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Surface Water Level Change in the Lower Reaches of Keriya River (2013–2014)

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Abstract: Daliyaboyi, in the lower reaches of the Keriya River, is the largest primitive animal husbandry oasis in the hinterland of the Taklimakan Desert. The water utilization contradiction is severe between the oasis ecological irrigation in Daliyaboyi and its upstream cultivation in Yutian. From August 2013 to March 2014, a water level gauge developed in this study was set up in Qigekuoyigan in the lower reaches of the Keriya River, and the dynamic data for the daily water level were recorded. In Daliyaboyi well No. 1, the groundwater pressure and pressure during the same period were measured using a HOBO water level gauge, and surface water level and groundwater depth datasets for the lower reaches of the Keriya River from 2013 to 2014 were obtained. The datasets included the following measurement data from August 2013 to March 2014: (1) the location of the measurement points; (2) the daily variations in and the average value of the surface water level at the Qigekuoyigan observation point; (3) the diurnal variations in and daily average values of the burial depth of the groundwater; and (4) the daily variations in the air pressure and water pressure during the groundwater depth measurements. The unit of the surface water level was cm, and the unit of the groundwater depth was m. The data formats were .shp and .xls, and the data size was 267 KB (compressed to one 255 KB file).

Keywords: Keriya River; Daliyaboyi; Yutian; oasis; surface water; water level; dynamic variations

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Dataset Availability Statement:

The dataset supporting this paper was published and is accessible through the *Digital Journal of Global Change Data Repository* at: https://doi.org/10.3974/geodb.2022.01.08.V1 or https://cstr.escience.org.cn/CSTR:20146.11.2022.01.08.V1.

1 Introduction

Daliyaboyi, in the lower reaches of the Keriya River, is the largest primitive animal

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husbandry oasis in the hinterland of the Taklimakan Desert, covering an area of 340 km^2, with more than 1,500 residents grazing animals for a living[1–4]. Its upstream area is the Yutian modern cultivation oasis, with an area of 1,716 km^2[5]. From Daliyaboyi to Yutian, a desert riparian forest ecosystem has developed along the banks of the Keriya River, which is mainly composed of *Populus euphratica*, *Tamarix chinensis, Phragmites communis,* and other dominant species, forming a 250 km long green ecological promenade in the interior of the desert[6]. There is a prominent contradiction between the ecological water use in the Daliyaboyi Oasis and the irrigation water use in Yutian. Located in the desert, the Daliyaboyi oasis and Yutian are both facing severe ecological degradation problems, such as desertification, and the population-land contradiction is extremely prominent[7]. This area is a very typical oasis for ecological security research in the arid region of western China.

In 2013, the Jiyin Reservoir was built in the mountainous area in the middle reaches of the Keriya River. It has a planned storage capacity of 0.82 × 108 m^3, which is close to 1/10 of the total annual runoff of the Keriya River[8]. The reservoir began to store water in September 2016. The Keriya River Basin is facing new exploitation of water and land resources, and the upstream and downstream water supply is facing adjustments. This poses the following question: what impact will this have on the ecological environment of the lower reaches of the Keriya River? The lower reaches of the Keriya River are deep in the desert, and travel to this region is extremely inconvenient. Early research on Daliyaboyi focused on investigations and some discontinuous observations, and basic data that can be used for research, especially the long time series dynamic observation data, are almost completely lacking. In August 2013, a self-designed photographic water level observation instrument was set up for the first time in Qigekuoyigan (37°31′N, 81°23′E). It recorded the dynamic variations in the water level from August 2013 to March 2014. The data obtained can be used to study hydrology and oasis ecology in the lower reaches of the Keriya River. In October 2012, a groundwater observation well was constructed in the hinterland of the oasis to record the groundwater depth in the hinterland of the Daliyaboyi oasis[9]. The data obtained can be used to verify the reliability of the surface water level observations.

