













**International  
Water Association**

**Young Water Professionals Programme  
Программа молодых специалистов и  
ученых водного сектора**

**Organised by:  
Организаторы:**

	International Water Association
	European Water Association
	UNESCO-IHE Institute for Water Education
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	National Technical University of Ukraine "Kyiv Polytechnic Institute"
	Water Works Kiev (Київводоканал)
	MosvodokanalNIPProject
	Polish Academy of Sciences scientific Station in Kiev

*Proceedings of the  
IWA 5<sup>th</sup> Eastern European  
Young and Senior Water  
Professionals Conference  
Part 1*

*Сборник статей  
IWA 5<sup>ая</sup> Восточно-  
Европейская конференция  
«Опыт и Молодость в  
решении водных проблем»  
Часть 1*

**26-28 JUNE 2013  
PREMIER PALACE  
KIEV UKRAINE**

**26-28 ИЮНЯ 2013  
ПРЕМЬЕР ПАЛАС  
КИЕВ УКРАИНА**

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## CONTENT

<u>WATER MANAGEMENT</u>	<b>Pages</b>
<b>Andjelic L., Pajic P., Urosevic U.</b> The Importance of Melioration Areas Protection on the Danube Riversides, under the Influence of the HPP „Djerdap 1“ Slowdown, by Valorization of caused Agricultural Production Damages	<b>8</b>
<b>Andjelic L., Pavlovic M., Babovic B.</b> Features of System for Water Recirculation in Thermal Power Plant “Morava” on the Right Bank of River Velika Morava	<b>16</b>
<b>Angold Y.V., Zharkov V.A.</b> Features of the Drip-sprinkling Irrigation Technology	<b>23</b>
<b>Ayşe B. Şengül, Celil Debrelı, Eyup Kutlu, Goktug Tahl.</b> Risk of Cyanobacteria and Their Toxins	<b>28</b>
<b>Boltachev A.R., Alyomov S.V., Zagorodnya Yu.A., Karpova E.P., Manzhos L.A., Gubanov V.V., Burdiyana N.V., Tikhonova E.A., Popova L.A.</b> Integral Assessment of the Environment, Species Diversity and Ecological Structure of Coastal Marine Biocenoses of Kazantip Nature Reserve (the Sea of Azov)	<b>32</b>
<b>Cherednichenko V.S., Cherednichenko A.V., Madibekov A.S., Bayhonova T.A.</b> The Dynamics of Water Flow of the River Ural (Zhaiyk) and its Relation to Rainfall in the Catchment Areas	<b>40</b>
<b>Chornomorets Yu.A., Lukyanets O.I.</b> Selection of the Optimal Scenario of Runoff Distribution for the Spring Season at the Forecast Spring Flood Hydrograph on Pripyat River Example	<b>43</b>
<b>Duishonakunov M., Imbery S., Mohanty A., King L., Narama C.</b> Recent Glacier Changes and Their Impact on Water Resources in Chon and Kichi Naryn Catchments, Kyrgyz Republic.	<b>50</b>
<b>Galesic M., Gotovac H.</b> Potential Impact of Heterogeneity on Groundwater Age	<b>63</b>
<b>Gomes V. P.</b> Techno-Science Democracy as an Instrument of Global Water Governance	<b>70</b>
<b>Hristov J., Martinovska-Stojcheska A., Surry Y.</b> Input-Output Analysis Applied to Water Consumption in Macedonia	<b>79</b>
<b>Inasaridze N., Cherkezia E., Archvadze N.</b> Integrating the Environmental Issues into the Curricula of Higher Educational Institutions in Georgia, Case Study	<b>97</b>
<b>Kaźmierczak B.</b> Testing of Maximum Precipitation Amount Trends in Wrocław (Poland)	<b>103</b>
<b>Koś K., Zawisza E.</b> Improving of Geotechnical Properties of Bottom Sediments from Czorsztyn Reservoir’s Backwater	<b>109</b>

