

# Intelligent Production and Application of S-124 Standard Navigation Warning Visualization Service

Xiaoting Wu

Southern Navigation Service Center, Maritime Safety Administration, People's Republic of China, Guangzhou, China  
Email: 625961053@qq.com

**How to cite this paper:** Wu, X. T. (2025). Intelligent Production and Application of S-124 Standard Navigation Warning Visualization Service. *Open Journal of Social Sciences*, 13, 732-740.

<https://doi.org/10.4236/jss.2025.1310042>

**Received:** September 25, 2025

**Accepted:** October 28, 2025

**Published:** October 31, 2025

---

## Abstract

This paper introduces China's development of a fully controllable, intelligent, and digital visualization service for navigation warnings, based on the International Hydrographic Organization (IHO) S-124 standard. It also outlines the practical applications of this service, encompassing data production and its utilization in both APPs and shipborne Electronic Chart Systems (ECS).

## Keywords

S-124 Navigation Warning, Digital Services for Maritime Security, Intelligence, Visualization

---

## 1. Introduction

Navigation warnings are issued by maritime authorities to inform ships and other maritime operators of potential hazards or restrictive measures in designated sea areas. These warnings may pertain to military exercises, live-fire drills, severe weather conditions, shipwreck obstructions, navigation route alterations, and other scenarios. Upon receiving a navigation warning, vessels can adjust their courses or implement other safety precautions based on the actual circumstances to prevent accidents (Wang, 2018). Consequently, navigation warnings play a pivotal role in ensuring maritime traffic safety.

## 2. Traditional Navigation Warning Service Model and Existing Issues

### 2.1. Analysis from the Information Dissemination Perspective

The Naval Hydrographic and Oceanographic Administration, Maritime Safety

Administration, and Waterway Management Agency are respectively responsible for issuing navigation notices, navigation warnings (notices), correction notices, and waterway announcements. The complex management model, combined with the absence of a unified mechanism and platform for disseminating maritime navigation warnings (notices), makes it challenging for information recipients to accurately and swiftly collect, screen and utilize navigation warnings (notices). The entire system for issuing navigation warnings (notices) lacks comprehensive and effective management, as well as interconnectedness, severely impacting the effective reception of navigation warnings (notices). The application of navigation warnings (notices) varies among publishers, recipients, and users, indicating room for improvement. There is an urgent need to update the existing dissemination mechanism and establish a comprehensive dissemination platform that meets current demands.

## **2.2. Analysis from the Information Acquisition Perspective**

For an extended period, navigation warnings have adhered to the traditional model from the 1990s, being issued in written form via radiotelegraphy (NAVTEX) or very high frequency (VHF) voice broadcasts (Zhang & Ji, 2012). Mariners are required to monitor or receive textual information and manually plot relevant content on nautical charts, leading to issues such as a heavy workload, low efficiency, non-intuitive information display, and a high likelihood of errors and omissions (Zhang & Zhu, 2021). With the rapid advancement of digitalization and intelligence in the maritime sector, traditional navigation warning service methods can no longer satisfy the pressing needs of modern maritime users for efficient, precise, intuitive and intelligent navigation safety information services.

## **2.3. Analysis from the International Compliance Perspective**

The S-124 standard is derived from the navigation warning guidelines outlined in the “Maritime Safety Information (MSI) Manual” (IHO Publication S-53), jointly published by IHO/IMO/WMO (Zhou et al., 2025). During its 108th session in May 2024, the IMO passed resolution MSC.530 (106), amending the performance standards for Electronic Chart Display and Information Systems (ECDIS) and underscoring the global commitment to implementing the S-100 data framework (Han & Yang, 2024). From January 1, 2026, maritime information data conforming to the S-100 standard will officially gain legal application status in shipboard electronic chart navigation systems, with full enforcement planned from January 1, 2029. This decision signifies a significant stride towards the digitalization and standardization of global maritime safety services. Currently, China adheres to the “Navigation Warning Standard Format of the People’s Republic of China”, which presents information in textual form, precluding visualization on electronic nautical charts and failing to meet the latest international ECDIS performance standards. As a key member of the implementing countries, China bears the responsibility

to develop a new generation of internationally standardized navigation warning visualization services.

