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Classification of earthquake repeaters in the central Ionian Islands area

Anastasios Kostoglou, Polyzois Bountzis, Vasileios Karakostas, and Eleftheria Papadimitriou
Geophysics Department, School of Geology, Aristotle University of Thessaloniki, Thessaloniki, Greece
(akostogl@geo.auth.gr)

The central Ionian Islands area accommodates remarkable seismic activity with frequent strong ($M > 6.0$) earthquake occurrence and continuous microseismicity. The dominant seismotectonic characteristic is the Kefalonia Transform Fault Zone (*KTFZ*), a dextral transform active boundary between oceanic subduction and continental collision, running along the western coastlines of Kefalonia and Lefkada Islands. *KTFZ* comprises two main fault branches (Kefalonia and Lefkada) connected with a step over zone in between. In the past 20 years, four strong earthquakes ruptured the Lefkada (06/08/2003– $M6.5$ and 17/11/2015– $M6.5$) and the Kefalonia (20/01/2014– $M6.0$ and 03/02/2014– $M6.1$) branches. Their aftershock activity along with the continuous microseismicity and some bursts of seismicity comprising moderate earthquakes, provided the data set proper for detailing seismicity characteristics in the area.

We investigate the identification of repeating earthquakes (repeaters), which are earthquakes with highly similar waveforms caused by rupture of the same fault area, through different clustering approaches, aiming to explore strategies for the discrimination of repeaters in an accurately located dataset. We compiled a catalog of ~15600 manually picked earthquakes in the period 09/2016 – 01/2020. Relocation with the Double Difference method, using cross-correlation differential times, resulted in highly accurate locations with spatial errors ranging from a few tens to a few hundreds of meters.

The establishment of groups of repeaters (multiplets) is discussed based on several approaches. We identify multiplets by grouping event pairs that contain a common event, which is a widely used method, against the application of a density-based clustering algorithm, known as DBSCAN. In DBSCAN events are grouped into multiplets based on their similarity (cross-correlation coefficient), information which is provided through a distance matrix of all event pairs whose elements correspond to zero when their cross-correlation coefficient is equal to one and so forth. A multiplet is created when an event is directly connected with at least n events, i.e. their distance is within the similarity upper cutoff, ϵ . We discuss differences between the two approaches and proper parameter setting for the DBSCAN algorithm for multiplet grouping and we explore geodynamic implications of the classified clusters.

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