<b>Ligata N., Hadžić E.</b> An Overview of Water Resources Management in Bosnia and Herzegovina	119
<b>Milišić H., Kalajđisalihović H.</b> Pollutant Dispersion Modelling in Natural Rivers	127
<b>Moskalenko S.A.</b> Implementation of Mathematical Model of the Processes of Rainfall Flood Formation for the Purpose of its Prediction for the Rivers of the Right-Bank Part of Pripyat	135
<b>Ondrejková I., Tlučáková A., Slivková K., Šulvová L.</b> The Impact of Agricultural Activities on Nitrate Concentration in Groundwater of Slovakia	141
<b>Pariy A.V.</b> Creating a National Benchmarking System for the Utilities of Water-Supplying and Wastewater Sector in Russia	150
<b>Prohaska S., Bartoš Divac V., Koprivica A., Božović N.</b> GIS Software for Spatial Interpolation of Short-Duration Heavy Rainfall Events in Urban Drainage Areas across Serbia	153
<b>Rokochinskiy A.M., Gromachenko S.Y.</b> Environment Protection Measures in the Location Zone of Municipal Solid Wastes Sites Based on the Theory of Physicochemical Barriers	161
<b>Rudic Z., Bozic M., Nikolic G., Milosev D.</b> Impact of Climate Change on Management of Water Resources for Irrigation – A Case Study of the Srem Region (Serbia)	166
<b>Shashkina P.S.</b> Assessment of Phytoplankton Community of Small Water-Intake Rivers (by the example of Desna River and Skhodnya River)	174
<b>Sepúlveda J., Mendizabal M., Bernal E.</b> Hydro-Economic River Basin Model for Territorial and Business Adaptation to Climate Change	180
<b>Trusz-Zdybek A.</b> Molecular Biology Techniques Used for Identification of Filamentous Microorganisms Species	187
<b>Vasilyev K., Bird R.</b> An Innovative Tool for Performance Testing of Flood Forecasting Models to Help Improve the Quality of Forecasts	196
<b>Zaifoglu H., Aksoy H.</b> Baseflow Index for Hydrological Watersheds in Eastern Part of Turkey	203
<b>Zharkov V.A., Angold Y.V.</b> The Forecast of Development of Irrigated Agriculture in Kazakhstan at Rational Management of Natural Water Resources	212

#### WATER SUPPLY

<b>Allerdings D., Viktorova L.</b> Application of Filtration Resistance Parameters for Water Treatment Plant Ultrafiltration Performance Evaluation	217
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<b>Avsar E., Toroz I., Hanedar A., Akmirza I., Yilmaz M.</b> Physical Characterization of Natural Organic Matter and Determination of Disinfection By Product Formation Potentials in İstanbul Surface Waters	<b>225</b>
<b>Chyketa O. O., Pobigay G. A., Konovalova V.V., Samchenko Y. M., Burban A.F.</b> Sensitive Polymer Membranes Modified with Poly-n-Isopropylacrylamide	<b>238</b>
<b>Dejus S., Rubulis J.</b> Challenges of Water Quality Modelling in Drinking Water Supply Systems	<b>246</b>
<b>Gheorghe S., Catranguiu A., Lucaciu I., Cruceru L., Cosma C., Nicolau M., Stoica C., Hem L.J., Hafskjold L.S., Eikebrokk B.</b> Drinking Water Safety in South–East of Romania	<b>253</b>
<b>Gönczi G.</b> Revision of Budapest’s Reservoir Operation Considering Decreasing Water Consumption	<b>264</b>
<b>Ivantsova N.A., Petrischeva M.S., Pigareva E.S.</b> Oxidative Degradation of Phenol in Water when Exposed to Ultraviolet Radiation	<b>272</b>
<b>Khmyelyevska O.N., Nikipelova E.M., Nikolenko S.I., Mokienko A.V., Bambura O.F.</b> Natural Mineral Water Safety and Quality Control in Ukraine	<b>277</b>
<b>Miller P.</b> Impact of Ambient Water Characteristics on Highly Turbid Water Treatment - Research Paper	<b>282</b>
<b>Novytska O.S.</b> Rational Water Use In Residential Areas.	<b>289</b>
<b>Orestov Y., Mitchenko T.</b> Novel Method of Stabilizing Water Pretreatment for Reverse Osmosis Desalination	<b>298</b>
<b>Pervov A., Andrianov A., Spicov D., Gorbunova T.</b> Production of Drinking Water Using Nanofiltration and Reverse Osmosis Membranes: Principles to Escape Chemical Consumption and Decrease Wastewater Discharge	<b>305</b>
<b>Roche B., Mihailovici M., Zaharia V.</b> Water Loss Reduction through Hydraulic Modelling	<b>316</b>
<b>Sus M., Mitchenko T.</b> Sorbents with Biocidal Properties for Disinfection of Water for Various Purposes	<b>327</b>
<b>Svetleishaya E.M., Mitchenko T.E.</b> Factors Influencing the Efficiency of "Inline" Coagulation – Ultrafiltration Technology	<b>335</b>
<b>Szlachta M., Wójtowicz P.</b> A Comparative Study on the Removal of Natural Organic Matter from Water Using Carbon Nanomaterials	<b>343</b>
<b>Szlachta M., Wójtowicz P.</b> Iron Based Inorganic Adsorbents for Phosphate Removal from Contaminated Water	<b>349</b>