### **3. S-124 Standard Navigation Warning Visualization Service**

The Navigation Warning Visualization Service adheres to the latest international S-124 standard, transforming textual navigation warning information into standardized digital products with precise geospatial data (South China Sea Maritime Safety Support Center, 2025). It visually represents the spatial scope and attribute details of navigation warnings through intuitive and clear graphical symbols on electronic nautical charts, thereby replacing abstract textual descriptions. This service can be published online via the Navigation Protection Digital Service, offering standardized interfaces for seamless integration and easy access by intelligent maritime supervision systems, maritime communication apps, and onboard terminals. The system automatically filters and highlights relevant active navigation warnings based on a ship's planned route or real-time position. Taking into account the vessel's movements, it automatically issues alerts or warnings when necessary (e.g., when the vessel is approaching or within an area affected by navigation warnings), providing intelligent navigation guidance.

#### **3.1. S-124 Data Production Software Development**

Currently China's production software for S-124 navigation warnings has achieved mature and fully controllable application across the entire chain. After the Maritime Safety Administration's Intelligent Maritime Supervision System issues a navigation warning, it automatically forwards it to the digital service system for maritime security of the South China Sea Navigation Support Center (As is depicted in the **Figure 1** and **Figure 2**). The digital service system for maritime security employs AI and other advanced technologies to automatically identify various types of information, elements, and their interrelationships, converting them into S-124 standard navigation warnings (As is depicted in the **Figure 3**). It also enables the automatic processing and conversion of spatial data from textual to graphical formats (As is depicted in **Figure 4**). Following proofreading and review by professional personnel, these S-124 standard navigation warnings can be published with a single click (As is depicted in the **Figure 5**). Through interface integration, the information is pushed in real-time and automatically to the Maritime Safety Communication APP and shipborne electronic chart systems, thereby achieving full automation in the production and dissemination of safety information throughout the entire chain.

#### **3.2. S-124 Data Production and Practical Application**

Currently, as there is no ECDIS supporting S-100 for the application of S-124 data, we can utilize S-124 data in navigation via mobile apps (such as the Maritime App) and ECS. In accordance with the principles set forth in the IALA G1128 guideline, "E-Navigation Technical Service Specification (G1128)", China has

航行警告(S-124)数据明细

序号	编号	标题	语言	等级	播发天数	播发台	同步状态	转化状态	操作
1	冀航警548/25	水下检验	中文	常规	2	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
2	SD632/25	TOWING	英文	常规	7	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
3	鲁航警720/25	航行拖带	中文	常规	7	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
4	粤航警290/25	撤销粤航警283/25	中文	常规	1	广州台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
5	GD267/25	CANCEL GD261/25	英文	常规	1	广州台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
6	冀航警547/25	试航	中文	常规	5	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
7	HB110/25	SEA TRIALS	英文	常规	5	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
8	沪航警662/25	长江口据报南槽航道S7灯浮漂失	中文	重要	3	上海台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
9	沪航警661/25	杭州湾据报1人失踪, 概位30-56N122-...	中文	极重要	3	上海台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
10	辽航警372/25	渤海军事演习	中文	重要	2	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
11	LN361/25	BOHAI SEA MILITARY EXERCISES	英文	重要	2	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
12	冀航警546/25	拖带	中文	常规	2	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
13	HB109/25	TOWING	英文	常规	2	天津台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略
14	浙航警971/25	余塘太桥418号灯源(灯)故障	中文	常规	3	上海台	发布	待转化	转化 S124 查看已转化 查看 定位 忽略

Figure 1. The Smart Maritime Supervision System pushes national standard navigation warnings to the Maritime Security Digital Service System.

**辽航警372/25 详情**

语言:  中文  英文

编号: 辽航警372/25

国家: 中华人民共和国

等级: 重要

发布单位: 葫芦岛海事局

直属单位: 辽宁海事局

收发时间: 2025-09-22 18:28:48

播发天数: 2

生效时间: 2025-09-23 06:00:00

截止时间: 2025-09-23 20:00:00

撤销时间: 2025-09-23 21:00:00

危险类别: 开展军事演习、武器发射、航行

危险类型: 军事演习

播发台: 天津台, 大连台

区域名称: 渤海

中文标题: 渤海军事演习

中文内容: 辽航警372/25、渤海, 自9月23日0600时至2000时在40-04.32N 120-23.97E、39-54.52N 120-40.47E、40-33.47N 121-20.28E和40-42.67N 121-03.78E诸点连线范围内进行军事演习。禁止驶入。

