The Use of Intensity-Duration-Frequency Curves for Precipitation in Central Africa – A Tool for Natural Disaster Prevention

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The establishment of Intensity-Duration-Frequency (IDF) curves for precipitation is a powerful tool to aggregate our knowledge on extreme precipitation events and therefore remains a valuable technique in risk analysis of natural hazards. Indeed the IDF curves allow for the estimation of the return period of an observed rainfall event for given aggregation times or conversely of the estimation of the rainfall amount corresponding to a given return period for a given aggregation time.

Although there is a high need for long-term high-frequency information on the occurrences of precipitation in Central Africa, few such data sets in that region are available. The present paper deals with the construction of IDF-curves at Yangambi in the Oriental Province of Congo. The IDF-curves for the tropical area of Central Africa are an interesting tool to be used in sewer design system, in particular, to combat the frequently occurring inundations in semi-urbanized and urbanized hilly areas of large African towns and mega-towns. Furthermore, based on long-term time-series, the relationship of extreme precipitation with the ENSO indicator will be assessed.

A set of IDF-curves for precipitation expresses the relationship between the mean intensity of precipitation i (in mm/h) during a certain aggregation time or duration d (in min) and the return period T (in years) of the event. The return period of a precipitation event indicates of how rare / frequent is this event and is defined in the annual block data maxima technique by the annual exceedance probability of the adjusted probability distribution.

The IDF-relationship is written as a function $i = f(T, d)$of the variables T and d, where only expressions of the type $i = \frac{a(T,p1)}{b(d,p2)}$ are considered. The functions $a(T)$and $b(d)$are parameterised by the parameter sets $p1$ and $p2$. Usually, for durations not exceeding 24 hours, only two parameters η and θ have to be estimated in the denominator$b(d)$. The nominator $a\ (T, p1)$ is directly derived from the cumulative distribution function of the annual maximum values of rainfall depths. As a consequence of the available data sets, consisting of monthly and annual extremes for various durations (15 minutes to 2 hours and the daily precipitation depths), only the annual maximum block data technique could be used.