JACKSON SCHOOL OF INTERNATIONAL STUDIES
UNIVERSITY of WASHINGTON

OCEAN AND ECOSYSTEM PREDICTION IN CHINA: POLICY PRIORITIES, SCIENTIFIC DEVELOPMENTS, AND DECISION-MAKING

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NORTH PACIFIC MARINE SCIENCE ORGANIZATION (PICES)

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China Ocean Institute
中国海洋研究所

OUTLINE



"Salmon"
By Mervin Windsor, Haisla–Heiltsuk First Nations artist

- Policy priorities
  - Key actors
  - Why does ocean and ecosystem prediction matter to China?
- Scientific developments
  - What advances has China made in physical, biogeochemical, and ecosystem forecasting systems?
- Decision-making
  - How has China applied these to decision-making in fisheries and marine environmental management?
  - What are the potential impacts on social-ecological systems, including socioeconomic effects?


POLICY PRIORITIES

KEY ACTORS


PARTY & GOVERNMENT CHINA ORGANIZATION CHART
PARTY
STATE
XI JINPING
GENERAL SECRETARY
SECRETARIAT
POLITBURO STANDING COMMITTEE
COMMISSIONS & DEPARTMENTS
POLITBURO
CENTRAL COMMITTEE
NATIONAL PARTY CONGRESS
PARTY CENTRAL MILITARY COMMISSION
STATE CENTRAL MILITARY COMMISSION
CENTRAL COMMISSION FOR DISCIPLINE INSPECTION
NATIONAL SUPERVISORY COMMISSION
SUPREME PEOPLE'S COURT
SUPREME PEOPLE'S PROCUROTORATE
NATIONAL PEOPLE'S CONGRESS
CHINESE PEOPLE'S POLITICAL CONSULATIVE CONFERENCE
PRESIDENT VICE PRESIDENT
STATE COUNCIL
MINISTRIES & COMMISSIONS
US-CHINA BUSINESS COUNCIL | 2018

KEY ACTORS

- Ministry of Natural Resources (自然资源部)
  - Physical ocean forecasting, marine hazard warnings, oceanographic research
  - National Marine Environmental Forecasting Center (国家海洋环境预报中心)
  - First, Second, and Third Institutes of Oceanography (第一、第二、第三海洋研究所)
- Ministry of Ecology and Environment (生态环境部)
  - Marine environmental monitoring and ecological protection
  - National Marine Environmental Monitoring Center (国家海洋环境监测中心)
- Ministry of Agriculture and Rural Affairs (农业农村部)
  - Fisheries research, resource management, fisheries policy
- Chinese Academy of Sciences (中国科学院)
- Ministry of Education
  - Universities, e.g., Ocean University of China, Shanghai Ocean University, Dalian Maritime University, Xiamen University
  - Fisheries modeling, fishing-ground prediction, technological development

POLICY HISTORY

WHY DOES OCEAN AND ECOSYSTEM PREDICTION MATTER TO CHINA?

- State Council, "National Medium- and Long-Term Science and Technology Development Plan (2006–2020) (国家中长期科学和技术发展规划纲要（2006—2020年）)," 2006, https://www.gov.cn/gongbao/content/2006/content_240244.htm
  - Overall goals: "develop a moderately prosperous society in all respects and accelerate socialist modernization"
    - "By 2020, the overall goal for China's scientific and technological development is: significantly enhance independent innovation capabilities, significantly enhance the ability of science and technology to promote economic and social development and safeguard national security, and provide strong support for building a moderately prosperous society in all respects; the comprehensive strength of basic science and frontier technology research will have been significantly enhanced, achieving a number of scientific and technological achievements with significant global influence, entering the ranks of innovative countries, and laying the foundation for becoming a world science and technology powerhouse by the middle of this century."
  - "3. 15. 海洋生态与环境保护: 重点开发海洋生态与环境监测技术和设备，加强海洋生态与环境保护技术研究，发展近海海域生态与环境保护、修复及海上突发事件应急处理技术，开发高精度海洋动态环境数值预报技术。"
  - "3. 15. Marine Ecology and Environmental Protection: Focus on developing marine ecological and environmental monitoring technologies and equipment, strengthen research on marine ecological and environmental protection technologies, develop technologies for ecological and environmental protection, restoration, and emergency response to offshore incidents, and develop high-precision numerical forecasting technology for the dynamic marine environment."

POLICY HISTORY

- State Council, 13th Five-Year National Science and Technology Innovation Plan (2016–2020) ("十三五" 国家科技创新规划), July 2016, https://www.most.gov.cn/xxgk/xinxifenlei/gjkjgh/201608/t20160810_127174.html
- Box 17, 海洋资源开发利用技术, subsection on marine environmental safety
  - Develop numerical ocean environmental forecasting models (研发海洋环境数值预报模式) in order to improve forecasts and warnings for marine environmental disasters and emergencies, with a view to strengthening emergency response capabilities

POLICY HISTORY

- Ministry of Agriculture, "Bureau of Fisheries Enforcement and Management, National Distant-Water Fishing 13th Five-Year Plan" (农业部渔业渔政管理局, "十三五"全国远洋渔业发展规划), 2017, https://yyj.moa.gov.cn/yyyy/201904/t20190428_6248320.htm
  - With a development philosophy of "innovation, coordination, green, openness, and sharing," aim to build a responsible strong distant-water fishery nation ("创新、协调、绿色、开放、共享"的发展理念，以建设负责任远洋渔业强国为目标)
    - Continue to crack down on IUU fishing activities (持续打击IUU渔业活动); Innovation-driven development … Comprehensively promote fishery technological innovation, focusing on enhancing scientific research and development capabilities and raising the technological level of the industry … Promote deep integration of distant-water fisheries with web-based industries, continuously improving the level of industrial informatization (坚持创新驱动 全方位推进渔业科技创新，着力提升科技研发能力，提升产业科技化水平 … 推进远洋渔业与互联网产业深度融合，不断提高产业信息化水平); … enhance quality and efficiency, and enhance risk response capabilities (提高质量效益，提高应对风险能力)
- Strengthen research on medium- and long-term squid resource forecasting technologies (加强鱿鱼资源中长期预测技术研究)
- For epipelagic and mesopelagic resources such as Pacific saury, jack mackerel, and mackerel, improve medium- and long-term forecasting technological capabilities (加强秋刀鱼、竹荚鱼、鲐鱼等中上层鱼类资源 … 中长期预测技术能力)
- Continuously improve fishing vessel monitoring technologies, perfect the position monitoring and early warning system for distant-water fishing vessels ... Build a risk early warning system for distant-water fisheries to enhance risk prevention and control capabilities (不断提高渔船监测技术手段，完善远洋渔船船位监测和预警系统 … 建设远洋渔业风险预警体系，增强风险防控能力)

POLICY HISTORY

- Central Committee–State Council Greater Bay Area Development Plan (2019) (中共中央、国务院《粤港澳大湾区发展规划纲要》), February 2019, https://app.www.gov.cn/govdata/gov/201902/18/435204/article.html
  - "Chapter 6, Section 4, Vigorously develop the marine economy (大力发展海洋经济): Strengthen capabilities in ocean observation, monitoring, forecasting, and disaster prevention and mitigation (强化海洋观测、监测、预报和防灾减灾能力)"

- Ministry of Natural Resources, National Marine Ecological Early-Warning and Monitoring Master Plan (2021–2025) (《全国海洋生态预警监测总体方案（2021—2025年）》), 2021.
  - This national plan directed the establishment of operational marine ecological investigation, monitoring, assessment, and early warning, and specifically called for trend monitoring in nearshore ecosystems, regular surveys of representative ecosystems, and early warning for ecological disasters such as red tides. [This is a dedicated MNR marine ecological warning program, distinct from the Ministry of Ecology and Environment's broader marine environmental protection plan.]

- Ministry of Natural Resources, Department of Marine Early Warning and Monitoring, "14th Five-Year Plan for the Overall Construction Scheme for a Smart Grid for Ocean Forecasting" (海洋智能网格预报业务"十四五"总体建设方案), 2021.