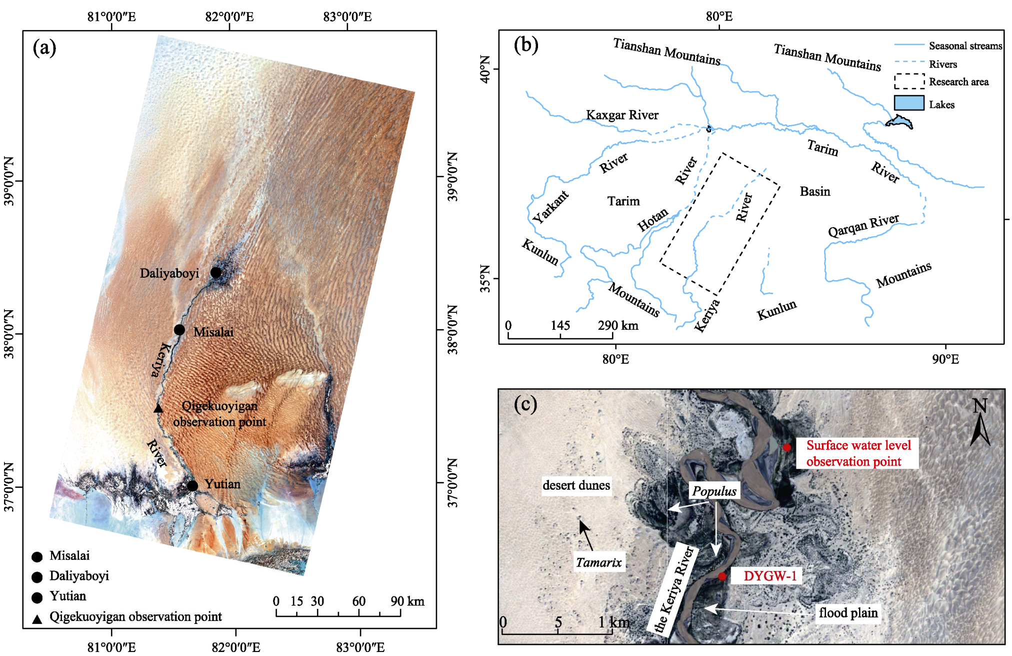

Figure 1 The location of the Qigekuoyigan surface water level observation point in the lower reaches of the Keriya River

2 Metadata of the Dataset

The *In situ* dataset of surface and groundwater in lower reaches of Keriya River (2013–2014) [10] is summarized in Table 1. It includes the dataset full name, short name, authors, year of the dataset, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the *In situ* dataset of surface and groundwater in lower reaches of Keriya River (2013–2014)

Items	Description
Dataset full name	*In situ* dataset of surface and groundwater in lower reaches of Keriya River (2013–2014)
Dataset short name	KR_QG_SW_2013
Authors	Wang J. ABH-1549-2020, Key Laboratory of Oasis Ecology (Xinjiang University) Ministry of Education, 1282509830@qq.com Zhang F. ABH-1946-2020, Key Laboratory of Oasis Ecology (Xinjiang University) Ministry of Education, zhang-f-eng@sohu.com Shi Q. D. ABH-2101-2020, Key Laboratory of Oasis Ecology (Xinjiang University) Ministry of Education, shiqd@xju.edu.cn
Geographical region	Qigekuoyigan, Yutian county, Xinjiang Uygur autonomous region (37°31′N, 81°23′E)
Year	August 3, 2013, to March 28, 2014
Data format	.xls, .shp
Data size	267 KB
Data files	The dataset consists of two files: (1) location data for the surface water observation point and the groundwater observation point; (2) daily variations in and daily mean of the surface water level in Qigekuoyigan (Tab. 1), Raw groundwater depth observation data (Tab. 2), and daily average groundwater depth data (Tab. 3)
Foundation	National Natural Science Foundation of China-Xinjiang United fund (U1178303, U1503381)
Data publisher	Global Change Research Data Publishing & Repository, http://www.geodoi.ac.cn
Address	No. 11A, Datun Road, Chaoyang District, Beijing 100101, China
Data sharing policy	***Data*** from the Global Change Research Data Publishing & Repository includes metadata, datasets (in the *Digital Journal of Global Change Data Repository*), and publications (in the *Journal of Global Change Data & Discovery*). ***Data*** sharing policy includes: (1) ***Data*** are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use ***Data*** subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute ***Data*** subject to written permission from the GCdataPR Editorial Office and the issuance of a ***Data*** redistribution license; and (4) If ***Data*** are used to compile new datasets, the 'ten per cent principal' should be followed such that ***Data*** records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset [11]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS

3 Methods

3.1 Principle

3.1.1 Surface Water Level

The scale of the water base-level on the gauge was directly read from the photo. Then, 197 days of surface-level variation data recorded every 3 hours during 238 days from August 3, 2013, to March 28, 2014, were obtained. For a few days in winter, the river water was frozen, and the river water level datum during this period was estimated visually in equal proportion with reference to the water gauge.

