

Analysis of the 30-m Raster Dataset Development of Seawater Quality in Bohai Sea (2017–2023)

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Abstract: Seawater quality monitoring data form the fundamental basis for studying marine environmental conditions. Based on the Bohai Sea water quality monitoring data (2017–2023) released by the Seawater Quality Monitoring Information Disclosure System on the official website of China Ministry of Ecology and Environment (MEE), this study developed a 30-m grid dataset of Bohai Sea water quality (2017–2023) through data collation, data conversion, spatial interpolation. The dataset includes annual 30-m resolution seawater quality grid data (.tif) and annual seawater quality monitoring point data (.gdb). Featuring high spatial resolution, a long-time span, and strong continuity, this dataset provides data support for research on the spatiotemporal distribution and improvement of Bohai Sea water quality. The dataset is archived in .gdb and .tif formats, and consists of 251 files with data size of 29.9 MB (compressed into one file with 3.91 MB).

Keywords: Bohai Sea; seawater; water quality; monitoring; 30-m grid dataset; 2017–2023

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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.2025.10.07.V1>.

1 Introduction

China is a country with extensive sea areas, long coastlines, numerous islands, abundant resources, and diverse ecosystems^[1]. Seawater quality protection is a key component of environmental protection and critical to the sustainable development of coastal cities. In 2019, the concept of building a “community with a shared future for marine life” was first proposed, contributing China’s wisdom and strength to marine ecological protection and security. Against this backdrop, seawater quality monitoring and the rational use of monitoring data serve as fundamental geographic information to scientifically guide the protection and management of marine water quality. They play an important role in the scientific evaluation of the marine environment, rational protection of the ecological environment, and maintenance of the integrity of marine ecosystems.

The Seawater Quality Monitoring Information Disclosure System of the MEE has

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[2] Li, J., Du, J. Z. 30 m raster dataset of seawater quality in Bohai Sea (2017–2023) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2025. <https://doi.org/10.3974/geodb.2025.10.07.V1>.

provided open access to a large volume of seawater quality monitoring data for the Bohai Sea, Yellow Sea, East China Sea, and South China Sea, presented in a webpage format. Most existing studies of this type focus on specific water quality detection methods, equipment, and evaluation technical routes based on monitoring results. Spatially, current relevant studies only analyze limited data from local regions, such as the analysis of seawater quality status and change trends in Shanghai Yangshan Port over the past 20 years^[2], water quality evaluation and its influencing factors in the coastal waters of South China^[3], current status and sustainable utilization countermeasures of the aquatic environment in the coastal waters of Zhuhai^[4], water quality status and pollution prevention suggestions in the coastal waters of Qingdao^[5], and comprehensive evaluation of water quality status in the coastal waters of major cities around the Bohai Sea^[6].

To facilitate the accurate analysis of vertical changes and horizontal comparisons of Bohai Sea water quality, improve the utilization rate of published data, and enable overlay analysis of seawater quality monitoring data with other spatial data such as regional environmental data, this study collated and developed a 30-m resolution spatial dataset of Bohai Sea water quality for 2017–2023. This dataset is characterized by high spatial resolution, a long-time span, and strong continuity.

2 Metadata of the Dataset

The metadata of the 30 m raster dataset of seawater quality in Bohai Sea (2017–2023)^[7] is summarized in Table 1. It includes the full name, short name, authors, geographical region, year of the dataset, data format, data size, data files, data publisher, and data sharing policy, etc.

Table 1 Metadata summary of the 30 m raster dataset of seawater quality in Bohai Sea (2017–2023)

Items	Description
Dataset full name	30 m raster dataset of seawater quality in Bohai Sea (2017–2023)
Dataset short name	BohaiSeaWaterQuality2017-2023
Authors	Li, J., Northwest Research Institute, China Urban Development Institute Co., Ltd., 1029349809@qq.com Du, J. Z., Northwest Research Institute, China Urban Development Institute Co., Ltd., hello.dujinze@vip.qq.com
Geographical region	Bohai Sea
Year	2017–2023
Data format	.gdb, .tif
Data size	3.91 MB (after compression)
Dataset files	Annual 30-m resolution seawater quality grid data; Annual seawater quality monitoring point feature data
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	(1) <i>Data</i> are openly available and can be free downloaded via the Internet; (2) End users are encouraged to use <i>Data</i> subject to citation; (3) Users, who are by definition also value-added service providers, are welcome to redistribute <i>Data</i> subject to written permission from the GCdataPR Editorial Office and the issuance of a <i>Data</i> redistribution license; and (4) If <i>Data</i> are used to compile new datasets, the “ten percent principal” should be followed such that <i>Data</i> records utilized should not surpass 10% of the new dataset contents, while sources should be clearly noted in suitable places in the new dataset ^[8]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

3 Methods

3.1 Study Area

The extracted data cover the Bohai Sea records (2017–2023) published by the Seawater

administrative regions around the Bohai Sea, obtained from the National Geographic Information Public Service Platform (TianDiTu)^[10].

