Geophysical Research Abstracts
Vol. 13, EGU2011-5736, 2011
EGU General Assembly 2011

Usefulness of historical information for flood frequency analyses: developments based on a case study and a Bayesian MCMC approach

Olivier Payrastre, Eric Gaume, and Hervé Andrieu
Ifsttar, Geotechnics, water and risks department, Bouguenais, France (olivier.payrastre@ifsttar.fr, 0240845998)

Frequency analyses, i.e. estimations of the quantiles of various hydrological variables like flood peak discharges, remain an important issue for hydrology. Due to the limited duration of existing flow measurement series, the accuracy of low frequency quantiles estimated through statistical inference procedures is often insufficient. This led hydrologists to investigate the possibility of incorporating information about large past floods (historical or paleofloods) in flood frequency analyses. A number of theoretical and applied works have already illustrated the possible usefulness of such additional information. Nevertheless, in real world applications, the usefulness of historical flood inventories may be limited by the quantity and quality of information that can be unearthed. The information on past floods may be sparse - only a few events are sufficiently well documented or left marks, and the corresponding estimated peak discharge values may be highly uncertain without direct current meter measurements or calibrated rating curves. As the conclusions on the benefit of historical inventories may depend on the quantity and type of data available in each application, the scientific debate on this topic cannot only rely on theoretical works and sensitivity analyses but must also be based on real world applications.

This presentation illustrates what kind of historical information on extreme floods can be retrieved in the a priori unfavourable case of small and sparsely populated catchments, and how this information can improve the estimation of flood discharge quantiles. It is based on the analysis of four small gauged rivers located in the south of France, with catchment surfaces of less than 200 km^2. Using various sources of archives, historical flood inventories that cover periods ranging from 100 to 200 years could be obtained. The possible bounds for historical flood peak discharges could be estimated for 5 to 22 floods in each case.

The corresponding historical discharge series are then used in combination with the available systematic measurement series to evaluate peak discharge quantiles. The selected Bayesian Monte Carlo Markov Chain statistical inference approach provides credibility intervals for the estimated quantiles, the width of which reflects the information content of the data set used for the inference. The use of the historical data in the inference procedure leads to significant reductions of these credibility intervals, even if important limitations in the content of historical inventories are introduced: reduction of the number of historical floods documented, or information limited to the number of times a threshold has been exceeded (binomial censored data).

A sensitivity analysis based on Monte Carlo simulations is then presented to illustrate to what extent these positive conclusions can be extrapolated to other case studies. The sensitivity to the respective lengths of the historical and systematic measurements periods, to the number of historical floods documented (position of perception threshold), and to the availability of accurate peak discharges estimates (censored data or binomial censored data) is evaluated. The results illustrate the important role of the historical record length, and the limited sensitivity to the position of the perception threshold, and to the level of detail of information on historical peak discharges. These results are consistent with other previous works on the same issue and also explain why these works could lead to apparently contradictory conclusions concerning the possible usefulness of historical data in flood frequency studies.