METEOROLOGICAL AND HYDROLOGICAL FEATURES IN SHKUMBINI WATERSHED

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In this paper shortly we present some result of our work on studding the precipitation, flow discharge and suspended sediment for Shkumbini River.

There are three factors determining the process occurred in a river watershed and in its channel:

1. Landscape – Factor of the land,
2. Precipitation and their consequence as stream flow discharge and suspended sediment.
3. Human impact in landscape and in river channel for different purposes as gravel mining etc.

The other processes occurring in watershed are the result of the combine co-operation of those factors. In the framework of the "Albanian watershed assessment" program, the Institute of Hydrometeorology is caring out the study of precipitation, water level, stream flow discharge, suspended sediment for two rivers Vjosa and Shkumbini. The evaluation of fluctuation during the time in river channel is another topic of this work.

1. Precipitation analyses

We had in consideration the total annual of precipitation for all the time series observed and the annual number of the day with precipitation > 10.0 mm for 57 stations in both rivers Vjosa and Shkumbini. Our aim is to analyze the fluctuation in time of the precipitations. Those station are selected to better represent the watershed: the first is situated upstream, the second somewhere in middle and the third one downstream.

$$R_S = \frac{1-6\sum d_i}{N\left(n^2-1\right)}$$

hhere: N is the number of the pair in two stations in consideration; d_i is the difference of the range for the corresponding value x and y of the two observed time series.

This test helps us to calculate the level of concordance of one of the series for the annual precipitation in one station with the data of the other 56 stations.

Calculating one station "i" the number "k" of the station "j" where the coefficient R_s (I,j) is significant and dividing this number "k" with 56 we obtain a local indicator "h" of the homogeneity which varied from 0 to 1. [2]. In the cases when this indicator is > 0.5 this means that the series of data is significantly correlated with more than the half of the stations we studied the correlation.

From all those calculation its come out that the indicator of the homogeneity for the annual sum of the precipitation for all 57 stations varied in the interval of 0.7 – 0.9. From here, it comes in the conclusion that the atmospheric annual precipitations are homogeneous from the point of view of their variation in time.

Therefore, taking in consideration those results we can confirm that for the study of the variation in time of the atmospheric precipitation in both watersheds, it is sufficient to study it with the data of one station.

For illustration, here we have a graph for the variation in time for the total annual precipitation (moving average 5 years) for the meteorological stations of Vrap (1951-2000), which is situated, down stream of Shkumbini watershed. Fig. 1

As we can see even from the graph from the year 1982 up to the 2000, there is a diminishing trend in the total annual of precipitation being smaller than the multiannual mean having a variation from the mean 89% of up to 54% for the year 1996-1997.

During this period only during the years 1994-1995, the total annual of the precipitation was above the mean and around it for the years 1990- 1991 and 1985 - 1986. Therefore, in general we can conclude that we deal with a dry period concerning the precipitation.

