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: July 2017

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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Scientific articles
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[1] Changes of precipitation extremes in arid Central Asia

Man Zhang, Yaning Chena, Yanjun Shen, Yupeng Li

Quaternary International 2017, 439 (Part A), Pages. 16–27
Link to the article: https://doi.org/10.1016/j.quaint.2016.12.024

Abstract

Despite growing evidence of increasing precipitation extremes around the world, research into extreme precipitation events in Central Asia (CA) is still scarce. In this study, based on daily precipitation records from 22 meteorological stations, several methods were used to detect the spatial-temporal distribution, abrupt change and return periods for six extreme precipitation indices as well as the total annual precipitation during 1938–2005 in CA. The results show that all precipitation indices experienced increasing trend except for annual maximum number of consecutive dry days (CDD), which had a significant decreasing trend. Abrupt changes for most of precipitation indices mainly occurred around 1957 during 1938–2005. Return periods for all seven precipitation indices concentrated in 10-year period. Meanwhile, all precipitation indices showed spatial diversity and heterogeneity, and the entire area tended to be wetter and experienced fewer dry conditions. Understanding these changes of precipitation extremes in CA will definitely benefit to water resource management, natural hazard prevention and mitigation, and reliable future projections in this region.

[2] Modeling plant structure and its impacts on carbon and water cycles of the Central Asian arid ecosystem in the context of climate change

Chi Zhang, Chaofan Li, Geping Luo, Xi Chen

Ecological Modelling 2013, 267, Pages. 158–179

Stay up to date on our updated Central Asian Journal of Water Research (CAJWR) website http://www.water-ca.org/

Link to the article: https://doi.org/10.1016/j.ecolmodel.2013.06.008

Abstract

The effect of the rapid climate change observed in recent decades on the carbon (C) dynamics of the Central Asian dryland remains unclear. The special root structure of desert plants, the non-uniform canopy structure of the dryland ecosystem, and the intensive root–water interaction in the groundwater–soil–plant continuum are important characteristics of dryland ecosystems that could affect the C and water processes in Central Asia. However, these characteristics of dryland ecosystems have not been adequately addressed by the current ecosystem models. In this study, a process-based arid ecosystem model (AEM) was developed to model plant and canopy structures and their effects on the coupled C and water processes in dryland ecosystems. In comparison to other models, the AEM includes an improved vertical root distribution submodel, a detailed mechanistic submodel for the root water uptake, a photodegradation submodel, and a plant form submodel that dynamically updates a plant's aboveground structure and canopy coverage daily. The AEM was parameterized for the major plant functional types (PFTs) in Central Asia, and its performance was evaluated by conducting sensitivity analyses and model validations against field observations. The model accurately predicted the water and C pulses in response to abrupt precipitation events. The numerical experiments indicated that (1) Central Asian dryland ecosystems could respond promptly to changes in climate and groundwater fluctuation, and (2) different PFTs have different sensitivities to environmental changes because of their different plant structures and physiologies. This study showed that a process-based model, such as the AEM, can be useful in studying the complex interactions between plants and their water-stressed environment in the context of the rapid climate change in Central Asia.

[3] Seasonal snow cover regime and historical change in Central Asia from 1986 to 2008

Hang Zhou, Elena Aizen, Vladimir Aizen

Global and Planetary Change 2017, 148, Pages. 192-216
Link to the article: https://doi.org/10.1016/j.gloplacha.2016.11.011

Abstract

A series of statistics describing seasonal Snow Cover Extent and timing in Central Asia (CA) have been derived from AVHRR satellite images for the time period from 1986 to 2008. Analysis of long term mean snow cover statistics shows that the area weighted mean of long term Snow Covering Days (SCD) for the whole CA is 95.2 ± 65.7 days. High elevation mountainous areas above 3000 m in Altai, Tien Shan and Pamir, which account for about

2.8% of total area in CA, have SCD > 240 days. Deserts (Karakorum Desert, Taklamakan Desert, Kumtag Desert) and rain shadow areas of major mountains, accounting for 27.0% of total area in CA, have SCD in the range of 0–30 days. Factors affecting snow cover distribution have been analyzed using simple linear regression and segmented regression. For plain regions and windward regions, the SCD rate is + 5.9 days/100 m, while for leeward regions, the rate jumps from + 0.7 days/100 m to + 10.0 days/100 m at about 2335 m. Latitude affects the SCD, especially in plain regions with insignificant change of elevation, with rates of 9–10 days/degree from south to north. The Mann-Kendal test and the Theil-Sen regression methods have been applied to analyze the spatial heterogeneous trends of change of SCD, Snow Cover Onset Date (SCOD), and Snow Cover Melt Date (SCMD). Area weighed mean SCD in the whole CA does not exhibit significant trend of change from 1986 to 2008. Increase of SCD was observed in the northeastern Kazakh Steppe. Low elevation areas below 2000 m in Central Tien Shan and Eastern Tien Shan, as well as mid-elevation areas from 1000 m to 3000 m in Western Tien Shan, Pamiro-Alai and Western Pamir, also experienced increase of SCD, associated with both earlier SCOD and later SCMD. Decrease of SCD was observed in mountainous areas of Altai, Tien Shan and Pamir, and vast areas in plains surrounding the Aral Sea.

