An accurate estimation of the flood peak, volume and hydrograph shape is needed to design both safe and cost-effective hydraulic structures and to manage flood risks in an integrative manner. The flood peak for a specific return period is frequently the only quantity considered. Although, it provides only limited information about a flood event.

We therefore propose a statistical approach that allows for the estimation of the design variables peak and volume by constructing a synthetic design hydrograph (SDH). This method is based on fitting different probability density functions to observed flood hydrographs and takes into account the dependence between flood peak and volume. Specifically, it consists of the following six steps: 1) sampling of flood events; 2) estimation of the direct runoff hydrographs (baseflow separation); 3) normalization of the hydrographs; 4) fitting these hydrographs with statistical density functions; 5) estimation of flood peak and volume considering their dependence; and 6) construction of the SDH.

The advantages of the method are its ease of application, its independence from a rainfall-runoff model, and the possibility to account for the dependence between flood peak and volume. The method was developed and successfully tested using 39 meso-scale catchments in Switzerland, providing reliable SDHs for all study catchments.

At the current stage, the method can be applied in any meso-scale catchment without significant glaciation and with unaltered flow conditions, given that observational data are available. In a next step, the method will be regionalized to allow for flood volume and hydrograph to be estimated in catchments without discharge measurements. To this end, we will first explore a typology of causative flood mechanisms and represent the modelled shape of hydrographs as a function of such flood types. Second, we will determine the relationships between various catchment properties and the design variables peak and volume.