Relationship between accelerating seismicity and quiescence, two precursors to large earthquakes

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We investigate the spatiotemporal distribution of precursory accelerating seismicity by following the recently proposed Non-Critical Precursory Accelerating Seismicity Theory (PAST).

The Non-Critical Precursory Accelerating Seismicity Theory (PAST) has been proposed recently to explain the formation of accelerating seismicity (increase of the a-value) observed before large earthquakes. In particular, it predicts that precursory accelerating seismicity should occur in the same spatiotemporal window as quiescence. In this first combined study we start by determining the spatiotemporal extent of quiescence observed prior to the 1997 Mw= 6 Umbria-Marche earthquake, Italy, using the RTL (Region-Time-Length) algorithm. The main shock occurred soon after the recovery of the RTL parameter to its normal background level as already observed for some other large earthquakes such as several Kamchatka earthquakes with M > 7.0, the M 7.2 Kobe earthquake, the Mw 7.4 Izmit earthquake, the Mw 7.6 Chi-Chi and more recently the Ms 8.0 Sichuan earthquake.

We then show that background events located in that spatiotemporal window form a clear acceleration, as expected by the Non-Critical PAST.

The Non-Critical PAST appears to be a promising approach to better understand precursory seismicity. We have shown that (1) the RTL algorithm is reliable in synthetic catalogues and that (2) the theoretical prediction of a quiescence/accelerating seismicity couple is correct prior to the Umbria-Marche main shock.