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: November 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

---

Scientific articles

---

[1] Central Asia in Search for its Own Way of Integration

Evgeniya V. Makhmutova

Vestnik MGIMO-University, 2018. Volume 5, Issue 62, pp. 78-91.
Link to the article: https://doi.org/10.24833/2071-8160-2018-4-61-78-91

Abstract

The article deals with perspectives for integration within Central Asian region. The existing experience of integration in the region is perceived as an important factor. Currently the discourse of regional integration is gaining ground in Central Asia. It can be seen by the updates in the foreign policy concepts of most of the post-Soviet Central Asian countries. Another driver of the issue is the growing international activity of Uzbekistan which is due to the new President of the republic elected in 2016. The article defines the context of regional development, challenges which the region face, specific traits of political process.

The rationale for integration is linked to economic problems which cannot be solved by each Central Asian country on its own. Construction of any transport and logistical infrastructure in the region as well as tackling security threats determine regional cooperation. Although the researchers give arguments for advantages of integration in the region, Central Asian leaders are still looking for more efficient format of interregional cooperation. This process is not linear with its ups and downs. The article reveals the institutional experience that Central Asia gained over 1990s in search for its own integration project. Today this experience can be treated as an important step to maturity of national governance in the region.

But the reason why there is no implementation of integration initiatives discussed in the region earlier is that the current Central Asian political elites are not favorable to any kind of cooperation that will lead in the future to the formation of supranational bodies in the region. They perceive it as a threat to a stable national development. Another factor is a

higher commitment of Central Asian countries to cooperate with non-regional economies rather than within the region. In such context a strategy of "bandwagoning" (as it describes S. Walt) will hamper any regional integration project.

[2] Regional disparities in warm season rainfall changes over arid eastern–central Asia

Wenhao Dong, Yanluan Lin, Jonathon S. Wright, Yuanyu Xie, Yi Ming, Han Zhang, Rensheng Chen, Yaning Chen, Fanghua Xu, Namei Lin, Chaoqing Yu, Bin Zhang, Shuang Jin, Kun Yang, Zhongqin Li, Jianping Guo, Lei Wang & Guanghui Lin

Scientific Reports, 2018. Volume 8, Article number: 13051.
Link to the article: https://www.nature.com/articles/s41598-018-31246-3

Abstract

Multiple studies have reported a shift in the trend of warm season rainfall over arid eastern–central Asia (AECA) around the turn of the new century, from increasing over the second half of the twentieth century to decreasing during the early years of the twenty-first. Here, a closer look based on multiple precipitation datasets reveals important regional disparities in these changes. Warm-season rainfall increased over both basin areas and mountain ranges during 1961–1998 due to enhanced moisture flux convergence associated with changes in the large-scale circulation and increases in atmospheric moisture content. Despite a significant decrease in warm-season precipitation over the high mountain ranges after the year 1998, warm season rainfall has remained large over low-lying basin areas. This discrepancy, which is also reflected in changes in river flow, soil moisture, and vegetation, primarily results from disparate responses to enhanced warming in the mountain and basin areas of AECA. In addition to changes in the prevailing circulation and moisture transport patterns, the decrease in precipitation over the mountains has occurred mainly because increases in local water vapor saturation capacity (which scales with temperature) have outpaced the available moisture supply, reducing relative humidity and suppressing precipitation. By contrast, rainfall over basin areas has been maintained by accelerated moisture recycling driven by rapid glacier retreat, snow melt, and irrigation expansion. This trend is unsustainable and is likely to reverse as these cryospheric buffers disappear, with potentially catastrophic implications for local agriculture and ecology.

[3] Water storage variations and their relation to climate factors over Central Asia and surrounding areas over 30 years

Xinwu Li, Xizhang Gao, Yuting Chang, Dapeng Mu, Hailong Liu, Zhongchang Sun, Jinyun Guo

Water Supply, 2017, Volume 18, Issue 5, pp. 1564-1580.

