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VARIABILITY OF PRECIPITATION AND LIQUID FLOW IN THE DESNĂȚUI HYDROGRAPHICAL BASIN

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Abstract

Desnatui river is a tributary of the Danube on the first order Oltean and is part of the small rivers, with a length of 53 km and a basin area of 325 km^2. On the whole hidrological basin has two second order tributaries with the springs of Desnatui river in the high Balacita field and tributaries on the lower piedmont hills. The confluence is in the complex of ponds, called Carna-Bistret. In the making of this paper we have used data from the hydrometric stations in the Desnățui basin (Dragoia and Afumați) and meteorological station (Craiova and Băilești), data obtained in forty-four years time. The processing of this data was made using classic methods like analysis and synthesis from mathematical statistics. The aim of the study is to examine of the rainfall variability and fluid flow to establish a relationship between these two elements. In an attempt to determine the rapport between rainfall variability and leakage of Desnățui hydrographical basin, by various analysis of flow and precipitation, we observed that the variation of these parameters reflects the action of other physical and geographical factors than ones studied.

Keyword: flow, precipitation, Desnăţui hydrographical basin, trendlines, Lang Index, SPA.

INTRODUCTION

Leakage rivers is a complex hydrologic phenomenon whereby water from a certain area is concentrated in riverbeds and moving as tilt relief. The formation is a consequence of water intake flow of surface and groundwater supply sources, and its characteristics are determined by all natural and anthropic factors specific area of formation (Ion Pişota, Liliana Zaharia, 2001). As a whole, tributary river basin, presents mostly a flat plain landscape except the northern part where there is a plateau aspect (Bălăciţa Piedmont). The form of the hydrographic basin is NW - SE developed to build near Fântânele reservoir where begins to turn south (Fig. 1).

