United Nations Educational, Scientific and Cultural Organization

UNESCO Chair on water resources management in Central Asia, German-Kazakh University, Almaty

Monthly Scientific Digest on Water Issues in Central Asia: April 2018

Dear members of the Academic Teachers' network in Central Asia,
the current monthly issue gives a short overview of recent research trends in the field of Water Resources in Central Asia

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Open Calls

Student research competition

CAREC invites graduate students, from universities within and outside the Central Asian region, who plan to focus their research on sustainable management of water, land and energy resources in Central Asian countries and Afghanistan to participate in the student research competition that aims to build capacities of the young generation of specialists in the water, agricultural and environmental protection sectors in the Central Asian countries and Afghanistan. The competition is sponsored by the Smart Waters (USAID) and Climate Adaptation and Mitigation Program for Aral Sea Basin (WB) projects. Proposed research must be part of applicant`s dissertation and must be completed within 10 months or within other timeline agreed with the organizers.

The competition winners will be provided with financial support to carry out their research in the amount of up to US$ 1,500. This support will be based on the reimbursement of actual expenses incurred by the students during the research. Eligible costs include expenses associated with field trips, surveys, laboratory tests, printing, etc.

For detailed information follow the link: http://student.carececo.org/

Capacity Building of Young Researchers from Central Asia and Afghanistan in Water for Policy Studies

OSCE Programme Office in Dushanbe (POiD) anticipates to follow the foot-steps of the Capacity Building Workshop held in 2016 (https://www.osce.org/tajikistan/283581), which was jointly organized with the German Kazakh University (GKU) and aimed at the development of a "critical intellectual mass" of researchers and professionals in the region. POiD will organize a 5-days scientific writing course with focus on water resources management issues for the most talented researchers and academics from Central Asia and Afghanistan. The training course will take place in Dushanbe, Tajikistan at 3-7 September

2018. OSCE will cover the travel costs (from within Central Asia and Afghanistan) and will provide per diem for the course participants.
For detailed information follow the link: https://www.osce.org/programme-office-in-dushanbe/379171

Scientific articles

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[1] Impacts of climate change on the discharge and glacier mass balance of the different glacierized watersheds in the Tianshan Mountains, Central Asia

Min Xu, Hao Wu, Shichang Kang

Hydrological Processes, 2017, Volume 32, Issue 1

Link to the article: https://doi.org/10.1002/hyp.11409

Abstract

The Tianshan Mountains represent an important water source for the arid and semi-arid regions of Central Asia. The discharge and glacier mass balance (GMB) in the Tianshan Mountains are sensitive to changes in climate. In this study, the changes in temperature, precipitation, and discharge of six glacierized watersheds of Tianshan Mountains were explored using non-parametric tests and wavelet transforms during 1957–2004. On the basis of the statistical mechanics and maximum entropy principle model, the GMB at the watershed scale were reconstructed for the study period. The discharge and GMB responses to climate change were examined in different watersheds. The results showed that regional climate warming was obvious, especially after 1996. The warming trend increased gradually from east to west, and the increase in temperature was greater on the north slope than on the south slope. The changing trends in precipitation increased from eastern region to central region, and then, the trend decreased in the western region, although the value was higher than that in the eastern region. The discharge presented significant periods of 2.7–5.4 years and increased from east to west. Significant periodicity indicated that the discharge in the different watersheds exhibited obviously different patterns. The GMB losses were larger in south and east than in north. The large glaciers had more stable interannual variations in discharge, and large fluctuations in discharge will be observed as the glacier areas shrink. Precipitation was the dominant factor for discharge during the study period, although the influence of increasing temperatures on hydrological regimes should not be neglected in the long term. Systematic differences in discharge and the GMB in glacierized watersheds in response to climate change are apparent in the Tianshan Mountains.