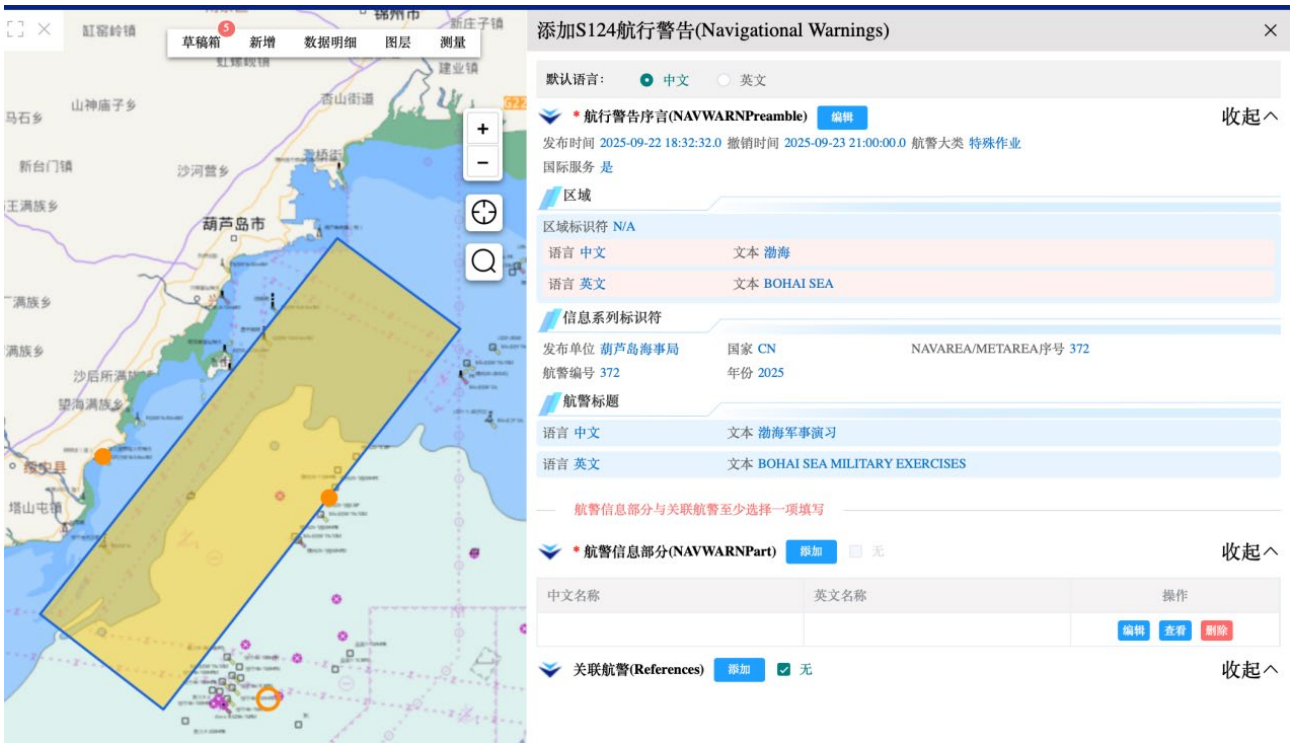
空间对象(1个)

