest post-strain transient seismicity originate from stress redistribution and breaking of remaining asperities. Our observations from a newly installed combined dense seismic and strainmeter network in the eastern Sea of Marmara region allows identifying repeated triggering of aseismic transients within an observation period of three years suggesting these may occur more often than previously thought.