

Analysis of the Dataset Development on Ecological Resilience Index in the Continental Coastal Zone of East China Sea (2000–2022)

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Abstract: The coastal zone is among the most ecologically fragile regions, where global change and human activities interact most intensively. Constructing a long-term ecological resilience dataset is of great significance for regional risk identification, resilience assessment, and ecological governance. Focusing on the continental coastal zone of the East China Sea (ECS), this study integrates remote sensing imagery from MODIS and TM/ETM+, basic geographic data, and socioeconomic statistics to develop an ecological resilience assessment indicator system under a framework combining ecological processes (risk-resistance-adaptation-recovery) and ecological background conditions (scale-density-morphology). A combined subjective-objective weighting approach was employed by integrating the fuzzy analytic hierarchy process (FAHP) and the CRITIC method, and the final integrated weights were determined based on the Lagrange extremum condition. Using the composite index method, an ecological resilience dataset and corresponding subsystem datasets for the continental coastal zone of the ECS from 2000 to 2022 were generated. The results show that ecological resilience exhibited a fluctuating but overall increasing trend during the study period, reached a relatively low level in 2005, and improved continuously after 2010. Spatially, the distribution pattern remained generally stable, with lower values in the northeastern part and higher values in the southwestern part of the study area. The dataset includes spatial distribution data of the ecological resilience index at 5-year intervals from 2000 to 2022, data for 7 subsystems including scale, density, morphology, risk, resistance, adaptation, and recovery, as well as zonal statistics for the ecological resilience index and each subsystem. The spatial data have a resolution of 100 m and are archived in .tif and .xlsx formats. The dataset comprises 241 files, with an original volume of 14.2 GB and a compressed size of 902 MB. This dataset supported the completion of the first author's Master of Science thesis.

Keywords: ecological resilience; multi-source data fusion; combination weighting; continental coastal zone of the East China Sea region; Master of Science thesis

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1 Introduction

The coastal zone is a complex and dynamic transitional region where land extends seaward^[1]. Owing to its advantageous geographic location and abundant resources, it has become a strategic hub and a key area for territorial spatial development and land-sea integration^[2]. Against the backdrop of global climate change and sea-level rise, the combined effects of continued population agglomeration and high-intensity development have accelerated the degradation of ecosystem structure^[3], ecosystem service value^[4], and landscape quality^[5]. These changes have progressively weakened ecosystem carrying capacity and self-purification capacity, increased natural and social hazard-inducing factors, and intensified risk exposure^[6], thereby creating an urgent need to support risk governance and integrated management through the concept of ecological resilience. Constructing a long-term, highly comparable, and traceable ecological resilience dataset for coastal zones can not only provide basic data for identifying regional ecological security patterns and improving territorial spatial governance, but also offer quantitative support for adaptation and disaster reduction under global change scenarios.

The concept of resilience originated in engineering, where it referred to the ability of a system to return to its original state after disturbance. It was subsequently expanded to ecology and human-environment regional systems research^[7]. From an ecological perspective, resilience emphasizes the ability of a system to maintain structural and functional stability under disturbance while transitioning toward a new stable state. From an evolutionary perspective, it highlights the capacity of a system to adapt, learn, and renew itself in response to uncertain disturbances^[8]. Ecological resilience can therefore be understood as the integrated capacity of an ecosystem to resist external shocks, maintain or restore its structure and functions, and sustain self-organization and self-renewal. Existing studies on ecological resilience mainly rely on conceptual framework construction, composite indicator evaluation, and multi-model coupling analysis^[9]. However, in the coastal-zone contexts, such studies still exhibit several limitations, including an overemphasis on single hazard types or individual processes, fragmentation among indicator dimensions, and insufficient integration of baseline conditions with process-based resilience capacities^[10]. Therefore, it is necessary to develop a comprehensive assessment within a unified framework that simultaneously considers resilience processes and resilience foundations, so as to improve the integrity and interpretability of ecological resilience data.

