International Water Association

Young Water Professionals Programme
Программа молодых специалистов и ученых водного сектора

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YOUNG WATER PROFESSIONALS

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CONTENT

WATER SUPPLY

WASTEWATER TREATMENT

The Dynamics of Water Flow of the River Ural (Zhaiyk) and its Relation to Rainfall in the Catchment Areas

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Abstract
The dynamics of flow in relation to the dynamics of rainfall and temperature in the catchment separately for unregulated and regulated periods. It is shown that such a link exists.

Keywords
Water resources; temperature; precipitation; inflow; correlation, types of processes.

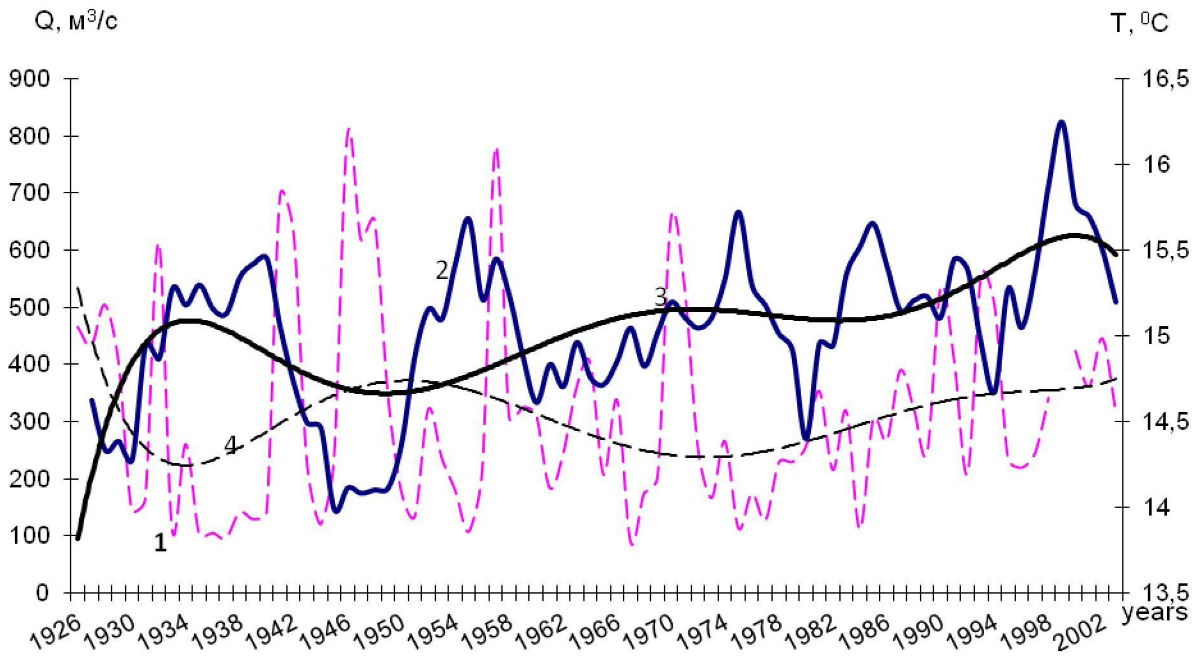
FOREWORD

Zhaiyk river originates in the Southern Urals (ridge Ural mountains) in the Russian Federation. At the bottom in Orenburg takes one of its largest tributaries Sakmara. Lower course of the river Zhaiyk crosses the border between the Russian Federation and the Republic of Kazakhstan.
The main catchment area, thus, is in Russia east of the Southern Urals (actually river Urals), and to the west of it (the basin river Sakmara) and only a small part - in Kazakhstan - the basin, Ilek (North Urals and Aktobe regions). Total inflow of water from the Russian Federation to river Ural (Zhaiyk) is estimated as 8674 million m^3, of which 4510 and 3312 million m^3 enters the rivers Ural and Sakmara respectively.
To river Zhaiyk receives from Russia an average of 8390 million m^3, which is about the amount of water received in 1974 ... 2007. Under natural conditions, for 1974 .. .2007 y it would received - 10,093 million m^3 [1].
In this paper, we tried to explore the links between time series of precipitation and temperature in western Kazakhstan, on the one hand, and fluctuations in river flow Zhaiyk - on the other. For this purpose, we used the average annual air temperature, average air temperature during the warm season (april-october), annual precipitation, and water consumption for the period 1921-2003 years.

KEY PART

It is known that the river flow which is regulated, show a weak link between rainfall and temperature in the catchment areas on the one hand and the amount of runoff from the other. So we split the time series into two parts: before 1958 - unregulated flow and after 1958 - regulated flow.
Let us first consider the results of analysis of the links for the entire time series runoff. The time course of the water flow at the station Kushum shows that over the period of 1921-2007 years it ranged from 89,1 to 800,0 m^3/s (figure 1). You may notice a large runoff variability from year to year, especially before 1973. This polynomial trend shows that from 1921 to 1940, a decrease of water flow, and from1941 is an increase in water consumption. From 1958 to 1978 there has been a decrease in the consumption of water, then to 2002 - an increase of water flow, although in recent years has been an increase again.
From figure 1 it can be seen that the interannual variability of runoff after 1958 significantly decreased, confirming the need for separate analysis. Figure 1 shows the time evolution of flow

river Zhaiyk and average air temperature during the warm period of the meteorological stations (MS) Uralsk designed for rolling five-year period.



