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Do regional methods really help reduce uncertainties in flood frequency analyses?

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Flood frequency analyses are often based on continuous measured series at gauge sites. However, the length of the available data sets is usually too short to provide reliable estimates of extreme design floods. To reduce the estimation uncertainties, the analyzed data sets have to be extended either in time, making use of historical and paleoflood data, or in space, merging data sets considered as statistically homogeneous to build large regional data samples. Nevertheless, the advantage of the regional analyses, the important increase of the size of the studied data sets, may be counterbalanced by the possible heterogeneities of the merged sets.

The application and comparison of four different flood frequency analysis methods to two regions affected by flash floods in the south of France (Ardèche and Var) illustrates how this balance between the number of records and possible heterogeneities plays in real-world applications. The four tested methods are: (1) a local statistical analysis based on the existing series of measured discharges, (2) a local analysis valuating the existing information on historical floods, (3) a standard regional flood frequency analysis based on existing measured series at gauged sites and (4) a modified regional analysis including estimated extreme peak discharges at ungauged sites. Monte Carlo simulations are conducted to simulate a large number of discharge series with characteristics similar to the observed ones (type of statistical distributions, number of sites and records) to evaluate to which extent the results obtained on these case studies can be generalized.

These two case studies indicate that even small statistical heterogeneities, which are not detected by the standard homogeneity tests implemented in regional flood frequency studies, may drastically limit the usefulness of such approaches. On the other hand, these result show that the valuation of information on extreme events, either historical flood events at gauged sites or estimated extremes at ungauged sites in the considered region, is an efficient way to reduce uncertainties in flood frequency studies.