The continental coastal zone of the ECS is a frontier region of China's marine economic development^[11]. However, rapid development has also been accompanied by intensive exploitation of land and coastlines, continuously reshaping land-use patterns and landscape configurations while aggravating resource and environmental risks^[12]. At the same time, the region's pronounced natural geographic differences and clear gradients in topography, climate, and human activities make it a representative area for characterizing the spatiotemporal heterogeneity of ecological resilience. Therefore, based on a framework of risk-resistance-adaptation-recovery-scale-density-morphology, this study integrates multi-source data, including socioeconomic statistics and natural ecological raster data, and applies a combined weighting method and weighted summation to generate a spatial distribution dataset of ecological resilience for the continental coastal zone of the ECS. The resulting dataset provides data support for ecological security assessment, integrated management, and the formulation of resilience enhancement strategies in coastal zones.

2 Metadata of the Dataset

The metadata for the Dataset of ecological resilience index of the continental coastal of the East China Sea (2000–2022)^[13], including its title, authors, geographic region, year of the dataset, temporal resolution, spatial resolution, dataset files, data publication and sharing platform, and data sharing policy, etc., is summarized in Table 1.

Table 1 Metadata summary of Dataset of ecological resilience index of the continental coastal of the East China Sea (2000–2022)

Items	Description
Dataset full name	Dataset of ecological resilience index of the continental coastal of the East China Sea (2000–2022)
Dataset short name	EcoRes_CoastalEastChinaSea_2000–2022
Authors	Ying, C., School of Geography and Remote sensing, Ningbo University, 2211420028@nbu.edu.cn Liu, Y. C., School of Geography and Remote sensing, Ningbo University, liuyongchao@nbu.edu.cn Tian, P., College of Life and Environmental Sciences, Wenzhou University, tianpeng@nbu.edu.cn Zhong, J., School of Geography and Remote sensing, Ningbo University, 2211420033@nbu.edu.cn Li, J. L., School of Geography and Remote sensing, Ningbo University, lijialin@nbu.edu.cn
Geographical region	Continental coastal of the East China Sea
Year	2000–2022
Temporal resolution	5/2 year
Spatial resolution	100 m×100 m
Data format	.tif, .xlsx
Data size	902 MB (compressed)
Data files	Spatial distribution of the ecological resilience index; data for 7 assessment subsystems, including scale, density, morphology, risk, resistance, adaptation, and recovery; regional statistical data of the ecological resilience index and statistical data for each subsystem
Foundation	National Natural Science Foundation of China (42276234)
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 ^[14]
Communication and searchable system	DOI, CSTR, Crossref, DCI, CSCD, CNKI, SciEngine, WDS, GEOSS, PubScholar, CKRSC

3 Methods

3.1 Study area

The continental coastal zone of the ECS is located between 23°36'N and 31°30'N and between 116°53'E and 122°08'E, covering an area of approximately 5.85×10^4 km². It extends from the boundary between Shanghai and Jiangsu in the north to the boundary between Fujian and Guangdong in the south. Owing to its strategic location linking east and west as well as north and south, the study area includes 45 coastal counties within 14 coastal prefecture-level cities in Shanghai, Zhejiang, and Fujian. The region is characterized by a long and highly indented coastline, numerous bays, diverse coastal types, and many large ports, and exhibits a regional pattern of intensive marine industrial distribution and high-intensity development and utilization^[11]. In terms of physical geography, the area displays marked north-south contrasts: the northern part is dominated by plains with well-developed muddy coasts, whereas the southern part is dominated by low mountains and hills with bedrock coasts. The region is rich in natural resources, with an average tidal range generally of about 4–5 m, which is even more pronounced in coastal and bay areas^[12].

Considering the large number of islands in the ECS and the absence of multi-source data for many island areas, this study excludes islands from the spatial extent and retains only the continental coastal zone to ensure data integrity and spatiotemporal consistency.

3.2 Data Sources

The data used in this study include remote sensing imagery from MODIS, Landsat 5 TM, Landsat 7 ETM+, and Landsat 8 OLI/TIRS, as well as raster datasets derived from these images, such as NDVI and NPP; vector data including maps, roads, and rivers; and socioeconomic statistics obtained from provincial and municipal statistical yearbooks and statistical bulletins. The specific data sources are summarized in Table 2.