Link to the article: https://doi.org/10.2166/ws.2017.206

Abstract

Continental or regional water storage variations (WSVs) are crucial to regional economic development and human society and play an important role in coping with global change. Water scarcity is currently an especially key issue in Central Asia (CA), and therefore the study of WSVs can aid in the adoption of measures for mitigating pressures from contemporary environmental changes and economic development in CA. Based on Gravity Recovery and Climate Experiment (GRACE), Global Land Data Assimilation System (GLDAS), and CRU meteorological datasets and a proposed combined filter strategy, WSVs in Central Asia and its surrounding areas over 30 years are investigated in this paper. The results indicate that the WSVs derived from GRACE and GLDAS over CA generally show a decreasing tendency. CRU data demonstrated that CA has been undergoing a warming trend. The water loss in CA may be caused by warming, which will lead to the loss of soil moisture. Moreover, the water mass in the Tibetan Plateau and Tarim basin increases, which may be caused by glacier melting in the Pamirs and Himalaya. The precipitation contributed little to changes in water storage, but at the basin scale, the precipitation anomalies were very similar to the GRACE and GLDAS data, which can be viewed as an indicator of WSVs.

[4] Sustainability of irrigation in Uzbekistan: Implications for women-farmers

Elena Kim

Water and Sustainability, 2018.
Link to the article: https://doi.org/10.5772/intechopen.79732

Abstract

This chapter focuses on a discussion of how global efforts to align local irrigation management with the good governance principles affect the lives of the rural poor, specifically women. Drawing in empirical data collected in post-soviet Uzbekistan, I illuminate unexpected effects of an apparently well-intended irrigation project on those categories of farmers whose connections to state apparatus of agricultural commerce of cotton were weak. Using fieldwork data from a village largely affected by desiccation of Aral Sea, I describe the everyday struggles by these people, who are mostly women, engage to make their living and provide subsistence to their families in situation of economic trauma, environmental disaster, and massive outmigration of male population. This analysis puts forward the local voices of real people whose lives are being restructured by sustainability oriented actions. Such perspective is often missed in scholarly and professional literature. These findings are hoped to assist policy developers in formulating irrigation programs in ways that would embrace sustainability both in terms of environmental and social justice.

[5] Last 1100 yr of precipitation variability in western central Asia as revealed by tree-ring data from the Pamir-Alay

Magdalena Opała-Owczarek, Tadeusz Niedźwiedź

Quaternary Research, 2018.
Link to the article: https://doi.org/10.1017/qua.2018.21

Abstract

We developed a 1108 yr chronology of tree-ring widths, based on 64 Himalayan pencil juniper (Juniperus semiglobosa Regel) trees, for the Pamir-Alay Mountains, central Asia. Dendroclimatological analysis demonstrates that precipitation has significant effects on tree growth in the semiarid mountainous area of northwestern Tajikistan located on the edge of the great midlatitude Karakum and Kyzylkum deserts. The highest level of linear correlation (r=0.67) is observed between tree growth and seasonalised winter (previous December–February) precipitation. Our studies also show that moisture (precipitation/Palmer Drought Severity Index) from the previous June to the current September was the dominant climatic factor accounting for interannual variations in tree-ring width, suggesting that this should be considered in climate reconstruction. Using the transfer function method, we reconstructed the region's drought history over the period AD 908–2015. The results of this moisture reconstruction showed that the most recent millennium was characterised by series of dry and wet stages. The driest periods occurred before 1000, 1200–1250, and at the end of the eighteenth century and beginning of the nineteenth century. The wettest conditions existed in 1650–1700 and after 1990.

