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Some physical insights on earthquake statistics derived from a physics-based earthquake seismicity simulator

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Earthquake occurrence stems from a complex interaction of processes that are still partially unknown. This lack of knowledge is revealed by the different statistical distributions (sometimes antithetical) that have been so far proposed, and by the different beliefs about the role of some key components as the tectonic setting, fault recurrence, seismic clusters, and fault interaction. In this presentation, we explore these issues through a numerical model based on a realistic interacting fault system. The model has three main features: 1) it may account for a realistic 3-D fault distribution; 2) it imposes, a priori, a simple behavior of earthquake occurrences on each fault (purely recurrent or purely Poisson); 3) it allows faults to interact through a co- and post-seismic Coulomb Failure Function (CFF) model. The model has been applied (in collaboration with Italian and US colleagues) to areas with different tectonic style, Central Italy and California. Here, we report the results of these applications in order to understand which physical components are more important to describe the statistics of earthquake occurrences. Specifically, we focus the attention on the time domain, comparing the time features of real seismic catalogs with the synthetic catalogs obtained by the model. The results highlight many interesting issues, such as the role of recurrent fault behavior versus earthquake time clusters, insights on long-term modulation of earthquake occurrence rates, and possible intrinsic limitations of earthquake forecasting based on CFF.