3.3 Algorithm

3.3.1 Construction of the Ecological Resilience Assessment Framework and Indicator System

Resilience assessment should consider not only the capacities demonstrated throughout the resilience process, but also the baseline conditions of resilience, indicating that resilience needs to be evaluated jointly from the perspectives of both process and baseline conditions (Table 3). The resilience process focuses on sources of pressure and system response capacities. Risk refers to factors that disturb and stress coastal ecosystems, reflecting the likelihood and severity of internal and external disturbances and stresses faced by the coastal zone. Resistance refers to the ability of coastal ecosystems to withstand the impacts of disturbances by virtue of their inherent attributes and indirectly reflects the extent to which coastal ecosystems are affected by them. Adaptation refers to the capacity of coastal ecosystems to respond to risk disturbances through passive adjustment and short-term updating when effective resistance cannot be achieved, thereby maintaining the stability of ecosystem structure and functions. Recovery refers to the capacity of ecosystems to recover, renew, and self-organize after experiencing risk disturbances. As the carrier and foundation of ecological resilience, the resilience baseline reflects the status of system elements in terms of quantity, structure, quality, and spatial configuration, and is influenced by ecosystem scale, density, and morphology.

3.3.2 Weight Determination and Composite Index Calculation

To eliminate differences in measurement units among indicators, all indicators were first normalized using the min-max method. A combined subjective-objective weighting approach was then adopted, in which the subjective weights were derived using the fuzzy analytic hierarchy process (FAHP), and the objective weights were obtained using the CRITIC (Criteria Importance Through Intercriteria Correlation) method. Based on the principle of Lagrange extremum conditions, the weighting coefficients α , β were solved to determine the final combined weights^[15]. Ecological resilience was then calculated by weighted summation using the composite index method. The Equations are as follows:

$$w = \alpha w_a + \beta w_b, \quad \alpha + \beta = 1 \quad (1)$$

$$ER = \sum_{j=1}^n w X_j \quad (2)$$

Where w_a is the subjective weight, w_b is the objective weight, w is the combined weight, ER denotes ecological resilience, and X_j represents the normalized value of the j -th indicator.

3.4 Technical Workflow

This study integrated multi-source data, including remote sensing raster data, vector data, and socioeconomic statistics. For missing values occurring over multiple periods along administrative boundaries, kriging interpolation was applied for gap filling, and the interpolated results were mosaicked with the original data to produce a complete time series. To ensure the comparability and integrability of multi-source data, all datasets were uniformly

Table 2 Data Source and related information

Data type	Data name	Data sources	Resolution
Vector data	Administrative divisions	Administrative division of prefecture-level cities and county-level administrative regions in China	National Geospatial Information Center /
	Coastline	Interpretation of the continental coastline of the East Sea	Remote sensing visual interpretation /
	Geological disasters	Dataset of the distribution of geological disaster sites in China	Chinese Academy of Sciences Center for Resources and Environmental Sciences and Data Management, 2020 /
	Typhoon	Typhoon IBTrACS dataset	National Centers for Environmental Information Gahtan, J., <i>et al.</i> , 2024 /
Raster data	Climate	Spatial distribution data of annual precipitation in China	National Earth System Science Data Center, Peng, 2025 1,000 m
		Dataset of China monthly evaporation and transpiration	National Earth System Science Data Center, Peng, 2025 1,000 m
		Dataset of the monthly average temperature in China	National Earth System Science Data Center, Peng, 2025 1,000 m
	Vegetation	Dataset of root depth of Chinese plants	Scientific Data Yan, <i>et al.</i> , 2020 1,000 m
		Dataset of China Monthly NDVI	National Earth System Science Data Center, Xu, 2025 1,000 m
		Dataset of net primary productivity of vegetation in China	National Earth System Science Data Center 500 m
	Land use	Dataset of China vegetation coverage	National Qinghai-Xizang Plateau Science Data Center, Gao, <i>et al.</i> 2022 250 m
		Dataset for remote sensing monitoring of land use in China	Chinese Academy of Sciences Center for Resources and Environmental Sciences and Data Management, Xu, <i>et al.</i> 2025 30 m
		Elevation	NASA DEM 30 m
	Remote sensing image	Remote sensing image dataset of the continental coastal zone in the East China Sea	USGS, 2025 30 m
	Soil	World Soil Database 2.0 (HWSD 2.0)	FAO & IIASA, 2023 1:10 ⁶
	Social economy	Dataset of the spatial distribution of China's population in kilometer grids Annual dataset of China's nighttime lights	Oak Ridge National Laboratory of the U.S. Department of Energy, 2024 Chinese Academy of Sciences Center for Resources and Environmental Sciences and Data Management, Xu, 2022 500 m
Statistical data	Social economy	GDP, healthcare, infrastructure and other social and economic data	Provincial and Municipal Statistical Yearbook /