[6] Contemporary Water Policy of Kyrgyzstan

Sergey S. Zhiltsov, Igor S. Zonn, Vladimir V. Shtol, Vladimir G. Egorov

The Handbook of Environmental Chemistry, 2018. Springer, Berlin, Heidelberg, pp 1-14.
Link to the article: https://doi.org/10.1007/698_2018_367

Abstract

The policy of Kyrgyzstan in water-energy resources management was formed after breakup of the Soviet Union when new independent states appeared. The Central Asian countries used the principle of assigning quotas on water resources which was widely practiced in the Soviet period. However, soon it has become clear that this approach is not in the interests of Kyrgyzstan. The country that practically had no hydrocarbon and quality coal resources could satisfy its energy needs only by hydropower plants on transboundary rivers. However, as soon as the countries of this region became independent, their interests turned out to be at variance. Kyrgyzstan as well as Tajikistan locates in the upper reaches of transboundary rivers and is interested in accumulation of water in reservoirs in summer for their further use

in winter for power generation. On the contrary, the downstream countries, such as Kazakhstan, Uzbekistan, and Turkmenistan, possessing extensive agricultural areas, are interested in getting water resources in summer. The directly opposing goals of the Central Asian countries provoked conflicts among them.

Having faced the difficulties in addressing the water-energy issues in the multilateral format, Kyrgyzstan consistently pursues the policy targeted to full control of water resources formed in its territory. It adopted the laws aimed at formation of the market-based relations with neighboring states in respect of water resources of cross-country waterways.

At the same time, Kyrgyzstan follows the course of construction of large water-energy facilities which should enhance its opportunities for addressing the energy security issues. However, these plans of Kyrgyzstan are criticized by other Central Asian countries that see in such policy a threat to their interests, first of all, for agriculture and solution of social and economic problems.

[7] Towards Global Water Security: A Departure from the Status Quo?

Cecilia Tortajada, Victor Fernandez

World Water Council (eds) Global Water Security. Water Resources Development and Management, 2018. Springer, Singapore, pp. 1-19.
Link to the article: https://doi.org/10.1007/978-981-10-7913-9_1

Abstract

Water resources are, and have always been, a multidimensional resource that crosses all social and economic sectors. Globally, growing population and urbanisation have increased the pressure to meet the water, energy, and food demands of larger populations with higher expectations. As a result, both developed and developing countries seem to be racing against the clock to respond to the needs of societies in which inequalities continue to grow. Water resources are scarcer and more polluted; their management, governance, and development increasingly depend on decisions that are made in other sectors, many times without sufficient coordination; and their availability is more than ever threatened by issues, such as climate variability and change, that impose nothing but uncertainty. These factors have led to water resources being seen through the lenses of risk and security. The security of water resources necessitates a departure from the status quo, to an innovative system that is able to understand and appreciate how different natural, policy, and political variables interact and affect each other. This system requires a wholesome perspective that is able to propose alternatives that consider complexity and that are adaptive to an uncertain future. A departure is necessary because the status quo has proven unable to respond to the present needs and expectations, much less to future ones.

[8] Controlled Subsurface Drainage as a Strategy for Improved Water Management in Irrigated Agriculture of Uzbekistan

Victor Dukhovny, Shavkat Kenjabaev, Shavkat Yakubov, Gulomjon Umirzakov

Irrigaition and Drinaige, 2018. Volume 67, Issue S2, pp. 112-123.
Link to the article: https://doi.org/10.1002/ird.2259

Abstract

An existing conventional drainage (CVD) was modified to control the flow from the drainage lateral and to control the groundwater table depth on a portion of irrigated winter wheat during the 2014–2015 cropping season in the Fergana Valley, Uzbekistan. Drainage outflow at one of two drainages was controlled (CTD), while the other was free (CVD). The cumulative drainage water volume from the CVD treatment was 22% greater than the CTD treatment. The flow-weighted mean salt concentration of the drainage water was on 7% lower in the CTD treatment (2.08 mS cm−1) compared to the CVD treatment (2.24 mS cm−1). The ratio of soil water content in the 1 m soil profile between inspection sumps A and B (1) versus B and the open collector (2) was 1.2, suggesting that the upper part of the field contained 20% more soil moisture. Conversely, the ratio of the groundwater table depth between (1) and (2) was 0.78, indicating that the groundwater table of the upper portion of the field was 47 cm (22%) shallower than the lower part. Thus, CTD increased the moisture storage of the soil layer in the upper part of the field. Managing the groundwater table resulted in less water stress between irrigation events and increased grain yields.

