THE EXAMINATION ALONG WITH THE PRESENTATION OF FLOOD-FORECASTING SYSTEM IN REAL TIME IN THE MAROON RIVER RESERVOIR DAM THROUGH USING WMS (SOFTWARE) WATERSHED MODELING SYSTEM

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ABSTRACT

The optimum exploitation of dam's reservoir requires the short and long term time steps projecting. In general, the exploitation of dams reservoir depends on the amount of the river flow. The howmuchness of the water importing into dams reservoirs may be different in regard to hydrologic and climatologic conditions.

The main concern of this study is the presentation of the Maroon River flood-warning system in Real Time manner and in the Maroon dams reservoir cross section. In order to prepare a Flood-Warning system WMS software has been used. Totally we should pass two basic stages for presenting the Flood-Warning system. The stages are as follows:

A. The calibration of the basin model, based on the recorded historical data such as: RIVER DISCHARGE, PRECIPITATION as well as TEMPRATURE.

B. The flood routing in different cross sections of the river by making use of hydraulic and hydrologic methods.

KEYWORDS: The analysis of the river flow, flood-warning system, the optimum exploitation of dam's reservoirs.

INTRODUCTION

In regard with the population increase, human activities, the important hydraulic changes on the Earth, being our country located in a dry zone and insufficiency of rainfall, this is a necessity to make some plans to get the best use of water resources in terms of developmental along with the constructive projects in our country, Iran, is felt more than ever.

If you want to meet having a sound planning as well as an increase in the exploitation yield output of the bounded water resources, one of the most important efforts you should undertake is to innovate a novel order in terms of census taking and getting access to the accurate statistics together with the information on water resources.

Nowadays, due to technology progress, applying the improved sciences as well as getting to the point use of the exact-working electronic machines not only the accuracy of statistics but also the translation speed has been developed.

The more the statistics accuracy and the translation speed, the more rational and economical the decisions which have been made on water resources exploitation.

Therefore capitalization on the work of water resources studies and researches is the most important factor in making the economical as well as social goals of our country, Iran, gains a great value.

Khuzestan province from the surface waters in our country, Iran, basins point of view has a high potentiality. The Maroon river with the basin (to where the Maroon river dam reservoir is) measuring 3824 square kilometer surface area between 49 degree and 50 minute, to 51 degree to 10 minute eastern longitudes , and 30 degree and 30 minute to 31 degree and 20 minute northern latitudes is located at the elevations of Behbahan city.

The Maroon basin is surrounded by the Zohre and the Karoon rivers in Khuzestan as well as Kohkiloye and Boyerahmad provinces. The Maroon River is made up of the headbranches of Loadab, Absaghaveh, Abshoor, Abcharusagh and Abghellat joining together. Passing the Maroon dam enters into the Behbahan plain, irrigating this plain comes into the narrow slopes.

Crossing about 45 km of the mountain direction, the river goes on to the western north and enters into the narrow plain of Jayzan.

This river receives some other subbranches down the Jayzan plain; afterwards it links to the Allah River and creates the Jarahi River. Irrigating the Khalafabad plain, the river enters to the Shadegan plain.

At the times of flood, this river scatters around the Shadegan plain to large extent, then flows down to the Persian Gulf.

Generally speaking, 71% of the Maroon dam reservoir basins are more than 1500 meters high. Due to the specific climatical situation, this zone is taken into account as a part of the wet Zagros and has got a considerable precipitation that is the main source of the maroon river water resources. Table 1 and Figure 1 show the Surface Area Distribution In terms of the Height.

