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Precursors of high magnitude events based on multifractal properties of elapsed time and distance between consecutive earthquakes. An application to New Zealand, years 2000-2018

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Multifractal properties of elapsed time and distances between consecutive earthquakes are analysed by means of the multifractal detrended fluctuation, MF-DF, algorithm. We determined the central Hölder exponent, $\alpha 0$, minimum αmin and maximum αmax Hölder exponents, and spectral amplitude, $\Delta\alpha$ = αmax - αmin, all of them characterizing the multifractal spectrum of the seismic activity. Changes on the evolution of $\alpha 0$, αmax and $\Delta\alpha$, when the analysed segment of seismicity approaches a main event of large magnitude, suggest that these three multifractal parameters could be considered as precursors of this possible event. The statistical significance of these changes is verified by means of the Buishand and Pettitt algorithms, which are used in climatology to detect irregularities on time series of temperature. MF-DF and Buishand and Pettitt algorithms are applied to series derived from the seismic activity of New Zealand (years 2000 – 2018), including close to 10,000 events equalling to or exceeding magnitude 2.5. Statistically significant changes on the three mentioned multifractal parameters are detected for five mainshocks with magnitudes ranging from 5.7 to 7.2. Whereas some of these changes have been detected before the forthcoming mainshock, in some cases they have been detected immediately after the earthquake. Consequently, these multifractal parameters might be considered as possible precursors of earthquakes of notable magnitude, but only after understanding the reason why these changes are detected before or after a mainshock.