POLICY HISTORY

- Ministry of Agriculture and Rural Affairs Opinion on 14th Five-Year Plan High-Quality Distant-Water Fisheries Development (2021–2025) (农业农村部关于促进“十四五”远洋渔业高质量发展的意见), February 2022, https://fgs.moa.gov.cn/flfg/202202/t20220215_6388748.htm
  - Section 2.4: Study resource variation of pelagic fish under climate change and “strengthen medium- and long-term resource prediction capabilities” (开展气候变化背景下中上层鱼类资源变动规律研究，增强资源中长期预测能力)
  - Section 4.8. Strengthen Science and Technology Support (强化科技支撑): Promote research and development and applications involving the Internet of Things, AI, and big data in distant-water fisheries (加强物联网、人工智能、大数据等在远洋渔业领域的研发和应用)

POLICY HISTORY

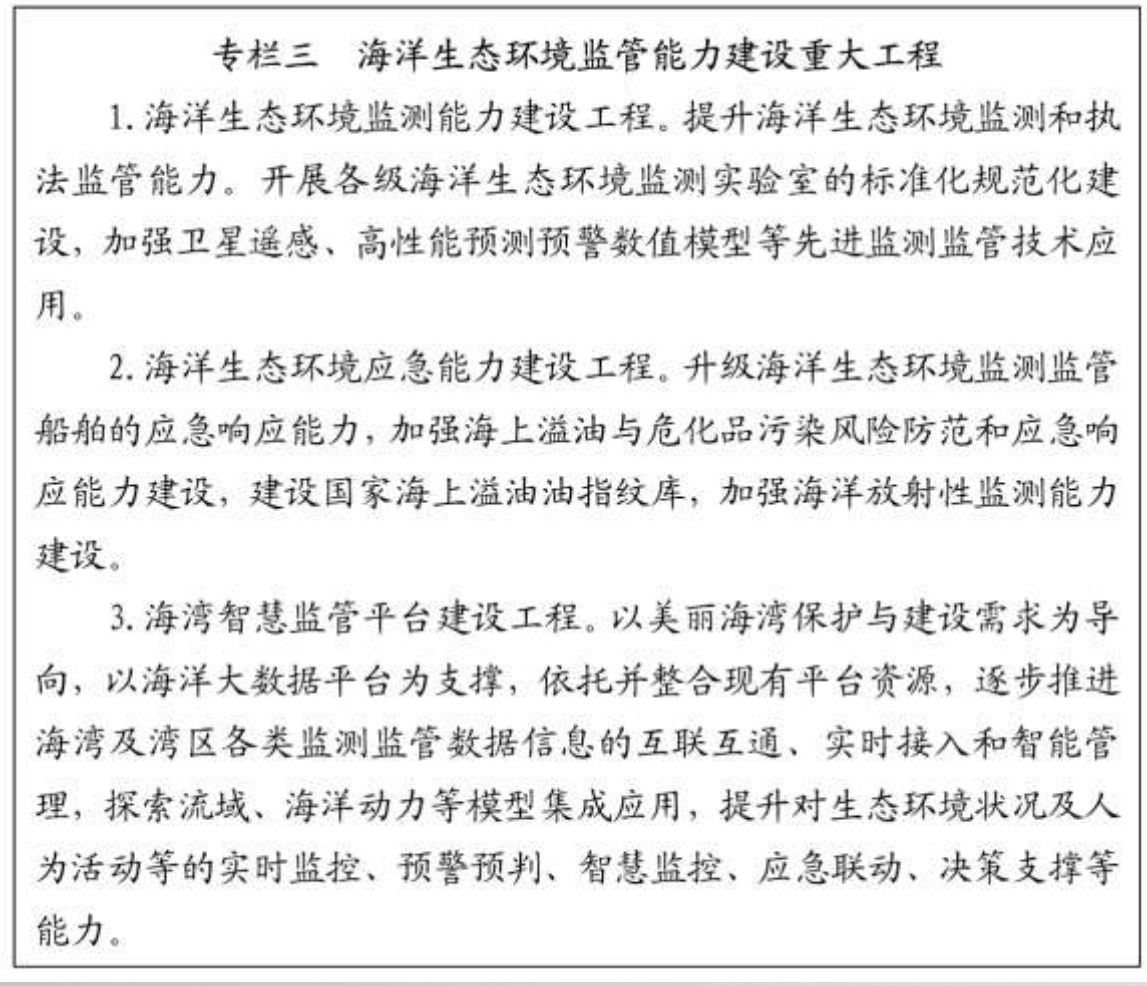
- Ministry of Ecology and Environment, The Marine Ecological and Environmental Protection 14th Five-Year Plan (“十四五”海洋生态环境保护规划), January 2022, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202202/t20220222_969631.html

- Section 15. Improve the marine ecological early warning and monitoring system (健全海洋生态预警监测体系)
  - **“Promote early warning and monitoring for typical marine ecosystems.** Based on the results of marine ecological surveys, set up marine ecological monitoring stations, develop refined field monitoring capabilities, and build supporting indoor testing, analysis, evaluation, and sample data storage capacities. For ecological damage issues and potential risks, select key species, key habitat indicators, and key threat factors for dynamic monitoring to track changes in ecological problems. Explore the establishment of early warning levels for typical marine ecosystems and produce and release early warning products for them. By the end of 2025, the marine ecological early warning monitoring indicator system should be basically in place, with a batch of scientific and guiding early warning products released.”
  - 推进典型海洋生态系统预警监测。依托海洋生态调查成果，布局建设海洋生态监测站，发展野外定点精细化监测能力和配套室内测试、分析评价、样品数据保存能力。针对生态受损问题和潜在风险，遴选关键物种、关键生境指标、关键威胁要素实施动态监测，跟踪生态问题动态变化。探索建立典型海洋生态系统预警等级，制作发布典型海洋生态系统预警产品。2025 年底前，海洋生态预警监测指标体系基本成型，发布一批具有科学性、指导性的预警产品。

POLICY HISTORY

- Ministry of Ecology and Environment, The Marine Ecological and Environmental Protection 14th Five-Year Plan (“十四五”海洋生态环境保护规划), January 2022, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202202/t20220222_969631.html

- Section 15. Improve the marine ecological early warning and monitoring system (健全海洋生态预警监测体系)
  - **“Strengthen the monitoring and early warning of marine ecological disasters.** Conduct three-dimensional monitoring in high-risk red tide areas to understand the types, scale, impact range, and hazards of red tide outbreaks and improve early warning accuracy. Enhance the monitoring and control effect evaluation of green tides, tracking the attachment, growth, floating, aggregation, and outbreak of algae throughout the process. Expand early warning monitoring for new biological outbreak events such as Sargassum, jellyfish, and long-spined sea stars, to track and understand the types, scale, and impact range of marine ecological disasters, release early warning information in a timely manner, and continuously improve early warning accuracy.”
  - 强化海洋生态灾害预警监测。开展赤潮高风险区立体监测，掌握赤潮暴发种类、规模、影响范围及危害，提高预警准确率。加强浒苔绿潮监测与防控效果评估，全过程跟踪浒苔附着生长、漂浮、聚集、暴发情况。拓展马尾藻、水母、长棘海星等新型生物暴发事件预警监测，跟踪掌握海洋生态灾害暴发种类、规模、影响范围，及时发布预警信息，不断提高预警准确率。



专栏三　海洋生态环境监管能力建设重大工程

1. 海洋生态环境监测能力建设工程。提升海洋生态环境监测和执法监管能力。开展各级海洋生态环境监测实验室的标准化规范化建设，加强卫星遥感、高性能预测预警数值模型等先进监测监管技术应用。

2. 海洋生态环境应急能力建设工程。升级海洋生态环境监测监管船舶的应急响应能力，加强海上溢油与危化品污染风险防范和应急响应能力建设，建设国家海上溢油油指纹库，加强海洋放射性监测能力建设。

3. 海湾智慧监管平台建设工程。以美丽海湾保护与建设需求为导向，以海洋大数据平台为支撑，依托并整合现有平台资源，逐步推进海湾及湾区各类监测监管数据信息的互联互通、实时接入和智能管理，探索流域、海洋动力等模型集成应用，提升对生态环境状况及人为活动等的实时监控、预警预判、智慧监控、应急联动、决策支撑等能力。

Ministry of Ecology and Environment, The Marine Ecological and Environmental Protection 14th Five-Year Plan (“十四五”海洋生态环境保护规划), January 2022, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202202/t20220222_969631.html

Section 29 – Box Three: Major Projects for Building Marine Ecological Environment Supervision Capacity

1. Marine Ecological Environment Monitoring Capacity Building Project. Improve the monitoring and law enforcement capabilities for the marine ecological environment. Carry out standardized construction of marine ecological environment monitoring laboratories at all levels, and strengthen the application of advanced monitoring and supervision technologies such as satellite remote sensing and high-performance predictive alert numerical models.

2. Marine Ecological Environment Emergency Capacity Building Project. Upgrade the emergency response capabilities of marine ecological environment monitoring and supervision vessels, strengthen the prevention and emergency response capabilities for offshore oil spills and hazardous chemical pollution risks, build a national offshore oil fingerprint database, and improve marine radioactive monitoring capabilities.

3. Smart Bay Supervision Platform Construction Project. Guided by the needs for the protection and construction of beautiful bays, supported by a marine big data platform, and relying on and integrating existing platform resources, gradually promote interconnection, real-time access, and intelligent management of various monitoring and supervision data in bays and bay areas, explore integrated applications of models like watershed and marine dynamics, and enhance capabilities for real-time monitoring, early warning and prediction, smart supervision, emergency coordination, and decision-making support regarding ecological environment conditions and human activities.