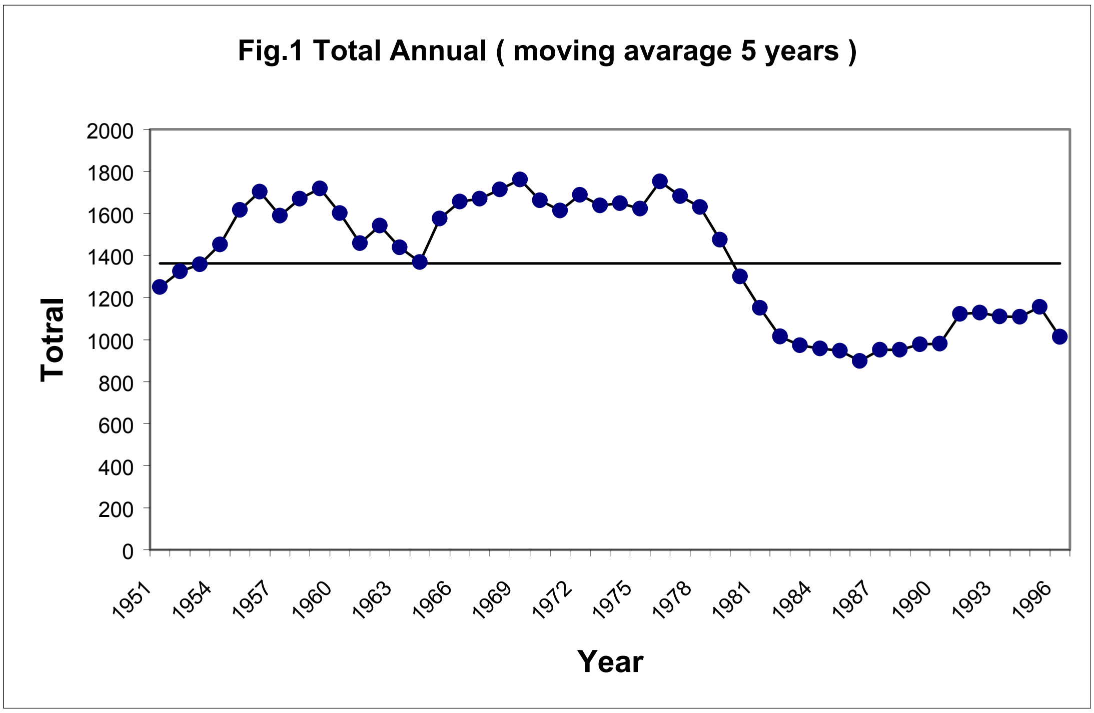

Fig. 1

We analyzed, also, the number of the raining days, having more than 10.0 mm precipitation, so the number of the days with intensity rain. This rain has a strong impact on the landscape and on the riverbed of the watershed because of the flood they cause.

As we can see from the graphic on the fig. 2 the variation in time for the raining days above the 10.0 mm rain is equal with that of the total annual precipitation.

Definitely, we can say that during the last 10 years the impact of the atmospheric precipitations on the landscape and on the riverbeds has been so smaller than the other precedent decade.

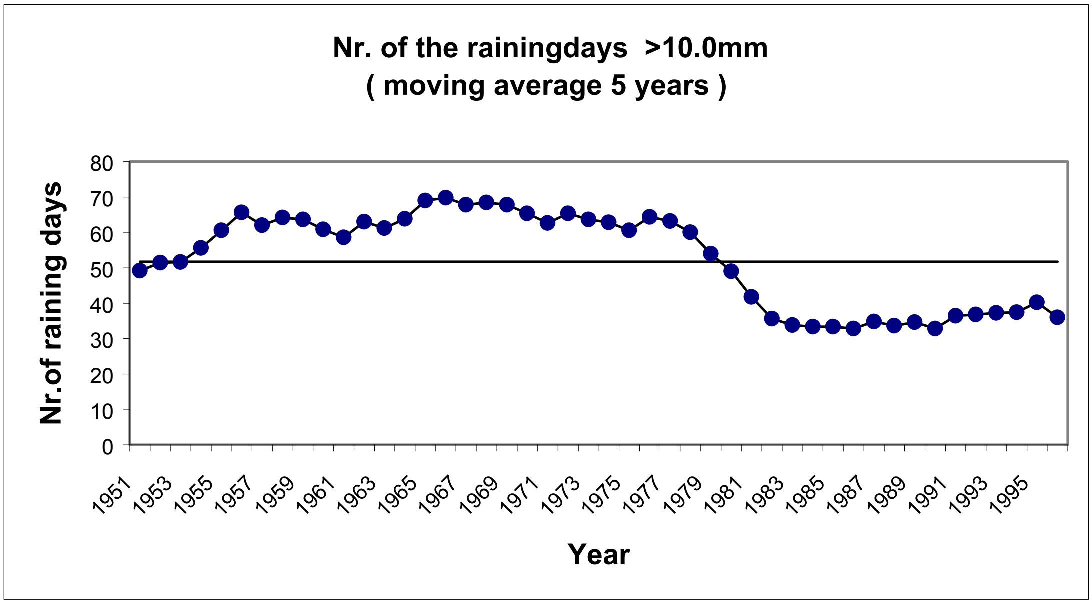

Fig. 2

It is obvious that knowing the relation between precipitation and stream flow discharge for consequence the last one must have the same variation in time as the precipitation have.