converted to the WGS_1984_Albers projected coordinate system, while raster data were resampled to 100 m and aligned at the pixel level. Based on the seven-dimensional framework of risk-resistance-adaptation-recovery-scale-density-morphology, previous studies, the actual conditions of the continental coastal zone of the ECS, and data availability, an ecological resilience assessment indicator system was constructed. A combined weighting method integrating the fuzzy analytic hierarchy process (FAHP) and the CRITIC method was adopted, and the final weights were determined according to the principle of Lagrange conditional extrema. The ecological resilience index and its associated data products were then generated through weighted integration using the composite index method (Figure 1).

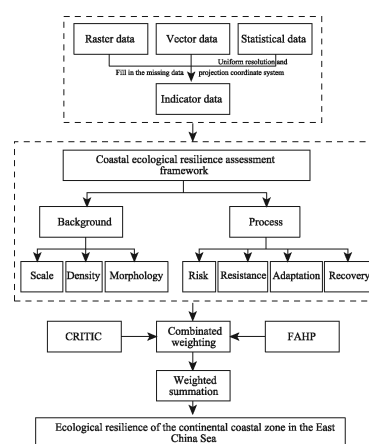
**Figure 1** Technical workflow

Table 3 Ecological resilience assessment indicator system

Criterion layer		Indicator layer	Indicators	Meaning
Process	Risk	Land use intensity	X1(−)	Land pressure
		Coastalline artificialization index	X2(−)	Coastalline development pressure
		Landscape ecological risk index	X3(−)	Ecological security level
		Population density (persons/km ²)	X4(−)	Population pressure
		PM _{2.5} concentration (μg/m ³)	X5(−)	Air pollution threat
		Industrial wastewater discharge per unit of GDP (tons per 10,000 CNY)	X6(−)	Water pollution threat
		Electricity consumption per unit of GDP (kWh/10,000 CNY)	X7(−)	Energy utilization level
		Typhoon hazard level	X8(−)	Typhoon threat level
		Geological disaster susceptibility	X9(−)	Geological disaster threat level
	Resistance	Water conservation capacity (mm)	X10(+)	Water conservation capacity
		Nutrient transport ratio	X11(+)	Water purification capacity
		Soil retention quantity (t/(km ² ·a))	X12(+)	Soil retention capacity
		Habitat quality	X13(+)	Environmental quality level
		Carbon sequestration capacity (tc/km ²)	X14(+)	Carbon storage capacity
		NPP	X15(+)	Strength of ecosystem functions
		Biodiversity index	X16(+)	Biodiversity level
	Adaptation	Landscape adaptability	X17(+)	Landscape adaptation level
		Landscape heterogeneity	X18(+)	Variation in landscape space level
		Landscape connectivity	X19(+)	Landscape connectivity degree
		Landscape stability	X20(+)	Landscape stability degree
		Atmospheric aerosol concentration	X21(−)	Situation of air pollution control
		Concentration rate of sewage treatment (%)	X22(+)	Situation of water environment governance
	Recovery	Ecosystem service value (CNY/km ²)	X23(+)	Potential ecological restoration
		Ecological resilience index	X24(+)	Ecological self-regulation capacity
		Proportion of environmental protection investment in GDP (%)	X25(+)	Government regulation level
		Trend of vegetation coverage change (%)	X26(+)	Trend of ecological vitality recovery
		Trend of humidity change (%)	X27(+)	Trend of water ecosystem restoration
		Trend of nighttime light intensity changes (%)	X28(−)	Trend of socio-economic disruptions
		Per capita expenditure on science and education (CNY)	X29(+)	Scientific education level
Background	Scale	Scale resilience index	X30(+)	Appropriateness of urban size
	Density	Ecological supply-demand level	X31(+)	Supporting capacity of ecosystem resources and environment
	Morphology	Average distance index	X32(+)	Rationality of ecological space layout

