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# Long-Term Memory in Earthquakes and the Distribution of Interoccurrence Times

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Recently, Corral [A. Corral, Phys. Rev. Lett. **92**, 108501 (2004).] studied the interoccurrence times in a large number of spatial areas of various sizes with stationary seismic activity. He found the remarkable result that independent of the considered area and independent of the threshold $M$, the distribution $D_M(\tau)$ of interoccurrence times scales with the mean interoccurrence time $\overline{\tau_M}$ as $D_M(\tau) = \frac{1}{\overline{\tau_M}} f(\tau/\overline{\tau_M})$ where $f(\Theta)$ is a universal scaling function which does not depend on $M$. When studying the functional form of the scaling function, Corral found that (apart from very small $\Theta$-values), $f(\Theta)$ can be well approximated by the Gamma distribution $f(\Theta) = A\Theta^{-(1-\gamma)}\exp(-\Theta/B)$ with $A = 0.50$, $B = 1.58$, and $\gamma = 0.66$. In a recent analytical study of the ETAS model, Saichev and Sornette [A. Saichev and D. Sornette, Phys. Rev. Lett. **97**, 078501 (2006).] obtained a different form for $f(\Theta)$ with 3 fit parameters and show that also this form fits nicely Corral's data including the regime of very small $\Theta$ values.

Here, we suggest an alternative approach to explain the functional form of $f(\Theta)$, which is based on our finding of long-term memory in the seismic activity. It is well known that long-term correlations are ubiquitous in nature and occur, for example, in climate, hydrometeorological and physiological records, as well as in financial data sets. We focus on the stationary parts of the Southern California Earthquake Catalog (SCEC) from 1995 - 1998 and find that both magnitudes and interoccurrence times are long-term correlated. We show explicitely that the long-term correlations can explain, without any fit parameter, the form of $f(\Theta)$ in the whole $\Theta$-regime, including very small values of $\Theta$.