2. Stream flow discharge

In fact, there is a displacement in time between the precipitation and discharge series. It is to take in consideration the hydro-geological characteristic of the basin as the different respond of the sub watershed to the precipitation. However, this displacement is within the year mostly during the smelt snow period. During this period there is a higher value of discharge and the precipitation are in diminution.

However, this does not represent difficulties in the interpretation of the results because we are dealing with the variation in time of the hydro meteorological elements and their possible trends during several years.

So for Shkumbini river to better characterize this river, we consider two station one upstream Shkumbini–Sllabinje and downstream Shkumbini –Paper (Fig. 3). In the first station, the hydrologic elements are observed for the period 1970-2000, the suspended sediment 1973-1995. For Paper this period is 1950-1999 and for the suspended sediment 1955-1995.

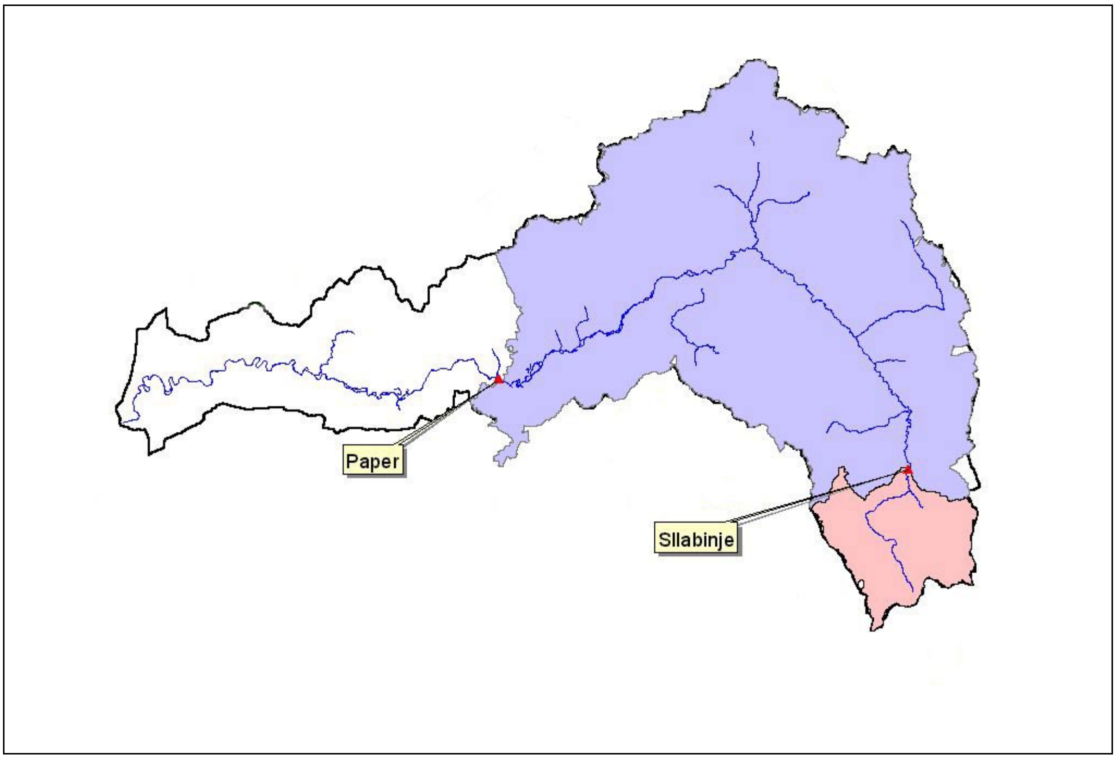

Fig. 3

The multiannual variation within the year, hydrological year, for the mean discharge of those two stations is represent on the figure 4.

Analyzing those data for this river, concerning the type of the hydrologic regime we can conclude:

- The water regime of Shkumbini river is characterized by one minimum during the dry period July-September as the result of the reduction of the water resources in the watershed and
- Two maximum occurring during the wet period, wintertime. The firs maximum observed in December is the result of the intensive precipitations coming down during the November-December month. After that in January there is another not very important minimum and caused by the acing. In April happened the second maximum greater than the firs one and this as the result of the smelt of the snow on the mountainous part of the basin.