4 Data Results and Validation

4.1 Dataset Composition

The dataset is archived in .tif and .xlsx formats and includes the following data at 5-year intervals from 2000 to 2022: (1) the spatial distribution of the ecological resilience index; (2) data for 7 assessment subsystems, including scale, density, morphology, risk, resistance, adaptation, and recovery; and (3) regional statistical data for the ecological resilience index and statistical data for each subsystem. Among these, the spatial data have a resolution of 100 m.

4.2 Data Results Analysis

The spatial pattern of ecological resilience in the continental coastal zone of the ECS

remained generally stable from 2000 to 2022 (Figure 2), exhibiting a persistent gradient characterized by lower values in the northeast and higher values in the southwest. High-value areas were distributed contiguously across southern Zhejiang, northern Fujian, and parts of southern Fujian, whereas low-value areas remained concentrated in Shanghai and the core development belt extending from northern Zhejiang to central Fujian. This indicates that the dominant spatial differentiation pattern did not undergo a fundamental reversal during the study period. Meanwhile, the spatial clustering pattern showed a weakening trend, with the overall extent of hotspot and coldspot patches shrinking and non-significant areas expanding, suggesting a certain degree of regional convergence. The spatial center of gravity also shifted slightly southwestward, further indicating that the overall distributional direction remained stable while the internal structure underwent gradual adjustment.

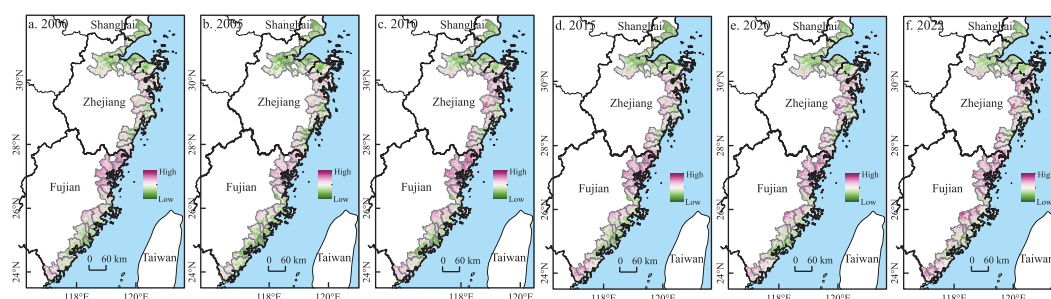


Figure 2 Maps of the spatial pattern evolution of ecological resilience in the continental coastal zone of the East China Sea, 2000–2022

The driving mechanisms can be explained by the combined effects of natural background conditions, development pressure, and governance responses. Southern Zhejiang and northern/southern Fujian have relatively high proportions of hilly and mountainous terrain, greater shares of ecological land, and stronger ecosystem service provision capacity, which provide a solid baseline support for ecological resilience. In contrast, Shanghai and northern Zhejiang are marked by highly concentrated populations and industries, while shoreline artificialization and land development intensity have long remained at high levels, continuously compressing ecological space and weakening ecosystem structure and functions, thereby giving the low-value belt a strong path-dependent character. After 2005, strengthened ecological governance, improved green infrastructure, and pollution control measures helped to alleviate risk pressures and enhance system adaptability, gradually blurring the boundaries between high- and low-value areas and promoting regional convergence. However, the rigid constraints imposed by high-intensity development meant that the overall evolution still manifested as local optimization under a broadly stable spatial pattern.