<b>Wójtowicz P., Łuźniak M., Ferenc Z., Kaźmierczak B., Kotowski A.</b> Modelling of the Main Water Pumping Station in Kłodzko, Poland	<b>355</b>
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### WASTEWATER TREATMENT

<b>Agaryov A. M., Vanyushina A.Ya.</b> Evaluation of the Potential of Techniques for Enhancement of Fermentation of Wastewater Sludge at the Kuryanovo Wastewater Treatment Facility	<b>365</b>
<b>Akmentina A. V.</b> A Study of Aeration Systems Efficiency in Actual Aeration Tank Operating Modes at Moscow Wastewater Treatment Facilities.	<b>374</b>
<b>Binh T.H., Barjenbruch M.</b> Increasing the Rate of Ammonia Nitrogen Removal from Wastewater by baffled Algal Reactors with Recycle Line under Laboratory Conditions.	<b>382</b>
<b>Bulskaya I., Volchek A.</b> Inorganic Constituents in Snow and Surface Runoff from Urbanized Areas in Winter: the Case Study of the City Of Brest, Belarus	<b>391</b>
<b>Drewnowski J.</b> The Impact of Slowly Biodegradable Organic Compounds on the Oxygen Uptake Rate in Activated Sludge Systems	<b>398</b>
<b>Gazizova N.G., Vanyushyna A.Y.</b> Impact of Sludge Prethickening on Efficiency of Methane Fermentation Process	<b>408</b>
<b>Gromov G. N., Shaposhnikov D.A.</b> Approaches to Substantiating the Roofing of Open Facilities at Wastewater Treatment Plants	<b>413</b>
<b>Heinrichmeier J., Buinauskaitė A., Jahnke J.</b> Comparative Evaluation of Volatile Suspended Solids and Chemical Oxygen Demand for Design and Evaluation of Modern Anaerobic Sludge Stabilization Plants	<b>421</b>
<b>Klímová M., Komínková D., Doležalová L., Šťastná G., Nábělková J.</b> Impact of Storm Water Drainage on Chemical and Ecological Status of Small Urban Creek - a Case Study of Prague	<b>429</b>
<b>Kochetov G.M., Prisyazhna O.V., Samchenko D.M., Naumenko I.V.</b> A Resource-Conservation Technology for Treatment of Electroplating Wastewater	<b>437</b>
<b>Kobasov G.A., Kevbrina M.V.</b> Tests of Disc Microfiltration Technology for Clarification of Sludge Mix of Aeration Tanks	<b>445</b>
<b>Korobtsova V.G., Kevbrina M.V.</b> Calculation of Volumes of Sludge at Kuryanovsk Treatment Facilities	<b>449</b>
<b>Kouba V., Catrysse M., Stryjová H., Jonatová I., Bartáček J.</b> The Impact of Low Influent Namon Concentration on NOB Inhibition in Biofilm Reactor	<b>454</b>
<b><u>Kozlov I.M.</u>, Kevbrina M.V., Nikolaev Y.A.</b> Evaluation of Efficiency of Biogenic Elements Removal from Moscow Waste Water Using Technology of Hannover University (MISAH)	<b>461</b>