The Seawater Quality Monitoring Information Disclosure System of the MEE has released data for the Bohai Sea from 2017 to 2023. A total of 4,074 monitoring points were set up in the Bohai Sea during this period, with the maximum of 720 in 2021 and the minimum of 437 in 2023. The specific distribution every year is shown in Figure 3.

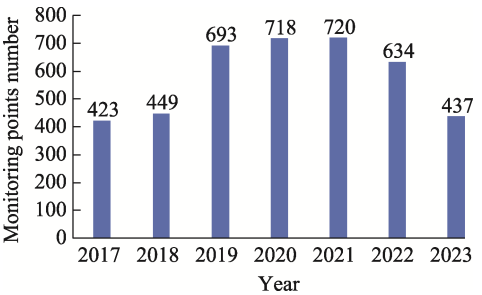


Figure 3 Number of water quality monitoring points in the Bohai Sea by year

3.3 Data Extraction

Seawater quality monitoring data published by the Seawater Quality Monitoring Information Disclosure System on the official website of the MEE were extracted annually via code, saved as .txt files, then imported into Excel, and organized via a series of steps including transposition and column splitting. A summary data table was compiled, including fields such as sea area, province, city, point code, measured longitude, measured latitude, monitoring time, pH, dissolved oxygen (mg/L), chemical oxygen demand (mg/L), inorganic salts (mg/L), reactive phosphate (mg/L), petroleum hydrocarbons (mg/L), water quality category, and data source (Figure 4).

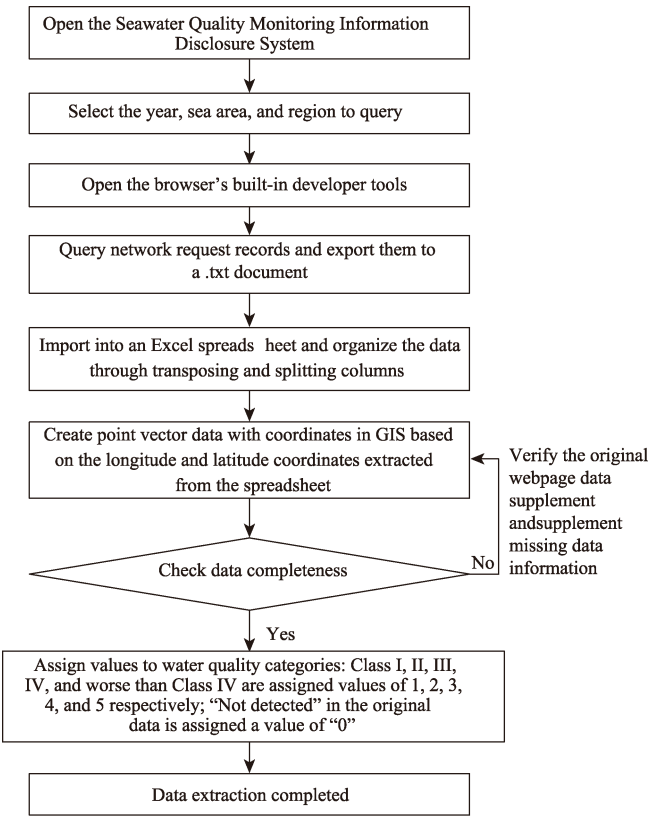


Figure 4 Flowchart of the data extraction process

Administrative division maps at the provincial, municipal, and county levels nationwide were downloaded from the National Geographic Information Public Service Platform (TianDiTu). Data around the Bohai Sea were extracted as the land-sea boundary on the northern, western, and southern sides of the Bohai Sea. The line connecting Laotieshan Cape at the southern end of the Liaodong Peninsula, via the Miaodao Islands, to Penglai Cape at the northern end of the Shandong Peninsula was used as the boundary between the Bohai Sea and the Yellow Sea^[11].