A comparison across the three administrative scales of province, prefecture-level city, and county reveals that ecological resilience in the continental coastal zone of the ECS exhibits strong temporal consistency and a typical scale effect in space (Figure 3). At the provincial scale, Fujian and Zhejiang remained above the regional average, whereas Shanghai persistently exhibited relatively low level. A widespread temporary decline occurred in 2005, followed by an overall recovery and continued upward trend after 2010. This synchronous fluctuation reflects the combined influence of shared macro-development stages and governance rhythms on regional systems. At the prefecture-level city scale, the internal differences masked by provincial averages become more apparent. Cities in southern Zhejiang, northern Fujian, and parts of southern Fujian generally exhibited higher ecological resilience, whereas lower values were observed in the northern core urban agglomerations and some cities in central Fujian, thus maintaining the stable gradient pattern of lower values in the northeast and higher values in the southwest across the study area.

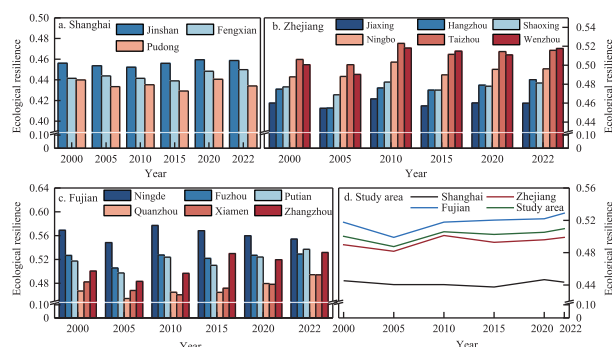


Figure 3 Temporal evolution of ecological resilience in the continental coastal zone of the East China Sea, 2000–2022

Heterogeneity is most pronounced at the county scale. Even within the same provincial governance framework, different functional zones still show persistent differentiation due to variations in development intensity and ecological spatial structure. The driving mechanisms can be summarized as the combined effects of natural background conditions, development pressure, and governance response. Hilly and mountainous areas generally have higher proportions of ecological land and stronger ecosystem service provision capacity, thereby forming a more favorable resilience foundation. By contrast, areas with highly concentrated population and industry are more likely to remain locked into low-values under the long-term constraints of shoreline artificialization and high-intensity land development. Meanwhile, urban expansion weakens baseline elements such as scale and morphology and reduces system resistance, making resilience improvement more structurally constrained. After 2005, strengthened ecological governance, improved green infrastructure, and pollution control measures helped to alleviate risk pressure and enhance system adaptability to some extent, leading to resilience recovery in most administrative units. However, external shocks and shifts in development orientation still generated periodic disturbances in the recovery process, allowing differentiation across scales to persist despite the overall upward trend.

From 2000 to 2022, the ecological resilience subsystems in the continental coastal zone of the ECS exhibited an evolutionary pattern characterized by a weakening resilience baseline but a fluctuating recovery in resilience processes (Figure 4). In terms of the resilience baseline, both scale and morphology declined continuously, indicating that ongoing urbanization and the outward expansion of construction land progressively compressed ecological space, reduced the supporting extent of ecological infrastructure, and led to the deterioration of spatial patterns. Meanwhile, density increased markedly after 2005, largely because strengthened ecological governance and a shift toward more intensive and green development improved the relationship between ecological supply and demand to some extent. However, this positive effect was insufficient to offset the negative impacts associated with declines in scale and morphology, and the baseline level therefore continued to show a gradual downward trend.

With respect to ecological processes, risk first declined and then increased. Specifically, during 2000–2005, it decreased under the influence of intensified development disturbance and aggravated landscape fragmentation, whereas after 2005 it rebounded as improvements in green infrastructure and pollution measures helped alleviate risk pressure. Resistance showed an overall decline, indicating that ecosystem structure, ecosystem functions, and ecosystem service provision capacity were continuously weakened under long-term high-intensity development. Adaptation increased significantly, mainly because enhanced policy intervention and management responses improved the system's adaptive capacity. Recovery increased before 2015 but declined thereafter. The earlier increase was associated with ecological restoration promoted by environmental investment and technological

progress, whereas the subsequent decline was related to the post-pandemic shift in governance priorities toward economic recovery, together with construction expansion that weakened the ecosystem's self-regulation capacity. Overall, the stage-specific improvement in process performance was driven by alleviated risk pressure and enhanced adaptation, whereas the continued weakening of the resilience baseline and resistance imposed long-term constraints on overall ecological resilience.