POLICY HISTORY

- State Council, "Outline for High-Quality Meteorological Development (2022–2035)" (国务院《气象高质量发展纲要（2022—2035年）》), May 2022, https://www.ndrc.gov.cn/fggz/fzzlgh/gjjzxgh/202206/t20220601_1326733_ext.html
  - Section 3.7: Improve specialized meteorological forecasting models for typhoons, oceans, and the environment (完善台风、海洋、环境等专业气象预报模式)
  - Section 2.3: Promote deep integration of AI, big data, and quantum computing with meteorology (加强人工智能、大数据、量子计算与气象深度融合应用)
  - Section 4.10: Improve the ability to monitor, forecast, and warn about weather-related disasters. Establish a complete monitoring, forecasting, and warning system for different types of disasters and key industries … [including for] marine disasters … Build a meteorological disaster risk assessment and decision-support information system, and set up a system for identifying and evaluating weather-related disasters. (提高气象灾害监测预报预警能力。健全分灾种、分重点行业气象灾害监测预报预警体系 … 海洋灾害 … 建设气象灾害风险评估和决策信息支持系统，建立气象灾害鉴定评估制度)
  - Also links these capabilities to environmental protection, shipping, and the ocean economy

POLICY HISTORY

- Central Government, PRC National Economic and Social Development 15th Five-Year Plan (中央人民政府，中华人民共和国国民经济和社会发展第十五个五年规划纲要), 13 March 2026, https://www.gov.cn/yaowen/liebiao/202603/content_7062633.htm

- Chapter 32: 加强海洋开发利用保护 (Strengthening Marine Development, Utilization, and Protection)
  - "Improve the marine ecological early-warning and monitoring system, and strengthen capabilities to prevent and manage major marine disaster risks. (健全海洋生态预警监测体系，提高重大海洋灾害风险防控能力。)"
  - "Strengthen strategic marine scientific and technological capabilities, enhance marine technological innovation, improve the support and support system for deep-sea polar exploration, and develop oceanic meteorological navigation services. Implement deep-sea engineering to enhance deep-sea access, detection, development, and safety capabilities. (强化海洋战略科技力量，加强海洋科技创新，健全深海极地考察支撑保障体系，发展远洋气象导航服务。实施深海工程，提高深海进入、探测、开发、安全能力。)"

POLICY HISTORY

- Ministry of Ecology and Environment and NDRC, Ecological and Environmental Monitoring Plan, 15th FYP (2026–2030) (生态环境监测“十五五”规划), July 2026, https://www.mee.gov.cn/xxgk2018/xxgk/xxgk03/202607/W020260713331557574344.pdf

- Section 5.2. Develop large monitoring models, operational AI agents, and algorithm toolkits for applications (加快突破数智化模型算法) including intelligent operations, pollution-source tracing, forecasting and early warning, and remote regulation (智能运控、污染溯源、预测预警、非现场监管)

- Develop an integrated land–sea–air–space environmental monitoring network, improve marine ecosystem monitoring, and more capable marine monitoring platforms

POLICY HISTORY

- China Meteorological Administration, National Meteorological Development "15th Five-Year Plan." (中国气象局, 全国气象发展“十五五”规划), 26 June 2026, https://www.ahjx.gov.cn/Jczwgk/show/3826200.html
  - Build a scenario-based, intelligent decision-making meteorological service system. 建设场景化、智能化决策气象服务系统。
  - Optimize coupled ocean–atmosphere forecasting model systems (优化海-气耦合预报模式系统) … and autonomous environmental emergency response models.
  - Build a global professional forecast product system, focus on developing refined and specialized marine meteorological services, and enhance the forecasting performance of key marine meteorological elements. Enhance spatial weather forecasting and early warning capabilities, and establish a refined product system for spatial weather forecasting. … specialized services for fisheries and marine ranching.
  - Develop AI weather-forecast models and AI agents (人工智能气象预报模型和智能体), with numerical models and AI models working together. … Build an AI forecasting business system … develop national and global climate forecast products for the next 1–5 years. Expand professional meteorological forecasting and forecasting services.

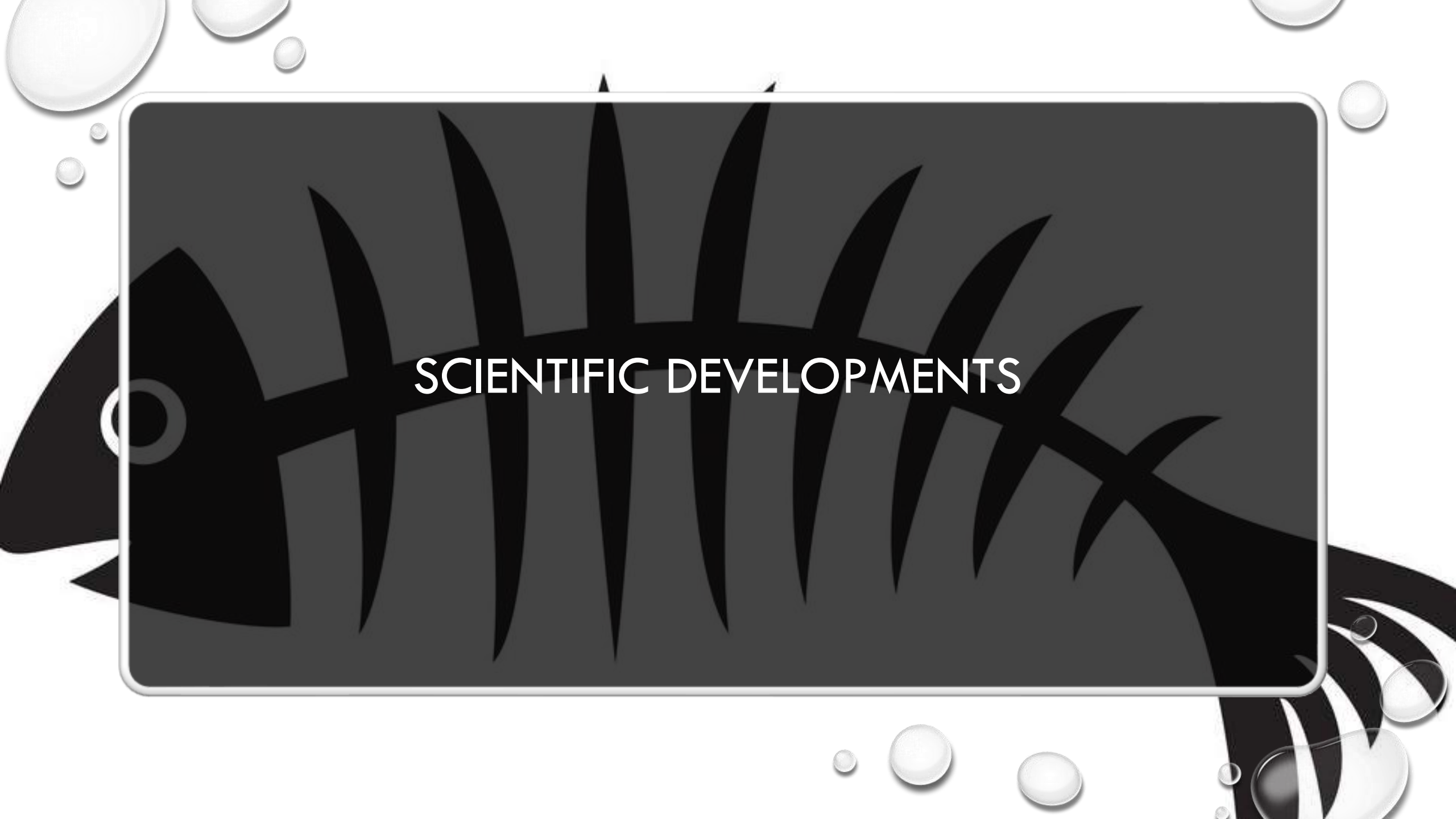
POLICY HISTORY

- China Shanghai Marine Development Plan, 15th FYP (2026–2030) (《上海市海洋发展“十五五”规划》), July 2026, https://www.shanghai.gov.cn/gwk/search/content/e55800bfc41b4f64945abd505d5fa1f5
  - Section 6.18. Improve independently controllable numerical prediction systems and develop a comprehensive range of domestically controlled ocean forecasting models (推进全谱系自主可控海洋预报模型建设)
  - Section 5.14. Develop ecological early-warning and monitoring systems, including forecasts or warnings of marine ecological risks
  - Section 3.8. Promote AI applications in marine industries and meteorological models
- Jiangsu Province 15th FYP Meteorological Development Plan (《江苏省“十五五”气象发展规划》), August 2026, https://www.jiangsu.gov.cn/art/2026/8/31/art_46144_11822830.html
  - Section 5.2.: Initiative for marine meteorological services: Develop high-resolution AI-based coupled ocean–atmosphere forecasting models suitable for Jiangsu’s marine areas (研发适用于江苏海区的高分辨率人工智能海气耦合预报模型)
  - Including applications to fisheries, marine ranching, coastal shipping, marine engineering, and ocean resource development

