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Spatial Distribution Dataset of Continuously Disappearing Surface Water in China (1980s–2019)

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Abstract: Surface water is an important water source for human life and production and plays a significant role in maintaining ecological security and environmental health. In recent years, subject to the dual influence of global climate change and people's overuse of water resources, changes in surface water in China demonstrated different temporal and spatial characteristics, of which the disappearance of surface water is the most distinct. In this research, based on the JRC (Joint Research Centre) Global Surface Water dataset, the spatial distribution scope of continuously disappearing water bodies larger than 0.1 km^2 in China for the period of 1980s–2019 was extracted, and the continuously disappearing water bodies were divided into four types, namely, lakes, rivers, coastlines, and others. Then, combining artificial reading and interpretation and quality control, a spatial distribution dataset of continuously disappearing water bodies in China for the period of 1980s–2019 was formed. The spatial data included the distribution data of continuously disappearing water bodies in China for the period of 1980s–2019 (.shp), and the table data included the type and area statistics of continuously disappearing water bodies in China for the period of 1980s–2019. The dataset was archived in .shp and .xlsx formats, consisting of nine data files with data size of 13.30 MB (compressed into a 9.24 MB file).

Keywords: continuously disappearing; permanent water; surface water; spatial characteristics

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1 Introduction

Surface water is a key link in the global water cycle, influencing energy balance on the earth's surface[1]. Moreover, surface water is the most important water source for human life and production and has an important social value. In recent decades, subject to the dual influence of global climate change and human activities, changes in surface water demonstrated different temporal and spatial patterns[2], of which the shrinkage and complete disappearance of surface water bodies are the most distinct[3]. For example, Baiyang Lake dried up in the 1980s[4], main streams of the Yellow River frequently dried up in the 1990s[5], and lakes in Inner Mongolian have been rapidly shrinking and disappearing since the beginning of the 21st century[6]. These examples of disappearing surface water bodies pose a serious threat to the security of regional water resources and may lead to serious ecological and environmental problems, such as loss of the water bodies' ecological service functions, land desertification and salinization, a reduction in biodiversity, and so on[7]. Thus, monitoring and conducting quantitative analyses on regions with disappearing surface water bodies are important and would have academic significance and application value. Scholars conducted considerable research on dynamic changes in surface water bodies[8,9]. Specifically, utilizing remote sensing data and technical methods, they revealed the temporal-spatial change patterns of surface water bodies at different scales[10]. Existing studies focused mainly on analyzing the shrinkage and disappearance of water bodies[11,12], especially via statistical analysis. However, few data products are dedicated to disappearing water bodies at present.

China is a vast territory with diversified climates, uneven water resource distribution[13], and unbalanced regional development. In recent years, against the background of climate change and rapid economic and social development, significant changes in the distribution characteristics of surface water bodies in China were observed. On the whole, under the guidelines and policies for ecological civilization construction, the shrinkage and degeneration trend of lakes, wetlands, rivers, and other surface water bodies were contained and improved, but the shrinkage and disappearance of surface water bodies remain serious ecological and environmental problems in certain regions. In this research, we introduce the concept of continuously disappearing surface water bodies, that is, surface water that was a permanent water body at the starting year of the research period but continuously shrank throughout the years until the end of the research period. In the JRC Global Surface Water (GSW) dataset, permanent water bodies refer to those with water all year round[7]. In this study, we take the permanent disappearing water bodies larger than 0.1 km^2 in China for the period of 1980s–2019 in the JRC GSW dataset as continuously disappearing water bodies then divide them into four types, namely, lakes, rivers, coastlines, and others. Finally, we establish a spatial distribution dataset of continuously disappearing water bodies in China for the period of 1980s–2019. Such data can reveal the spatial characteristics of continuously disappearing surface water in China in the past two decades, which can provide basic information for the sustainable development of water resources and environmental governance in the future.