Therefore, the conclusion is that the water regime of the Shkumbini River is Mediterranean snow-pluvial and much closed with that of snow.

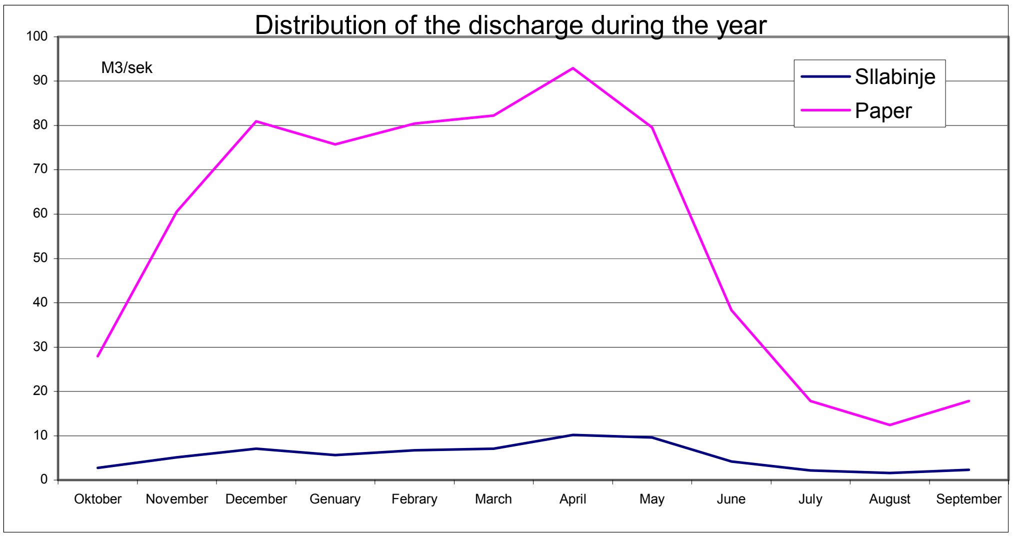

Fig. 4

The fig 5; 6 represent the multiannual (1951-1999; 1970-1999) variation for the mean annual discharge.