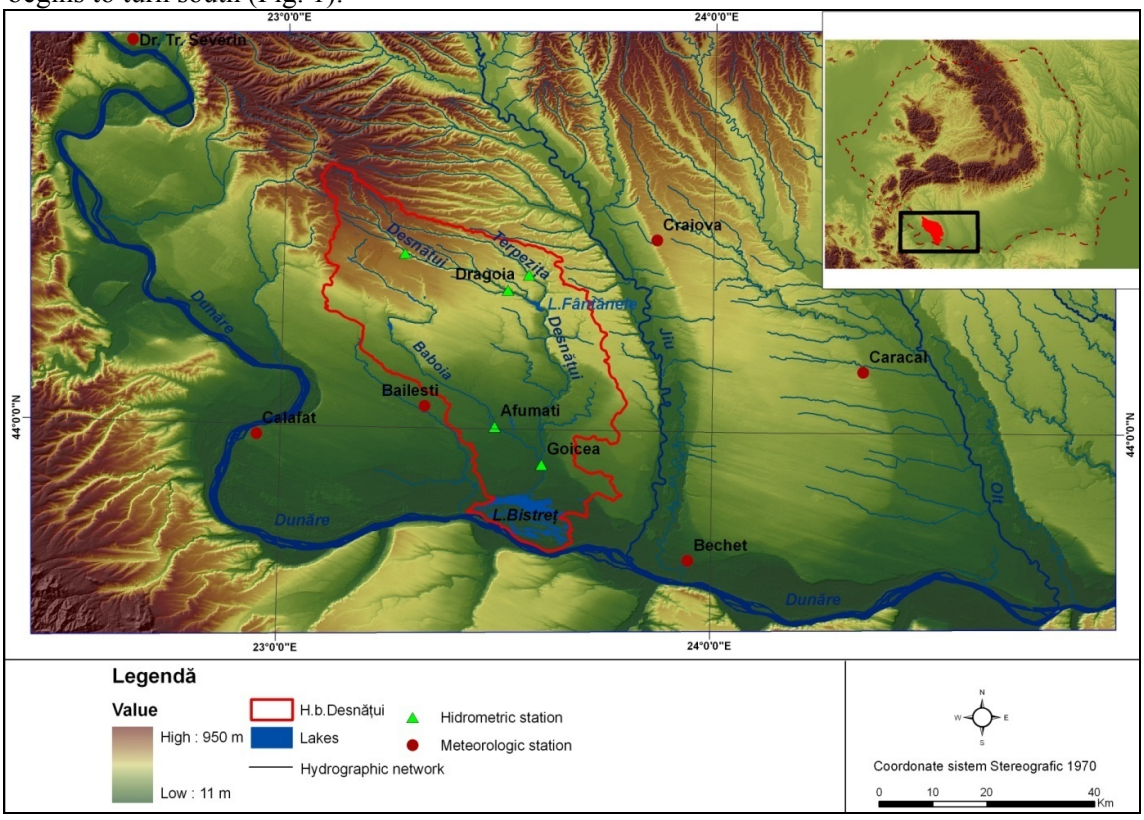

Fig.1 Location of the Desnăţui hydrographical basin

Climatic conditions (represented mainly by precipitation, evaporation and temperature), based on their characteristics is constitute in factors favoring or limiting the rivers flow. Position to the main centers of barometric (further than the influence of warm and dry air, coming from dry land, from the East and closer to the Mediterranean maritime and humid ocean), but also plain terraced location into a depression inside the Carpathian-Balkan arc and his lap, print specific characters climate of this region compared to the other sectors of the Romanian Danube Valley (Geografia Văii Dunării Româneşti, 1969). In this area are quite high values of heat and radiative balance, annual mean values reaching 125 kcal/cm2, which are added frequent invasions of warm air from the west and southwest.

METHODS AND DATA

In carrying out the work we used hydrological data from hydrometric stations Dragoia, located on the Desnățui river upstream of the Fântânele reservoir and Afumați hydrometric station located on Baboia, the main tributary of Desnățui. These data represent monthly and annual average flows measured (arranged under) the establishment of two stations until 2009, more precisely from 1965 to 2009. For the analysis of the rainfall we used data from weather stations Băileşti and Craiova, mean monthly and annual quantities, for common period of 1965-2009 to which we added the average temperatures for the same period. We used data from these meteorological stations because they are nearest hydrometric stations (Craiova for Dragoia station and Băileşti for hydrometric station Afumați) and can influence the liquid flow. Data on precipitation for Craiova and Băileşti station were obtained from Oltenia Regional Meteorological Center, and data flow belongs to The Jiu Basinal Water Administration. The primary methods used were the statistical and mathematical data for time series analysis (average monthly and annual flow, monthly and annual precipitation), Standardized Precipitation Anomaly, Lang Index and correlations.

RESULTS AND DISCUSSION

According to Geografia României (2005), the way of how the river Desnatui is fueled is complex, combining nivo-pluvial water resources (55 – 65%) and subterranean water resources (35 – 45%). Average annual precipitation at the meteorological stations Craiova and Bailesti are 600,1 l/m^2 respectively 560,7 l/m^2. In order to highlight the rainfall character of the years analyzed, was determined Standardized Precipitation Anomaly (SPA), which represents the difference of rainfall in a given year and the annual average, reported to standard deviations (Gaceu, 2001). This method reveals periods of deficit and excedent (Table 1) which can influence the liquid flow in the basin of Desnățui.

According SPA, from meteorological station Craiova and Băileşti during the years 1965-2009 have prevailed normal years from the pluviometric point of view. In the same time a cyclical rainfall regime can be observed, in the first period analysed there are years with positive values follow the cycle of SPA years with negative values and finally there are once again years with positive values. From the analysis of value classes were observed the years 1992 and 2000, as years of exceptional and excessively drought, 1983 and 1993 drought and excessively wet year was 2005 for both meteorological stations (Fig. 2).

