Turkey Surface Water Potential And Its Change In Time

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Abstract

Water which is in brisk demand for drinking, watering, energy and the other requirements gains in importance in Turkey day by day. Questions about the existence of water which is rised in value and its changes in the period of time are placed on the agenda importantly. This study which intends to answer these questions, surveys the position of surface water trend and its changes in the period of time. In this study; data of daily mean, annual mean and maximum, minumun trend belonging to 130 of river observation stations in the 25 basins in Turkey are used.

When the changes in the trends according to distribution over the regions are examined with the available water potential, trends of rivers in Marmara, Ege, İç Anadolu,(including Sakarya basin)and Akdeniz regions, have a change. This change observed in the trend is in the position of decreasing generally except same stations. As a conclusion, in the last 40-75 years, it is obvious that there is a decreasing trend in surface water in the west, middle and South regions. In contrast, surface water in the other regions increases in the period of time

Keywords: *Water Potential, River Basin, Trend, drought, Dry and Wet Period*

1. INTRODUCTION

Climate change and global warming are the main concerns of the world today. Especially in the recent years flood and drought cases made us think about these points. Not only flood but olsa drought is a natural disaster. The decrease or increase in the discharge of the river should be defined either is a charge or not is important not only for the natural disaster but also the operation of hydraulic engineering structures. Mean, minumum and maximun discharge is important for hydrolic structures for different reasons overflow and mean discharge values, are important for the computation of the dam reserves, stating the amount of flow, conserving the quality of water. For this reason, past flow records should be examined both low flow and high flow trends should be defined. Besides the trends should be known since they are important for the management of the hydraulic structures. Low, mean and maximum trends are evaluated in different ways by the hydraulic engineer. The decrease in the low flow can indicate that the river can drain from time to time, especially in the summer. The decrease in the statistics of the low trend helps to decide the places of refinement facilities. The change in the statistics of low trend effects the hydroelectric stations, water collection structures and the calculations of the minumun in the cooling facilities. The decrease in the yearly mean trend is important in stating the capacity of reservoir and later realising the reservoir management. A decrease in the floods is significant for the design of spillways.

As well known, the flood discharge values are considered in dam design. Similarly the variation in flood values should be considered in the design of the river regulation structures. Though there are international studies in the literature for the rivers in different countries, the studies in our country are limited. Only Malkoç and Yıldız (2001) and Cigizoglu et al.(2003) completed studies covering the whole country. The results of this study can shed light to the future climate change models. Besides it will provide supplementary information for the future of the projects in water resources engineering.

In this study, the present surface water potential in basin and country scales are investigated. Also the temporal change in river flow data is considered. The data employed in the study is provided by General Directorate of Electrical Power Resources Survey and Development Administration and the study results obtained by the collaborative work between this organization and Istanbul Technical University Civil engineering Faculty Hydraulics Division are examined.

2. THE DATAS AND THE METHOD

2.1. The Stream Observetion Stations That Were Analysed

The datas of the river flow that were analyzed through the project were supplied from the General Directory of EIE. In the first step attention was paid for all the available data on river flow, from totally 25 basins. It was investigated that whether any interferences were done or not at the rivers at any time during the period of measurements. In the light of the obtained information 2 of the total 25 basins were eliminated (Basins with Number 2 and 19) and the study included the river flow datas of the stations from 23 basins with no interferences or with very low interference ratios that has no influence on the study. The interference positions of the streams were determined from the situation reports of stream observation stations which are operated by EIE Directory Hydrometry Study Centers. So, in this study the number of stream basins was 23 and the number of flow observation stations was 130. The daily mean, yearly mean, maximum and minimum flow values belonging to the determined stations were used.

2.2.Method

The study was realized on three groups as yearly maximum flow statistics, mean flow statistics and low flow statistics. Yearly maximum flow was evaluated as the maximum instant flow that was observed during a water year period; and yearly mean flow was evaluated as the mean of daily mean flows that was observed during a water year period. Yearly low flow was evaluated as the minimum value of 1-day or 7-day low flows belonging to each water year period.