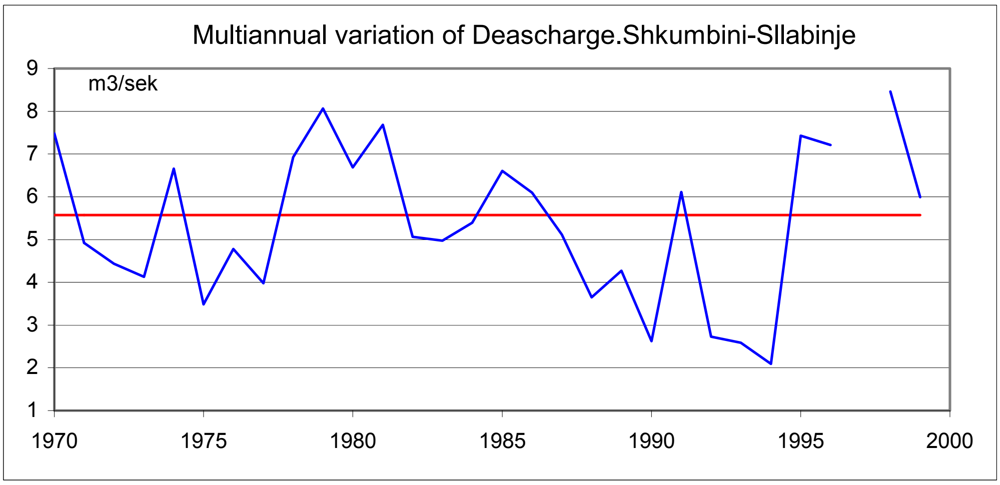

Fig. 5

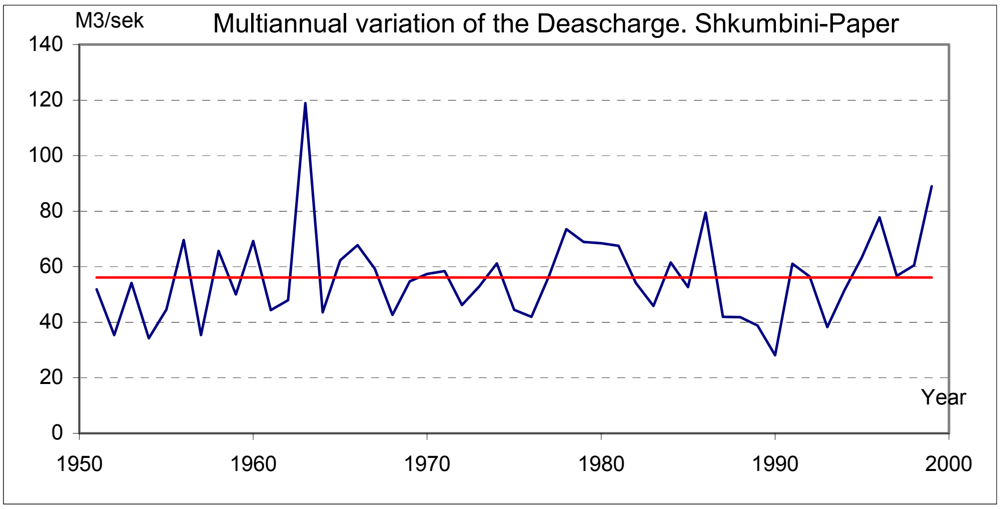

Fig. 6

Analyzing this variation, we can note that the highest value occurred in winter 1962-63. Particularly this year represent the extreme wet year not only in Shkumbini River but also for all rivers in Albania this is considered the year of the big floods happening in Albania after the Second World War and the third on the list of catastrophic floods on the last 100 years.

In the mean time, a growing trend is reflected from the 1950 to the 1966-year; a period with the variation of the discharges around the mean for the years 1966-1987; and a period from 1987-1995 with discharge in general under the mean.

3. Suspend sediment discharge

Analyzing the mean daily-suspended sediment (turbidity) transport, (gr/l) for Paper and Sllabinja stations we have the distribution within the year as in fig 7; 8