2 Metadata of the Dataset

The metadata of the Dataset of surface persistent disappearing water in China (1980s–2019)[14] is summarized in Table 1. It includes the dataset full name, short name, authors, year of the dataset, temporal resolution, spatial resolution, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the Dataset of surface persistent disappearing water in China (1980s–2019)

Items	Description		
Dataset full name	Dataset of surface persistent disappearing water in China (1980s–2019)		
Dataset short name	DisappearingWaterChina_1980s-2019		
Authors	Zhang, D. P., School of Surveying and Land Information Engineering, Henan Polytechnic University, Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, zdp_1994@163.com Jing, H. T., School of Surveying and Land Information Engineering, Henan Polytechnic University, jht_6153@163.com Liu, K., Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, kliu@niglas.ac.cn Ma, J. S., School of Geographical Sciences, Nanjing University of Information Science and Technology, Nanjing 210044, China; 20191210011@nuist.edu.cn Xu, J. H., School of Surveying and Land Information Engineering, Henan Polytechnic University, Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, jiahui_x1996@163.com Song, L. J., School of Surveying and Land Information Engineering, Henan Polytechnic University, Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, lijuansong88888@163.com Song, C. Q., Key Laboratory of Watershed Geographic Sciences, Nanjing Institute of Geography and Limnology, Chinese Academy of Sciences, cqsong@niglas.ac.cn		
Geographical region	China		
Year	1980s–2019	Spatial resolution	30 m
Data format	.shp, .xls	Data size	13.3 MB
Data files	Spatial data: distribution data of continuously disappearing water in China from 1980s to 2019 Table data: statistics of types and areas of water continuously disappearing in China from 1980s to 2019		
Foundations	Ministry of Science and Technology of P. R. China (2019YFA0607101); Chinese Academy of Sciences (XDA23100102)		
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[15]		
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS/ISC, GEOSS		

3 Methods

The research processing method is shown in Figure 1. First, the change data of water bodies in China were screened from the JRC GSW dataset[7]. Data with a value of 3 were extracted from the layer (disappeared permanent water bodies) and converted into vector data. Next, the area was calculated, and the surface water body data with an area of >0.1 km^2 were extracted. Second, the vector data of the lakes, rivers, and coastlines were used to classify the disappeared water bodies. As different datasets use different processing methods, and omissions and overlapping among datasets are common, the priority of the classification was specified as lake>river>coastline. In addition, to guarantee the integrity and accuracy of the data, the classified water body data were removed and superposed with a Google image, and patches with an area of >1 km^2 were manually inspected and screened then classified and combined. The water bodies that could not be judged, did not belong to the above three types, and had an area of <1 km^2 were classified as"others". Finally, the disappeared permanent water bodies nationwide were classified into four types, namely, lakes, rivers, coastlines, and others, to form the spatial distribution dataset of continuously disappearing surface water bodies in China for the period of 1980s–2019 (>0.1 km^2).

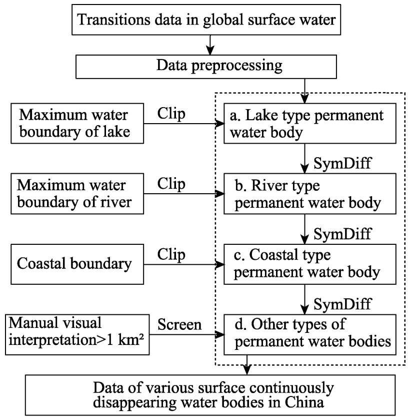

Figure 1 Technical flow chart

4 Data Results and Validation

4.1 Data Composition

The spatial data included the distribution data of continuously disappearing water bodies in China for the period of 1980s–2019 (.shp). The table data included the type and area statistics of continuously disappearing water bodies in China for the period of 1980–2019. In the attribute table of the Continuously_disappearing_water.shp dataset, the ID values of 1, 2, 3, and 4 corresponded to coastline-type disappearing water bodies, lake-type disappearing water bodies, river-type disappearing water bodies, and other types of disappearing water bodies, respectively. The dataset, with a data size of 13.30 MB, was stored in .shp format (compressed into a file with a data size of 9.24 MB).

4.2 Data Products

4.2.1 Distribution of Continuously Disappearing Surface Water Bodies Nationwide

During the period of 1980s–2019, a total of 3,870.53 km^2 of surface water disappeared in China, of which the largest continuously disappearing water body area of 473.72 km^2 was observed in Jiangsu province. In this study, continuously disappearing water bodies were divided into four types, namely, coastlines, lakes, rivers, and others. Among the disappearing water body types, the coastlines were the largest, with an area of 2,522.86 km^2, accounting for 65.18% of the total area of disappeared water bodies in the country and the most dominant type, followed by lakes, with an area of 764.26 km^2, accounting for 19.75% of the total area of disappeared water bodies. The river-type disappearing water bodies had an area of 313.44 km^2, accounting for 8.10% of the total area of disappeared water bodies, whereas the other disappearing water bodies had an area of 269.97 km^2, accounting for 6.98% of the total area of disappeared water bodies. As shown in Figure 2, the disappearing water bodies in China were distributed mainly along the coastlines and in the northeast region.

