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# Mathematical aspects of assessing extreme events for the safety of nuclear plants

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In the paper the review of mathematical methodologies applied for assessing low frequencies of rare natural events like earthquakes, tsunamis, hurricanes or tornadoes, floods (in particular flash floods and surge storms), lightning, solar flares, etc., will be given in the perspective of the safety assessment of nuclear plants. The statistical methods are usually based on the extreme value theory, which deals with the analysis of extreme deviation from the median (or the mean). In this respect application of various mathematical tools can be useful, like: the extreme value theorem of Fisher–Tippett–Gnedenko leading to possible choices of general extreme value distributions, or the Pickands–Balkema–de Haan theorem for tail fitting, or the methods related to large deviation theory. In the paper the most important stochastic distributions relevant for performing rare events statistical analysis will be presented. This concerns, for example, the analysis of the data with the annual extreme values (maxima – "Annual Maxima Series" or minima), or the peak values, exceeding given thresholds at some periods of interest ("Peak Over Threshold"), or the estimation of the size of exceedance. Despite of the fact that there is a lack of sufficient statistical data directly containing rare events, in some cases it is still possible to extract useful information from existing larger data sets. As an example one can consider some data sets available from the web sites for floods, earthquakes or generally natural hazards. Some aspects of such data sets will be also presented taking into account their usefulness for the practical assessment of risk for nuclear power plants coming from extreme weather conditions.