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Extreme value statistics in records with long-term persistence

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Many natural records exhibit long-term correlations characterized by a power-law decay of the auto-correlation function, $C(s) \sim s^{-\gamma}$, with time lag s and correlation exponent $0 < \gamma < 1$. We study how the presence of such correlations affects the statistics of the extreme events, i. e., the maximum values of the signal within time segments of fixed duration R. We find numerically that (i) the integrated distribution function of the maxima converges to a Gumbel distribution for large R similar to uncorrelated signals, (ii) the deviations for finite R depend on the initial distribution of the records and on their correlation properties, (iii) the maxima series exhibit long-term correlations similar to those of the original data, and most notably (iv) the maxima distribution as well as the mean maxima significantly depend on the history, in particular on the previous maximum. The last item implies that conditional mean maxima and conditional maxima distributions (with the value of the previous maximum as condition) should be considered for improved extreme event prediction. We show explicitly that this dependence of the mean maxima on the previous maximum occurs also in observational long-term correlated records. We also focus on the quantity Q_{100}, an estimator for centennial events mostly regarded in hydrology.