名称	几何类型	操作
	面	定位

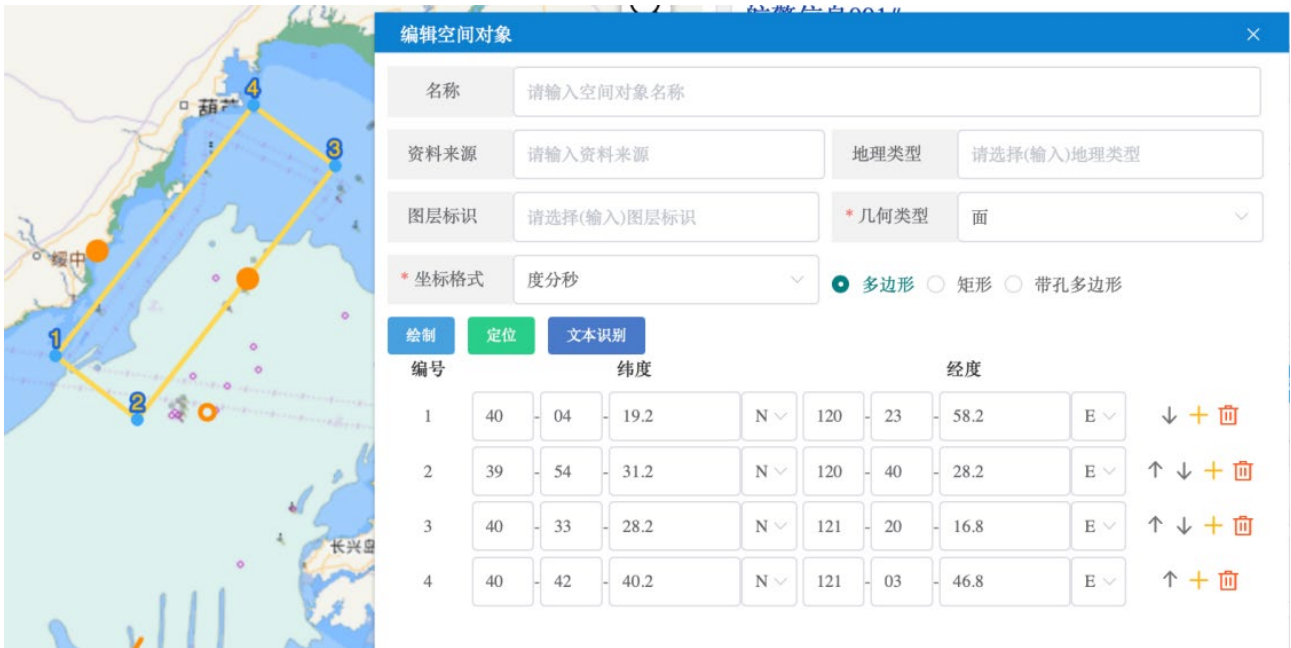
关联(0个)

关闭

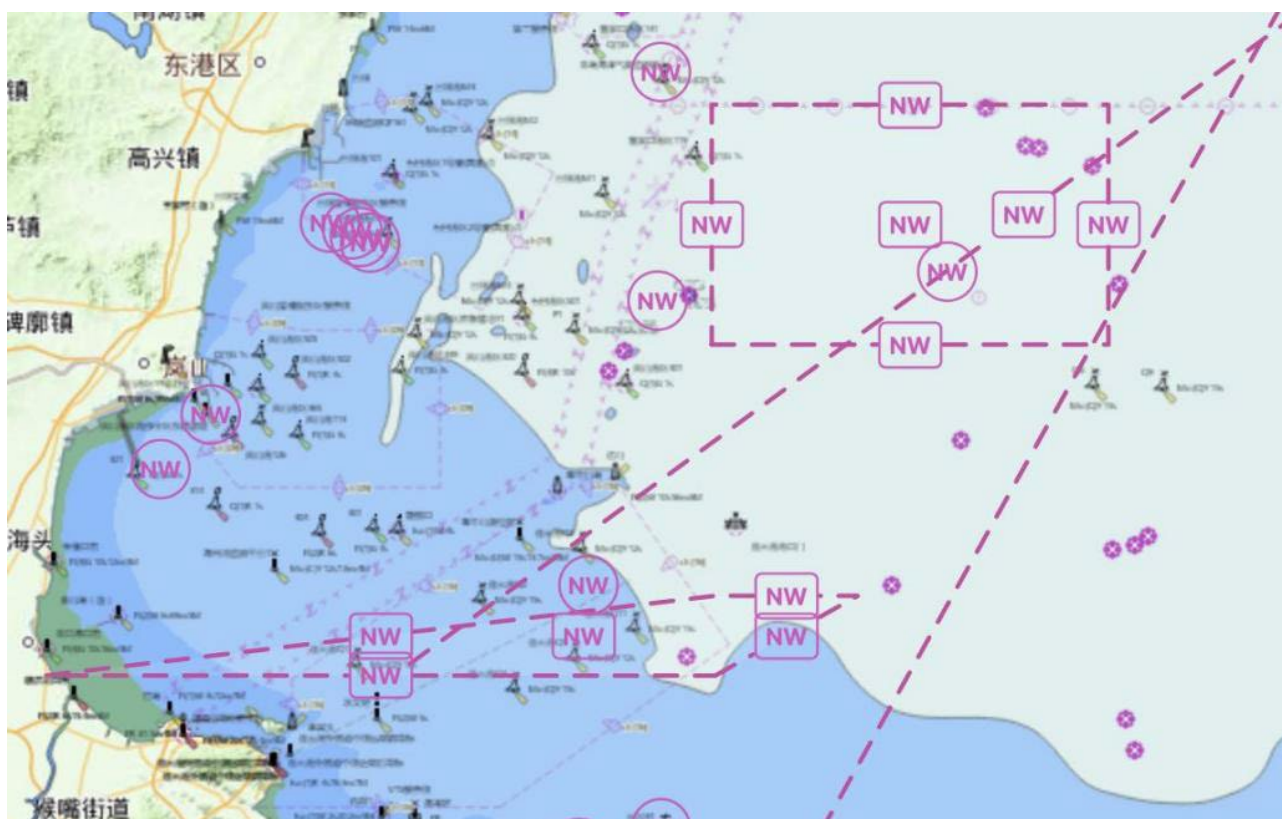
Figure 2. The Maritime Security Digital Service System receives these national standard navigation warnings.