Tabel 1- Years characteristics from pluviometric point of view

Values ASP	Qualifying	Colors
> 2,5	Exceptionally rainy	
2 and 2,5	Excessively rainy	
1,5and 2	Very rainy	
1and 1,5	Rainy	
1 and -1	Normal	
-1 and -1,5	Drought	
-1,5 and -2,0	Very drought	
-2,0 and -2,5	Excessively drought	
< -2,5	Exceptionally drought	

Source: O.Gaceu, 2001

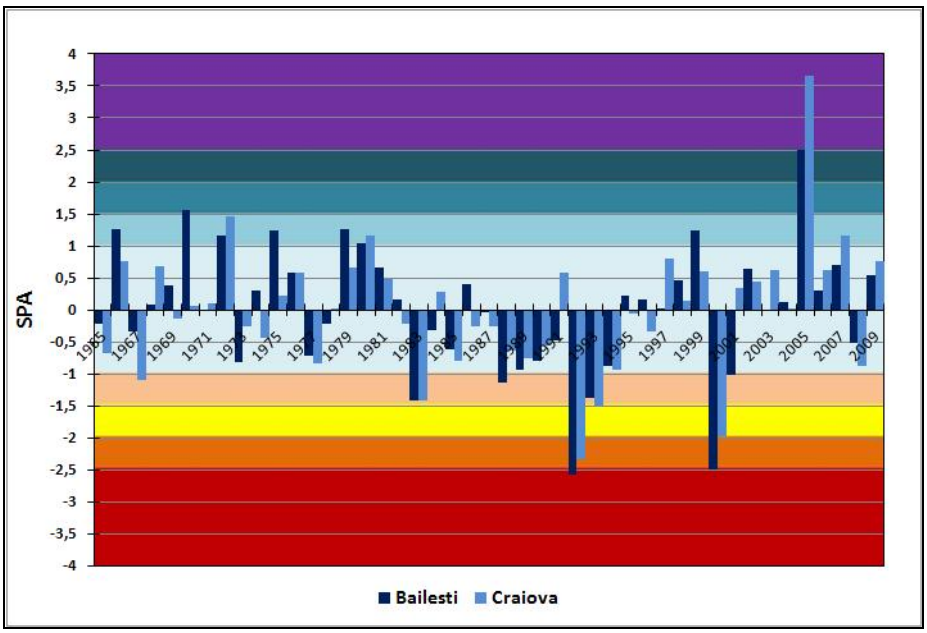

Fig.2 Standardized Precipitation Anomaly (SPA) from Craiova and Băilești meteorological station (1965-2009)

If from pluviometrical point of view we can observe a cyclicality, then in terms of average annual flow in the two hydrometrical stations an increase with a peak in 1986 is observed, followed by a decrease. On one hand there are many years when flows increased 2-3 times more than the multiannual flow and on the other hand there are years that can be highlighted which flows decreased much below the multiannual limit. Therefore, a real example may be the Afumați hydrometric station, which accumulated an annual total quantity of 2.78 m3 / s in 1986 and Dragoia hydrometric station which recorded an annual flow of 1.41 m3 / s in 1969 (Fig. 3) .