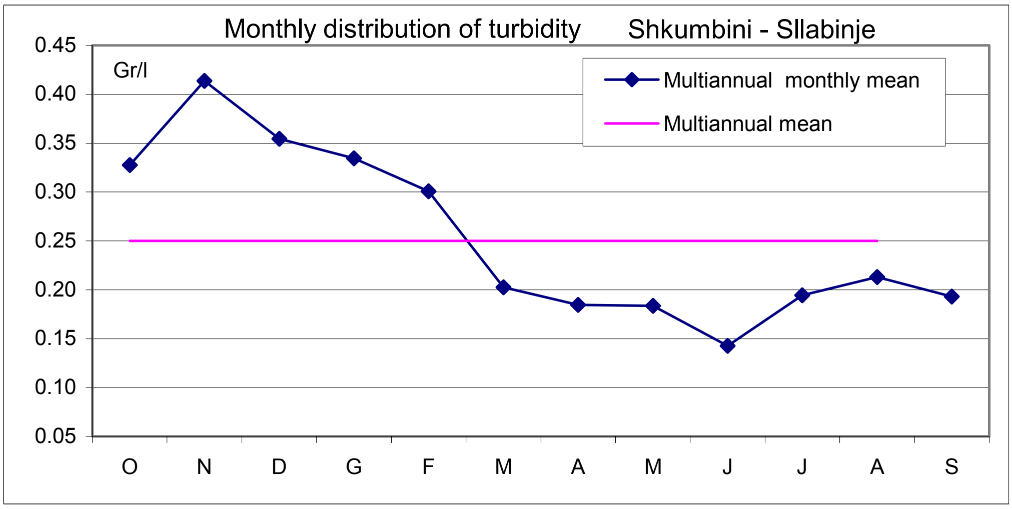

Fig. 7

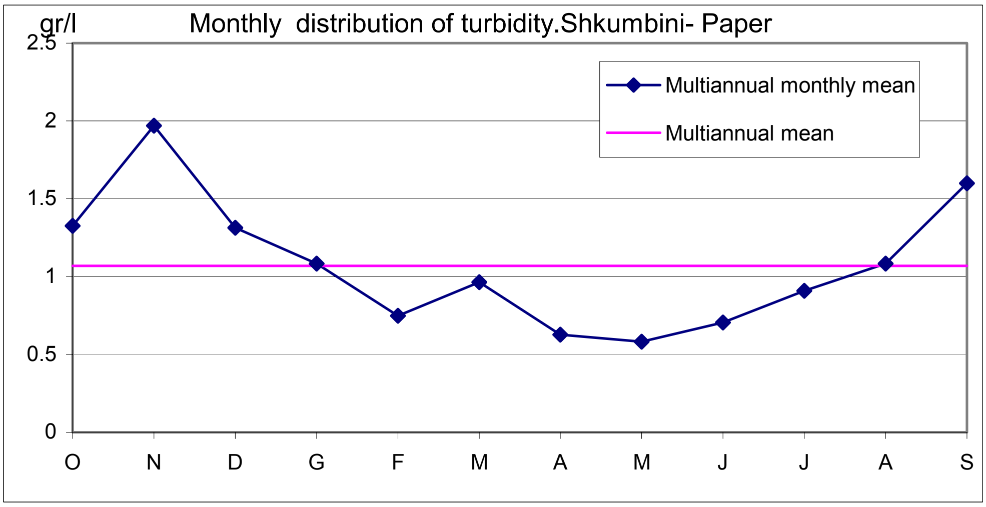

Fig. 8

In conclusion, we have high value of the turbidity in the river during November. This is the month when the precipitations reach their highest value in the watershed. During the months of April-May the main contribute in the flow is due to the smelt of the snow and from the underground reservoir and the turbidity has the lowest value. The month of September, the precipitation begun, so the turbidity starts to grow.

From all the data observed in this station, the period 1958-1995 is selected.

In the Fig 9; 10 is show the multiannual variation of the turbidity.

Here we observe the very high value of turbidity especially for the year 1958 and further for the year 1963.

After the year 1973, the values of the turbidity are always under the mean. Only after the year, 1994 we can observe an augmentation of those values.

