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Extreme flood estimation by different probability distribution laws in different climatic conditions

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In flood plain planning, flood plain mapping, and flood control reservoir design, an estimate of the once in 100 (or 50 or 500) year flood event is often used as the design event upon which design and management policies are based. The traditional approach to obtain such an estimate is based on fitting an analytical distribution to historical data.

In European, American and Russian publications many different types of distribution functions are used. But there does not seem to be a standard method to take into account hydrological, geographical and meteorological knowledge in the estimation of extreme hydrological events in different flooding regions.

Fitting a distribution to empirical data sets does not necessarily provide a basis for extrapolation to frequencies far beyond the range of the data set. This type of extrapolation raises difficult questions both from a mathematical and a philosophical point of view.

Under these circumstances a physically based stochastic model for estimating flood events seems a better solution. As a modest step on the road to such a solution this presentation examines whether certain physical circumstances result in time series

of extremes that behave in a way more in line with one particular type probability distribution or group of distributions than with others.

In other words, the working hypothesis will be that different types of probability distribution functions correspond to different kinds of catastrophic hydrological events. For example, the behavior of “trend type catastrophe” like see level fluctuation under the climate change is usually well fitted by the normal distribution, the behavior of “extremal catastrophes” like moderate floods is well approximated by the exponential distribution function, and catastrophic floods tend to have distributions with power law tails.

For this study flood series were collected from four different climatic regions: The Danube Basin in Austria (67 series), the Baikal Basin in Siberia (39 series), a coastal region in the Russian Far East (45 series) and Hawaii (66 series).