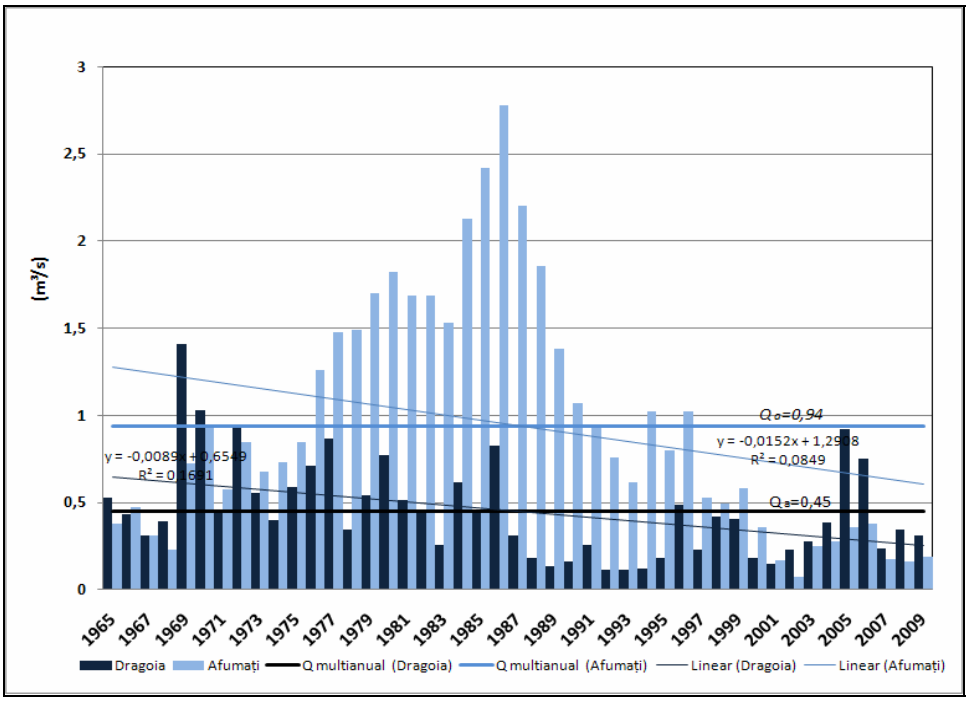

Fig. 3 The hydrograph of annual averave flow from Desnăţui and Baboia rivers for Dragoia respectively Afumaţi hydrometrical station (1965 - 2009)

Monthly level, the highest amounts of precipitation are recorded in June (60 l/m^2 from Băilesti and 74,7 l/m^2 from Craiova), and the smaller are register in February (36,3 l/m^2 to Băileşti and 34,2 l/m^2 to Craiova). Winter and spring were identified trends of increasing rainfall and summer and autumn is noticed a growing trend (Table 2). In terms of monthly averages for the entire period 1965-2009 for hydrometric stations Afumați and Dragoia from Baboia river respectivelly Desnățui, were found only three positive

trends to Dragoia hydrometric station, the other maintaining the declining throughout the period analyzed. The highest flow rates for both hydrometric stations show the months of February and March having the highest values (Afumați – 1,09 $m^{3/}$s and Dragoia – 1,02 $m^{3/}$s), but the general trend of variation in the area study is decreasing (Table 3).

Table 2 Trendlines and average monthly precipitation amount from Băileşti and Craiova whether station (1965 - 2009)

	Băileşti		Craiova	
Month	Average (l/m²)	Trendline	Average (l/m²)	Trendline
I	36,8	↗	37,2	↗
II	36,3	↘	34,2	↘
III	37	↘	37,3	↘
IV	48,7	↘	49,3	↗
V	58,6	↘	64,8	↘
VI	60,6	↘	74,7	↘
VII	55	↗	64,2	↗
VIII	44,2	↗	51,1	↗
IX	44,5	↗	45,3	↗
X	41,3	↗	42,9	↗
XI	49,7	↘	51,4	↘
XII	49	↗	47,8	↗

Table 3 Trendlines and average monthly amount from Desnăţui and Baboia rivers for Dragoia respectively Afumaţi hydrometrical station (1965 - 2009)

	Afumați		Dragoia	
Month	Tendline	Flow (m³/s)	Tendline	Flow (m³/s)
I	↘	0,91	↗	0,43
II	↘	1,09	↘	0,94
III	↘	1,09	↘	1,02
IV	↘	0,95	↘	0,45
V	↘	0,94	↘	0,40
VI	↘	0,98	↘	0,27
VII	↘	0,92	↘	0,34
VIII	↘	0,77	↗	0,21
IX	↘	0,76	↘	0,16
X	↘	0,91	↘	0,35
XI	↘	0,96	↘	0,35
XII	↘	0,96	↗	0,42

The degree to which rainfall influences the liquid flow in tributary basin is relatively small, but their decrease due to higher temperatures, determining the average flow decreases in basin analysis.

