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The Increase of Risk in Extreme Events due to Long-Range Persistence

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Restrictions on land use, building codes, and emergency preparedness are often based on probabilistic hazard forecasting–estimating how often a given size event will occur in a given area. These hazard estimates are usually constructed from the frequency-size distribution of historical events in that area. However, this assumes that event sizes are independent of each other in time (uncorrelated), and no 'clustering' of large events occur. If clustering, or persistence, does occur, then the occurrence of one large event increases the likelihood of another large event occurring. Similarly, if antipersistence occurs, where large events tend to be followed by small ones, then the occurrence of one large event decreases the short-term likelihood of another large event occurring. It is therefore important to quantify not only the statistical distribution of historical events in an area, but also their temporal persistence. With this aim, we (1) construct fractional noises, synthetic time series consisting of Gaussian and log-normal time series with a range of long-range persistence strengths, (2) compare these synthetic time series to 'actual' extreme event time series, (3) superimpose multiple iterations of these constructions to create an ensemble whose properties over time can be calculated. The resulting ensemble forecast measures the increase (decrease) of risk due to persistence (antipersistence) in common hazard probability distributions and 'actual' extreme event series.