<b>Moiseev V. L.</b> Radial-Flow and Horizontal-Flow Settling Tanks: the Relevance of their Application	468
<b>Moyzhes S.I., Kevbrina M.V., Kazakova E.A., Dorofeev A.G., Grachyov V.A., Nikolaev Yu.A.</b> Pilot Tests of the M-Dephanox Process.	473
<b>Pervov A., Matveev N., Andrianov A.</b> Decentralization of Wastewater Treatment in Local Utilities and Industries Applications	481
<b>Prut'yanova Yu.O.</b> Specificities of Use of the Membrane Technology of Final Sewage Water Treatment in the Conditions of Kazakhstan	493
<b>Shurshin K. A.</b> The Use of Microalgae for Wastewater Treatment in an Open Type Photobioreactor: Results of Laboratory Studies	498
<b>Siekanowicz-Grochowina K., Wójtowicz P.</b> LiDAR Support for Surface Permeability Recognition and Mapping in Urban Area of Wrocław, Poland	505
<b>Szaja A., Łagód G., Jaromin-Gleń K.M.</b> The Effect of Bioaugmentation on Oxygen Uptake Rate in Sequencing Batch Reactor	510
<b>Tashyrev A., Suslova O., Bondar K., Pokaluk V., Sachko A.</b> Microbial Karst Cave Exploration for Metal-Bearing Wastewater Treatment Biotechnologies	517
<b>Tricolici O., Bumbac C., Patroescu V., Postolache C.</b> Batch Experiments for Strength Dairy Wastewater Treatment in Activated Sludge-Microalgae System at Different Light Intensities.	524
<b>Vojtěchovská Šrámková M., Wanner J.</b> Comparison between Pilot-Plant and Laboratory Sand Filter Efficiency for Tertiary Wastewater Treatment	535
<b>Wójtowicz P., Szlachta M.</b> Design and Application of Innovative Hydrodynamic Flow Regulators in Urban Drainage Systems	543
<b>Zharkov A.V., Kevbrina M.V., Kazakova Y.A., Dorofeev A.G., Aseeva V.G., Nikolaev Y.A.</b> Characteristics of New Anammox Bacteria from a Filtrate Treatment Reactor of Belt Thickeners on Kuryanovsk Treatment Facilities (Moscow)	554

## 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<sup>3</sup>, of which 4510 and 3312 million m<sup>3</sup> enters the rivers Ural and Sakmara respectively.

To river Zhaiyk receives from Russia an average of 8390 million m<sup>3</sup>, 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<sup>3</sup> [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