3.4 Data Processing

3.4.1 Data Conversion

Data within the Bohai Sea were extracted based on the “sea area” field in the summary data table. Using the measured longitude and latitude information in the table, GIS software was used to generate point spatial vector data of Bohai Sea water quality monitoring (.gdb) with the WGS84 geographic coordinate system. All field information from the summary data table was linked to the attribute table of the point spatial vector data through GIS software, forming complete point spatial vector data of Bohai Sea water quality monitoring (.shp) with 21 fields.

For the convenience of analysis and statistics, 6 types of indicators—pH, dissolved oxygen (mg/L), chemical oxygen demand (mg/L), inorganic nitrogen (mg/L), reactive phosphate (mg/L), and petroleum hydrocarbons (mg/L)—were set to double-precision type. For the “not detected” records in the original monitoring data of these 6 indicators, the corresponding field values in the vector data were set to “0”. Water quality categories (Class I, Class II, Class III, Class IV, and Worse than Class IV) were assigned values of 1, 2, 3, 4, and 5, respectively.

3.4.2 Raster Data Processing

The geographic coordinates of the point vector data of seawater quality monitoring were uniformly projected to the WGS 1984 World Mercator projected coordinate system. Using the Inverse Distance Weighting (IDW) method in the Spatial Analyst tool of GIS software, interpolation analysis was performed on the point vector data at the same monitoring time each year. The water quality category was used as the field, the data precision was set to 30 m×30 m, and the distance exponent was 2. This yielded 30-m resolution spatial distribution grid data of seawater quality categories at each monitoring time point per year.

The average value of seawater quality categories at different monitoring time points in the same year was calculated using the Raster Calculator in the Spatial Analyst tool (Map Algebra), generating the basic grid data of Bohai Sea water quality monitoring for each year. The basic grid data were reclassified, and water quality categories were reassigned according to the reclassification mapping rules (Table 2).

Table 2 Description of reclassification assignment mapping

Serial NO.	Original value	New value	Meaning
1	1–1.5	1	Class I
2	1.5<a≤2.5	2	Class II
3	2.5<a≤3.5	3	Class III
4	3.5<a≤4.5	4	Class IV
5	<4.5	5	Worse than Class IV

3.4.3 Scope Verification

The 30-m resolution grid data of Bohai Sea water quality (2017–2023) were compared with the vector data of administrative regions around the Bohai Sea. Grid data consistent with the scope of the Bohai Sea were obtained using the clipping tool. The area of each water quality category was recalculated, resulting in the 30-m resolution grid data of Bohai Sea water quality (2017–2023) containing 6 fields: object identifier, assignment, number of grids, seawater quality type, and area.

3.5 Data Visualization

ArcGIS software was used for the spatial visualization of the 30-m resolution grid data of Bohai Sea water quality (2017–2023). Through the symbology system, water quality category was used as the unique value, an appropriate color scheme was selected, and administrative division data around the Bohai Sea (obtained from TianDiTu) were added. Necessary elements such as map frames, legends, and scales were produced. By querying TianDiTu, place names such as Juehua Island, Changxing Island, Miaodao Islands, Bohai Bay, Laizhou Bay, and Liaodong Bay were labeled on the map, generating spatial data maps of Bohai Sea water quality with 30 m resolution for 2017–2023.

4 Data Results

4.1 Dataset Composition

The 30 m raster dataset of seawater quality in Bohai Sea (2017–2023) includes: (1) Annual 30-m resolution seawater quality grid data (.tif), containing 6 fields: object identifier, value, number of grids, water quality type, and area (Table 3).

Table 3 Attribute table description of 30 m resolution seawater quality category grid data

NO.	Field name	Field meaning	Field type	Example
1	OID	Object identifier	string	2
2	Value	Value	string	3
3	Count	Count	string	8634593
4	Szlb_CN	Water quality category (Chinese)	string	Class III
5	Szlb_EN	Water quality category (English)	string	Class III
6	Area	Area (m ²)	string	7771133700

(2) Annual seawater quality monitoring point data (.gdb), including 21 fields such as sea area, province, city, point code, measured longitude, measured latitude, monitoring time, pH, dissolved oxygen (mg/L), chemical oxygen demand (mg/L), inorganic salts (mg/L), reactive phosphate (mg/L), petroleum hydrocarbons (mg/L), water quality category, and data source (Table 4).

The point data (.gdb) adopt the WGS84 geographic coordinate system, and the grid layers (.tif) adopt the WGS 1984 World Mercator projected coordinate system.