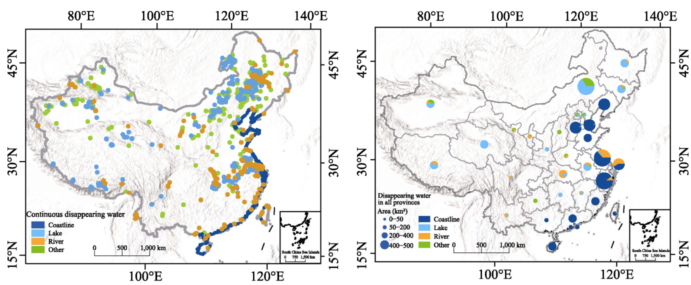

Figure 2 Spatial distribution of continuously disappearing water bodies in China (1980–2019)

As depicted in Figure 3, the spatial distribution of continuously disappearing water bodies in China has been uneven since the 1980s, and the area and proportion of disappearing water bodies in various provinces demonstrated considerable differences. Generally, the area of disappearing water bodies in the eastern region was greater than that of disappearing water bodies in the western region, and the area of disappearing water bodies in the coastal region was greater than that of disappearing water bodies in the inland region. Specifically, the disappearing water bodies were concentrated mainly in five provinces (municipalities directly under the central government), namely, Jiangsu province (473.42 km^2), Zhejiang province (452.21 km^2), Liaoning province (351.68 km^2), Shanghai (369.23 km^2), and the Inner Mongolia autonomous region (455.00 km^2), with a total area accounting for 54.37% of all disappearing water bodies nationwide. The total area of the disappearing water bodies in Jiangsu province, Liaoning province, Zhejiang province, and Shanghai exceeded 300 km^2, of which coastlines were the largest disappearing water bodies, with an area exceeding 60% of the total area of the disappearing water bodies in the provinces. Meanwhile, Jiangsu province had the largest river-type disappearing water bodies, with an area of 144.98 km^2. The main disappearing water bodies in the Inner Mongolia autonomous region were lakes, with an area of 300.92 km^2, accounting for 66.13% of the total area of the disappearing water bodies in the Inner Mongolia autonomous region. The other water bodies included marshlands, paddy fields, and so on, which were distributed mainly in the Inner Mongolia autonomous region, accounting for a small proportion of the total area of disappearing water bodies. Only the spatial distribution characteristics and reasons for the disappearance of the coastline-type, lake-type, and river-type water bodies were included in this study.

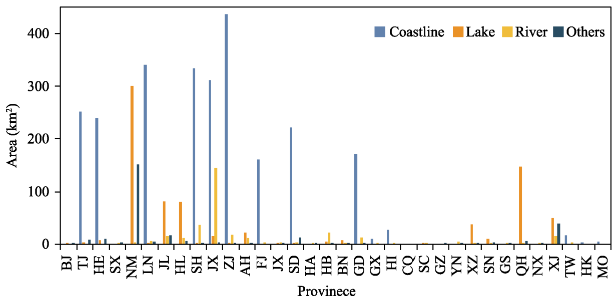

Figure 3 Statistical graph of areas of continuously disappearing water bodies in various provinces

(Note: The province abbreviation rules in this figure are as follows: Anhui-AH, Beijing-BJ, Fujian-FJ, Gansu-GS, Guangdong-GD, Guangxi-GX, Guizhou-GZ, Hainan-HI, Hebei-HE, Henan-HA, Heilongjiang-HL, Hubei-HB, Hunan-HN, Jilin-JL, Jiangsu-JS, Jiangxi-JX, Liaoning-LN, Inner Mongoria IM-NM, Ningxia-NX, Qinghai-QH, Shandong-SD, Shanxi-SX, Shaanxi-SN, Shanghai-SH, Sichuan-SC, Tianjing-TJ, Tibet-XZ, Xinjiang-XJ, Yunnan-YN, Zhejiang-ZJ, Chongqing-CQ, Macao-MO, Hong Kong-HK, Taiwan-TW. The same as below)

4.2.2 Distribution of Coastline-type Disappearing Water Bodies

Among the disappearing water body types, the coastline type was the largest, with an area of 2,522.86 km^2, accounting for 65.18% of the total area of all disappearing water bodies in the country. The four provinces with the largest area of coastline-type disappearing water bodies were Zhejiang province (436.54 km^2), Liaoning province (340.86 km^2), Shanghai (333.34 km^2), and Jiangsu province (311.01 km^2), accounting for 56.36% of the total area of coastline-type disappearing water bodies. As shown in Figure 4, among the disappearing water body types in the coastal provinces (municipalities directly under the central government), the coastline type was the largest.