Table 1: Surface Area Distribution in terms of the Height

SURFACE AREA PERCENTAGE		BASIN SURFACE AREA		AVERAGE HEIGHT	ELEVATION LIMITS	ROW
TOTAL	PARTIAL	TOTAL	PARTIAL			
%	%	(km^2)	(km^2)	(m.s.l)	(m.s.l)	
0.8	0.8	29	29	430	360-500	1
19.9	19.1	749	720	750	500-1000	2
45.2	25.3	1704	955	1250	1000-1500	3
71.2	26.0	2684	980	1750	1500-2000	4
93.1	21.9	3509	825	2250	2000-2500	5
99.5	6.4	3749	240	2750	2500-3000	6
100.0	0.6	3770	21	3028	3000-3415	7

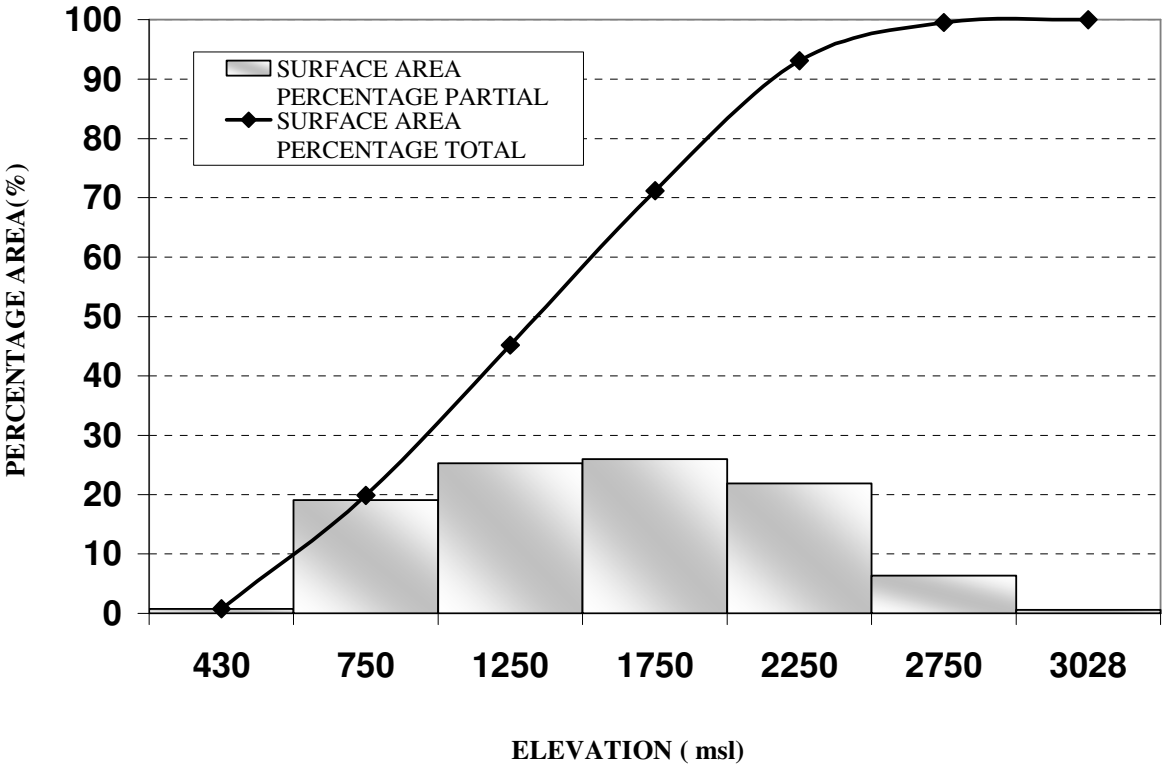

Figure 1: The Altimetrical Histogram and the Hypsometric Curve of the Maroon River Basin in terms of Height and Surface Area Percentage

2. THE SUMMARY OF THE MAROON RIVER PHYSIOGRAPHIC FEATURES AT THE GIVEN HYDROMETRIC STAIONS

This survey has been accomplished in the Maroon river basin as well as the three subbasins of Idenak, Behbahan and Chamnezam. Table 2 shows the concise Physiographic features of the given subbasins.