After the calculation of maximum, mean and low flow values based on the stations belonging to the one flow year period, the changes of these values by time were converted to the graphs. Then the trend lines were formed on these graphs and the correlation coefficients were determined that define the relationship between the time and the flow statistic values and that also specify the direction of the relation. Subsequent to that the contours were drawn showing the increase or decrease of the flows due to the correlation coefficients determined. The red tone and the green tone of contours pointed the decreases and increases, respectively. Then, the flow calculations performed on the base of the stations were generalized to the base of basins in the study. The basin flow informations and characteristics depending on that; and the yearly changes of superficial water potential over the country were determined.

3. FINDINGS

3.1. Mean Flows

Following information was obtained when the relation between the long term daily flows of flow observation stations in Turkey and time; A decrease in flows of western part of Marmara Region, Aegean Region, western part of Inner Anatolia, Mediterranean Region (except for western parts of Middle and East Mediterranean Regions) and middle of Southeast Anatolia Region were observed. (red contours) An increase can be seen on the mean flows of other regions with time. (green contours) (Figure 1).

3.2. Maximum Flows

There was a decrease in maximum flows at partially, western part of Marmara Region, partially coasts of Aegean Region, western part of Inner Anatolia Region, very limitedly in Mediterranean Region, limitedly West and East Blacksea Regions (red contours). There was an increase in maximum flows for other regions. (green contours) (Figure 2).

3.3. Minimum 1-Day Flows

On the base of minimum 1-day flows there were decreases at Aegean Region, East Mediterranean Region, western part of Inner Anatolia Region, and limitedly Southeast Anatolia Regions (red contours). Increases were available for other regions (green contours) (Figure 3).

3.4. Minimum 7-Day Flows

On the base of minimum 7-day flows, there were decreases at Aegean Region, part of East Mediterranean Region, western part of Inner Anatolia Region (red contours). The other regions showed an increasing trend for the minimum 7-day flows (green contours) (Figure 4).

3.5. Superficial Water Potential of Turkey

Flow potential information depending on the basin characteristics of the 25 basins were obtained by using the yearly mean flow information (Table 1) and have been determined dry and wet periods (Table 2). Also long term period yearly superficial water potential change was found by using yearly mean flow datas (Figure 5).

4. RESULTS

It was determined that there was a meaningful decrease in mean and low flows (for some in maximum flows) for the streams at western, middle and southern regions of Turkey for the last 40-75 year-period. In general, particularly in the above mentioned regions, it is observed that the lengths of the wet periods became shorter and the water efficiency decreased. In contrast it is seen that the intensities of the dry periods have increased.

Moreover, from the superficial water potential calculations which were performed in the 40-year-long time period, it was determined that the amount of water that our country had was 178,15 billion m^3. However, it was realized that this amount decreased to 163,79 billion m^3 concerning the 1989 - 2009 inefficient period due to the decrease in flows. As a concequence, there is a decrease of 8 % in our total water potential.

