Geophysical Research Abstracts, Vol. 7, 08357, 2005
SRef-ID: 1607-7962/gra/EGU05-A-08357

Regional short-term heavy rainfalls and their causes

M. Gajic-Capka and M. Horvat

Meteorological and Hydrological Service of Croatia, Zagreb, Croatia (capka@cirus.dhz.hr, Phone: +385 1 45 65 640)

The area of the Istra peninsula at the Croatian eastern Adriatic coast with its few small rivers belongs to the Adriatic catchments. Floods that appear as a consequence of heavy rainfalls harm mainly agricultural valleys. This paper deals with the investigation of magnitude (design parameter) and causes (forecasting input) of rainfall extremes over this region (coastal and inland sites).

On average they appear in the warm part of the year; most frequently in August (September), corresponding to the summer maximum of continental precipitation regime in Croatia. This pattern remains over the peninsula inland also during the last 20 years (1985-2002), but at the coast August maximum is weakening and annual maximum appears most frequently in June and October. Autumn maximum is associated with the pattern of the maritime annual course of precipitation.

Extreme value analysis (GEV) according to Jenkinson (Jenkinson, 1969, Faragó and Katz, 1990, Gajic-Capka, 1991) has been applied to rainfall maxima for intervals t up to two hours that are relevant for surface drainage. Estimates of maxima that can be expected for different return periods are important input data in design calculations of hydro-technical infrastructures in order to reduce climatic risk.

According to the coefficient of variation there is no large difference in spatial variability of short-term maxima (inland: 0.32-0.40, coastal sites: 0.30-0.36). Recorded 10- and 20- minute maxima (23 and 34 mm at coastal site and 42 and 52 mm in inland) during the observed 40-year period were rare phenomena that could be expected once in a period longer than 100 years.

The calculated values of the parameters R_0, k and α of the Jenkinson distribution according to the 1962-2002 data series (Gajic-Capka, 2000) are presented for two stations (coastal and inland) and intervals of 10-, 20-, 30-, 40-, 50- 60- and 120-minutes.

The expected maxima Rt_T, namely the design values for each intervals (t) and desired return periods (T) were calculated. This has been done for the return periods of 10, 20, 50 and 100 years, namely for those supposed not to be exceeded with the 90%, 95%, 98% and 99% probability.

Jenkinson distribution for almost all intervals has positive values of curvature parameter k, except for very short intervals (10-40 min) in inland, but close to zero. Estimated short-term rainfall maxima are a little bit higher in inland than at coastal site (10-15%).

Weather types causing rainfall maxima over threshold for all observed intervals have been determined according to Poje's classification (1965) and the analysis for the Northern Adriatic (Loncar and Vucetic, 2003). The basic characteristics of weather types are presented by surface fields of air pressure and in some cases at 850 hPa. Frequency of weather types was calculated for two locations, at the coast and in the central part of the Istra peninsula.

During the period 1985-2002 weather type characterized by front side of the cyclone caused heavy precipitation in 26% of the episodes at the coast and in 31% in inland. These were the weak cyclones with the pressure of 1000 hPa in its centre and their front side over the Istra peninsula and Northern Adriatic. It was followed by low air pressure weather types, front side of trough, with 12% of episodes in inland and back side of trough, with 14% of episodes at the coast. Unexpectedly 11% of rainfall episodes were caused by low gradient anticyclone surface field. In the most cases they were accompanied by upper level cyclones or low pressure troughs. Such situations prevail during the warm part of the year when upper air disturbances over the relatively warm ground are favourable for the evolution of convective cloudiness and local precipitation. Three episodes of heavy rainfall followed by floods are analysed in more detail.

References

Faragó, T., Katz, R. W., 1990: Extremes and Design Values in Climatology, World Meteorological Organisation, WMO/TD-NO. 386, WCAP - 14, pp 46

Gajić-Čapka, M., 1991: Short-term precipitation maxima in different precipitation climate zones of Croatia, Yugoslavia. Int. J. Climatol., 11, 677-688.

Gajić-Čapka, M., 2000: Normal Length Of Maximum Short-term precipitation Series. 5^{th} International Workshop on Precipitation in Urban Areas, From Precipitation Measurements to Design and Forecasting Modelling, Preprints of papers, Ed. P. Burlando and Th. Einfalt, IHP-V / Technical Documents in Hydrology, UNESCO, 177-182.

Jenkinson, A. F., 1969: Statistics of Extremes, Estimation of Maximum Floods. World

Meteorological Organisation, Geneve, WMO Technical Note No. 98, Chapter 5.

Loncar, E., Vucetic, V., 2003: Weather Types and Their Application to the Northern Adriatic (in Croatian), Hrv. Meteor Cas., 38, Zagreb, 57-81.

Poje, D., 1965: Weather Types in Yugoslavia and Their Relation to Atmospheric Circulation over Yugoslavia (in Croatian). Dissertation, University of Zagreb, pp 215.