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Property of long term (1990-2009) seismicity in the region of L'Aquila M_w 6.1 earthquake revealed from machine learning

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On April 6th 2009 (01:32 UTC) strong earthquake of magnitude M_w 6.1 occurred near the city of L'Aquila in the Abruzzo region in the Central Apennines of Italy. Due to the extensional processes the Abruzzo region is characterized by prominent historical seismicity. However, before the 2009 event the background seismic activity is characterised as sparse and mostly clustered in space and time. The general lack of events, especially small magnitude events before the 2009 event motivated us to study the long-term near-fault seismicity before the large earthquake occurrence. To achieve this we first have to extend the existing catalog. We take into consideration the data from the AQU (42.354, 13.405) station that has been recorded in the city of L'Aquila, near Paganica fault responsible for the 2009 event, during an extensive period of 29-years, 19 years before the event itself. The catalog extension is performed by applying the two-stage convolutional neural network pipeline for earthquake detection and characterisation (epicentral distance and magnitude) using three component signal station waveforms. The algorithm allows us to successfully detect ~800 local events (less than 10 km from the AQU station) in the period 1990-2009. We here present a detailed analysis of this catalog including waveforms characterization to derive new insights about the long term preparation processes(es) occurring before the 2009 M_w 6.1 earthquake.