Geophysical Research Abstracts
Vol. 20, EGU2018-2741, 2018
EGU General Assembly 2018

Flood frequency analyses and the added value of historical datasets: case study for the Meuse River basin (1500 – 2015)

Jan De Niel (1), Gaston Demarée (2), and Patrick Willems (1)
(1) KU Leuven, Belgium (jan.deniel@kuleuven.be), (2) Royal Meteorological Institute of Belgium, Brussels, Belgium

Hydrological structures, nowadays, are designed to withstand storms with return periods ranging between 1,250 and 10,000 years. These design levels can be obtained through flood frequency analyses. Here, assumptions are made and extrapolations are carried out, both contributing to a highly unclear accuracy of quantified extreme design levels. In order to evaluate extreme river peak flow extrapolation and accuracy, we studied historical and instrumental data along the Meuse River.

A database with historical evidence of floods in the Meuse River basin for the period 1500 – 2015 is built by a thorough investigation of contemporaneous (non-)published manuscripts, annals, journals, diaries, almanacs, chronicles, descriptions, tracts, collections, yearbooks, essays, ephemerides, registers, pamphlets, mémoires, newspapers starting in the early eighteenth century, magazines, reports, and scientific publications by historians, environmentalists, and hydrologists. These floods are categorized by means of flood intensity indices, ranging from cat. 1 (a small, regional flood with little damage) to cat. 3 (a flood on a disastrous scale with severe damage to buildings). When this mainly qualitative dataset is complemented with (limited) systematically measured instrumental data, we show how an empirical extreme value distribution can be obtained with return periods up to 500 years. Obviously, this approach has its own limitations and assumptions and thus still holds a certain degree of uncertainty.

The extreme value distribution based on the historical dataset is further used to verify more traditional flood frequency analyses with instrumental data only. Therefore, we apply three different techniques to estimate extreme daily peak flows at a particular gauging station based on systematically measured data from the mid nineteenth century onwards: a traditional Generalized Pareto Distribution (GPD) and a weather typing based GPD are fitted; a model-based approach consisting of a rainfall generator coupled with a rainfall-runoff model was available from literature. Comparison of these various traditional flood frequency analyses with the empirical values from the historical dataset clearly shows the added value of the latter, especially for the extreme high return periods larger than 50 years.

Main reference: De Niel, J., Demarée, G. & Willems, P. (2017). Weather typing-based flood frequency analysis verified for exceptional historical events of past 500 years along the Meuse River. Water Resources Research, 53. https://doi.org/10.1002/2017WR020803