3.3. PRECIPITATION PROBLEMS IN RELATION TO WATER RUNOFF ON THE TRNOVSKI GOZD

(J. PRISTOV)

As the basis for the study of precipitation problems served the daily precipitation gauged at 07 hrs. From among 15 stations in the area of the Trnovski Gozd and the Nanos, only the station Podkraj is equipped with a gauge of Hellmann type which continuously registers the precipitation. Indeed, it is not enough for the analysis of precipitation situation because the distribution of precipitation in individual areas of the Nanos and the Trnovski Gozd considerably differs, from one precipitation situation to another.

For the comparison of precipitation with discharges, the data from the following four hydrological gauging profiles in the area of the Trnovski Gozd and the Nanos and their rims were selected:

the Idrijca-LP Podroteja
the Vipava-LP Vipava
the Hubelj-LP Ajdovščina
the Lijak-LP Šmihel

Analysis of the precipitation was performed on data from precipitation situations after the end of the long-lasting dry period in 1993. Heavy precipitation occurred on September 25, and were recurring until the end of October 1993. The precipitation situation between October 21 and 25, 1993 was studied in detail.

The precipitation situation between October 21 and 25, 1993

The time and spatial distributions of precipitation were even over the entire area in this situation. The precipitation maximum occurred between Črni Vrh Nad Idrijo and Mrzla Rupa. This is the only case that the ratio of precipitation quantities was only 1:2 (Ozeljan 134 mm; Črni Vrh 265 mm). Podkraj received 206 mm of precipitation. This even distribution was possible due to more permanent precipitation without any longer interruptions. The precipitation in this case did not fall in the form of rainstorms.

More abundant precipitation began in Podkraj on October 21, at 06 hrs, and by 09 hrs, 25 mm of precipitation fell; followed an interruption by 14 hrs, then followed more or less continuous precipitation by 01 hrs on October 23. Then, interruptions began to occur and precipitation completely ceased on October 24, at 15 hrs.

The discharges at the gauging station Vipava reacted on the beginning of rather heavy precipitation with a 6-hour lag. A five-hour interruption of precipitation is almost unnoticeable on the diagram of discharges. The latter only began to lower some six hours after the end of precipitation. The precipitation, or, storms under 10 mm in short time are much blurred on the diagram of discharges, and there are no sharp extremes.

Quite different are the discharges of the Hubelj. They react much faster on the precipitation than those of the Vipava, and also, any several-hour interruption is already manifested in the decrease of discharges. The lag of discharges behind the precipitation is 3 to 5 hours. The discharges of the Hubelj are lower by approx. one half than the discharges of the Vipava.
There are two possible explanations:

- that the precipitation catchment area of the Hubelj is much smaller, or,
- that, at certain high water levels, the waters from this area reorient elsewhere.

In this case, too, the spring Lijak behaves quite differently than the spring Hubelj or the Vipava springs. The increase, or the beginning of the increase of discharges lags behind the increase of the Vipava as much as 10 hours, and from the beginning of precipitation to the beginning of the Lijak discharge, as much as 16 hours. Also its hydrogram differs a lot. After the very fast increase of discharges, they amount to 10 - 14 m^3/sec as long as four days. However, the Lijak did not exceed this upper limit in the discussed case, and it only reached this value when the discharges of the Vipava, Hubelj and Idrijca already decreased a lot. This could somehow confirm the hypothesis that the Lijak lacks its own contributing area in the close proximity of the spring, but the water flows in from a more distant contributing area, and therefore, it is impossible to determine or delineate the area from which the Lijak is supplied.

A quite different scene is offered by the discharges of the Idrijca at Podroteja which react much faster on the time distribution of precipitation. The beginning of the increase of discharges lags behind the beginning of precipitation by 9 hours, and at the following interruptions, i.e. during the already established high wave, these lags are only from 2 to 6 hours long.

The ratio of discharges at the high wave approximates the following:

Lijak - Hubelj - Vipava - Podroteja = 1:2:4:8, or it is slightly higher.

Determined in the described case of October 1993, were only the occurrence and duration of precipitation in the entire area, and the reaction of discharges on the precipitation at the following gauging profiles: Podroteja on the Idrijca, Vipava on the Vipava, Ajdovščina on the Hubelj, and Šmihel on the Lijak.

We tried to discover the time reaction of discharges on the precipitation; naturally, we had troubles in doing it since the entire area is rather well covered with a network of stations for daily gauging of precipitation heights, but very poor (only one gauging point, and even this one located at the eastern rims of the discussed area) in the continuous registration of precipitation.

The crucial problem still remains; this is the co-ordination of the total quantity of precipitation with the discharges by individual precipitation situations in the month of October 1993, and for the 1961-90 period. For these cases, the complex water balance analysis will be made. This problem is difficult because the gauged waters at the rims of the Trnovski Gozd and the Nanos do not represent the total quantity, because a part of the waters from this area drain underground towards the Soča (the Mrzlek spring). These quantities have not been determined so far, and it is very difficult to do it due to the reservoir of the Solkan hydropower plant.

3.4. CORRELATION AND SPECTRAL ANALYSIS

(PH. MARTIN, J. KOGOVŠEK, M. PETRIČ, S. ŠEBELA, C. MARTIN)

3.4.1. Methodology

The hydrodynamic functioning of the Hubelj and Vipava springs was studied also with the time series analysis - with correlation and spectral analysis (BOX & JENKINS 1976; JENKINS & WATTS 1968). For this purpose the STOCHASTOS programme, which was designed by MANGIN (1981a, 1981b, 1984) and written by D'HULST of the "Laboratoire Souterrain du CNRS" at Moulis (Ariège, France) was used. Presented results were obtained in a co-operative research of CNRS URA 903 (Aix-en-Provence, France) and Karst Research Institute ZRC SAZU (Postojna, Slovenia).

This approach is based on the concept of the karst system (MANGIN 1975). We can define a karst system as an underground carbonate basin, which can however integrate unkarstified superficial sub-basins in the background. In this karst flows form the drainage network, which has in general a branching structure. Such karstic system is a place of dynamic processes, determined by inflows (precipitation and/or loss of water from rivers, CO_2, etc.) and outflows (discharges, aqueous solutions and so on). The karstification efficiency must be defined as work capacity within the system, it means that in case of gravitational karst as a runoff product in regard to the altitude of gradient (the altitude difference between the inflow and outflow (spring) points). The heterogeneity of the area, the non-linearity of the flows and the contrast in hydraulic conductivity between the different parts of the aquifer (IURKIEWICZ & MANGIN 1994) are conductive to the adoption of the systemic and functional approach which is based on the study of the relations input - output.

The use of correlation and spectral analysis necessitates time series of precipitation and discharges which are uninterrupted and of an identical duration. This approach first of all aims to describe the structure of time series (with random and periodical components, tendencies etc.), and then to establish the form of unit hydrogram and finally to draw attention to the multiple relationships between input and output.