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Improvements on the seismic catalog previous to the 2011 El Hierro eruption.

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Precursors from the submarine eruption of El Hierro (Canary Islands) in 2011 included 10,000 low magnitude earthquakes and 5 cm crustal deformation within 81 days previous to the eruption onset on the 10th October. Seismicity revealed a 20 km horizontal migration from the North to the South of the island and depths ranging from 10 and 17 km with deeper events occurring further South. The earthquakes of the seismic catalog were manually picked by the IGN almost in real time, but there has not been a subsequent revision to check for new non located events jet and the completeness magnitude for the seismic catalog have strong changes during the entire swarm due to the variable number of events per day.

In this work we used different techniques to improve the quality of the seismic catalog. First we applied different automatic algorithms to detect new events including the LTA-STA method. Then, we performed a semiautomatic system to correlate the new P and S detections with known phases from the original catalog. The new detected earthquakes were also located using Hypoellipse algorithm. The resulting new catalog included 15,000 new events mainly concentrated in the last weeks of the swarm and we assure a completeness magnitude of 1.2 during the whole series.

As the seismicity from the original catalog was already relocated using hypoDD algorithm, we improved the location of the new events using a master-cluster relocation. This method consists in relocating earthquakes towards a cluster of well located events instead of a single event as the master-event method. In our case this cluster correspond to the relocated earthquakes from the original catalog.

Finally, we obtained a new equation for the local magnitude estimation which allow us to include corrections for each seismic station in order to avoid local effects. The resulting magnitude catalog has a better fit with the moment magnitude catalog obtained for the strong earthquakes of this series in previous studies. Moreover, we also computed the spatial and temporal evolution of the b value from the Gutenberg-Richter relation of the improved catalog. The b value map and evolution of the relocated seismicity suggests the presence of a expanding sill of magma in the north of the island at the beginning of the unrest. During the last month of the series, seismicity tracked a magma migration towards the South, where there was the final vent of the submarine eruption.