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Monitoring seismic velocity changes caused by the 2014 Northern Aegean earthquake using continuous ambient noise records

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The 24 May 2014 Northern Aegean earthquake (6.9 Mw), an event on the Northern Aegean Trough (NAT), ruptured on two different fault segments with a total ruptured length of ∼100 km. For the second delayed segment, rupture propagated eastward from the hypocenter for ∼65 km with a supershear velocity (5.5 km/s). Low-aftershock seismicity on the supershear segment implies a simple and linear fault geometry there.

An effort to monitor temporal seismic velocity changes across the ruptured area of the Northern Aegean earthquake is underway. In recent years, neighboring seismic broadband stations near active faults have been successfully used to detect such changes. The crosscorrelation functions (CCF) of ambient noise records between stations yields the corresponding traveltimes for those inter-station paths. Moreover, the auto-correlation functions (ACF) at each station produce the seismic responce for a coincident source and receiver position. Possible temporal changes of the measured traveltimes from CCFs and ACFs correspond to seismic velocity changes.

Initially, we investigate the characteristics and sources of the ambient seismic noise as recorded at permanent seismic stations installed around NAT at the surrounding islands and in mainland Greece and Turkey. The microseismic noise levels show a clear seasonal variation at all stations. The noise levels across the double frequency band (DF; period range 4–8 s) reflect the local sea–weather conditions within a range of a few hundred kilometers.

Three years of continuous seismic records framing the main shock have been analysed from ∼15 stations within a radius of 100 km from the epicentre. We observe a clear decrease of seismic velocities most likely corresponding to the co-seismic shaking. The spatial variation of this velocity drop is imaged from all inter-station paths that correspond to CCF measurements and for station sites that correspond to ACF measurements. Thus, we explore a possible correlation between co-seismic decrease and the amount of slip and rupture speed across the fault. We also intent to detect any potential post-seismic recovery of velocity variations.

Based on this study, we aim to improve existing stations and relocate sites in order to design an optimal seismic network able to monitor, in a cost effective way, temporal seismic velocity changes across the Northern Aegean Trough.