

Generation of synthetic flood hydrographs by hydrological donors (SHYDONHY method)

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For the design of hydraulic infrastructures like dams, a design hydrograph is required in most of the cases. Some of its features (e.g. peak value, duration, volume) corresponding to a given return period are computed thanks to a wide range of methods: historical records, mono or multivariate statistical analysis, stochastic simulation, etc. Then various methods have been proposed to construct design hydrographs having such characteristics, ranging from traditional unit-hydrograph to statistical methods (Yue et al., 2002).

A new method to build design hydrographs (or more generally synthetic hydrographs) is introduced here, named SHYDONHY, French acronym for “Synthèse d’HYdrogrammes par DONneurs HYdrologiques”.

It is based on an extensive database of 100 000 flood hydrographs recorded at hourly time-step on 1300 gauging stations in France and Switzerland, covering a wide range of catchment size and climatology. For each station, an average of two hydrographs per year of record has been selected by a peak-over-threshold (POT) method with independence criteria (Lang et al., 1999). This sampling ensures that only hydrographs of intense floods are gathered in the dataset.

For a given catchment, where few or no hydrograph is available at the outlet, a sub-set of 10 “donor stations” is selected within the complete dataset, considering several criteria: proximity, size, mean annual values and regimes for both total runoff and POT-selected floods. This sub-set of stations (and their corresponding flood hydrographs) will allow to:

- Estimate a characteristic duration of flood hydrographs (e.g. duration for which the discharge is above 50% of the peak value).
- For a given duration (e.g. one day), estimate the average peak-to- volume ratio of floods.
- For a given duration and peak-to-volume ratio, generation of a synthetic reference hydrograph by combining appropriate hydrographs of the sub-set.
- For a given daily discharge sequence, being observed or generated for extreme flood estimation, generate a suitable synthetic hydrograph, also by combining selected hydrographs of the sub-set.

The reliability of the method is assessed by performing a jackknife validation on the whole dataset of stations, in particular by reconstructing the hydrograph of the biggest flood of each station and comparing it to the actual one.

Some applications are presented, e.g. the coupling of SHYDONHY with the SCHADEX method (Paquet et al., 2003) for the stochastic simulation of extreme reservoir level in dams.

References:

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