[2] Natural Water Quality and Its Suitability in the Northern Tianshan Catchments (Central Asia)

Bing-Qi Zhu, Yan Gao, Xiao-Jun Meng

Hydrology, 2018, Volume 6, Issue 1, pp. 32-42

Link to the article: https://doi.org/10.11648/j.hyd.20180601.14

Abstract

The use of water resources in arid lands is strongly limited by their quantity. To add to such knowledge, this study evaluates the natural water quality and its suitability for drinking, agricultural and industrial purposes in the northern Tianshan catchments (Central Asia), using chemical-physical indicators. The waters are neutral to alkaline and most of them are soft-fresh waters. The total dissolved solid (TDS) varies over two orders of magnitude. Much of the solutes and physicochemical parameters in water are under the highest desirable limits of the World Health Organization (WHO) for drinking purpose and most waters are of good water quality for irrigation. The effects of local pollution are minimal in the montane and piedmont areas of these watersheds but are significant in the oases and central areas of the drainage basins. Although the headwaters of the northern Tianshan catchments represent natural background conditions (soft-fresh water in salinity and hardness) and population densities within the catchment are relatively low, the river basin is facing relatively high anthropogenic pressure on water quality in the low reaches. The main contributors to the nutrient emissions are agricultural land use and, to a lesser extent, unban settlements with a high proportion of households without connection to wastewater treatment plants. Proposals for regional water resources management are advised, i.g. the geographic data and information should be detailedly included in the assessment and monitoring procedure, a water quality model should be built, and information technology such as visualization technology and the internet should be used.

[3] Water in Kazakhstan, a key in Central Asian water management

Aibek Zhupankhan, Kamshat Tussupova, Ronny Berndtsson

Hydrological Sciences Journal, 2018, Volume 63, Issue 5, pp. 752-762

Link to the article: https://doi.org/10.1080/02626667.2018.1447111

Abstract

Central Asia is one of the regions with the highest probability of conflicts over water. Kazakhstan is the main Central Asian economic power and therefore it is important to understand how the country's water management policy is influencing water availability in the other Central Asian states. Already, the Central Asian economies are developing under increasing water deficiency, resulting in developmental problems. The main reasons for this are increasing political tensions and worsening ecological and socio-economic conditions. Kazakhstan was the first country in Central Asia to develop the pre-requisites for a transition towards integrated water resources management (IWRM). Therefore, Kazakhstan has potential to lead the development of transboundary water integration between all Central Asian states. A scenario for successful regional cooperation on water management in Central Asia involves establishing legal mechanisms for water management following international water law, assistance by international agencies and donors, and integrated social, economic and environmental methodology.

[4] Understanding and managing the food-energy-water nexus – opportunities for water resources research

Ximing Cai, Kevin Wallington, Majid Shafiee-Jood, Landon Marston

Advances in Water Resources, 2018, Volume 111, pp. 259-273

Link to the article: https://doi.org/10.1016/j.advwatres.2017.11.014

Abstract

Studies on the food, energy, and water (FEW) nexus lay a shared foundation for researchers, policy makers, practitioners, and stakeholders to understand and manage linked production, utilization, and security of FEW systems. The FEW nexus paradigm provides the water community specific channels to move forward in interdisciplinary research where integrated water resources management (IWRM) has fallen short. Here, we help water researchers identify, articulate, utilize, and extend our disciplinary strengths within the broader FEW communities, while informing scientists in the food and energy domains about our unique skillset. This paper explores the relevance of existing and ongoing scholarship within the water community, as well as current research needs, for understanding FEW processes and systems and implementing FEW solutions through innovations in technologies, infrastructures, and policies. Following the historical efforts in IWRM, hydrologists, water resources engineers, economists, and policy analysts are provided opportunities for interdisciplinary studies among themselves and in collaboration with energy and food communities, united by a common path to achieve sustainability development goals.