5. REFERENCES

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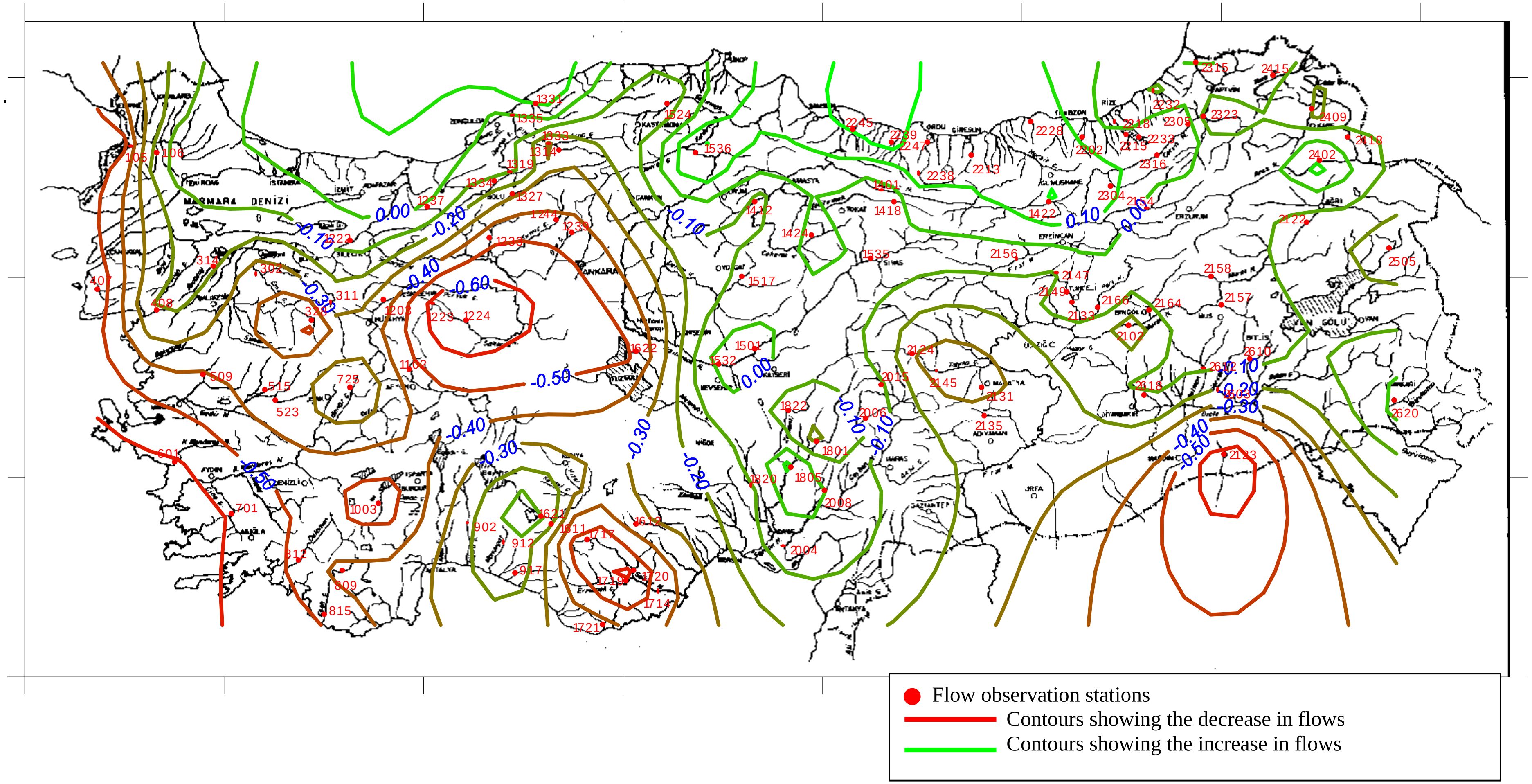