As presented in Table 2, Zhejiang province had the largest area of coastline-type disappearing water bodies mainly owing to the development and construction of Hangzhou Bay. The disappeared water body area in Hangzhou Bay was 233.31 km^2, accounting for 60.57% of the total area of the disappearing water bodies in Zhejiang province. In 1985, the main landscape of the Hangzhou Bay wetland included mudflats, shallow waters, and reed marshes, whereas in 2015, most of the region had been converted into farmlands, planted forests, and marine culture sites[16]. The newly reclaimed lands generated considerable

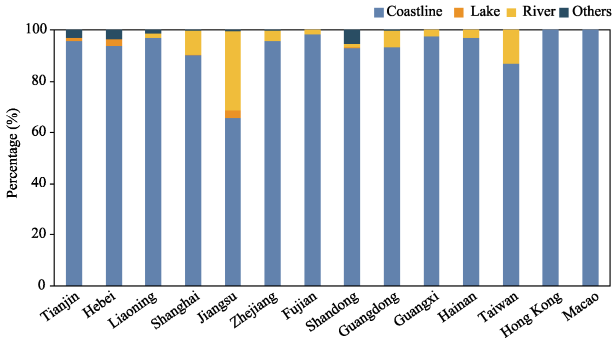

Figure 4 Proportion of area of various types of water bodies in coastal provinces

Table 2 Summary of provincial unit area of coastline disappearing water body

Area of lake type disappearing water (km^2)	Province
0	SX, NM, JL, HL, AH, JX, HA, HB, HN, CQ, SC, GZ, YN, XZ, SN, GS, QH, NX, XJ
0–300	HK, MO, GX, TW, HI, FJ, GD, SD, HE, TJ
300–400	JS, SH, LN
400–450	ZJ

income for the local residents, and driven by interest, the transformation process from natural wetlands to artificial wetlands then to impervious beds was irreversible. At the same time, the reclamation activities facilitated the rapid washing away of some of the natural silt by the shore current, thereby resulting in water loss and soil erosion.

4.2.3 Distribution of Lake-type Disappearing Water Bodies

Lakes are important surface water components and play an indispensable role in the hydrologic cycle. With human encroachment on lakes, the enhancement of artificial water diversions in lakes, and lakes' sensitivity to climate change, lake shrinkage and expansion are common. The lake type ranked second among the disappearing water body types, with an area of 764.26 km^2, accounting for 19.75% of the total area of disappearing water bodies nationwide. The two provinces with the largest area of lake-type disappearing water bodies were the Inner Mongolia autonomous region (300.92 km^2) and Qinghai province (147.72 km^2), accounting for 58.70% of the total area of lake-type disappearing water bodies. The lake-type disappearing water bodies were distributed mainly in North and West China.

The Inner Mongolia Autonomous Region had the largest area of lake-type disappearing water bodies. In the region, the five lakes with the largest disappeared area were Daihai Lake (42.03 km^2), Xindalainor Lake (31.47 km^2), Chagannor Lake (32.09 km^2), Dalinor Lake (28.09 km^2), and Huangqihai Lake (14.54 km^2), with a total area accounting for 50.96% of the total area of the lake-type disappearing water bodies in the Inner Mongolia autonomous region and 20.41% of the total area of lake-type disappearing water bodies nationwide. In Qinghai province, Qarhan Salt Lake had the largest disappearing area (due to salt mining and artificial reforming) of 59.68 km^2, accounting for 41.87% of the total area of the lake-type disappearing water bodies in the province, and was the largest disappearing water body in China.