On February 2, 2014, ice gradually formed around the water gauge. From 1:00 on February 21, 2014, to 16:00 on March 1, 2014, the water surrounding the gauge was frozen, but the surface of the river was not. The diurnal variations in the water level during this period were visually estimated.

The water gauge was fully thawed at 19:00 on March 1, 2014, but abrasion made the scale on the gauge appear fuzzy. The image of the abraded part was estimated in equal proportion according to the water gauge’s scale, and the variation in the water level was recorded every 3 hours.

By calculating the average value of the surface level variations every 3 hours recorded every day, we obtained the daily average. The photo files for 12 days between August 2013 and March 2014 were lost, leading to missing observation data.

3.1.2 Groundwater Depth

The formula for calculating the groundwater depth in the monitoring well is as follows:

$$\mathrm{H} = \mathrm{h} - \frac{P_h - P_a}{\rho g} \qquad (1)$$

where h is the distance from the HOBO water level gauge to the ground surface. P_h is the groundwater pressure. P_a is the air pressure. ρ is the density. g is the acceleration due to gravity (9.8 N/kg)[9]. The average value of the diurnal variations in the groundwater depth was obtained from the diurnal variations in the groundwater depth at each time point[9].

3.2 Technical Routes

An industrial CCD camera was installed on the bank of the river, and the camera shutter was connected to a timing flash device to ensure that it could capture the scale at night (Figure 2a). We also made sure that the water gauge and the water surface were both in the camera’s view window. We installed the water gauge on August 3, 2013, and the initial water level scale reading was 10 cm. The camera started taking pictures at 1:00, and the camera was programmed to take a picture every 3 h to obtain dynamic surface water level observation data recorded 8 times a day.

Well No. 1 was constructed in the hinterland of the Daliyaboyi Oasis and was located 5 m from the riverbank. The main reason for setting up the observation well here was that at the location of the observation well, there was no surface water supply from other sources in the Daliyaboyi Oasis, which controlled the source and flow of the surface water in the Daliyaboyi oasis. A HOBO groundwater level meter was placed in the well to ensure that the water level gauge was below the surface of the shallow groundwater, and it was used to measure water pressure (Figure 2b). An identical HOBO water level gauge was placed outside the well to measure the atmospheric pressure[9]. The water level gauge was programmed to collect pressure and temperature data every 4 h.

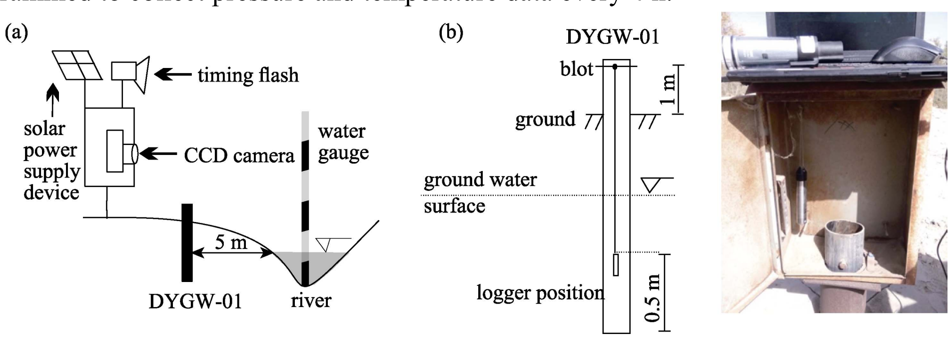

Figure 2 (a) Surface water level observation system and (b) groundwater level observation system[9]

4 Data Results and Validation

4.1 Data Composition

The data results include two data files: a dataset file in .xls format and a location data file in .shp format. The data include (1) location data for the Qigekuoyigan observation point and Daliyaboyi well No. 1 (.shp); and (2) surface water level data logged every 3 hours at the Qigekuoyigan observation point from August 3, 2013, to March 28, 2014, and the average value of the daily surface water level variations during this period (Tab. 1), raw data for the observations of the groundwater depth in Daliyaboyi well No. 1 (Tab. 2), and the average daily variations in the groundwater depth during the study period (Tab. 3).