Figure 1. The temporal distribution of the mean flows

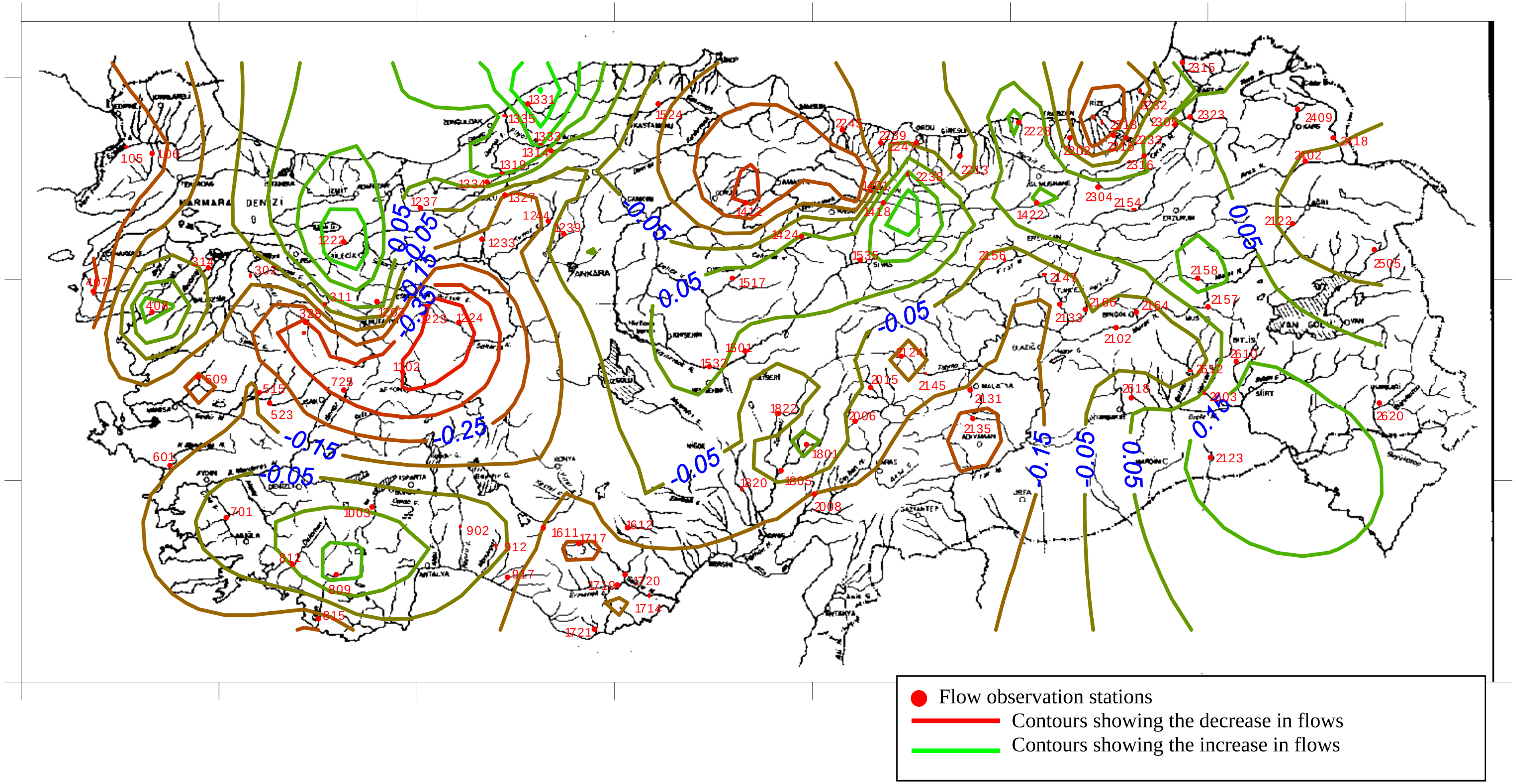

Figure 2. The temporal distribution of the maximum flows.

