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Abstract

The radioactive nature of radon makes it a powerful tracer for fluid movements in the crust, and a potentially effective marker to study processes connected with earthquakes preparatory phase. To explore the feasibility of using soil radon variations as earthquakes precursor, we analyse the radon concentration data recorded by two stations located close to the epicentre of the strongest mainshock (Mw 6.5 on October 30, 2016) of the seismic sequence which affected central Italy from August 2016. The two stations CTTR and NRCA operate in the framework of the permanent Italian Radon monitoring Network and recorded almost continuously since 2012 and 2016, respectively, the latter being installed just after the first mainshock of the sequence (Mw 6.0 on August 24, 2016). An increase of radon emanation is clearly visible about 2 weeks before the Mw 6.5 event on both the time series, more pronounced on NRCA, nearer to the epicentre, suggesting the possibility of a direct association with the earthquake occurrence. An independently developed detection algorithm aimed at highlighting the connections between radon emission variations and major earthquakes occurrence succeeds in forecasting the Mw 6.5 mainshock on NRCA time series. The resulting time advance of the alarm is consistent with that obtained using a Bayesian approach to compute the a posteriori probability of multiple change points on the radon time series of NRCA. Moreover, it is in agreement with the delay time which maximizes the correlation between radon and seismic anomalies. Applying the detection algorithm to CTTR time series returns alarms for both the Mw 6.0 event, with epicentre closer to this station, and the stronger Mw 6.5 event, but with a higher number of false detections. Finally, we found that a preliminary correction of the bias introduced by variations of meteorological parameters does not affect our main finding of an increase in radon concentration before the major mainshocks. Our study confirms that, although much work is still needed, a monitoring approach based on a permanent dense network is crucial for making radon time series analysis an effective complement to traditional seismological tools.