4.2 Data Products

The changes in the surface water level represent the change in the amount of water flowing from the Keriya River through Yutian to the Daliyaboyi Oasis. From August 2013 to March 2014, the daily surface water variations in the lower reaches of the Keriya River were not significant. The lowest water level during the year was 0 cm in August 2013, and the highest water level reached 142 cm in February, with a range of 142 cm. There were at least two peaks in summer and winter. The summer peak was narrow, and it rose and fell rapidly. The winter peak was wide, and it rose and fell gently. The curve of the mean 8-month diurnal variation series was generally continuous (Figure 3c). The variation trend of the groundwater burial depth was relatively consistent with the variation trend of the surface water level, with two peaks in summer and winter, and the variation sequence was generally continuous (Figure 3c).

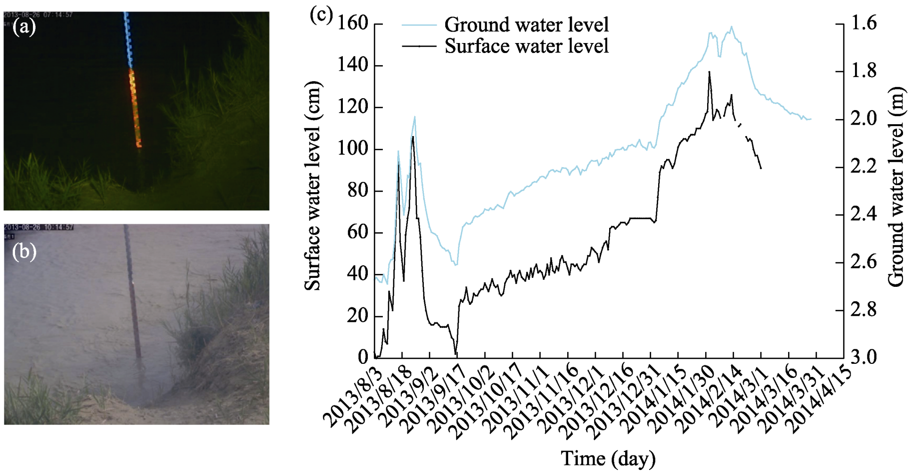

Figure 3 Shooting effect of surface water level observation system: (a) at night, (b) during the day, and (c) average diurnal variations in the surface water level and groundwater depth from August 3, 2013, to March 28, 2014

4.3 Data Validation

Data spanning 197 days (from August 3, 2013, to February 18, 2014) were obtained through visual means. The water gauge scale was mostly submerged, which ensured a reliable determination. There were 29 days of data missing (the 36 days from February 21, 2014, to March 28, 2014) because the water gauge scale wore out. Because the distance between the water gauge and the camera remained unchanged during the shooting period, the shooting parameters also remained unchanged, and the missing water levels were read out according to the submerged proportion of the water gauge. Although these data were read from photos, they were measured proportionally. The date are reliable. The dynamic variations in the groundwater level during the same period recorded using the HOBO groundwater level gauge exhibit good consistency (Figure 3c).

5 Discussion and Conclusion

The dynamic changes in the surface water level recorded at the Qigekuoyigan observation point suggest that the water quantity changed in the downstream region of the Keriya River after flowing through Yutian county. Two flood peaks in winter and summer exhibited clear characteristics. The Keriya River has the characteristics of a Chinese northwestern river, but the data show that its summer peak is not significant; this suggests that a portion of the river water is intercepted in the upstream area. The broad peaks in winter reflect the upstream water discharge during the slack season, and multiple sources such as groundwater recharge and snowmelt may be involved. The data indicate that the fluctuation in the downstream water was due to seasonal changes in the upstream irrigation. These data also provide a reference for the scientific allocation of water resources in the upstream and downstream oases where the seeds of plants such as *Populus euphratica* and *Salix euphratica* germinate under flood irrigation in summer.

Author Contributions

Wang, J. contributed to the data analysis and writing. Zhang, F. and Shi, Q. D. designed the overall dataset development. Zhang, F. designed the photographic water level monitoring device and set it up in the field.

Conflicts of Interest

The authors declare no conflicts of interest.

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