POLICY PRIORITIES, SUMMARIZED

OVERALL POLICY GOALS

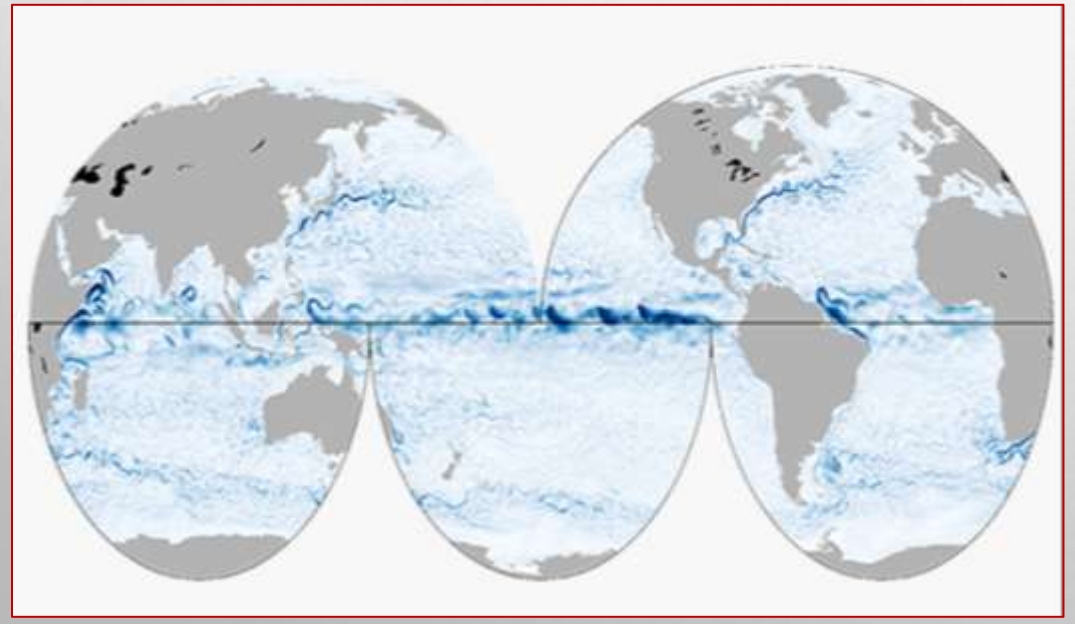
- Risk prevention and disaster preparedness
  - Long-standing emphasis on marine hazards, emergency response, environmental monitoring, and ecological early-warning systems (supporting sources: 2006 S&T Plan; 2016 S&T Innovation Plan; 2022 MEE Plan)
- Marine economic development and resource utilization
  - Forecasting as a means of supporting fisheries productivity, resource exploration, navigation, and ocean economic activity (supporting sources: 2017 and 2022 distant-water fisheries policies; 2026 national plan)
- Technological innovation and self-reliance
  - Development of indigenous numerical models, AI, big data, coupled prediction systems, and autonomous technological capabilities (supporting sources: 2022 meteorological plan; 2026 MEE, CMA, Shanghai, and Jiangsu plans)
- Integration of predictive science into governance
  - A growing emphasis on linking observations, models, early warnings, integrated information platforms, and decision-support services (supporting sources: 2022 MEE Smart Bay provisions; 2026 MEE and CMA plans)

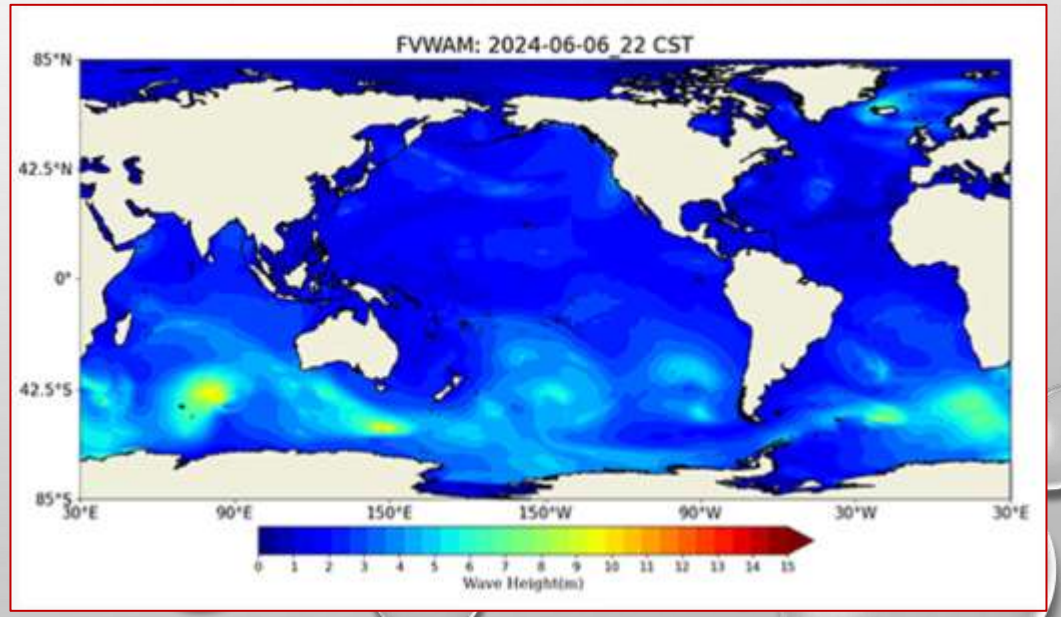

SCIENTIFIC DEVELOPMENTS

OCEAN FORECASTING

ADVANCES IN CHINA'S FORECASTING SYSTEMS

- Mass Conservation Ocean Model (MaCOM) Mazu 妈祖海洋模式
  https://macom.oceanguide.org.cn/
  - The MNR National Marine Environmental Forecasting Center launched an indigenous ocean circulation model (initial launch in 2021), along with a finite volume wave model (FVWAM) (initial launch in 2023). The MaCOM models support more efficient forecasting through parallel and GPU computing. Released as open source in 2024, MaCOM is intended for scientific and business/commercial applications.





ADVANCES IN CHINA'S FORECASTING SYSTEMS

- LangYa 2.0 (琅琊 2.0) Global Ocean Prediction AI Model, Developed by the Chinese Academy of Science Institute of Oceanology

- "A state-of-the-art artificial intelligence model designed for high-resolution global ocean prediction" for forecasting extreme weather events and ocean-related disasters, LangYa integrates advanced AI algorithms with specialized oceanographic knowledge
  - LangYa 1.0: "delivers highly accurate short- to medium-term forecasts of global ocean state variables, including temperature, salinity and ocean currents, for periods ranging from one to seven days"
  - LangYa 2.0: forecasts for typhoons, extreme rainfall, storm surges, internal solitary waves, mesoscale eddies, and sea ice
    - "LangYa 2.0 marks a leap from global ocean state forecasting to intelligent prediction of complex marine phenomena, making ocean forecasts perceptible, actionable, and decision-ready … It will provide intelligent support for marine disaster prevention, shipping safety, polar navigation, and climate response"
  - Future versions may incorporate marine ecosystem forecasting

Sources: CAS, "China Unveils Global Ocean Prediction AI Model," 31 December 2024, https://english.cas.cn/newsroom/news--archives/2024/cas-in-media/202412/t20241231_1130560.shtml; and "China Releases LangYa 2.0 AI Model for Full-blown Marine Phenomenon Forecasting," 8 June 2026, https://english.cas.cn/newsroom/cas-in-media/202606/t20260608_1161354.shtml; Xiaofeng Li et al., Artificial intelligence for ocean phenomena forecasting, Science Bulletin, Vol. 71, No. 10, 30 May 2026, pp. 2632–2652, 10.1016/j.scib.2026.04.002.

LANGYA 2.0 LAUNCH




DECISION-MAKING

FISHERIES

ADVANCES IN CHINA'S FORECASTING SYSTEMS

- Hai Ying AI Tuna Forecasting 海鹰AI金枪鱼智慧渔情 预报系统, officially announced in 2024, a partnership between Shanghai Ocean University and China National Fisheries Corporation (CNFC)

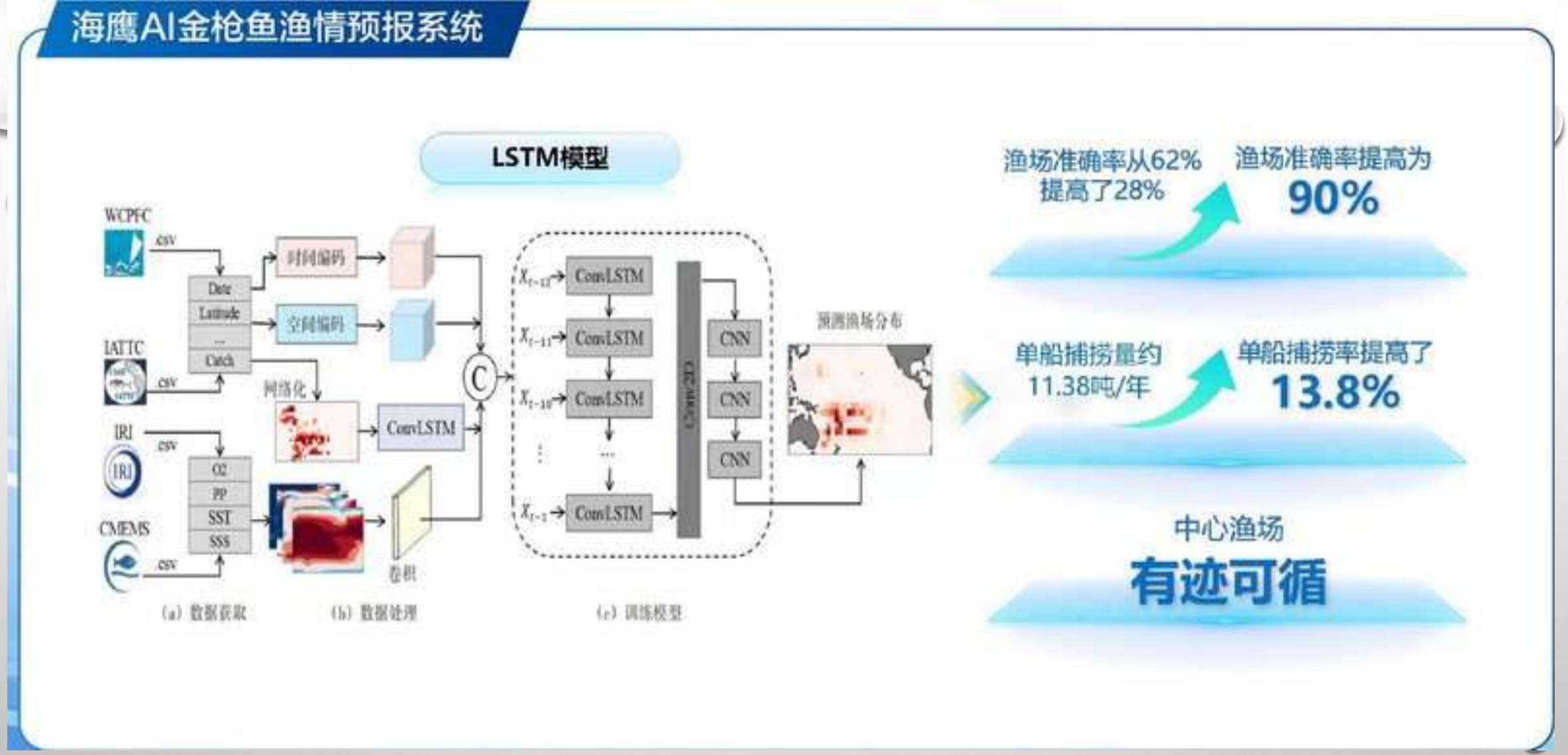
- Based on "nearly 70 years of global tuna fishery and marine environmental data, integrating artificial intelligence, big data, and other technologies for analysis. This system not only provides real-time data on more than 20 marine habitat elements such as air pressure, wind fields, waves, sea temperature, salinity, sea surface height, flow field, dissolved oxygen, chlorophyll, plankton, and primary productivity, but also integrates specialized knowledge from tuna biology, ecology, and fishery habitatology, using big data mining and deep learning technologies to achieve central tuna fishery forecasting and medium- to long-term resource forecasting, providing technological support for scientific production and management of tuna fisheries."