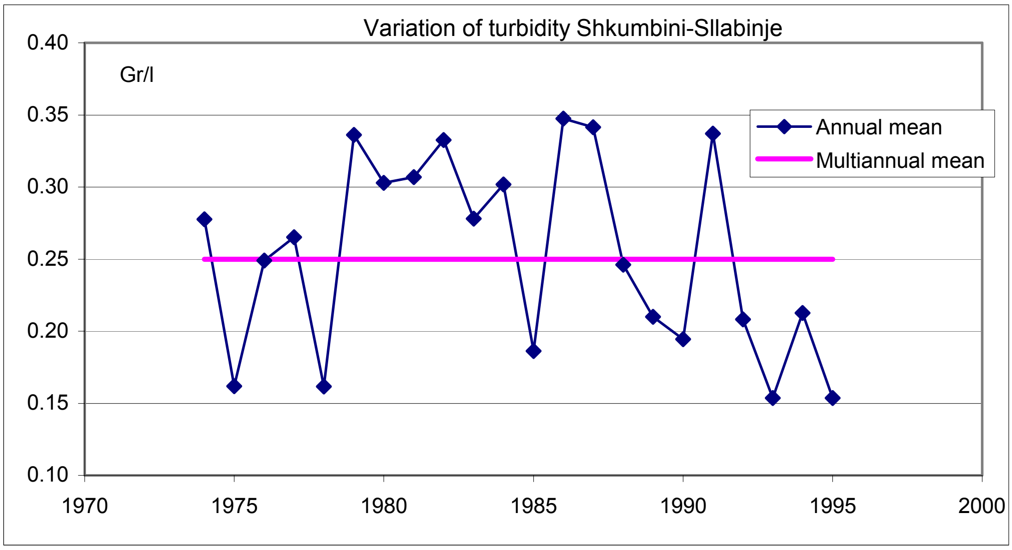

Fig. 9

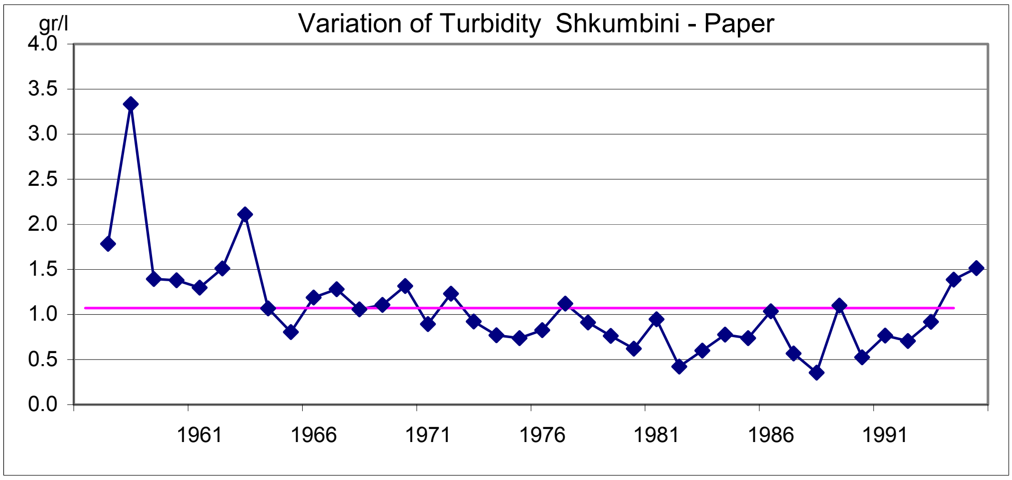

Fig. 10

4. Channel morphology

Natural discharge, in particular the floods, human activity in the river watershed as deforestation of the slope, gravel mining on the riverbed, etc. have a direct impact on the river channel. All this non-natural activity leads to the changes and cause its degradation on deposing or eroding the bed material.

This moving process is clearly detected from the direct measurements realized in the cross-section for a long period.

In the figure 11, we can make the comparison between two years 1975 and the year 1995 for Paper station. The change in thalweg is approximately 1.5m.

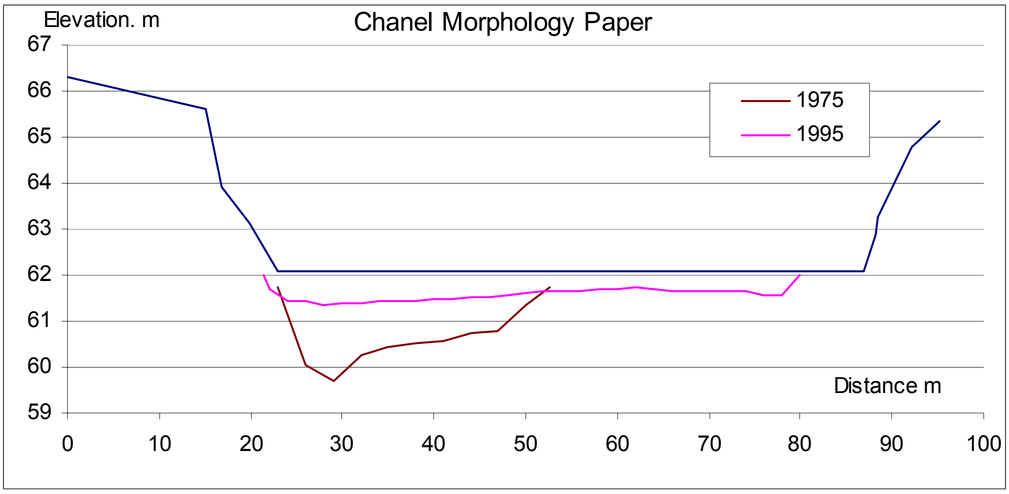

Fig. 11

In figure 12 is reflected the multiannual changes of the thalweg above the sea level. In Sllabinja station, from 1971 up to 1987 a process of deposition occurred and it is clear that something happened at 1987 in the river bad. This change is due to the human activity because in March of this year only few meters above the station a bridge was constructed so the riverbed reflects those interferences.

From this analyzes for Paper, it comes out the process of erosion starting from the year 1955 reaching the lowest point at the 1975. Another process of deposition has the maximum at the 1995. After that year, another period of erosion is observed.