[9] Integrated water resources management in the Republic of Kazakhstan: problems and prospects

Abubakirova K.D., Tanybaeva A.K., Pavlichenko L.M., Pysmagambetova A.A.

Journal of Geography and Environmental Management, 2018, Volume 47, Issue 4, pp. 23-31.
Link to the article: http://bulletin-geography.kaznu.kz/index.php/1-geo/article/view/433

Abstract

The article analyzes the state of Kazakhstan's water resources, shows that in recent years the flow of Trans Boundary Rivers has been decreasing. As a result, in the coming years, with the growth of thecountry's economic potential, based on the development of rich mineral resources, fuel, energy and land resources, there will be a serious problem with water supply. The scarcity and irrational use of freshwater resources pose a serious threat to the sustainable development and protection of the country's environment. The regulation of water use is of great importance in solving this problem. It is necessary to ensure the implementation of the Program for the rational use and protection of water resources in the

context of large river basins by introducing new technologies for water supply and sanitation. The system of integrated water resources management should become the basis of the country's interstate and interstate water management policy. At present, the countries of Central Asia are moving towards the introduction of the principles of sustainable development into strategic documents and public administration practices. Integrated water resources management is one of the tools for the transition to sustainable development. This article is a review of progress made in the planning and implementation of integrated water resources management. The article summarizes the problems, successes, and directions for further integration in the field of water resources management. It also examines the successes and enormous difficulties still facing the regions, in particular, the issues of trans boundary waters, where states have different views and priorities for water use.

[10] Water Resources and Lakes in Kyrgyzstan

Jilili Abuduwaili, Gulnura Issanova, Galymzhan Saparov

Hydrology and Limnology of Central Asia, 2018. Springer, Singapore, pp. 271-295.
Link to the article: https://doi.org/10.1007/978-981-13-0929-8_8

Abstract

The basis of the hydrographic system in Kyrgyzstan is the river systems and water catchments that are separated by watershed mountain ranges from each other (Fig. 8.1). The hydrographic system of river basins is made up of lakes, glaciers, groundwaters, swamps, and wetlands. All of them are products of orography, relief/topography, underlying surface, and climate. They have an interaction and mutual influence and take a direct part in the formation of the water balance of the river flow regime.

[11] Present-Day Water Balance of the Aral Sea Seen from Satellite

J.-F. Cretaux, A. Kostianoy, M. Bergé-Nguyen, A. Kouraev

Remote Sensing of the Asian Seas, Barale V., Gade M. (eds), 2018. Springer, Cham. pp 523-539
Link to the article: https://doi.org/10.1007/978-3-319-94067-0_29

Abstract

The Aral Sea shrank drastically over the past 50 years, largely due to water withdrawal from Amu Darya and Syr Darya rivers for land irrigation. This has led to the separation of Aral Sea into two (in 1986–1987) and then four (in approximately 2010) water bodies. Lakes and enclosed inland seas are integrators of environmental and climate changes occurring at regional to global scale and present a high variety of behaviors on a variety of time scales

(from seasonal to decadal) depending on many factors, natural and anthropogenic. In addition, their crucial importance as water stocks has increased the necessity of monitoring all of their morphodynamics characteristics, such as water level, surface (water contour) and volume. The satellite altimetry and satellite high resolution optical imagery together are now widely used for the calculation of lakes and reservoirs water storage changes worldwide. Based on these different techniques we can determine the water extent within the Aral Sea basin since 1993, as well as volume variations, which is key parameter in the understanding of hydrological regime at time scales ranging from months to decades in this largely ungauged basin. Remote sensing techniques coupled with complementary in situ data have allowed precisely quantifying the water balance of the Aral Sea since 1993 and to understand the recent desiccation of this inland sea. Moreover, unprecedented information can be obtained by coupling models and surface observations with data from space, which offers global geographical coverage, good spatial-temporal sampling, continuous monitoring over time, and the capability of estimating water mass change.

