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Time-Dependent Båth law

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The well-known Båth law measures an average difference between the magnitude of mainshocks and their largest aftershock, which is approximately equal to 1 unit of magnitude in all tectonic settings. Most of the largest aftershocks occur however within few hours after the mainshocks. We find that the time distribution of the largest aftershocks follows an Omori-like power-law. Nevertheless, the delayed aftershocks may have more dramatic consequences than immediate ones. Accordingly, a special interest is given to the relative magnitude of the largest aftershocks that occurred after a given moment t. Using global statistics of the aftershocks of $M \geq 6.5$ earthquakes, we present these empirical distributions. We show also that the overall aftershock productivity (number of aftershocks per main shock) is more likely to follow exponential distribution than commonly assumed Poisson distribution. The Gutenberg-Richter and the Omori laws combined with the statistics of extremes proposed by D. Vere-Jones and an exponential distribution of the aftershock productivity can reproduce the empirical distributions and the dependence of quantiles with respect to time t. The research was partially supported by Russian Science Foundation (Project 16-17-00093).