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Editorial

Flood Investigations in Europe and Lithuania

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Flooding is the most pervasive natural hazard and the third most damaging disaster after storms and earthquakes (World Bank/United Nations 2010). There were dangerous floods in Lithuania too. The highest floods in Lithuanian rivers were observed in 1931, 1941, 1951, 1953, 1956, 1958, 1968, 1970, 1979, 1985 and 2010. Most of them have a return period of less than 5 years in 100 years. It means that such flood can occur once every twenty year. Recent years were marked by very early floods with multiple peaks, causing additional difficulties in their management. In addition, under the current climate change conditions, extreme flood events become an increasing hazard in terms of risk and damage potential.

According to the European Flood Directive 2007/60/EC, the flood assessment and management could reduce the risk of adverse consequences, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015. In Lithuania implementation of these activities is currently carried out.

Reliable estimates of expected extreme flood events are required for design and operation of vital infrastructure such as flood defences, bridges and culverts, and also for more general flood risk management and planning (emergency planning, flood risk mapping, and for defining flood insurance premiums). In practice, this information is obtained through the use of flood frequency estimation techniques based on the principle of analysing series of observed events to infer a probabilistic behaviour, which is then extrapolated to provide estimates of the likely magnitude of forthcoming extreme events (e.g. the magnitude of the flood expected to be exceeded on average once every 100-year). Extreme flood events are seldom observed locally and hydrologists do not have much information concerning to catastrophes. This raises the question of how best to extrapolate to extreme events when no or only short series of recent events are available.

While the occurrence of extreme floods is a common problem across Europe, the individual countries develop national procedures for flood frequency estimation. Examples of such programmes are “Flood and coastal erosion risk management R&D programme” in the UK, “Risk Management of Extreme Flooding Events” (RIMAX) in Germany, the Italian National grant: “Characterisation of average and extreme flow in ungauged basins by integrated use of data-based methods and hydrological modelling” (CUBIST), the French research programme “Extreme Rainfall and Flood Assessment” (EXTRAFLO), and the Slovak National programme “Study of dependence and spatial properties of multivariate characteristics of hydrometeorological and hydrological extremes in the mountainous regions of Slovakia”. As a result, no standardised European approach

to flood frequency estimation exists. Where methods do exists they are often simple and their ability to accurately predict the effect of environmental change (e.g. urbanisation, land-use change and climate change) is unknown. Also, the problem of consistent estimates of extreme floods for trans-boundary rivers is rarely considered. There is no national research programme for flood estimation in Lithuania.

The international research projects could help develop European approach to flood estimation methods. One of such projects is the COST Action ES0901 "European procedures for flood frequency estimation" (FloodFreq). This COST Action has developed a network of experts from 25 European countries (Lithuanian representatives are scientists from Lithuanian Energy Institute) and provided an excellent opportunity for sharing knowledge and data, and to develop the next generation of hydrological tools providing solutions to common problems. FloodFreq will act as a European focal point for fragmented research into flood frequency estimation being undertaken at the Member State level, and will constitute the first comparative study of different methods for flood frequency estimation on a European scale. The Action will also deliver a framework for assessing the impact of environmental change on flood frequency characteristics, and its outcome will lead to improved and spatially consistent European flood frequency estimation procedures.

The physical mechanisms responsible for flood generation vary through-out Europe, but do not align with national and administrative borders currently determining the choice of method for flood frequency estimation. There is a need for a coordinated European initiative to test the different techniques, and to test their applicability considering the different climatological and geographical conditions, and different levels of data availability. The specific scientific challenge of COST activity is the pan-European comparison and evaluation of the methods, physiographic regions and a variety of spatial scales in order to ensure comparable flood frequency estimates and safety measures over Europe.

One of the case studies in FloodFreq was the research of flood pattern changes in the rivers of the Baltic countries. The spring flood data of the 19 rivers from different hydrological regions in the Baltic countries were analysed applying the same methodology for the different periods (1922–2010, 1922-1960, 1961–2010 and 1991–2010).The calculation of trend statistics of spring flood data series was done with the nonparametric Mann-Kendall test. In this study five frequently used probability distributions (Gumbel (EV1), generalized extreme value (GEV), log-Pearson type III (LP3), three-parameter lognormal (LN3) and generalized logistic (GLO)) were selected for the analysis of statistical characteristics of river flood data in the Baltic States.

The Baltic State rivers can be attributed to one of the three hydrological regions: marine, continental and transitional. The estimated spring flood patterns differed among the rivers of the separate hydrological regions in the selected different time periods. The biggest floods ever recorded in the rivers of the Baltic countries occurred in the period of 1922–1960: the greatest ones were observed in the western regions and the lowest - in the eastern and south-eastern parts of the States. Maximum discharges of spring floods were decreased in the long periods of 1922–2010 in almost all studied rivers. Flood data series trends are definitely negative and maximum discharges are observed earlier and earlier because winters became warmer. In the last period (1991–2010) fewer changes in maximum discharges were observed. The analysis has shown no significant trends in the studied river flood data. The reason for the detected tendencies is that no big floods occurred in the last period (except the large flood of 2010 in the Nemunas River). A long series of spring flood data allows performing flood frequency analysis and projecting the floods of a certain probability. The analysis has revealed that GEV or LP3 distributions provide the best approximation to the flood data series of the studied rivers. These widely used probability distribution models enable specialists to calculate the design floods in the rivers of the studied area.

The study has shown that spring floods in the rivers of the Baltic Countries have decreased in the last years. Nevertheless, it does not mean that extensive spring floods will not occur in the future and there is no reason to worry about prevention and protection. The observed variability of spring flood discharges in time is definitely climate driven, although the changing scale of anthropogenic activities plays significant role as well. Combination of all these factors together makes estimation and prediction of flood events even more complicated.