Table 2: The Concise Physiographic Features of the Given Subbasins

LINEAR PROFILE OF RIVER			BASIN ELEVATIONS		EQUIVALENT RECTANGLE			SHAPE and SURFACE AREA OF BASIN			RIVER	STATION
PURE SLOPE	IMPURE SLOPE	LENGHT	MAX.	MIN.	SLOPE	WIDE	LONG	GRAVLIOUS COEFFICIENT	PERIMETER	SURFACE AREA		
%	%	km	m	m	%	km	km		km	Km^2		
1.13	1.72	97.5	3400	610	2.05	20.20	136.4	1.68	314.9	2754.0	MAROON	IDENAK
0.99	1.33	146.3	3400	325	1.66	20.62	185.5	1.68	413.0	3824.2	MAROON	BEHBAHAN
0.61	1.03	201.3	3400	195	1.41	23.71	227.8	1.68	493.4	5401.0	MAROON	CHAMNEZAM

3. THE HOMOGENEITY TEST THE MAROON RIVER HYDROMETRIC STATIONS

Before dealing with the analysis and ingestion of data, it is necessary for a hydrologist to be assured of the quality and completeness of the statistical series. If you don't assess the data, the complicated statistical analysis will not show an authentic result. There are many ways to know whether these data and the figures which are analyzed are homogeneous or not. These ways can be classified into two groups:

1. Graphical
2. Non-graphical

In this study the non-graphical one has been used to do homogeneity test. According to this test, Idenak, Behbahan and Chamnezam hydrometric stations data are homogeneous at the confidence level of 5%.

For example, the homogeneity test of Idenak hydrometric station data is shown in Table 3, Alizadeh Amin [1].

Table 3: The homogeneity test of Idenak hydrometric station average flow (in the statistical time span 1976-2000)

YEAR	ANNUAL DISCHARGE AVERAGE	BASED ON SEQUENCES MEDIANS	SEQUENCE NUMBER	BASED ONAVERAGE SEQUENCES	SEQUENCE NUMBER
1967	27.61	a	1	a	1
1968	40.05	a		a	
1969	89.79	b	1	b	1
1970	23.01	a	2	a	2
1971	30.76	a		a	
1972	58.75	b	2	b	2
1973	22.28	a	3	a	3
1974	44.94	a		a	
1975	46.89	a		a	
1976	108.60	b	3	b	3
1977	30.89	a	4	a	4
1978	69.31	b	4	b	4
1979	41.12	a	5	a	5
1980	78.24	b	5	b	5
1981	42.81	a	6	a	6
1982	41.99	a		a	
1983	51.41	b	6	a	
1984	28.00	a	7	a	
1985	41.99	a		a	
1986	51.18	b	7	a	
1987	88.68	b		b	6
1989	48.69	b		a	7
1990	35.52	a	8	a	
1991	67.75	b	8	b	7
1992	44.96	a	9	a	8
1993	90.23	b	9	b	8
1994	115.28	b		b	
1995	18.10	a	10	a	9
1996	74.87	b	10	b	9
1997	63.91	b		b	
1998	32.69	a	11	a	10
1999	85.64	b	11	b	10
2000	46.67	b		a	11
2001	24.06	a	12	a	

MEDIAN AVERAGE na=11 n b=11
45.82 53.14 n b=12 nb =12
u=7-19 u =7-19

4. STATISTICS OF HYDROMETRIC STATIONS

The statistics of Idenak hydrometric station in the statistical time span (1967-1999) has some flows. Most of them are related to the water year of (1986-1987).

Consequently it necessitates for the statistics of the chosen years to be completed. To do so regarding to the monthly statistics of Behbahan hydrometric station being perfect, a correlative relation between these two stations is established so that the results are as follows:

$$R = 0.98 \quad (1)$$
$$Y = 0.96X - 0.18$$
$$N = 323$$

In this relation X is equal to the monthly water table of Behbahan hydrometric station in (m^3/s); Y is equal to the monthly water table of Idenak hydrometric station in (m^3/s).