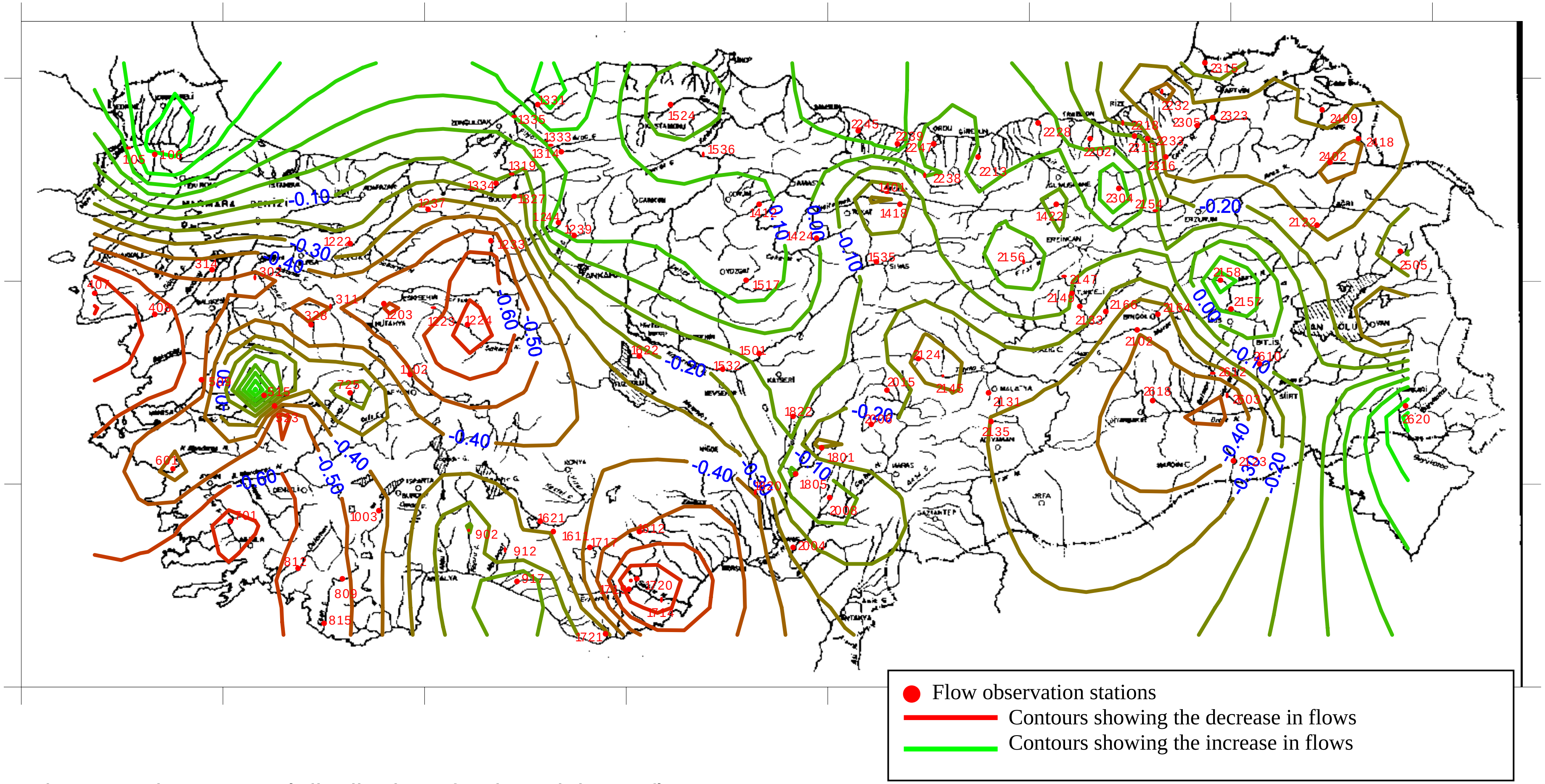

Figure 3. The temporal distribution of 1 day minimum flows.