Daihai Lake was the largest disappearing water body in the Inner Mongolia autonomous region, with an area of up to 42.03 km^2. Regarding the main background of this change, since the 1990s, Daihai Lake has been vigorously involved in the development of agriculture, industry, aquaculture, and tourism in the region. Moreover, the Daihai Power Plant, cultural farms, and so on were established around Daihai Lake, thereby substantially increasing lake water consumption. However, in recent years, precipitation around the Daihai Lake basin decreased, the confluence channel was blocked, and high temperatures increased

Table 3 Summary of provincial unit area of lake type disappearing water body

Area of lake type disappearing water (km^2)	Province
0–1	SX, FJ, HA, GD, GX, HI, CQ, GZ, YN, GS, NX, TW, HK, MO, BJ, SH, ZJ, SC, SD, LN
1–30	JX, TJ, HB, HE, BN, SN, JS, AH,
30–100	XZ, XJ, HL, JL
100–350	QH, NM

evaporation. Under the joint influence of natural and social factors, the area of Daihai Lake continued to shrink. In addition, against the background of global warming and wetting, the lakes in the northwest region tended to expand, but some lakes demonstrated the continuously disappearing phenomenon, of which Qarhan Salt Lake in Qinghai province was the typical representative. During the period of 2002–2018, the rapid development of industrial mining activities in the salt lake and its surrounding salt pans as well as the influence of human activities dominated the changes in the water body, thereby resulting in a total loss of 54.28 km^2 of natural water.

4.2.4 Distribution of River-type Disappearing Water Bodies

The river type ranked third among the disappearing water body types, with an area of 313.44 km^2, accounting for 8.10% of the total area of all disappearing water body types. The two provinces with the largest area of river-type disappearing water bodies were Jiangsu province (144.98 km^2) and Shanghai (35.18 km^2), accounting for 57.48% of the total area of river-type disappearing water bodies. The river-type disappearing water bodies were distributed mainly in the lower reaches of the Yangtze River in China.

Table 4 Summary of provincial unit area of river type disappearing water body

Area of river type disappearing water (km^2)	Province
0–5	BJ, TJ, HE, CQ, GZ, HK, MO, SX, QH, GX, GS, HA, SN, BN, HI, SC, XZ, NX, TW, JX, FJ, NM, SD, YN
5–30	LN, AH, HL, GD, JL, XJ, ZJ, HB
30–100	SH
100–200	JS

The province with the largest area of river-type disappearing water bodies was Jiangsu province, at 144.98 km^2. The causes of such disappearance were as follows. On one hand, the estuary of the Yangtze River is located in Shanghai and Jiangsu province, and the sediment carried by the runoffs of the Yangtze River accumulates constantly, thereby forming estuary sandbanks. On the other hand, to meet the requirements of urban expansion, the reclaimed area was increased, and the reclamation construction of Chongming Island was conducted in 1992 and 1998, which changed the land use type at the estuary of the Yangtze River, thereby resulting in the continuous reduction of the river water. Therefore, the water disappearance at the estuary of the Yangtze River was mainly due to the natural factor of sediment accumulation and human factor of reclamation activities.

5 Discussion and Conclusion

In this dataset, the spatial distribution characteristics of continuously disappearing surface water bodies in China for the period of 1980s–2019 (>0.1 km^2) were provided, and the disappearing water bodies were divided into four types, namely, coastlines, lakes, rivers, and others. The statistical analysis showed that during the period of 1980s–2019, a total area of 3,870.53 km^2 of surface water disappeared continuously, of which coastlines had the largest area (2,522.86 km^2), accounting for approximately three fifths of the total area of disappearing water bodies nationwide and the most dominant type. The distribution of the disappearing water bodies demonstrated significant spatial differences. Specifically, the area of disappearing water bodies in the eastern region was greater than that of disappearing water bodies in the western region, and the area of disappearing water bodies in the coastal region was greater than that of disappearing water bodies in the inland region. In addition, the four provinces with the largest area of coastline-type disappearing water bodies were Zhejiang province, Liaoning province, Shanghai, and Jiangsu province, and the provinces with the largest area of lake-type disappearing water bodies were the Inner Mongolia autonomous region and Qinghai province. Moreover, the provinces with the largest area of river-type disappearing water bodies were Jiangsu province and Shanghai. This dataset provided spatial distribution information for four types of continuously disappearing water bodies in China for the period of 1980s–2019 and a data foundation for analyzing various types of disappearing water bodies in different regions. Furthermore, the dataset can provide a scientific reference for water resource conservation and ecological restoration in various regions nationwide.

Author Contributions

Song, C. Q. and Jing, H. T. designed the algorithms of dataset. Zhang, D. P., Ma, J. S., Xu, J. H. and Song, L. J. contributed to the data processing and analysis. Zhang, D. P., Liu, K. and Song, C. Q. wrote the data paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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