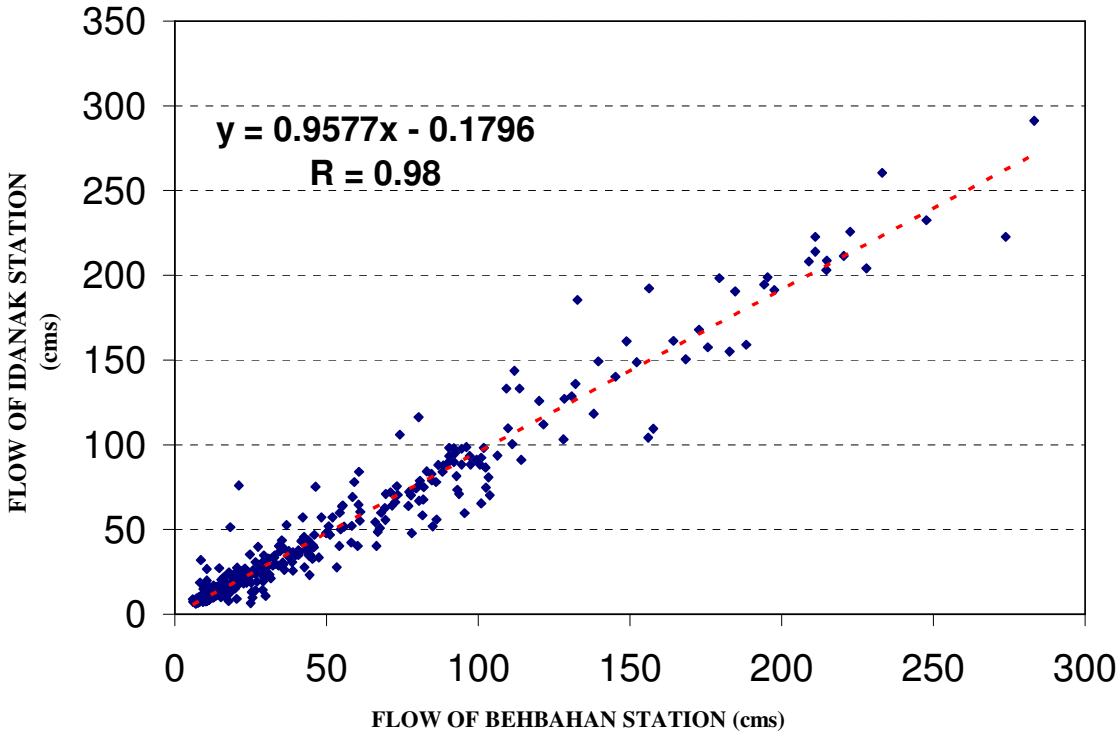

Figure 2 The correlative relation between the Maroon River Flow at the cross sections of Idenak and Behbahan hydrometric stations (1967-1999)

5. THE ANALYSES OF THE OCCURRED FLOODS AT THE GIVEN HYDROMETRIC STATIONS

As it was discussed previously, this survey has been done in three subbasins of Idenak, Behbahan and Chamnezam hydrometric stations in turn since 1977, 1956 and 1987 are available. In these trinary stations most of the floods have been occurred in November. For instance, the results of the occurred floods analysis in Idenak subbasin are shown in Figure 3.

