Geophysical Research Abstracts, Vol. 7, 06364, 2005
SRef-ID: 1607-7962/gra/EGU05-A-06364

Spatial analysis of extreme precipitation in North-East Bohemia in July 1998 (comparison of Gumbel distribution and Generalized extreme VALUE (GEV) distribution - focus on shape (k) parameter)

O. Prosova (1), P. Stepanek (2)

(1) Czech Hydrometeorological Institute, Regional office Hradec Kralove, Czech Republic (prosova@chmi.cz / Fax: ++420-495 436 175 / Phone: ++420-495 436 164)

(2) Czech Hydrometeorological Institute, Regional office Brno, Czech Republic (petr.stepanek@chmi.cz / Fax: ++420-541 421 019 / Phone: ++ 420-541 421 030)

Introduction

Extreme precipitation event occurred in North-East Bohemia in summer 1998. It was in July, in the evening of the 22^{nd} and in the morning of 23^{rd} when observed precipitation hit the highest totals at some stations (more than 200 mms). Extreme precipitation caused flash flood with extensive damage. 6 people died, many buildings and bridges were badly damaged or destroyed. Total economic losses were estimated to be about 2 billion CZK (60-70 mill's USD). Many articles were written about this event. They summarized causes and consequences of this flash flood or they reconstructed precipitation totals from the viewpoint of remote sensing and numerical models results.

The aim of this study was to calculate maximum daily precipitation totals for 10, 20, 50 and 100-years return period and their spatial distribution. We wanted to find the changes in a return period before extreme event and after it. We tried to control calculation with selected distributions parameters.

Data

Absolute daily precipitation totals were used from climatological and precipitation stations of Czech Hydrometeorological Institute (CHMI). 48 stations were processed for the time period 1961-2003. All stations were located in the area of regional office

CHMI Hradec Kralove (East Bohemia).

Processing

Gumbel distribution and Generalized Extreme Value (GEV) distribution were used for a calculation of return periods. Gumbel method is one of the most well-known and used methods. Both distributions are generally used for extreme events. We focused on the parameters of the distribution (scale, location and especially shape parameters). These three parameters of selected station were compared how they changed if the series were taken only before extreme event of July 1998 or including this event. For better spatial structure of return periods, distribution parameters of selected stations were used as parameters of all other stations and change in return periods was investigated.

Maps were created by means of dependence of absolute daily precipitation totals on altitude using linear regression model.

Two special programs were used for data processing. The first one was ProClimDB – a database software for processing whole climatological datasets and the second one was AnClim – a software for time series analysis and homogenization. ArcView3.2. software was used for data imaging.

Results

A big leap was detected in time series of four stations in the study area. This leap was caused by an extreme event. The calculation of return period was changed depending on occurrence of high precipitation totals (of July 1998). We had 48 stations which measured in time period 1961-2003. Only the station Belec nad Orlici had the longest time series from 1933 to 2003 – that means 70 years. So 50-years return period was the most representative. Larger return periods were rather expert estimations. There were about 10 stations of which the shape parameter was higher than $|k|>0,2$. These stations are located in a marginal region of the study area. The dependence of absolute daily maximum precipitation totals on altitude using whole study area was not so good (from the statistical point of view it was not significant). But the regional dependence was statistically significant and the determination coefficient was about 60 percents before the event as well as after it so it was possible to use this dependence for plotting maps of return periods of the region.

Conclusions

Absolute daily maximum precipitation totals were measured in the Orlicke hory Mountains. It was caused by terrain effect and by a special synoptic situation in this area. Absolute maximum precipitation totals are related to topographical conditions.

Density of climatological and precipitation stations net is a big problem in case of flash floods. The net is in regional scale very good, but in local scale it is not sufficient. The flash floods occur in very small (local) scale and affect an area only of size of a few square kilometers.

References

BAILLON, M., BESSEMOULIN, P., BOUTORBE, J.P., VEYSSEIRE, J.M.(2004): Behaviour of the shape parameter of the generalized extreme value (GEV) distribution applied to the determination of extreme precipitation in France, for accumulation times from 6 minutes to 10 days, In: 4th Annual Meeting of the European Meteorological Society, Abstracts CD-ROM, Nice, France

FARAGÓ, T., DOBI, I., KATZ, R.W., MATYASOVSKY, L. (1989): Meteorological application of extreme value theory: probléme of finite, dependent and non-homogeneous samples. Idöjárás (Journal of the Hungarian Meteorological Service), 93, 5, 261-275 s.

FARAGÓ, T., KATZ, R.W. (1990): Extremes and design values in climatology. Report No.WCAP-14, WMO/TD-No.386, World Meteorological Organization, Geneva

HANCAROVA, E. ET AL. (1999): Katastrofalni povoden podhuri Orlickych hor ve dnech 22.-25.7.1998. Meteorol.Zpr., 52, 1999, c.1, s.1-12.

METELKA, L. (2000): Studie moznosti statisticke korekce radarovych odhadu srazek pomoci neuronovych siti na pripadu Rychnovska, 22.-23.7.1998, Meteorol.Zpr., 53, c.x, s.146-152

PALUTIKOF, J. P., ET AL (2004): Methods to calculate extremes in climate change studies [online]. http://www.cru.uea.ac.uk/projects/mice/extremes_description.pdf.

PROSOVA, O. (2004): Spatial and temporal changes in absolute maximum daily precipitation totals in Moravia and Silesia during the instrumental period, In: 4th Annual Meeting of the European Meteorological Society, EMS Annual Meeting Abstracts CD-ROM, Nice, France

SALEK, M. (2000): Privalove srazky v podhuri Orlickych hor 22.-23.cervence 1998 z hlediska metod dalkove detekce a vysledku numerickych modelu. Meteorol.Zpr., 53, c.1, s.4-15.

STEPANEK, P. (2004a): AnClim - software for time series analysis. Dept.of Geography, Fac. of Natural Sciences, MU, Brno, 1.54 MB. http://www.sci.muni.cz/∼pest/AnClim.html

STEPANEK, P. (2004b): ProClimDB - software for processing climatological datasets.

CHMI,regional office Brno. http://www.sci.muni.cz/∼pest/ProcData.html

STRIZ, M. (2001): Nastroje pro prostorovou analyzu srazek v GIS. Diplomova prace. Institut ekonomiky a systemu rizeni Technicke univerzity Ostrava, Ostrava, s. 63