[5] Runoff variations in Lake Balkhash Basin, Central Asia, 1779–2015, inferred from tree rings

Irina P. Panyushkin, D. M. Meko, M. G. Macklin, W. H. J. Toonen, N. S. Mukhamadiev, V. G. Konovalov, N. Z. Ashikbaev, A. O. Sagitov

Climate Dynamics, 2018, pp. 1-17

Link to the article: https://doi.org/10.1007/s00382-018-4072-z

Abstract

Long highly-resolved proxies for runoff are in high demand for hydrological forecasts and water management in arid Central Asia. An accurate (R2 = 0.53) reconstruction of October-September discharge of the Ili River in Kazakhstan, 1779–2015, is developed from moisture-sensitive tree rings of spruce sampled in the Tian Shan Mountains. The fivefold extension of the gauged discharge record represents the variability of runoff in the Lake Balkhash Basin for the last 235 years. The reconstruction shows a 40 year long interval of low discharge preceded a recent high peak in the first decade of the 2000s followed by a decline to more recent levels of discharge not seen since the start of the gauged record. Most reconstructed flow extremes (± 2σ) occur outside the instrumental record (1936–2015) and predate the start of large dam construction (1969). Decadal variability of the Ili discharge corresponds well with hydrological records of other Eurasian internal drainages modeled with tree rings. Spectral analysis identifies variance peaks (highest near 42 year) consistent with main hemispheric oscillations of the Eurasian climatic system. Seasonal comparison of the Ili discharge with sea-level-pressure and geopotential height data suggests periods of high flow likely result from the increased contribution of snow to runoff associated with the interaction of Arctic air circulation with the Siberian High-Pressure System and North Atlantic Oscillation.

[6] Sustainability and long-term impact of community-managed water supply in rural Kyrgyzstan, Central Asia

Chris Wardle, Nazgul Zakiriaeva

Waterlines, 2018, Volume 37, Issue 2

Link to the article: https://doi.org/10.3362/1756-3488.17-00021

Abstract

How can Community Managed Water Supply (CMWS) become more sustainable? Recent studies in several countries indicate that the sustainability of many CMWS is poor. As a

result, their long term impact on village lives is limited. This paper presents the findings of research on the sustainability and long-term impact of a group of CMWS created by the Rural Water Supply and Sanitation Project (RWSSP) in Kyrgyzstan, Central Asia. This project adopted a Community-Based Approach to maximize the sustainability and long-term impact of its CMWS. The research assessed the sustainability of these CMWS a decade after their completion. It used six measures to assess sustainability and examined four long-term impacts. The results are compared with studies from other countries. The influence of Community-Based Approach (CBA) on the results is discussed. Recommendations are made for changes in policies and strategies to improve the sustainability and long term impact of future CMWS in Central Asia and elsewhere.

[7] Quantitative evaluation of the rainfall influence on streamflow in an inland mountainous river basin within Central Asia

Congjian Sun, Yanjun Shen, Yaning Chen, Wei Chen, Weibo Liu, Yongqing Zhang

Hydrological Sciences Journal, 2018, Volume 63, Issue 1, pp. 17-30

Link to the article: https://doi.org/10.1080/02626667.2017.1390314

Abstract

Stable isotopes of water have been widely used in understanding the hydrological functions of alpine inland catchments. This study identifies dominant runoff generation mechanisms based on isotopic data (δ18O and δ2H) of 487 rainwater and river-water samples from three tributaries in the Tarim River Basin in China for the period May–September 2013. The isotope hydrograph separation results provide a comprehensive overview of the rainfall influence on hydrological processes. Stream water and groundwater have varied responses to different intensities of rainfall events. Only a small proportion of rainfall is directly transported to the stream during such events. An inconsistent temporal trend of event water contribution is observed in the three catchments. The average fractional contributions of rainfall for the Tizinafu, Kumalak and Huangshuigou rivers are 10.3% (±1.1%), 9.7% (±2.9%) and 8.7% (±2.4%), respectively.