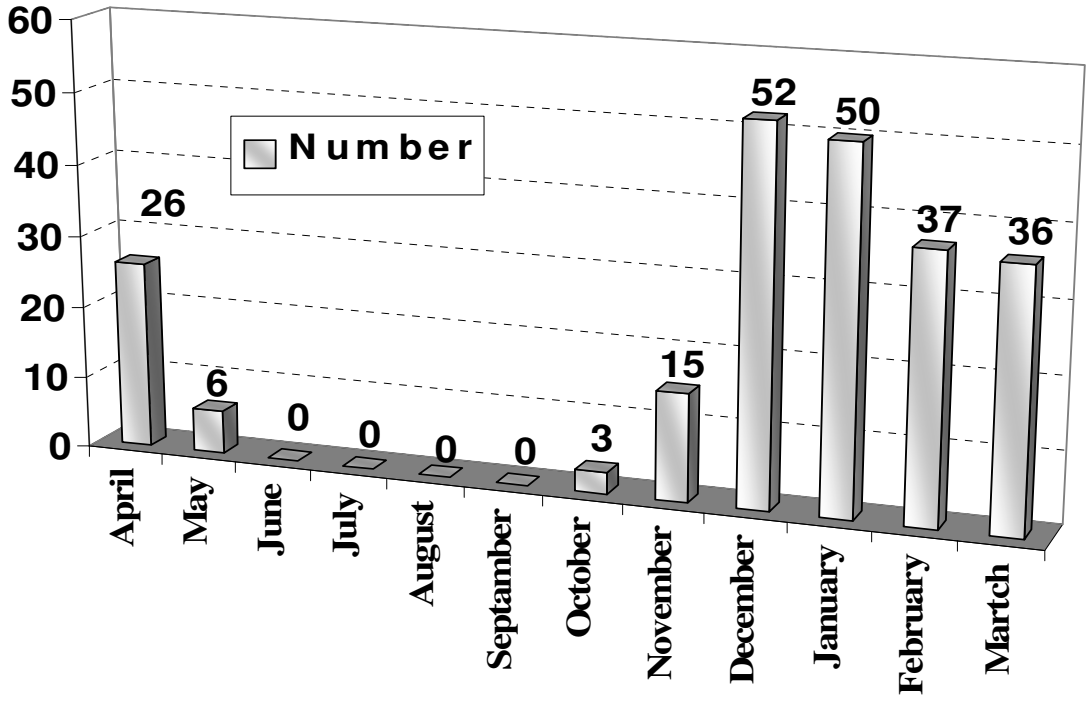

Figure 3 The frequency of the occurred floods peaks in Idenak hydrometric station in the time span of April to March (1967-2000)

It is well to say that this process has been repeated for Behbahan as well as Chamnezam hydrometric stations too.

6. THE PRECIPITATION ANALYSIS IN THE MAROON PLUVIOMETRIC STATIONS TO RESERVOIR DAM CROSS SECTION OF IT

Idenak pluviometric station is located in the vicinity of the hydrometric station and its altitude to sea-level is 5600 meters. The rainfall statistics of Idenak pluviometric station from 2000 on are available. The information on the precipitation of 1973 to 1974 water years is completed and prolongated through using the correlative relations to Behbahan pluviometric station. This relation is as follows:

$$R = 0.94 \quad (2)$$
$$Y = 0.5403X$$
$$N = 323$$

Where X is equal to the amount of the monthly precipitation in Idenak hydroclimatological station and Y is equal the amount of the monthly precipitation in behbahan hydroclimatological station. This subject is shown in Figure 4.