**Figure 3.** The Maritime Security Digital Service System automatically converts national standard navigation warnings into S-124 standard navigation warnings.



**Figure 4.** The Maritime Security Digital Service System performs automatic processing and conversion of spatial data, transforming text into graphics.



**Figure 5.** Visual display of S-124 navigation warning overlaid on electronic nautical chart.

formulated its own E-Navigation Technical Service Specification, technical design, and service examples specifically for “navigation warnings”. Within this specification, the S-124 data model is employed to encapsulate navigation warning data, with S-124 data or functional services being delivered to applications through service interfaces (Lyu & Yang, 2022). These functional services can directly provide navigation warning information pertinent to specific areas or a designated route, thereby facilitating a digital dialogue between the server system (machine) and the client system (machine).

Within the app, users have the capability to display and inspect S-124 elements, as well as delve into their details (As is depicted in the **Figure 6**). Moreover, the app can seamlessly integrate with data from the Automatic Identification System (AIS), navigation regulations, hydrometeorological conditions, and other relevant sources to offer users precise route recommendations and reminders about navigation rules, thereby bolstering the efficacy of ship navigation assistance services (Chen, 2017). For instance, when a user’s vessel enters an area affected by an S-124 navigation warning element while using the app, the app will automatically assess the impact of the navigation warning and issue a corresponding alert or prompt (As is depicted in the **Figure 7**). During route planning, the app can verify the relationship between the planned route and any navigation warnings, identify restricted zones such as those for “military exercises”, and prompt users to adjust their routes accordingly.



**Figure 6.** Visual display of S-124 navigation warnings in the APP, along with push notifications of navigation warnings along the planned flight route.



**Figure 7.** Visual display of S-124 navigation warnings in the APP, along with push notifications of navigation warnings along the planned flight route.

In the shipborne electronic chart system, S-124 data has been integrated into the ship's Electronic Chart System (ECS) through collaboration with equipment manufacturers. This integration enables data access, display, and intelligent assessment of navigation impacts on the ECS termina (As is depicted in the **Figure 8** and **Figure 9**), aiding ships in better risk avoidance, route optimization, and