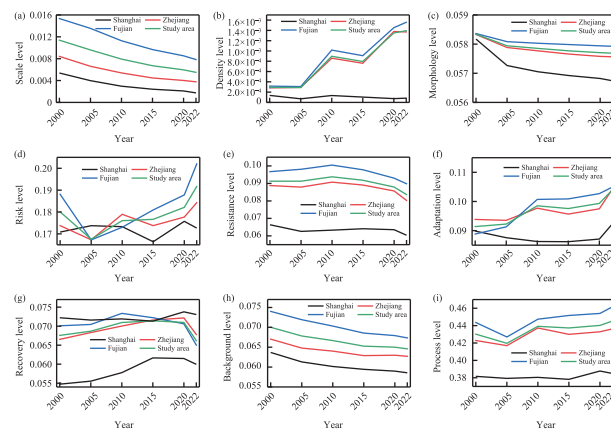


Figure 4 Temporal evolution of ecological resilience subsystems in the continental coastal zone of the East China Sea, 2000–2022

5 Discussion and Conclusions

This study integrates multi-source remote sensing raster data and socioeconomic statistics to construct an ecological resilience indicator system based on the ecological baseline-process framework and generates data products of ecological resilience and its subsystems for 2000–2022 through a combined subjective-objective weighting scheme and composite index integration. The results show that ecological resilience in the continental coastal zone of the ECS exhibited stage-specific fluctuations but an overall upward trend, reaching a low point in 2005 and improving steadily after 2010. Spatially, it maintained a gradient pattern characterized by lower values in the northeast and higher values in the southwest. High-value areas were mainly distributed in southern Zhejiang, northern Fujian, and parts of southern Fujian, whereas low-value areas were concentrated in Shanghai and the core development belt extending from northern Zhejiang to central Fujian. Provincial averages tend to smooth internal differences, while prefecture-level city and county scales are better able to reveal resilience differentiation resulting from variations in functional zoning and development intensity. The ecological resilience subsystems also showed divergent developmental trends: scale declined continuously, density fluctuated upward, morphology decreased progressively, risk decreased first and then increased, resistance fluctuated downward, adaptation fluctuated upward, and recovery increased first and then declined. Overall, the stage-specific rise in process performance was driven by alleviated risk pressure and enhanced adaptation, whereas the continued weakening of the baseline and resistance imposed long-term constraints on integrated ecological resilience.

This dataset provides basic data support for identifying ecological security patterns in coastal zones, territorial spatial governance zoning, diagnosing resilience shortcomings, and conducting cross-scale comparative studies. It can also be coupled with thematic datasets on disaster processes, ecological restoration, and carbon sink assessment for scenario simulation and policy effectiveness evaluation. However, constrained by data availability and organization, the dataset characterizes long-term changes at multi-year intervals and is therefore less capable of capturing rapid disturbances and recovery following extreme

events. In addition, the spatialization of some socioeconomic indicators may introduce scale-related errors, and there remains room for improvement in representing key coastal risks such as storm surges, sea-level rise, and compound flooding. Future work will incorporate higher-temporal-frequency remote sensing and process-based data to improve the representation of compound risks and recovery processes, while also conducting uncertainty quantification and iterative version updates to enhance the interpretability and transferability of the dataset. This dataset supported the completion of the first author's Master of Science thesis.

Author Contributions

Ying, C. agreed with and adopted Li, J. L.'s overall design scheme for the dataset development, collected and processed the data, and designed the models and algorithms. Zhong, J. performed data validation. Liu, Y. C. and Tian, P. provided guidance and revisions on the overall framework of the dataset. Ying, C. completed the first draft of the data paper, and all authors jointly revised the paper.

Conflicts of Interest

The authors declare no conflicts of interest.

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