- "The Haiying AI system has been commercialized on all CNFC tuna vessels, with significant results." "During the 2023 Atlantic fleet trial, single-vessel catch volume increased by 13.8% year-on-year, reaching a record high in total output. … In the first three quarters of 2025, with the help of Haiying's AI system and intelligent sorting equipment to improve operational efficiency, net profit attributable to shareholders reached 53.4081 million yuan, a year-on-year increase of 230.08%."

Source: 我国首个金枪鱼智慧渔情预报系统在沪发布, 15 April 2024, https://hyxy.shou.edu.cn/2024/0416/c15782a329958/page.htm



Source: http://140.210.143.7/dt/zs_tuna/#/Login



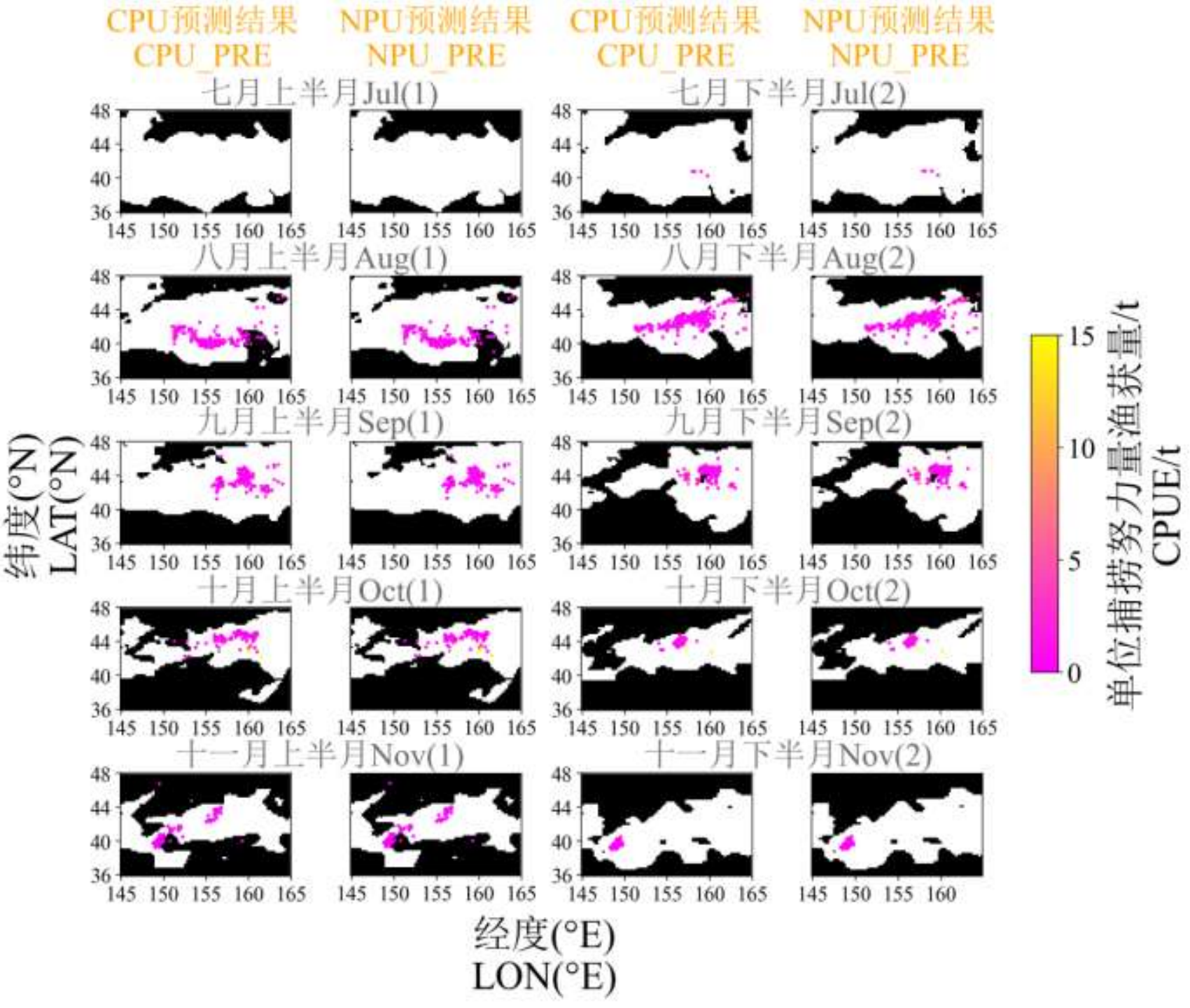
“Fishing-ground prediction accuracy increased by 28 percentage points, from 62%; fishing-ground prediction accuracy reached 90%; catch per vessel: approximately 11.38 metric tons/year; catch rate per vessel increased by 13.8%; principal fishing grounds can be identified or tracked through discernible patterns”

Source: 我国首个金枪鱼智慧渔情预报系统在沪发布, 15 April 2024, https://hyxy.shou.edu.cn/2024/0416/c15782a329958/page.htm

