Geophysical Research Abstracts, Vol. 9, 02338, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02338
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Uncertainty in rainfall depth-duration-frequency curves

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Statistics of extreme rainfall are important for hydrologic design purposes, such as the construction of sewerage systems, to prevent pollution of surface waters and flooding. These statistics are often contained in rainfall depth-duration-frequency (DDF) curves, which describe rainfall depth as a function of duration for given return periods. For the Netherlands DDF curves are constructed and the uncertainty due to sampling variability is quantified. For this purpose the hourly rainfall depths from 12 rain gauges are analysed. The records of these stations are concatenated to one station-year record, since no geographical variation in extreme rainfall statistics could be found. A Generalized Extreme Value (GEV) distribution is fitted to the 514 annual rainfall maxima from the station-year record for durations of 1, 2, 4, 8, 12 and 24 hour separately. DDF curves can be constructed by describing the estimated GEV parameters as a function of duration and substituting these relationships into the quantile function of the GEV distribution. The dependence of the GEV parameters on duration is modelled by the method of generalized least squares using the bootstrap to estimate the correlation between these parameters. The bootstrap is also used to quantify the uncertainty in the DDF curves due to sampling variability of the estimated GEV parameters. It turns out that the uncertainty in the DDF curves can be described by a lognormal distribution for a range of durations and return periods.

Key words: Rainfall, DDF curves, Bootstrap, GEV distribution