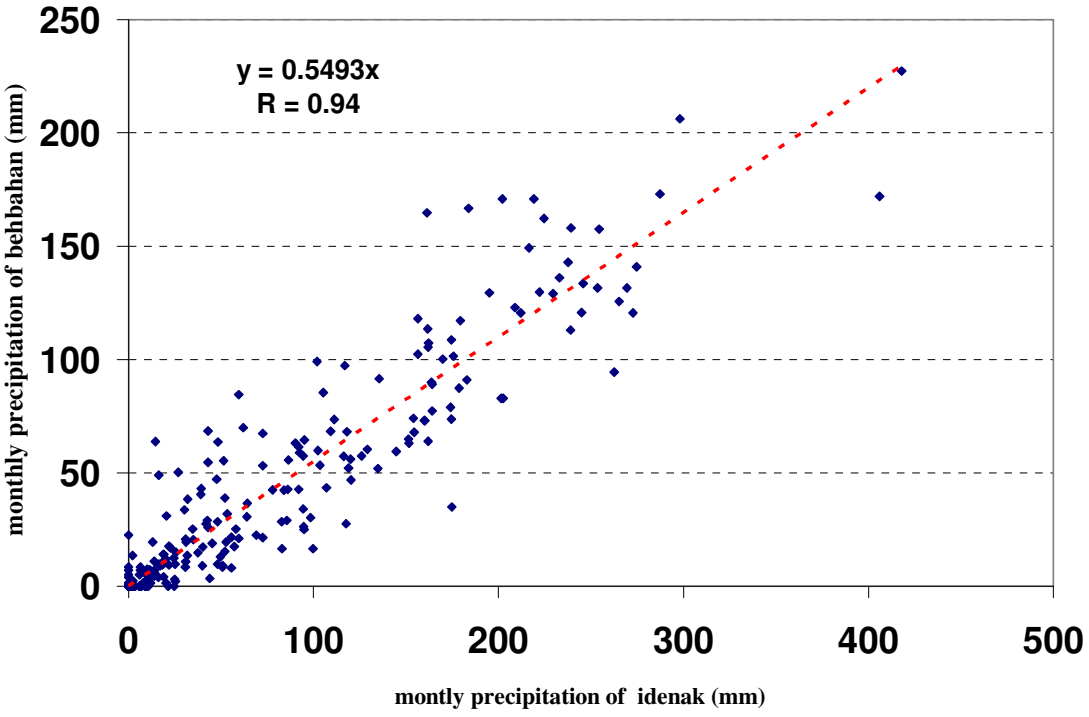

Figure 4 The precipitation correlative relation between Idenak and Behbahan pluviometric stations in the observed statistical span (1970-2000)

By the way the horal precipitation statistics have been used in the calibration process the run-off rainfall in the related basin.

The pluviometric station of Behbahan has nearly located close to the Maroon reservoir dam and its altitude to sea-level is 333 m. The precipitation statistics of Behbahan pluviometric station from 1966 on are available. The pluviometric station of Chamnezam is nearly located in the vicinity of Chamnezam hydrometric station and its altitude to sea-level is 190 meter.

The precipitation statistics of Chamnezam pluviometric station from 1977 on are available. The monthly precipitation correlative relation of this station as well as Behbahan pluviometric station is as follows:

$$Y = 0.9247X \quad (3)$$
$$R = 0.90$$
$$N = 235$$

Where Y: The amount of monthly precipitation of Behbahan hydroclimatological station and X: The amount of monthly precipitation of Chamnezam hydroclimatological station**.**

7. SOME PIECES OF INFORMATION ON THE SNOW COVERING SITUATION OF THE MAROON RIVER BASIN

At the present time, there are many snows-measuring in the Dez and the Karoon basins by which the size of the snow thickness, the equivalent water depth together with the snow considerations are measured in a turn and in the yearly manner.

Unfortunately, up to now this has not been donable in the Maroon River basin and no snow-measuring stations have been established. At the result it has been tried to make use of the taken statistics out of the available stations in Khuzestan river basin (one of the main headbranches of the Karoon River) that is positioned near the Maroon River and is very helpful to determine the amount of the Maroon river snow budget.

For the same reason we get use of the taken statistics of Lordegan and Yasooj synoptic stations to assign the days in which snowfall has been happened.

It is good to mention that by means of satellite pictures which are accessible on the Internet from 1989 on, the snow cover percentage of the Maroon and the Karoon basins is .computed. Figures 5 and 6 show this matter.