1 - water flow riv. Zhaiyk 2 - the average temperature for the warm period of the MS Uralsk, for rolling five-year period, 3 - the trend line of average air temperature during the warm period, 4 - trend line flow

Figure 1. The time course of the water flow riv. Zhaiyk and average air temperature during the warm period of the MS Oral designed for rolling five-year period.

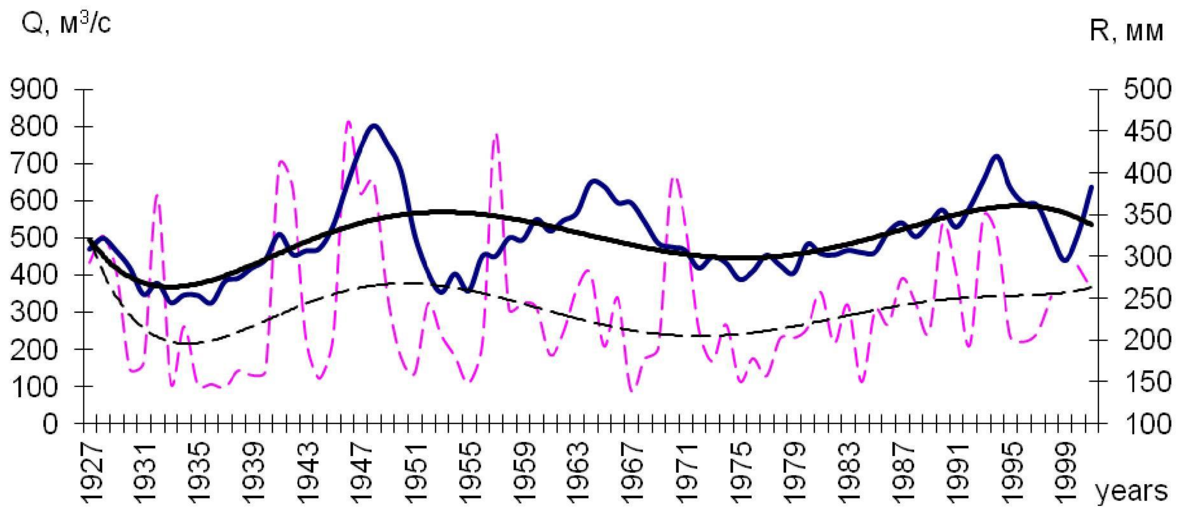
Figure 1 shows that there is an inverse relationship, namely, the air temperature increase corresponds to a decrease of water flow, from 1941 to 1957 years, and a decrease in the average air temperature corresponds to an increase in water consumption. Then from 1958 to 1977 years against the increase in mean air temperature decreases water consumption.

We calculated correlation between the drain and the air temperature during the warm period, for the station Uralsk is -0,30, that is the connection is very weak.

In this case, the weak link also mobilized for the air temperature during the warm period, calculated over a rolling three-year period and the average air temperature during the warm period without calculating the slip. Note that, in determining the correlation between the annual consumption of water and air temperature during the warm period were removed initial (1926-1930 years) and end (1999-2003 years) five years to eliminate the effect of uncertainty inherent in all time series. For air temperature relationship between annual precipitation and water flow riv. Zhaiyk closer, but a direct correlation, which is naturally [2]. So, the time evolution of the annual amount of precipitation in the course of MS Uralsk repeated consumption of water, even when the amount of precipitation, calculated over a rolling three-and five-year period (Figure 2).

CONCLUSION

Excluding the beginning and end of the series, we can say that throughout their length time series of water flow follows the time variation of rainfall. We can therefore conclude that the time series of rainfall, as well as the time evolution of the temperature in Uralsk well the time variation in the flow and the task of evaluating changes in the flows under the influence of global climate change, at least at the level of overall ratings, the data can be used, without recourse to other information [3].



----- Water consumption riv. Zhaiyk; --- the annual rainfall on the MS Uralsk, calculated over a rolling five-year period; --- trendline precipitation ---- Trendline water flow

Figure 2. The time course of the water flow rive. Zhaiyk and annual precipitation for Uralsk calculated for a rolling five-year period

As for the magnitude of the coupling between the flow of water riv. Zhaiyk and annual total precipitation for MS Uralsk, the correlation coefficient is 0,56.

But it is clear that after 1958 stroke approximation curves smoother than before. This points to the need for separate analysis of time series for periods of unregulated and regulated flow after 1958 reservoirs, and that we have done more.

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