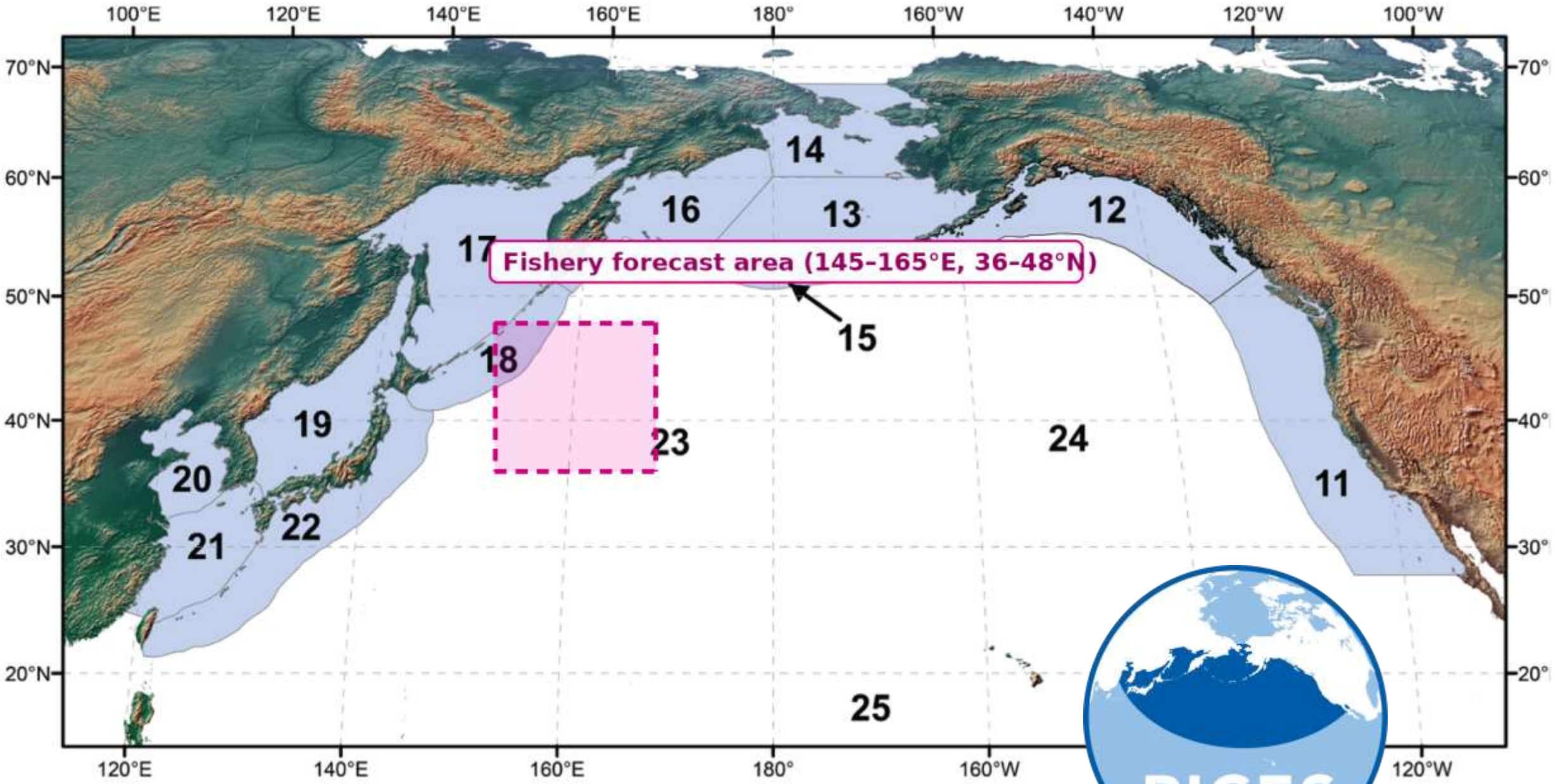
ADVANCES IN CHINA'S FORECASTING SYSTEMS

- Ao Xin 1.0 (敖芯1.0), a 72-hour fishery forecasting platform for squid in the Northwest Pacific (柔鱼, *Ommastrephidae*), developed by Shanghai Ocean University, announced in 2025
- Uses AI technology for asymmetric spatiotemporal scale modeling, multi-environmental factor coupling analysis, and short- to medium-term future trend forecasting; uses edge computing to provide real-time forecasts to fishing vessels; relies on a combination of SST (sea surface temperature) and Chl-a (chlorophyll a concentration) to predict species distribution
- Successfully tested on the "Zhouyu 968" (舟渔968) from CNFC Zhoushan Oceanic Fisheries Co., Ltd. (中水集团舟山远洋渔业有限公司)
- Plans to integrate multi-source data and high-resolution environmental parameters, expand forecast timescales, extend from short- and medium-term forecasts to seasonal forecasting, include resource volume forecasting, and expand to other locations and species

Sources: 上海海洋大学 "敖芯1.0"平台助力渔情预报智能化升级 ("Shanghai Ocean University's "Aoxin 1.0" platform supports the intelligent upgrade of fishery forecasting"), 29 April 2025, https://hyxy.shou.edu.cn/remote_ocean/2025/0429/c8364a340487/page.htm; 海大智渔芯创平台 (AoXin Platform), https://shouai.github.io/aoxin/index.html



AOXIN 1.0 SQUID FORECAST



AOXIN 1.0 SQUID FORECAST

ADVANCES IN CHINA'S FORECASTING SYSTEMS

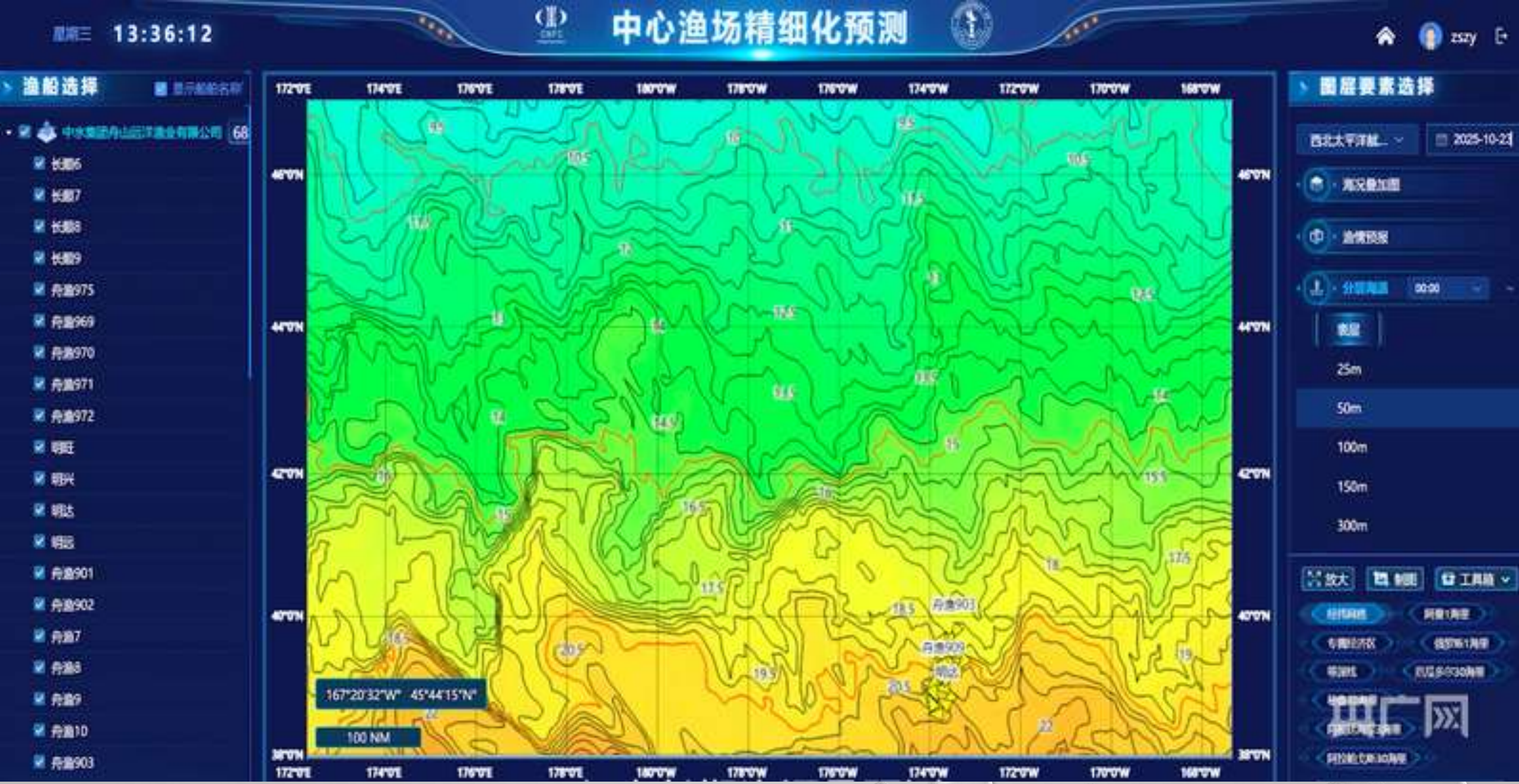
- Heron AI (苍鹭 AI) Squid Smart Fishery Forecasting System, also developed by Shanghai Ocean University, announced/tested in 2025 after three years of development

- "Integrates technologies such as marine remote sensing, geographic information, artificial intelligence, and big data, providing accurate five-day fishing ground forecasts for global oceanic squid fishing areas, as well as resource abundance forecasts for the coming year"

- "The system includes four major functional modules: medium- and long-term forecasting and decision-making, refined forecasting of central fisheries, fisheries management, vessel position tracking, and three major application platforms: desktop, mobile, and vessel-loaded, covering 99% of distant-water squid fishing application scenarios."