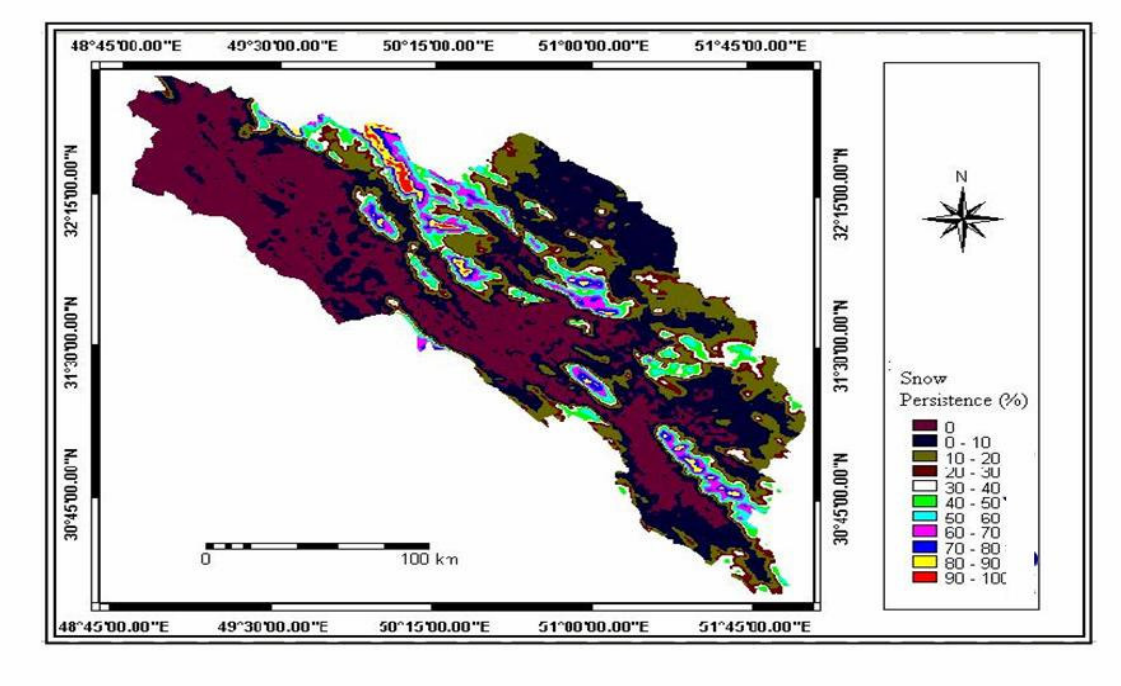

Figure 5 The snow-cover region of the Karoon River in the statistical time span (1989-2003) along with the percentage of snow existence in these regions

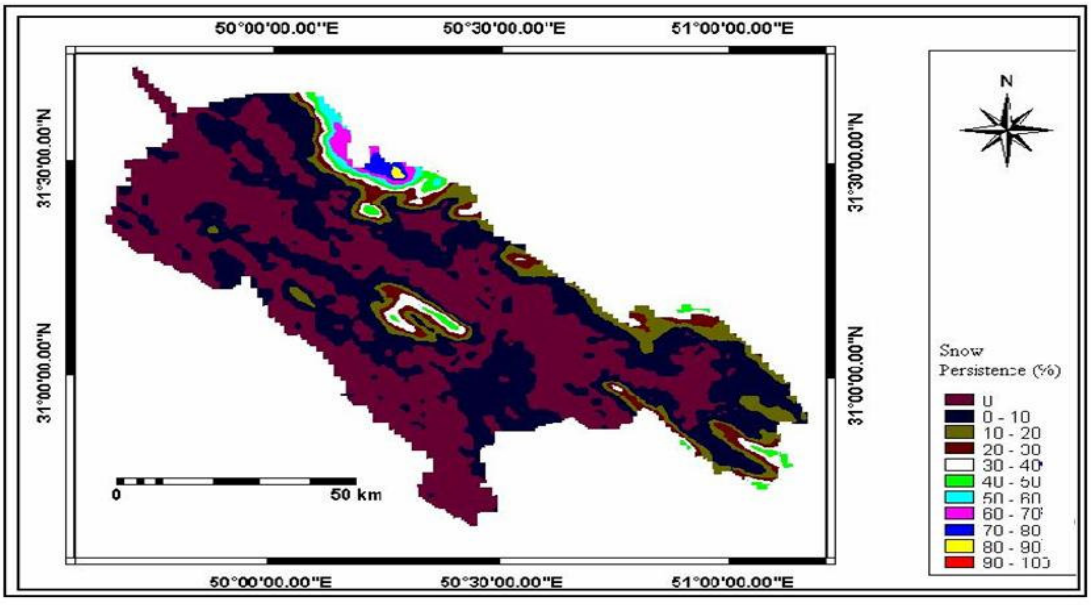

Figure 6 The snow-cover region of the Maroon River in the statistical time span (1989-2003) along with the percentage of snow existence in these regions

8. THE CALIBRATION PROCESS OF TURN–OFF and FLOOD ROUTING SIMULATION PARAMETERS IN DIFFERENT CHOSEN CROSS SECTIONS

This survey has been achieved by getting help of WMS software. This software simulates the floods in a single- event manner. The procedure is that at first some prevailing floods in those basins which are chosen for calibration. (For example, in this study 29 floods have been selected for calibrating the sub basins of Idenak, Behbahan and Chamnezam). Each flood is defined individually and separately for the software then some parts of the basin model such as the surface area of the subbasins, the Lat-Lon of the hydrometric and pluviometric stations as well as water deviation are determined .Afterwards the methods of computing precipitation damages such as penetration, evaporation as well the computing method of unit hydrograph is defined. Moreover for simulation of the snow-melting, one should define the flood starting and stopping dates, the snow-covered elevations of the basin along with the aerology stations temperature for the software.