Lang Index represents the ratio between precipitation and temperatures and characterized the evaporation in a specific territory. The importance of this index is given by the relationship between precipitation and temperature, the decrease of rainfall due to increasing temperatures, in the context of global climate change causes a decrease of the flow. By correlating this index with average annual flows we tried to emphasize the relationship between both of the parameters. We chose the stations Dragoia and Craiova analysis as a result of relatively small distance between the two of them. The coefficient of determination is 0.26 which results that the value of the correlation coefficient is 0,51, meaning the average annual flow between the hydrometric station Dragoia and Lang Index from Craiova weather station is not strongly connected (Fig. 4). The weak correlation between the two parameters reflects the fact that leakage is greatly influenced by other parameters such as the degree of infiltration in conditions of a substrate lithological and porous soil with a low slope.

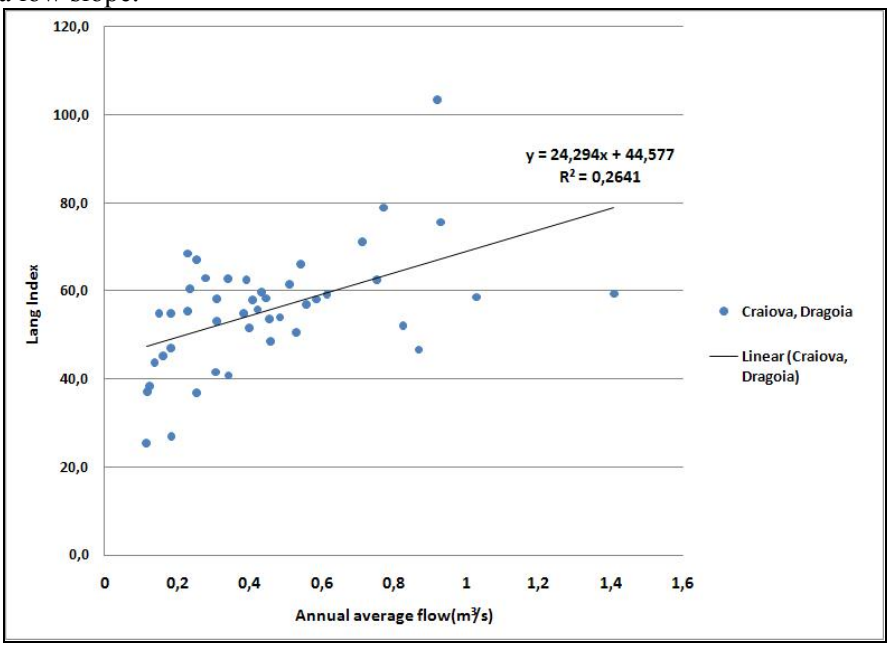

Fig. 4 Correlation of Lang Index from meteorological station Craiova and annual mean flow from hydrometric station Dragoia (1965-2009)

CONCLUSIONS

The annual rainfall variability analysis showed the existence of some cyclicals with positive values of SPA in the first period analyzed, negative in the second half and again positive in the last part. In terms of average annual flow from both hydrometric stations it is observed an increase with a maximum in 1986 followed by a steady decrease in values. During a year the highest values of rainfall are recorded in the Spring and Summer months (May, June and July), and lowest during Winter-Spring (January, February and March), while average flows monthly have high values in February, March and lowest in August and September. The trends of precipitation amount are decreasing for the Spring and Summer months and they are increasing for Autumn months for both meteorological stations (Băileşti and Craiova), these corresponding to the underlying trends in Romania. According to research conducted by Dr. Aristița Busuioc for Winter and Spring there were identified downward trends of precipitation in most parts of the country, but these were statistically significant at a reliability level of 90% only on certain areas of South and East (Winter) and at several points in Oltenia (Spring). Significant increase trends precipitation in larger areas is obvious in the Autumn season. Summer, although large areas have a tendency to increase, it is not statistically significant and in some larger areas they have a tendency to decrease, this being significant only in some isolated points. The influence of rainfall on fluid flow in tributary basin is relatively small, flow variation is the result of a combined and simultaneous causes complex climate: annual amounts of precipitation decrease due to higher average annual air temperature, the influence of enhanced evaporation in conditions of a permeable lithological and pedological substrate and relatively low slopes.

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