[12] Human Contribution to the Increasing Summer Precipitation in Central Asia from 1961 to 2013

Dongdong Peng, Tianjun Zhou, Lixia Zhang, Bo Wu

Journal of Climate, 2018.
Link to the article: https://doi.org/10.1175/JCLI-D-17-0843.1

Abstract

The ecosystem and societal development over arid Central Asia, the core connecting region of the Silk Road Economic Belt, are highly sensitive to climate change. The results derived from multiobservational datasets show that summer precipitation over Central Asia has significantly increased by 20.78% from 1961 to 2013. It remains unclear whether anthropogenic forcing has contributed to the summer wetting trend or not. In this study, the corresponding physical processes and contributions of anthropogenic forcing are investigated by comparing reanalysis and experiments of the Community Atmosphere Model, version 5.1 (CAM5.1), from the CLIVAR Climate of the Twentieth Century Plus (C20C+) Project. The observed wetting trend is well reproduced in the simulation driven by all radiative forcings (CAM5-All), but poorly reproduced in the simulation with natural forcings only (CAM5-Nat), confirming the important role of human contribution in the observed wetting trend. Moisture budget analysis shows that the observed wetting trend is dominated by the increasing vertical moisture advection term and results from enhanced vertical motion over nearly all of Central Asia. The observed contributions of moisture budget components to the wetting trend are only captured by CAM5-All experiments. The dynamic contribution is determined by the warm advection anomalies in association with a human-induced meridional uneven warm pattern. Human-induced warming increases the

specific humidity over all of Central Asia, increasing (decreasing) the precipitation over the climatological ascent (descent) region in eastern (western) Central Asia.

[13] Precipitation measurement biases in an arid setting of central Asia: using different methods to divide precipitation types

Mingxia Du, Mingjun Zhang, Shengjie Wang, Yanjun Che, Jie Wang, Rong Ma, Sen Yang

Climate Research, 2018. Volume 76, pp. 73-86.
Link to the article: https://doi.org/10.3354/cr01527

Abstract

Accurate precipitation data play important roles in climate and hydrology research at regional and global scales. The correction of system errors associated with precipitation represents a feasible and effective way to improve the accuracy of rainfall data. We analysed and corrected rainfall data collected at 45 meteorological sites in Xinjiang over 55 years (from 1 January 1960 to 31 December 2014) in terms of the wetting loss, trace precipitation and wind-induced loss, with 2 judgement methods of precipitation types. We based our analysis on daily temperature, wind speed, precipitation, relative humidity and air pressure data. Precipitation after correction was compared to precipitation before correction. The primary conclusions are: (1) Based on the new method of distinguishing precipitation types, the results show more snow days, fewer mixed precipitation days and slightly fewer rain days than the traditional method. (2) The sum values of corrections for each loss based on the new method of distinguishing precipitation types are higher than those based on the traditional method in spring and autumn. The sum values of corrections and differences of each loss are all larger in North Xinjiang and smaller in South Xinjiang. The sum values of total corrections are larger on the north slope of the Tianshan Mountains and smaller on the south slope, and they decrease from the south slope to South Xinjiang. (3) The median values of the sum of each loss and total correction in the northern region of Xinjiang are higher than those in the central region of Xinjiang, which are higher than those in the southern region of Xinjiang on the whole. (4) Precipitation increases after correction. The annual mean corrected values at Bayanbulak (in the Tianshan Mountains), Altay (in North Xinjiang) and Yutian (in South Xinjiang) are 81.48, 54.60 and 12.55 mm, respectively.