[8] Tree ring record of annual runoff for Issyk Lake, Central Asia

Tongwen Zhang, Mamatkanov Diushen, Ermenbaev Bakytbek, Huaming Shang, Yaqi Gao, Liping Huang, Ruibo Zhang, Feng Chen, Shulong Yu, Zifeng Yin, Yujiang Yuan

Journal of Water and Climate change, 2018, Volume 9, Issue 1

Link to the article: https://doi.org/10.2166/wcc.2018.232

Abstract

Revealing hydrologic variations in the past is helpful to understand the dynamic changes and evolution of a given water body. The widespread long-lived spruce forests growing in the mountainous area around Issyk Lake in Central Asia provide a good opportunity for dendrohydrologic studies about that lake. A regional tree-ring width chronology developed for Picea schrenkiana was used to reconstruct 345-year annual runoff for Issyk Lake. Based on frequency of the wettest/driest years and decades, the 20th century was identified as having the most frequent hydrologic fluctuations among the last three centuries. After applying a 21-year moving average, seven wet and six dry periods were found in the runoff reconstruction. The 10- and 2.1–5.4-year cycles of this reconstruction revealed that annual runoff variability of Issyk Lake may be influenced by solar activity and the atmosphere–ocean system. Spatial correlation proves that the runoff reconstruction contains climatic signals representative of a large area, including the western Tien Shan Mountains and Junggar Basin. A comparison between the annual runoff reconstruction and other hydroclimatic reconstructions reveals similar variations, particularly in the high-frequency domain. The annual runoff reconstruction also accurately captures some flood/drought events noted in the meteorological records and hydroclimatic reconstructions of Central Asia.

[9] Transboundary Rivers in Central Asia: Cooperation and Conflicts Among Countries

Sergej S. Zhiltsov, Igor S. Zonn, Oleg E. Grishin, Vladimir G. Egorov, Mark S. Ruban

Chapter in The Handbook of Environmental Chemistry. Springer, Berlin, Heidelberg, 2018

Link to the chapter: https://doi.org/10.1007/698_2017_226

Abstract

Nowadays many scientists and specialists say that in the twenty-first century, not hydrocarbons but water will be the key issue for economic development, well-being, and quality of life. This fully applies to the Central Asian countries where historically the problems of water resources have been in the focus of attention as the main factors determining stability in all sectors of the economy. This is connected with their geographical location and specific natural conditions. The Central Asian states locate in a region with severe climate featuring very high temperatures, uneven spatial distribution of water resources, and their insufficiency as no mechanism for addressing water issues is available. By the early twenty-first century, all water supply reserves in the region have been practically exhausted. The situation is aggravated by the fact that the river basins in this region are transboundary and their watersheds do not coincide with the existing state borders. In addition, the economies of the Central Asian countries depend enormously on

the use of transboundary water resources adding complexity to the water relations among these states which may be fraught with ethnic and social conflicts. The problem is aggravated by differing hydropower priorities of the countries located in the upper reaches of rivers, such as Tajikistan and Kyrgyzstan that control more than 80% of all freshwater supplies, and agricultural needs of the downstream countries – Uzbekistan, Kazakhstan, and Turkmenistan. In other words, some of the countries need electricity, while others water for irrigated farming.

[10] A Water Rights Trading Approach to Increasing Inflows to the Aral Sea

Maksud Bekchanov, Claudia Ringler, Anik Bhaduri

Land Degradation and Development, 2018, Volume 29, Issue 4, pp. 952-961

Link to the article: https://doi.org/10.1002/ldr.2394

Abstract

Tremendous development of irrigation since the 1960s combined with unbalanced water resources management led to the destruction of the ecosystems in the delta zone and the gradual desiccation of the Aral Sea, once the fourth largest freshwater lake of the world. Command-and-control-based water management in the Aral Sea basin inherited from Soviet times did not create any incentives for investing in improved irrigation infrastructure, adopt water-wise approaches, and thus maintain flows into the Aral Sea. This study examined the potential for market-based water allocation to increase inflows to the Aral Sea while maintaining stable agricultural incomes. We find that a water trading system can improve inflows to the Aral Sea but would require significant compensation for agricultural producers. Agricultural producers can use the compensation payments to cope with reduced water supply by improving irrigation and conveyance efficiencies and by developing alternative rural activities such as livestock grazing, agro-processing, and cultivation of low water-consumptive crops. We also find that a water trading system would be more efficient if it includes both trade among irrigation sites and between sites and instream uses.