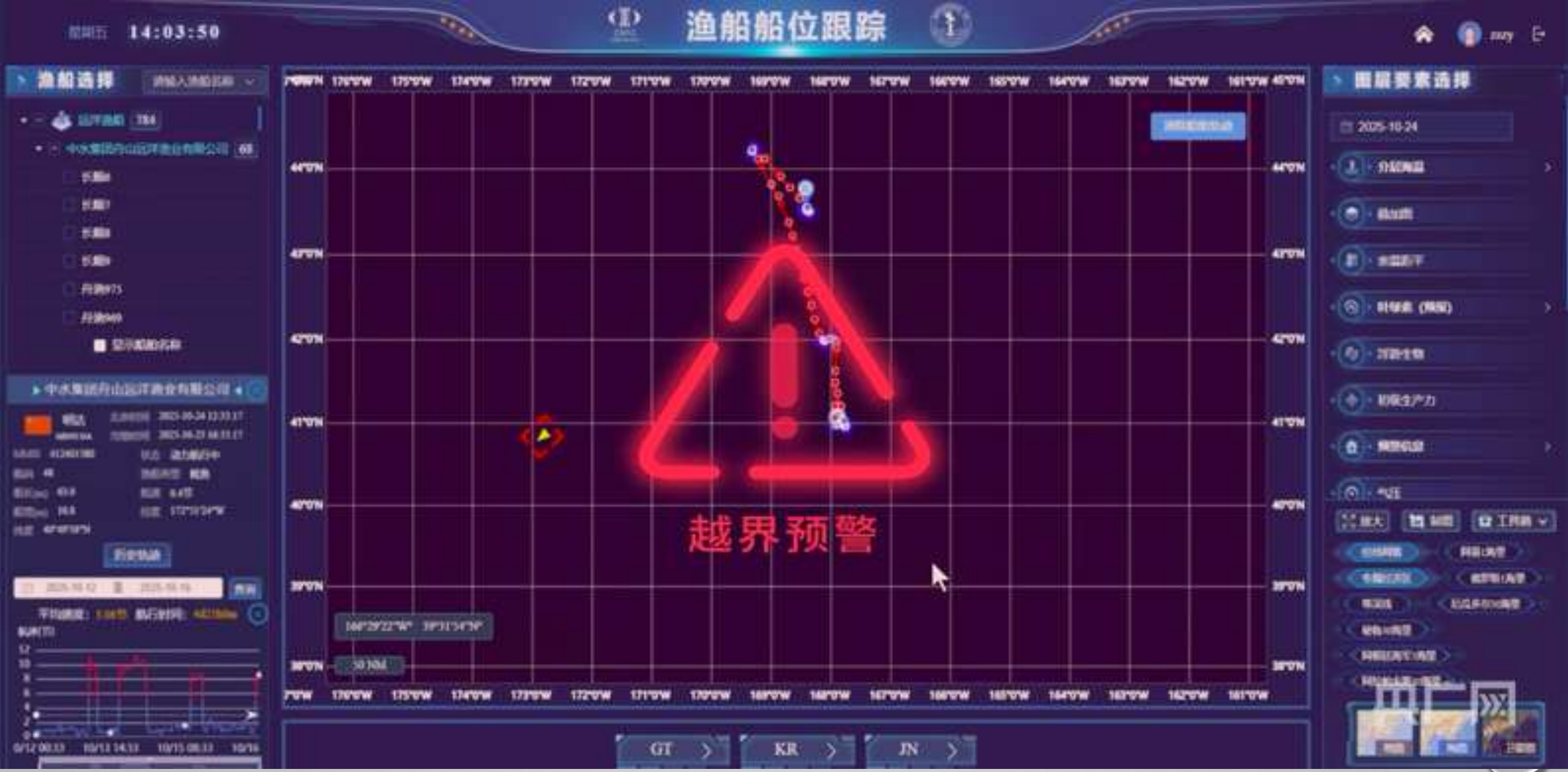
- The system was tested on CNFC Zhoushan Oceanic Fisheries Co., Ltd. (中水集团舟山远洋渔业有限公司) squid fishing vessels, "achieving a 14% year-on-year increase in single-vessel catch, with a fishing ground forecast accuracy as high as 90%. By 2025, the output per vessel is expected to reach about 500 tons, a 48% increase compared to the historical annual output of over 330 tons. Through the application of the fishery weather forecasting system, for the first time, the squid fishing season in the western longitudinal waters of the North Pacific has been extended to November."

Sources: 我院科技小院成果入选全国十佳科技小院工作成果, 17 December 2025, https://hyxy.shou.edu.cn/2025/1217/c7379a349333/page.htm; 远洋鱿鱼捕捞告别"靠天吃饭"！上海海洋大学自主研发AI渔情预报系统上线, 5 November 2025, https://export.shobserver.com/baijiahao/html/1012445.html; https://news.sciencenet.cn/htmlnews/2025/11/554808.shtm; https://hyxy.shou.edu.cn/2025/1105/c7379a347905/page.htm



HERON FISHING GROUND FORECAST

Source: https://news.qq.com/rain/a/20251107A029J800



HERON VESSEL TRACKING
AND BOUNDARY CROSSING WARNING

Source: https://news.qq.com/rain/a/20251107A029J800

ADVANCES IN CHINA'S FORECASTING SYSTEMS

- Research is being conducted by the Marine Fisheries Technology Lab at Ocean University of China on forecasting for China's trawl fisheries, which accounts for 50% of China's marine catch annually; announced in June 2026

- The proposed digital twin system framework would cover the entire trawl fishing—trawl vessel monitoring, fishery forecasting, fishing operations, and catch handling—and includes three major modules: virtual simulation, reality perception, and intelligent decision-making
  - Vessel monitoring: Through BeiDou/GPS positioning, VMS (Vessel Monitoring System), and AIS (Automatic Identification System), it obtains real-time data on fishing vessel position, speed, and course, for navigation and collision avoidance, operational behavior identification, and combating IUU Fishing.
  - Fishing Forecast: Integrates satellite remote sensing (sea surface temperature, chlorophyll, etc.), fish finder/sonar data, and AI models to generate fish prediction maps, assisting captains in accurately searching for fish schools and reducing fuel consumption.
  - Fishing operations: Install net position meters, tension sensors, underwater cameras, and other equipment at key points of the net to monitor net mouth shape, operating depth, and catch in real time, combined with intelligent control to achieve precise towing and selective fishing.
  - Catch handling: Automated conveyor belts, optical cameras, and computer vision for automatic sorting and grading, and building a full-chain traceability system from ocean to table using RFID/NFC electronic tags and blockchain technology.

Source: 北斗+AI+数字孪生：我国拖网渔业正在经历一场“智慧革命” (Beidou + AI + Digital Twin: China's trawl fishing industry is undergoing a "smart revolution"), 29 June 2026, https://scxy.ouc.edu.cn/lmft/2026/0629/c24312a533264/page.htm

ADVANCES IN CHINA'S FORECASTING SYSTEMS

- Future plans for OUC's Smart Trawling technology:
  - Develop a big data model for China's DWF resources—integrating acoustic detection, environmental data, historical catch and operation information, dynamically identifying the structure and spatiotemporal evolution of fishery resources, and providing scientific support for precision and quota fishing;
  - Breakthroughs in fast-fidelity virtual simulation and intelligent decision-making technologies for fishing gear—enhancing the real-time performance and reliability of digital twin systems, achieving precise mapping and closed-loop optimization of trawling operations;
  - Developing behavior-driven high-welfare nets—integrating underwater embodied intelligence, biobehavior, and net hydrodynamics to achieve a sustainable utilization model of "protection while fishing, fishing while protecting";
  - Connecting data channels across the entire industry chain—from fishing production to market circulation—improving the digital fishery standards system, gathering synergy for industrial transformation and upgrading, and ultimately achieving coordinated improvement of ecological, economic, and social benefits.

Source: 北斗+AI+数字孪生：我国拖网渔业正在经历一场"智慧革命" (Beidou + AI + Digital Twin: China's trawl fishing industry is undergoing a "smart revolution"), 29 June 2026, https://scxy.ouc.edu.cn/lmft/2026/0629/c24312a533264/page.htm



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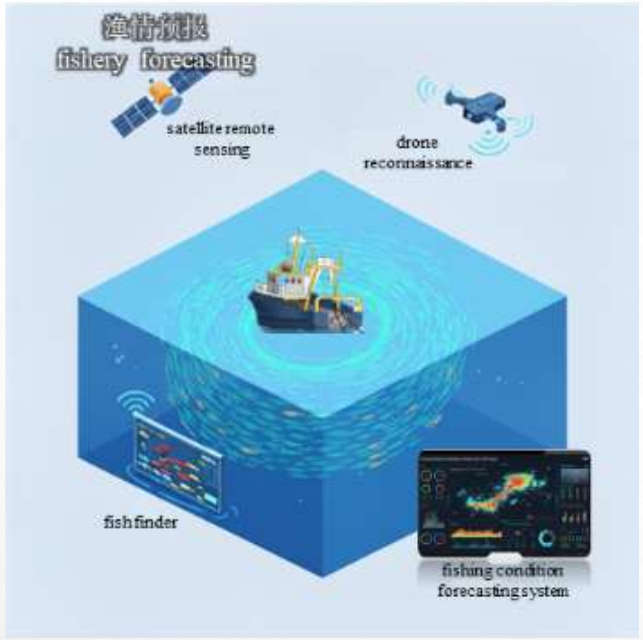

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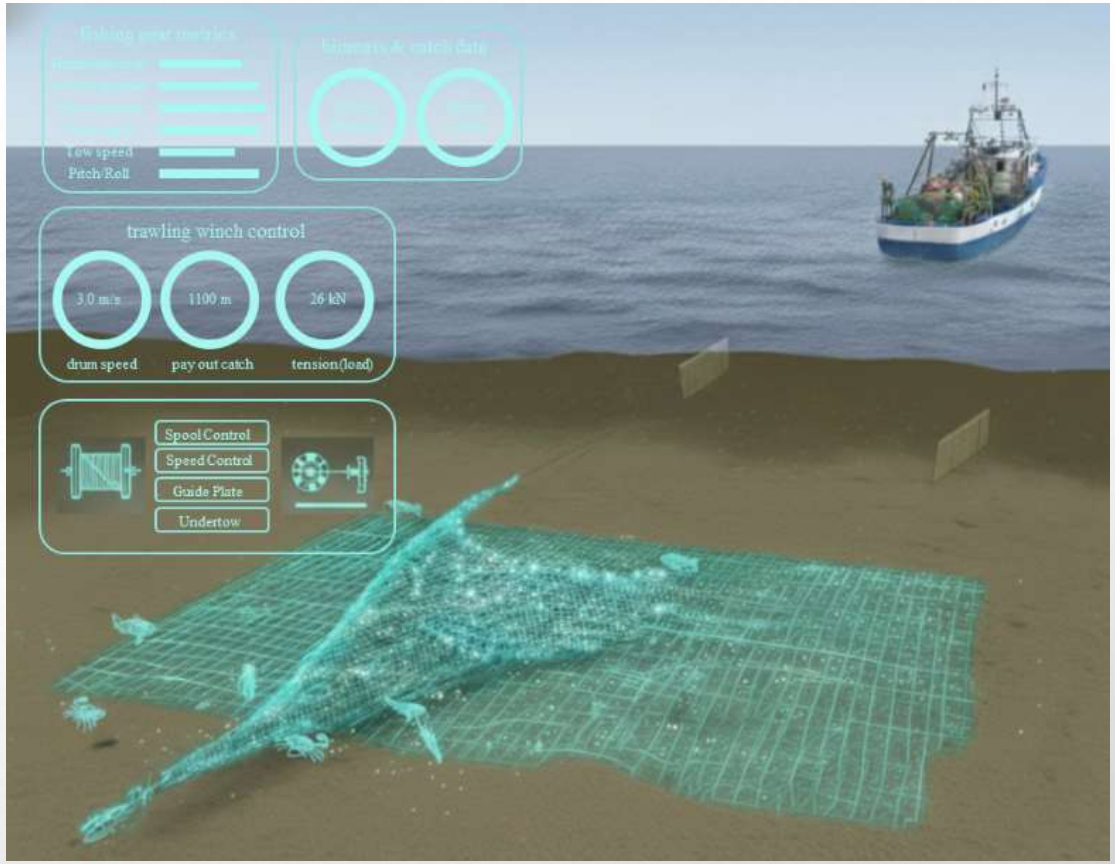