4.2 Data Results Analysis

Data analysis shows that the seawater quality of the Bohai Sea has improved significantly from 2017 to 2023, specifically, the proportion of Class I water quality area increased from

48.31% in 2017 to 79.02% in 2023 (Figure 5). The proportion of Class IV water quality area decreased from 6.5% in 2018 to 0.003% in 2023 (Figure 6). The proportion of Worse than Class IV water quality area was 1.38% in 2017 and 1.21% in 2018, and was completely eliminated after 2019 (Figure 7).

Table 4 Attribute table description of point-type seawater quality monitoring vector data

NO.	Field name	Field meaning	Field type	Example
1	OBJECTID	Object ID	string	18
2	Shape	Vector type	string	Point
3	Sea_CN	Sea area (Chinese)	string	渤海
4	Sea_EN	Sea area (English)	string	The Bohai Sea
5	Province_CN	Province (Chinese)	string	辽宁
6	Province_EN	Province (English)	string	Liaoning Province
7	City_CN	City (Chinese)	string	大连
8	City_EN	City (English)	string	Dalian
9	Site	Site code	string	B21YQ007
10	Lon	Measured longitude (E)	Double	121.49
11	Lat	Measured latitude (N)	Double	39.67
12	Monitor_time	Monitoring time	Date	2017-5-1
13	pH	pH	Double	8.05
14	Rjy	Dissolved oxygen (mg/L)	Double	7.79
15	Hxxyl	Chemical oxygen demand (mg/L)	Double	1.09
16	Wjd	Inorganic nitrogen (mg/L)	Double	0.051
17	Hxlxy	Reactive phosphate (mg/L)	Double	0.009
18	Syl	Petroleum hydrocarbons (mg/L)	Double	0.013
19	Szlb_CN	Water quality category (Chinese)	string	一类
20	Szlb_EN	Water quality category (English)	string	Class I
21	Cite	Data source	string	http://ep.nmnc.org.cn:8888/Water/

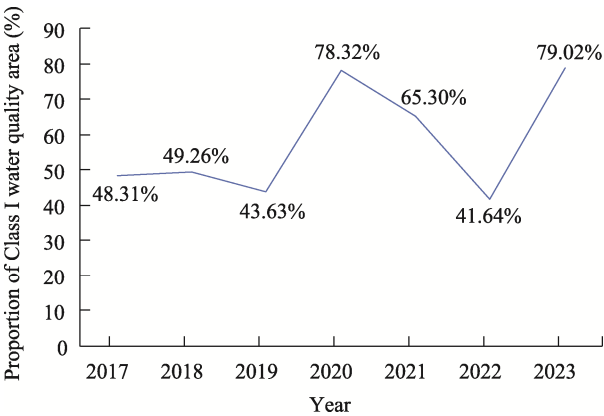


Figure 5 Proportion of Class I water quality area in the Bohai Sea (2017–2023)

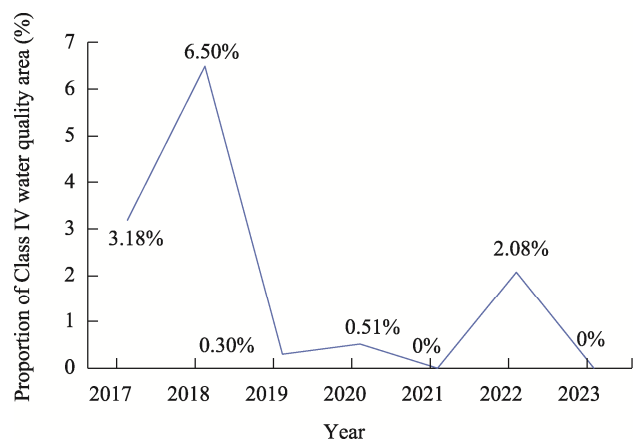


Figure 6 Proportion of Class IV water quality area in the Bohai Sea (2017–2023)