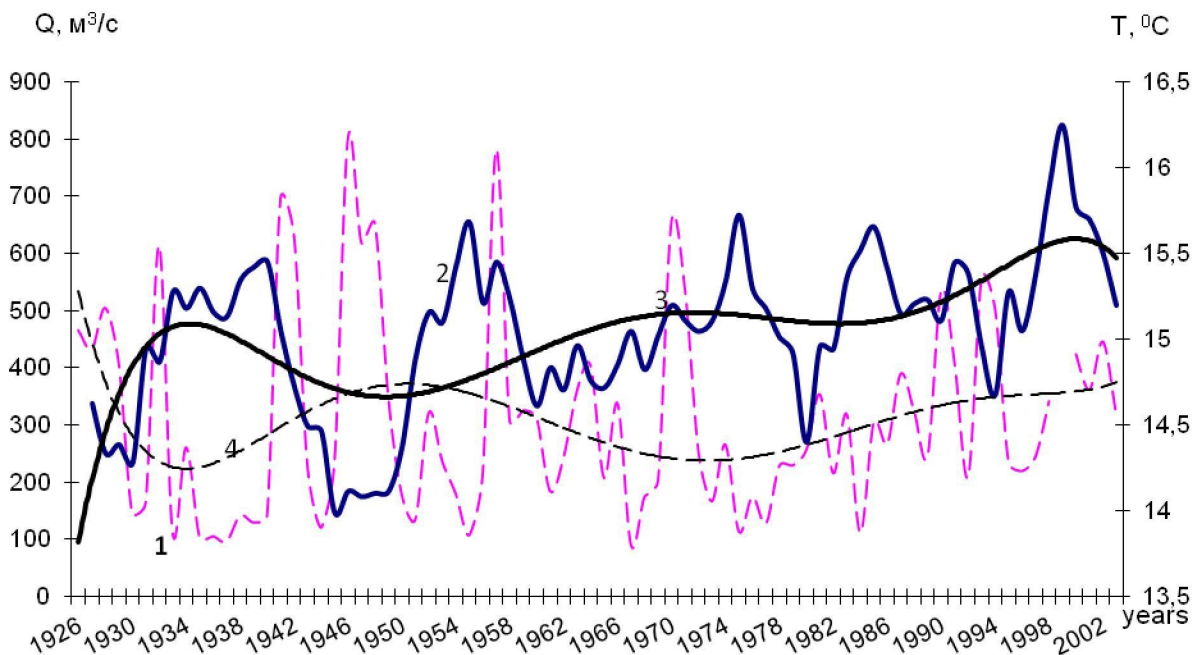
It is known that the river flow which is regulated, show a weak link between rainfall and temperature in the catchment areas on the one hand and the amount of runoff from the other. So we split the time series into two parts: before 1958 - unregulated flow and after 1958 - regulated flow.

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<sup>3</sup>/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 from 1941 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.

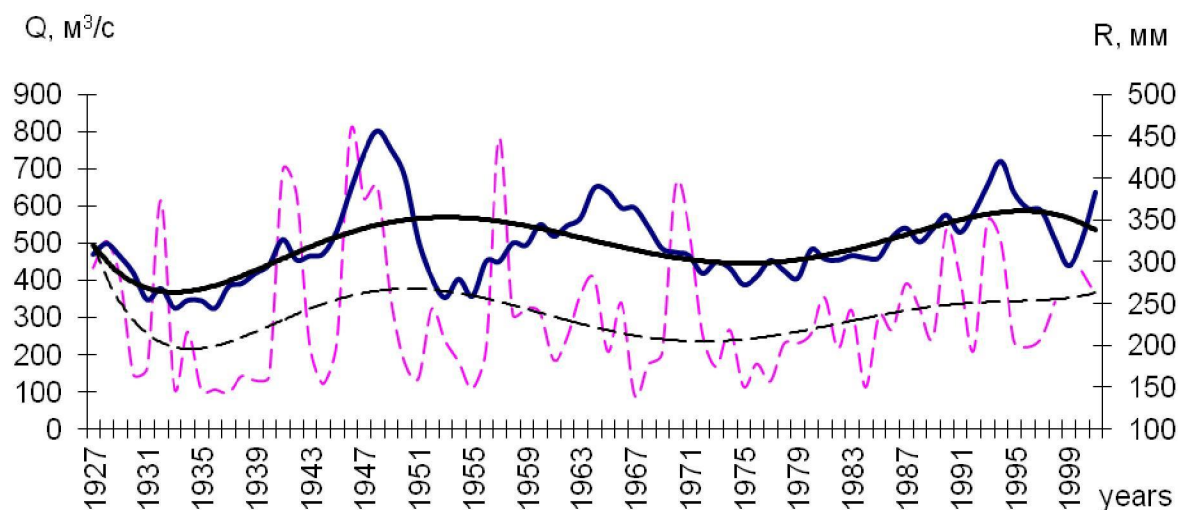
We calculated correlation between the drain and the air temperature during the warm period, for the station Uralsk is  $-0,30$ , that is the connection is very weak.

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 river. 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 river. 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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