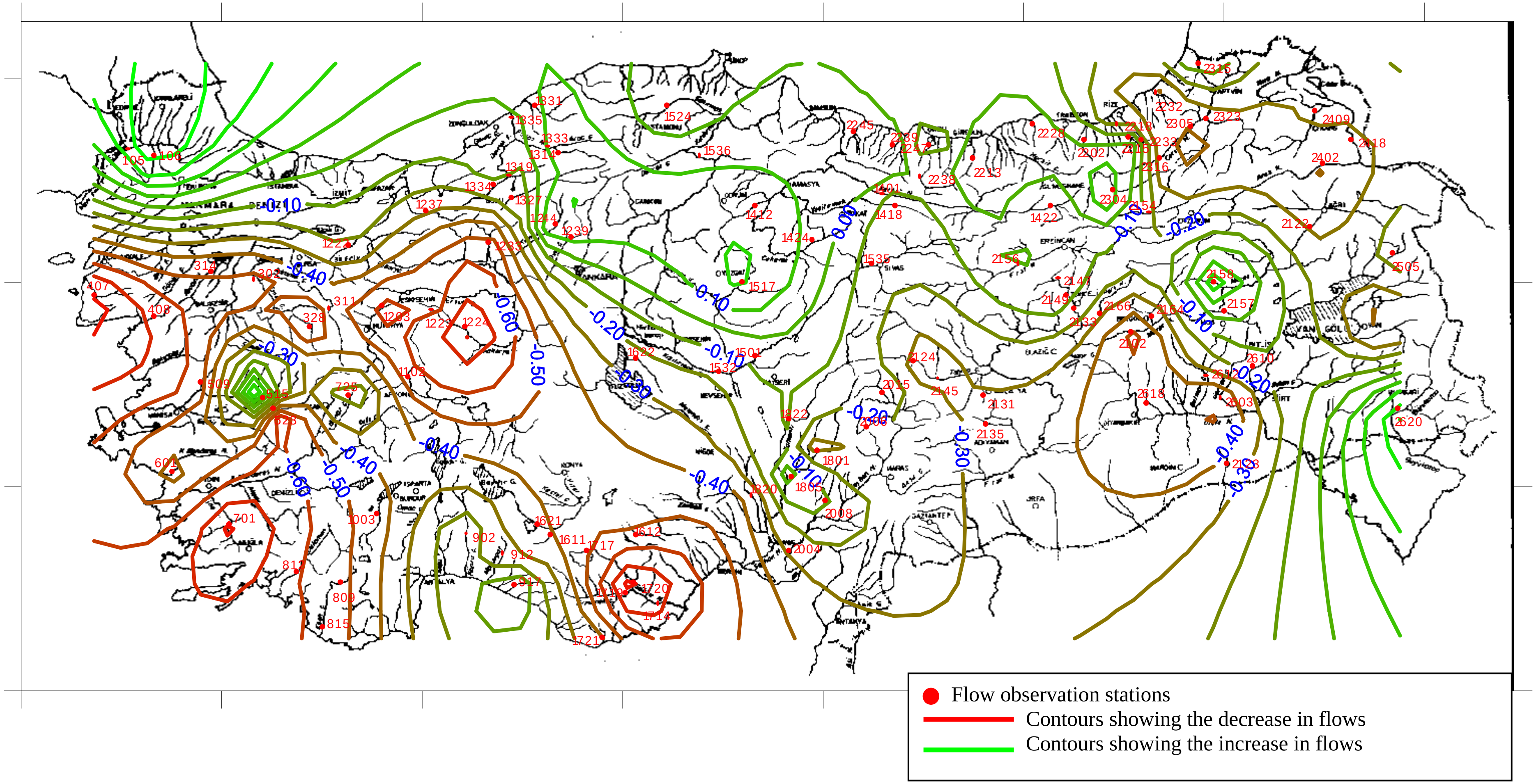

Figure 4. The temporal distribution of 7 day minimum flows.

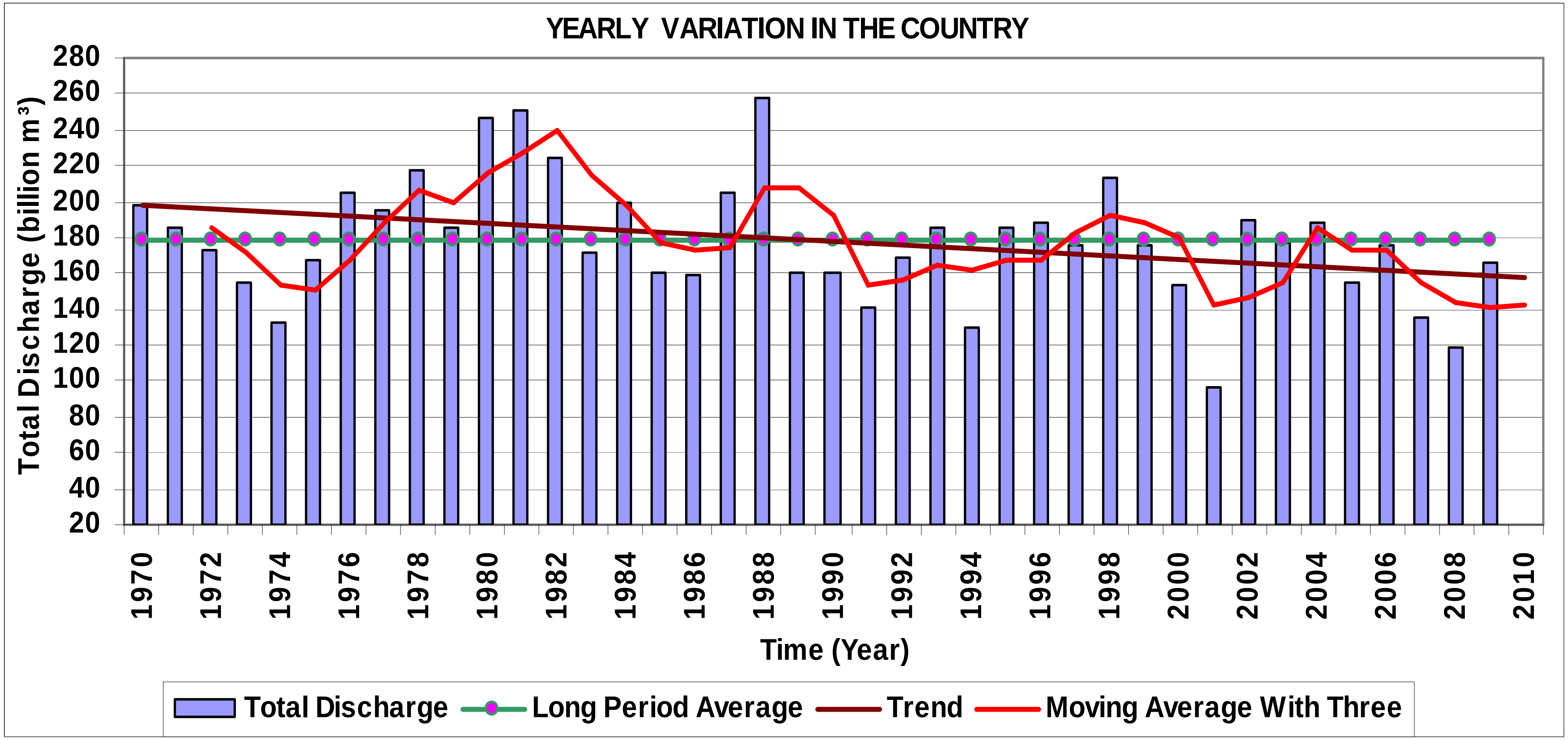

Figure 5. The long term total yearly mean flows and trends of the river basins in the whole country.