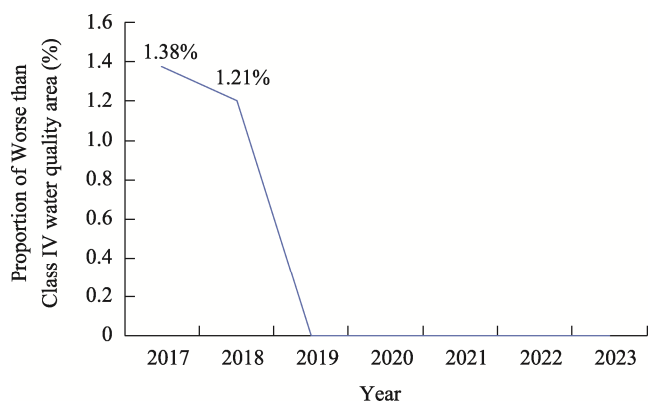


Figure 7 Proportion of Worse than Class IV water quality area in the Bohai Sea (2017–2023)

Spatially, since 2017, the water quality in the Bohai Sea waters of Hebei Province and southwestern Liaoning has been relatively stable, basically reaching Class I by the end of 2023. Laizhou Bay and Liaodong Bay, once the most polluted areas, completely eliminated Worse than Class IV water quality in 2019. In 2023, all Class IV water quality in the Bohai Sea was concentrated in Laizhou Bay, while all Class III water quality was distributed in Laizhou Bay and Liaodong Bay, accounting for 18% and 82% respectively. The water quality in Bohai Bay has improved significantly: dominated by Class II and III in 2017, it was mainly Class I in 2023, accounting for 74% of the Bohai Bay area, with Class II accounting for only 26% (Figure 8).

5 Discussion and Conclusion

This study developed a 30-m resolution gridded dataset of seawater quality in the Bohai Sea (2017–2023) based on water quality monitoring data from the Bohai monitoring stations published on the Seawater Quality Monitoring Information Disclosure System of the Ministry of Ecology and Environment. The dataset was constructed through data cleaning, format transformation, and spatial interpolation. Characterized by long temporal coverage, multi-dimensional attributes, consistent structure, and rigorous quality control, it supports