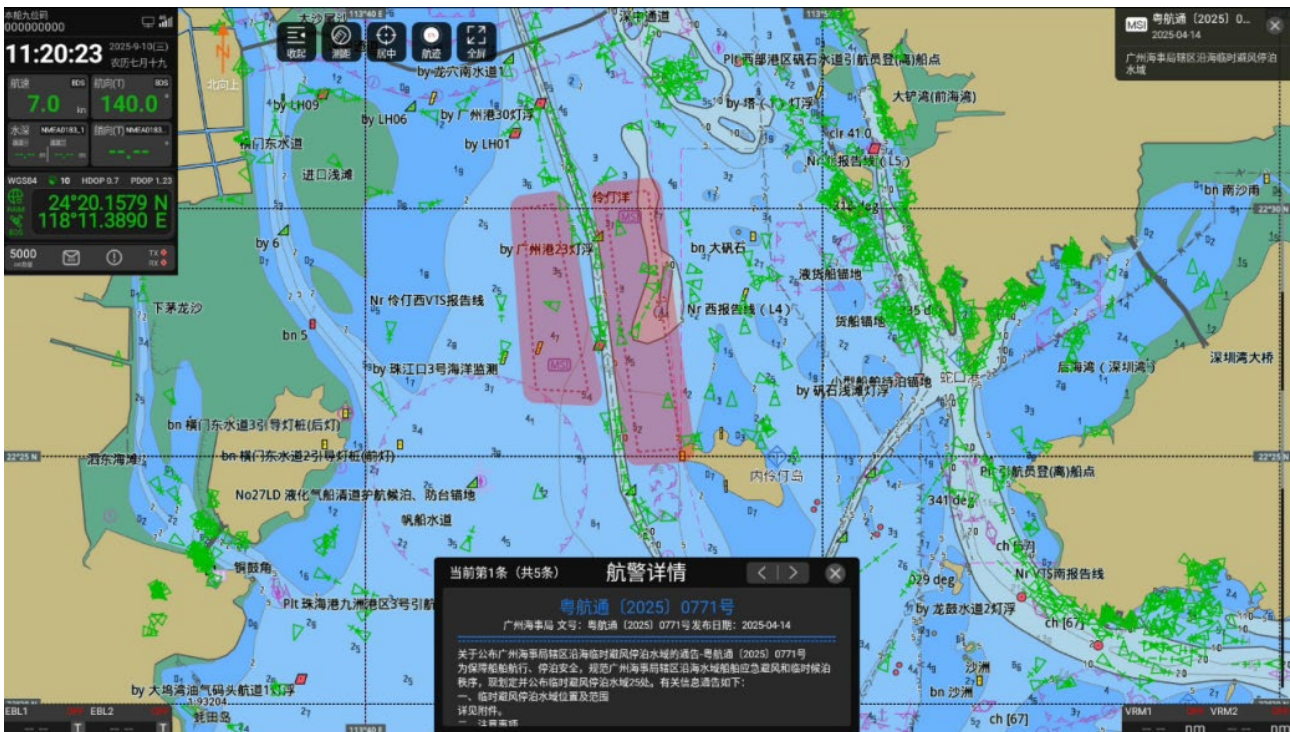


Figure 8. Visualization display of S-124 navigation warnings in ECS.



Figure 9. Visualization display of S-124 navigation warnings in ECS.

enhancing the accuracy and safety of ship navigation. Additionally, by establishing a comprehensive ocean spatial geographic data foundation, multiple S-100 data elements can achieve interoperability on the ECS, further facilitating water traffic safety supervision, shipping company fleet management, and port traffic organization management. The following figure illustrates the display of S-124 navigation warnings on the shipboard ECS. Currently, S-124 data has been implemented in the ECS of 8850 vessels operating along China's coastal areas and inland rivers.

#### 4. Conclusion

China's navigation warning visualization service represents the first full-chain system encompassing "data production - intelligent release - accompanying services", constructed in accordance with the IHO S-124 standard. This system achieves a revolutionary upgrade from paper-based notices to spatial data and intelligent early warnings, driving the digital transformation of coastal radio stations. It establishes a replicable and scalable national paradigm, introducing a novel service model characterized by "proactive push, dynamic accompaniment and lifelong traceability" for navigation warning information. This advancement significantly bolsters China's international discourse power in maritime affairs, carrying profound implications.

#### Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

#### References

- Chen, B. (2017). Suggestions for Using Navigation Notices (Warnings) to Correct ENCs. *Marine Technology, No. 3*, 69-71.
- Han, J., & Yang, Y. (2024). Brief Report on the 108th Session of the IMO Maritime Safety Committee. *World Shipping, No. 12*, 8-13, 17.
- Lyu, Y., & Yang, Y. (2022). Analysis and Application of the IHO S-127 Maritime Traffic Management Data Model. *Hydrographic Surveying and Charting, 42*, 81-85.
- South China Sea Maritime Safety Support Center, Ministry of Transport (2025). South China Sea Maritime Safety Support Center Fully Escorts the 2025 Spring Festival Travel Season. *China Transportation News*.
- Wang, H. (2018). *Research on Coastal Navigation Warning (Notice) Integrated Distribution Platform*. Dalian Maritime University.
- Zhang, L., & Ji, B. (2012). An Intelligent Offshore Waterborne Traffic System Gate Based on AIS. *Electronic Science and Technology, 25*, 104-106.
- Zhang, T., & Zhu, Y. (2021). Research on ECDIS Development in the e-Navigation Environment. *China Maritime Safety, No. 1*, 46-49.
- Zhou, X., Gong, M., & Lin, X. (2025). Visualization of Navigation Warnings (Notices) Based on e-Navigation. *Zhujiang Water Transport, No. 1*, 150-152.