The objective of the channel morphology assessment is to document whether or not changes in channel pattern, profile, or dimension has occurred as a result of changes in soils, land use vegetation cover, hydrology and developments. As we mention it above the factors having the direct impact in this process are different and linked between them. Here we can suggest a good and further relation between the Institutions, dealing with those problems, on analyzing the changes on the bed river. This analyze can be more complete on realizing the relation between the hydrologic elements and the changes of the land factors as: deforestation, agricultural activities, the use of the new land in the hilly zones in different periods, activities on the river bed, etc.

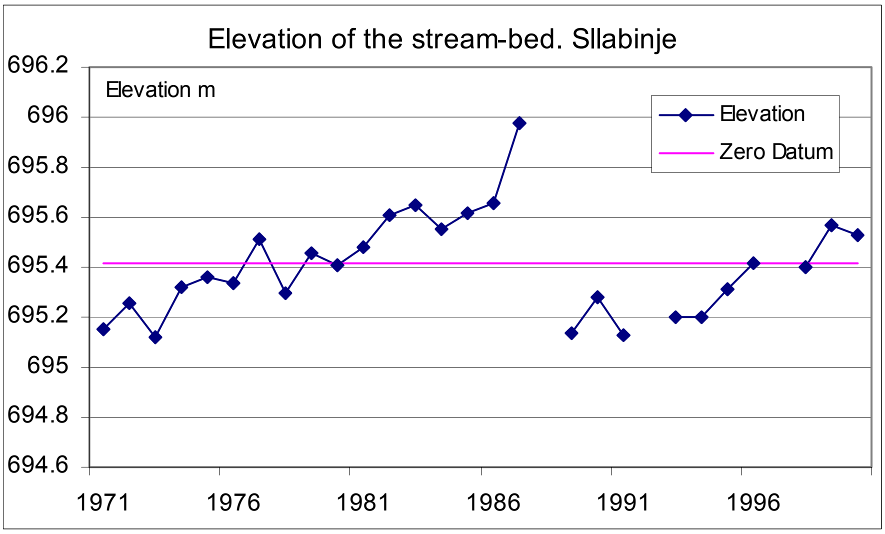

Fig. 12

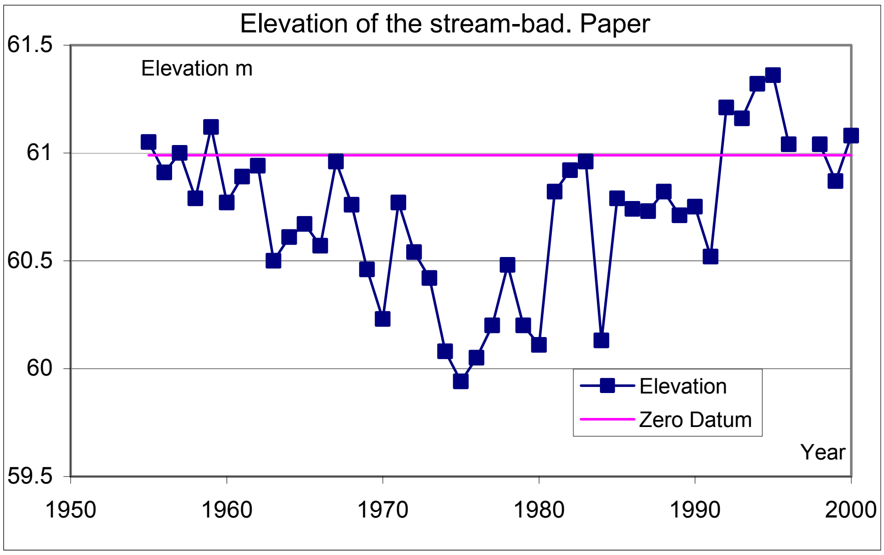

Fig. 13

Consequently managing those data for different station on the river, we can estimate the weigh each part of the basin has in the suspended material discharge. In this way, we know the hot spot of the watershed needed priority intervention.

It is obvious that the human intervention without any criteria in the landscape of the watershed and direct in the riverbed has have its consequences.

All this makes necessary the elaboration of a strategy concerning the mitigation of this impact to gradually improve the situation. For the Hydrometeorological Institute this strategy must emphasize on the monitoring of precipitation in the water basin particularly their intensity with recorders, flow discharges and sediment transport having the possibility to follow the dynamic of the changes.

References

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