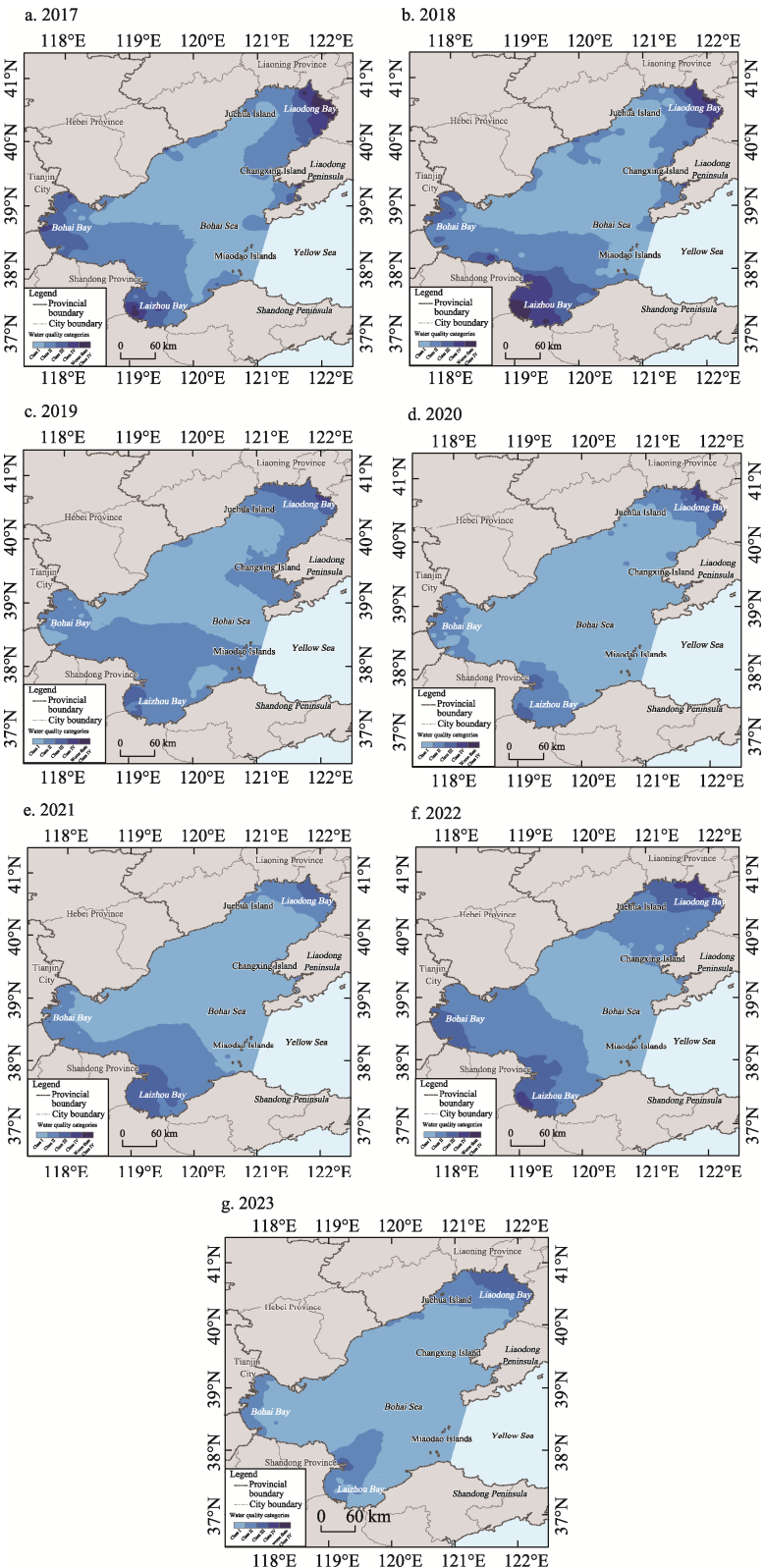


Figure 8 Distribution maps of 30-m resolution seawater quality in the Bohai Sea (2017–2023)

both longitudinal analysis of annual trends and cross-regional comparison of seawater quality. Moreover, it provides a reliable data foundation for multidimensional correlation research. By integrating this dataset with spatial information such as administrative divisions, GDP distribution, locations of industrial enterprises, aquaculture zones, and shipping routes, further studies can be conducted to explore the mechanistic relationships between seawater quality variations and factors such as regional economic development levels, industrial pollution types, intensity of aquaculture activities, and impacts of maritime transportation.

Author Contributions

Li, J. designed the overall development of the dataset, collected and processed the data, and wrote the data paper; Du, J. Z. performed the data validation.

Conflicts of Interest

The authors declare no conflicts of interest.

References

- [1] Wang, Q. Marine Environmental Protection Law comes into force today [N]. People's Court Daily, 2024-01-01(4).
- [2] Qian, J. Y. Analysis of seawater quality status and change trends in Shanghai Yangshan Port over the past 20 years [J]. *Green Technology*, 2023, 25(10): 65–71,77. DOI: 10.16663/j.cnki.lskj.2023.10.008.
- [3] Huang, P. H., Wang, G., Huang, Z. Y. Water quality evaluation and its influencing factors in coastal waters of South China [J]. *Tropical Geography*, 2021, 41(1): 124–135. DOI: 10.13284/j.cnki.rddl.003299.
- [4] Wu, Z. F., Guo, Z. X., Wang, J. Z., et al. Current status and sustainable utilization countermeasures of the aquatic environment in coastal waters of Zhuhai [J]. *Environment and Development*, 2000(4): 22–23.
- [5] Wang, Y. L., Sun, L., Wang, J. S. Water quality status and pollution prevention suggestions in coastal waters of Qingdao [J]. *Science and Technology Innovation*, 2020(22): 144–145. DOI: 10.3969/j.issn.1673-1328.2020.22.086.
- [6] Zhang, G. S., Yan, J. S., Wu, T. T., et al. Comprehensive evaluation of water quality status in coastal waters of major cities around the Bohai Sea [J]. *Journal of Hydroecology*, 2022, 43(4): 63–70. DOI: 10.15928/j.1674-3075.202102060309.
- [7] Li, J., Du, J. Z. 30 m raster dataset of seawater quality in Bohai Sea (2017–2023) [J/DB/OL]. *Digital Journal of Global Change Data Repository*, 2025. <https://doi.org/10.3974/geodb.2025.10.07.V1>.
- [8] GCdataPR Editorial Office. GCdataPR data sharing policy [OL]. <https://doi.org/10.3974/dp.policy.2014.05> (Updated 2017).
- [9] Ministry of Ecology and Environment of P. R. China. Seawater Quality Monitoring Information Disclosure System [OL]. <http://ep.memc.org.cn:8888/Water/>.
- [10] National Geographic Information Public Service Platform (TianDiTu). Administrative region visualization [OL]. <https://cloud.tianditu.gov.cn/administrativeDivision/>.
- [11] Zheng, D. Physical Geography of China [M]. Beijing: Science Press, 2015: 136.