[5] Influences of recent climate change and human activities on water storage variations in Central Asia

Haijun Deng, Yaning Chen

Journal of Hydrology, 2017, 544 Pages. 46–57
Link to the article: http://dx.doi.org/10.1016/j.jhydrol.2016.11.006

Abstract

Terrestrial water storage (TWS) change is an indicator of climate change. Therefore, it is helpful to understand how climate change impacts water systems. In this study, the influence of climate change on TWS in Central Asia over the past decade was analyzed using the Gravity Recovery and Climate Experiment satellites and Climatic Research Unit datasets. Results indicate that TWS experienced a decreasing trend in Central Asia from 2003 to 2013 at a rate of −4.44 ± 2.2 mm/a, and that the maximum positive anomaly for TWS (46 mm) occurred in July 2005, while the minimum negative anomaly (−32.5 mm) occurred in March 2008–August 2009. The decreasing trend of TWS in northern Central Asia (−3.86 ± 0.63 mm/a) is mainly attributed to soil moisture storage depletion, which is driven primarily by the increase in evapotranspiration. In the mountainous regions, climate change exerted an influence on TWS by affecting glaciers and snow cover change. However, human activities are now the dominant factor driving the decline of TWS in the Aral Sea region and the northern Tarim River Basin.

Report of an international organization
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[6] Report FAO: Drought characteristics and management in Central Asia and Turkey

Link to the report: http://www.fao.org/3/a-i6738e.pdf

FAO with the Robert B. Daugherty Water for Food Institute of the University of Lincoln-Nebraska conducted a study on drought characterization and management in drought prone regions of the world. This reports reviews drought issues in the region of Central Asia - in the countries of Kazakhstan, Kyrgyzstan, Tajikistan Turkmenistan, Uzbekistan and Turkey - which is prone to drought with varying intensity and frequency. This situation is exacerbated in the region by political instability, conflicts and structural characteristics of the economy, with a high rural poor population depending on agriculture and livestock for income and employment generation and weak institutional and policy frameworks, contributing to higher vulnerability. The severe drought that hit the region in 2001 proved this vulnerability. Policy options to tackle drought vary from centralized soviet structures to reformed decentralized frameworks. In most countries there is a system to manage water at basin levels, national drought planning and mitigation strategies and early warning systems; however, all these are improvable. Disaster risk management activities and emergency responses also need to be strengthened in the region according to the report findings. Greater funding, strengthened preparedness planning and coordination among the actors are amongst the factors required to carry out good practices. The report constitutes a basis to rethink policies and reformulate preparedness and response plans that can strengthen resilience to droughts in Central Asia, taking into account the social, economic and environmental contexts specific to each country.

Manual
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[7] IWRM ToolBox Teaching Manual

Authors: Dr José R. Fábrega D., Dr Yiqing Guan, Dr Barbara Janusz-Pawleta, Dr Jean-Marie Kileshye-Onema, Dr Carlos Hiroo Saito
Editor: Dr Danka Thalmeinerova

Teaching IWRM, as opposed to other water-related academic programmes, is unique because it requires a trans-institutional and interdisciplinary consciousness. This manual is to help educators designing and executing IWRM courses to incorporate as many IWRM disciplines as they feel is appropriate. Throughout this manual, we hope to spread guidance and inspiration on how to incorporate IWRM thinking and useful tools and case studies into a specific course or professional workshop. Although the IWRM ToolBox is referred to

extensively throughout the Teaching Manual, it does not replace it. This manual is intended to serve as supplementary material for users looking to expand use of the ToolBox within their programme or training. The objectives of this Teaching Manual are to:

- guide lecturers in incorporating the IWRM ToolBox into their courses;
- inspire and unite IWRM lecturers by sharing lessons learned and useful teaching methods;
- provide an overview of common IWRM disciplines and their related teaching subjects that can be integrated into a wide range of courses related to water resources;
- provide ready-to-use example lectures to make integration of IWRM disciplines easier;
- provide links to interactive teaching resources;
- facilitate the transfer of up-to-date knowledge within the water sector.

Announcement
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[8] Call for Papers. A special issue of Water (ISSN 2073-4441)

Deadline for manuscript submissions: 31 July 2017
Guest Editors: Prof. Dr. Ronny Berndtsson & Dr. Kamshat Tussupova

Link: http://www.mdpi.com/si/water/water_management_Central_Asia#info

Special Issue of Water is focused on the future of water management in Central Asia. Central Asia represents an important strategic geopolitical region. It has often been identified as a region close to potential conflict regarding water usage. For example, sharing of the water from the Syr Darya and the Amu Darya in the Aral Sea Basin has exposed a complex picture of water needs and potential political conflict. The rapid population increase together with climate change impacts are likely to further aggravate the near-future situation for water management in the region. Papers for this Special Issue should be forward-looking in the sense that we use contemporary knowledge together with water management tools to forecast how the future of water usage might look like in the region in response to future climate changes and how this will affect socioeconomic development. Case studies that consider aspects of water management in view of climate variability are suitable; however, they must substantively contribute to a broader understanding of this topic and allow for general management aspects regarding climate change effects.