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The generalized truncated exponential distribution as a model for earthquake magnitudes

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The random distribution of small, medium and large earthquake magnitudes follows an exponential distribution (ED) according to the Gutenberg-Richter relation. But a magnitude distribution is truncated in the range of very large magnitudes because the earthquake energy is finite and the upper tail of the exponential distribution does not fit well observations. Hence the truncated exponential distribution (TED) is frequently applied for the modelling of the magnitude distributions in the seismic hazard and risk analysis. The TED has a weak point: when two TEDs with equal parameters, except the upper bound magnitude, are mixed, then the resulting distribution is not a TED. Inversely, it is also not possible to split a TED of a seismic region into TEDs of subregions with equal parameters, except the upper bound magnitude. This weakness is a principal problem as seismic regions are constructed scientific objects and not natural units. It also applies to alternative distribution models. The presented generalized truncated exponential distribution (GTED) overcomes this weakness. The ED and the TED are special cases of the GTED. Different issues of the statistical inference are also discussed and an example of empirical data is presented in the current contribution.