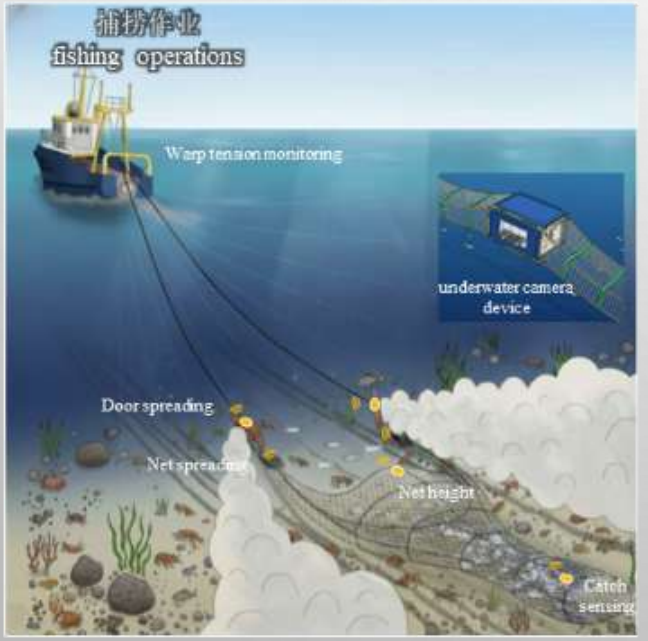

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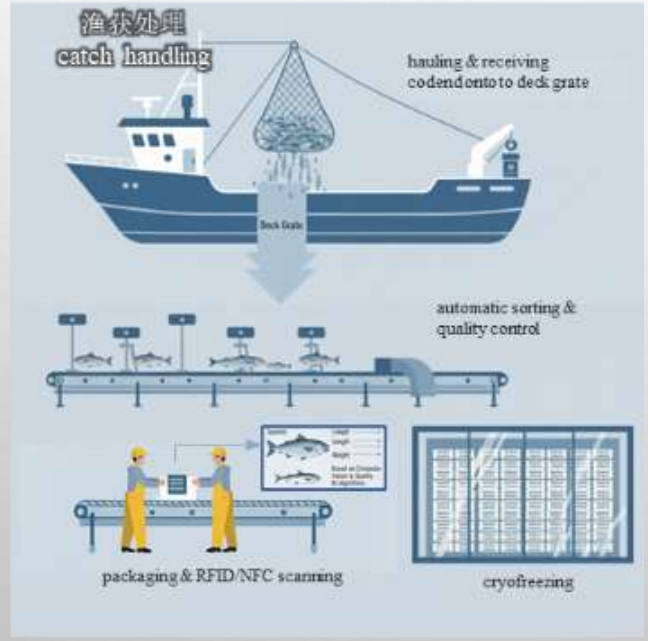

(d)

Source: 北斗+AI+数字孪生：我国拖网渔业正在经历一场“智慧革命” (Beidou + AI + Digital Twin: China’s trawl fishing industry is undergoing a “smart revolution”), 29 June 2026, https://scxy.ouc.edu.cn/lmft/2026/0629/c24312a533264/page.htm

DECISION-MAKING CONSIDERATIONS

DECISION-MAKING CONSIDERATIONS

- 李雪丁 (Li Xueding), 福建省海洋生态灾害防控辅助决策支持系统的实现和应用 (Implementation and Application of a Decision Support System for Marine Ecological Disaster Prevention and Control in Fujian Province), 海洋开发与管理 (Ocean Development and Management), 2021, 38(6): 37–41
  - Describes an operational decision-support system developed for Fujian Province
  - Integrates monitoring, predictive modeling, emergency response, and decision support for three types of marine environmental emergencies: harmful algal blooms, oil spills, and abnormal water conditions
  - Operational example of forecast-informed decision support, but not proven forecast-driven decision-making

DECISION-MAKING CONSIDERATIONS

- 李响、向先全、任兴元、王慧、辛冰, 面向基层海洋环境安全精细化保障需求的典型应用场景服务产品 (Information Services for Typical Application Scenarios Addressing Local Marine Environmental Security Needs), 海洋信息技术与应用, 2024, 39(4): 249–256.
  - Examines remote sensing analysis, early warning and forecasting, risk assessment, scenario deduction, and response decision-making for 13 typical scenarios:
    - Offshore oil and gas platform evacuation response; Offshore oil and gas development area oil spill response; Offshore oil and gas platform vessel collision response; Coastal community seawall breaching and flooding response; Evacuation of residents from inundation zones in coastal communities; Routine disaster prevention drills in coastal communities; Typhoon and wave response for deep-water cage aquaculture; Response to abnormal temperature and salinity conditions in aquaculture areas; Red tide and macroalgal bloom disaster response in aquaculture areas; Oil spill pollution response in mariculture areas; Port and terminal operations during typhoons; Red tide and macroalgal bloom disaster response in marine ecological protected areas; Oil spill pollution response in marine ecological protected areas
  - Descriptive, identifies stakeholders and their information needs for decision-making

DECISION-MAKING CONSIDERATIONS

- 孙松、臧文潇、孙晓霞、张芳、王楠, 海洋科学观测的本体论反思与方法论重构——从“均匀性预设”到“问题驱动的异质性认知” (Ontological Reflection and Methodological Reconstruction in Marine Scientific Observation), 海洋与湖沼, 57(3): 582–588 (2026), DOI: 10.11693/hyhz20260300074
  - Argues that there is a “significant disconnect between abundant marine observational data and effective management decisions” (当前海洋观测在数据丰富性与决策有效性之间存在显著脱节)
  - Argues that China’s ocean observing systems need to move away from simply collecting ever-greater volumes of data toward designing observations around specific scientific questions and management objectives
  - Proposed framework: Scientific questions/management goals → Key ecological processes → Observation requirements
  - Advocate an integrated approach involving adaptive observation networks, real-time data assimilation, and predictive decision-making
  - Conceptual, not empirical, but shows that technological improvements do not automatically translate into better management decisions

DECISION-MAKING CONSIDERATIONS

- 孙松、臧文潇、孙晓霞、张芳、孙妍、沙忠利, 海洋生态系统健康的目标驱动式评估体系 (A Target-Driven Framework for Assessing Marine Ecosystem Health), 海洋与湖沼, 57(3): 589–598 (2026), DOI: 10.11693/hyhz20260300066

- Argues that conventional marine ecological monitoring often emphasizes physical and chemical indicators while neglecting ecosystem structure and function

- Proposes a management-oriented assessment framework that begins by identifying the specific ecological problem a decision-maker needs to address, for example:
  - Assessing overall ecosystem health
  - Managing aquaculture carrying capacity
  - Providing early warnings of ecological disasters

- Discusses using an intelligent diagnostic system to turn observational information into knowledge relevant to management decisions

- Advocates for ecosystem-based management, and connects science to management priorities



POTENTIAL IMPACTS

POTENTIAL IMPACTS ON SOCIAL-ECOLOGICAL SYSTEMS

- Potential Benefits
  - Earlier warnings and improved disaster preparedness
  - Better environmental monitoring and conservation planning
  - Reduced search time and fuel use per unit of catch
- Potential Risks
  - Increased efficiency could intensify fishing pressure
  - Unequal access to technologies and predictive information
  - Changes in spatial fishing patterns, with possible transboundary effects
- Outcomes depend on how predictions are used, by whom, and under what incentives and/or regulations
  - Who receives and uses forecasts?
  - Are forecasts incorporated into management rules?
  - How are uncertainty and ecological outcomes evaluated?

CONCLUSION

- China is advancing rapidly in its ocean-prediction capabilities and is beginning to incorporate them into operational applications, especially for fisheries. The implications for social-ecological systems will depend not only on the accuracy of forecasts, but also on how predictive information is incorporated into decision-making, as well as on the economic and institutional incentives shaping its use.



THANK YOU!

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