It is helpful to say that for the calibration of the run-off precipitation model, WMS can be applied in to two ways: The first one is when no information on snow-covering conditions is accessible. In this case we can make use of the recorded size of precipitation as well as discharges to calibrate the run-off precipitation model.

The second case is when some data on the snow-covering basin is accessible.

To determine the size of the temperature rate decrease, precipitation times as well as the 24 hour forecasting rainfall we get use of some Websites like WWW.IGES.ORG, WWW.ACCUWEATHER.COM.

Routing the flood in the Maroon river different cross sections requires using MUSKINGUM hydrologic method. The results of the Maroon river basin calibrating by means of WMS are shown in Table 4 distinctly, NEWAR Engineering [2].

Table 4: The final computed parameters of precipitation, snow-melting, unit hydrograph and MUSKINGUM routing method refers to the trinary chosen stations by WMS software

HYDRO-METRIC STATION	PENETRATION					SNOW MELTING		KLARK UNIT HYDROGRAPH		MUSKINGU	
	STRKR	DLTKR	RTIOL	ERAIN	RTIMP	STRKS	RTIOK	TC	R	K	X
	mm	mm	mm	mm	%	mm	mm	hr	hr	hr	---
IDENAK WITH SNOW-MELTING	4.20	10.61	1.79	0.46	0.00	5.28	1.77	2.69	9.11	0.91	0.45
IDENAK WITHOUT SNOW-MELTING	4.04	10.00	1.79	0.46	0.00	---	---	3.25	6.82	0.91	0.45
BEHBAHAN	1.16	2.48	1.83	0.50	0.00	---	---	5.01	5.52	0.90	0.35
CHAMNEZAM	0.72	3.17	3.06	0.50	0.00	--	---	14.11	6.97	0.91	0.45

9. CONCLUSION AND COMPARING THE RESULTS

In these days the developed countries have fixed some useful mechanisms and censors in their rivers basins to be able to record the occurred events as well as to avoid of some stubborn happenings (calamities) such as floods and the destructive avalanche crash as much as possible. The censors which are appointed in the basins are capable of recording the data about the amount of the occurred precipitation, temperature degree, the depth of the available snow on the elevations, snow condensation along with the height of the water within the river in the different cross sections.

Applying these softwares can smooth the direction of the uniformity of the even basins management, consequently we can be able to prevent of some probable damages in the essential times. Table 9 shows the comparison of the results of the applied software in a chosen flood (24/01/1983) for these three subbasins. The error percentage of computation is less than 10%.

Table 5: The computation of the differential percentage in the degree of the maximum discharge of the floods and the occurrence time in these triple hydrometric stations in the flood of 24/01/1983 by using WMS

HYDRO-METRIC STATION	MAX. AMOUNT OF REAL PEAK	MAX. AMOUNT OF COMPUTA-TIONAL PEAK	DIFFE-RENTIAL	DEVIATION PERCENTAGE	MAX. TIME OF COMUTA-TIONAL PEAK	MAX. TIME OF REAL PEAK	DIFFE-RENTIAL	DIFFERENTIAL PERCENTAGE
	CMS	CMS	CMS	%	hr	hr	hr	%
IDENAK	697.00	635.00	62.00	9.76	15.00	15.00	0.00	0.00
BEHBAHAN	732.00	710.00	22.00	3.10	15.00	16.00	-1.00	-6.25
CHAMNEZAM	1060.00	980.00	80.00	8.16	21.00	22	-1.00	-4.55

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