Table 1. The information for the river basin characteristics.

BASIN NO:	BASIN NAME	BASIN TOTAL RAINFALL AREAS (km²)	BASIN YEARLY MEAN FLOW (BILLION M³)	BASIN YEARLY MEAN FLOW HEIGHT (mm)	YEARLY MEAN EFFICIENCY OF THE BASINS (L/S/KM²)	FLOW RAINFALL RATIO	THE PARTICIPATION OF THE BASINS TO THE TOTAL FLOW (%)
1	*MERİÇ*	49482.30	6,48	130,90	4,15	0,22	3,64
2	*MÜT.MARMARA SULARI*	24100.00	5,09	211,31	6,70	0,29	2,86
3	*SUSURLUK*	23765.00	4,01	168,93	5,36	0,24	2,25
4	*MÜT.EGE SULARI*	9032.00	1,34	148,77	4,72	0,24	0,75
5	*GEDİZ*	17118.00	1,04	60,70	1,92	0,10	0,58
6	*KÜÇÜK MENDERES*	7165.00	0,51	71,83	2,28	0,10	0,29
7	*BÜYÜK MENDERES*	24903.00	1,89	76,08	2,41	0,11	1,06
8	*MÜT.BATI AKDENİZ*	22615.00	6,91	305,71	9,69	0,35	3,88
9	*MÜT.ORTA AKDENİZ*	14518.00	12,55	864,34	27,41	0,86	7,04
10	*BURDUR GÖLÜ KAPALI HAVZASI*	8764.00	0,23	26,66	0,85	0,06	0,13
11	*AFYON SULARI KAPALI HAVZASI*	8377.00	0,26	30,91	0,98	0,07	0,15
12	*SAKARYA*	56504.00	4,88	86,31	2,74	0,16	2,74
13	*MÜT.BATI KARADENİZ*	29682.00	9,12	307,37	9,75	0,38	5,12
14	*YEŞİLIRMAK*	36129.00	5,23	144,63	4,59	0,29	2,93
15	*KIZILIRMAK*	78646.00	4,87	61,87	1,96	0,14	2,73
16	*ORTA ANADOLU KAPALI HAVZASI*	56554.00	5,73	101,26	3,21	0,24	3,21
17	*MÜT.DOĞU AKDENİZ*	22484.00	9,13	406,08	12,88	0,55	5,12
18	*SEYHAN*	20731.00	6,43	310,34	9,84	0,50	3,61
19	*HATAY SULARI*	25241.40	1,94	77,04	2,44	0,09	1,09
20	*CEYHAN*	21222.00	6,40	301,35	9,56	0,41	3,59
21-1	*FIRAT - DİCLE HAVZASI FIRAT KOLU*	120917.00	31,34	259,16	8,22	0,48	17,59
22	*MÜT.DOĞU KARADENİZ*	24022.00	17,56	730,85	23,18	0,61	9,85
23	*ÇORUH*	19894.00	6,30	316,65	10,04	0,50	3,54
24	*ARAS*	27548.00	4,74	172,13	5,46	0,40	2,66
25	*VAN GÖLÜ KAPALI HAVZASI*	15254.00	2,98	195,16	6,19	0,41	1,67
21-2	*FIRAT - DİCLE HAVZASI DİCLE KOLU*	51489.00	21,19	411,50	13,05	0,51	11,89
	Total	816156.7	178,15				
	Average			229,92	7,29	0,35	

(*) Lake areas have not been included to the catchments. Meriç and Asi as interboandry rivers, Their part of catchment outside the country borders have been included to the calculations.

(**) Annual average values which catchment average precipitation depth, runoff and yield have been derived from the long period (1970- 2009)

Table 2. Turkey River Basins and Their Dry and Wet Periods