9th China - Southeast Asian Countries Marine Cooperation Forum

ABSTRACT

Host

Department of Marine and Coastal Resources,
Ministry of Natural Resources and Environment, Thailand

Department of International Cooperation,
Ministry of Natural Resources, China

24 - 25 September 2026
The Bazaar Hotel Bangkok, Bangkok, Thailand

Tentative Agenda
9th China - Southeast Asian Countries Marine Cooperation Forum
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23 September 2026	
15:00 - 18:00	**Registration**
18:30 - 21:30	**Banquet**
24 September 2026	
8:30 - 9:00	**Registration**
9:00 - 9:40	**Opening ceremony** **Welcome Remarks** **Dr. Pinsak Suraswadi** Director-General, Department of Marine and Coastal Resources, MNRE, Thailand **Congratulatory Remarks** **Ms. Chen Danhong** Director-General, Department of International Cooperation, MNR, China **Opening Remarks** **Mr. Sun Shuxian** Vice Minister, Ministry of Natural Resources (MNR), China **Opening Remarks** **Ms. Darika Sarunyagate** Advisor to the Minister of Natural Resources and Environment (MNRE), Thailand **Group photo**
9:40 - 10:30	**Keynote Presentation** Synergistic Air-Space-Land-Sea monitoring: from coastal areas to polar seas **Prof. Chen Jianfang**, Fourth Institute of Oceanography, MNR, China
	Blue-Synergy: Fostering China-Southeast Asian Marine Cooperation through Nature-based solution **Assoc. Prof. Dr. Thamasak Yeemin**, Faculty of Science, Ramkhamhaeng University, Thailand
	Scientific breakthroughs for accurate typhoon intensity forecasting: A challenge for half century **Prof. Qiao Fangli**, First Institute of Oceanography, MNR, China
10:30 - 11:00	**Coffee/Tea break**

Session I:	**Ocean and Climate Observation, Forecasting, Projection, and Application** **Conveners:** Dr. Yu Weidong, Dr. Somkiat Khokiattiwong, Prof. Fredolin Tangang, Dr. Chalermrat Sangmanee
11:00 - 11:20	**Keynote Presentation** Coordinated regional climate downscaling over Southeast Asia under the CORDEX Southeast Asia (CORDEX-SEA) initiative **Prof. Fredolin Tangang**, Universiti Brunei Darussalam, Brunei
11:20 - 12:20	**Oral Presentations** 1) Channel-attention U-Net correction of GFS sea surface winds over the South China Sea **Dr. Zhao Chang**, First Institute of Oceanography, MNR, China
	2) Rivers in the sea: Riverine freshwater pathways and their implications for ocean forecasting in the Indonesian maritime continent **Dr. Bayu Edo Pratama**, Indonesian Agency for Meteorology, Climatology and Geophysics, Indonesia
	3) Progress and new puzzles in internal solitary wave dynamics in the Andaman Sea **Dr. Liu Yanliang**, First Institute of Oceanography, MNR, China
	4) Long-term warming strengthens Indian Ocean dipole air-sea coupling **Dr. Zhang Lei**, South China Sea Institute of Oceanology, Chinese Academy of Sciences
	5) Assessment of atmospheric reanalysis data based on in-situ observations over the tropical Indian Ocean **Dr. Liu Lin**, First Institute of Oceanography, MNR, China
12:20 - 13:30	**Lunch**
13:30 - 15:10	**Oral Presentations** 6) Achieving Explainable ENSO Prediction Using Small Data Training **Dr. Feng Jie**, Second Institute of Oceanography, MNR, China
	7) What sets the monsoon onset sequence over the Indo-Pacific Warm Pool Ocean? **Prof. Yu Weidong**, Sun Yat-sen University, China
	8) Impacts of strong sea surface temperature diurnal variation on the Asian summer monsoon onset **Dr. Song Yajuan**, First Institute of Oceanography, MNR, China
	9) A coupled ocean-wave-sediment modelling framework for assessing climate-driven extreme sea-level impacts on Brunei Darussalam's coastal-offshore zone **Dr. Novan Tofany Sugeng**, Universiti Brunei Darussalam, Brunei
	10) Simulated ocean circulation in the Sunda Strait and water-mass exchange between the Indian Ocean and the Java Sea **Dr. Agus Saleh Atmadipoera**, IPB University, Indonesia

13:30 - 15:10	11) Observation technique for marine CO_2 and their application **Dr. Zhan Liyang**, Third Institute of Oceanography, MNR, China
	12) Ocean acidification in coral reefs around the Sichang Islands, Chon Buri Province, Thailand (2024-2025) **Ms. Narinrat Nimprasert**, Department of Marine and Coastal Resources, MNRE, Thailand
15:10 - 15:40	**Coffee/Tea break**
Session II:	**Marine Ecosystem Protection, Biodiversity Research and Marine Biotechnology R&D** **Conveners:** Dr. Zhang Xuelei, Ms. Tipamat Upanoi, Mrs. Ratchanee Puttapreecha, Dr. Faisal Hamzah
15:40 - 16:00	**Keynote Presentation** Hydrodynamic controls on coastal mangrove stability and protection strategies **Dr. Vo Luong Hong Phuoc**, Viet Nam National University, Ho Chi Minh City, Vietnam
16:00 - 17:30	**Oral Presentations** 1) Shift of algal symbiont communities in the coral Acropora digitifera: Shuffling and switching during thermal stress and recovery **Prof. Gu Haifeng**, Third Institute of Oceanography, MNR, China
	2) Using ITS2 rDNA profiling to elucidate the coral symbionts composition in Scleractinian coral species **Dr. Po Teen Lim**, Universiti Malaya, Malaysia
	3) The prey, population age structure, and mating behaviors of Eden's whales around Weizhou Island, China **Ms. Xiuzi Huang**, Nanjing Normal University, China
	4) From Poles to Asia: Exploring polar marine biodiversity through Thailand-China scientific cooperation **Prof. Suchana Apple Chavanich**, Chulalongkorn University, Thailand
	5) A Study on the Effectiveness of High-Frequency Acoustic Devices in Preventing Dolphin Stranding in the Bang Pakong River, Chachoengsao Province, Thailand **Ms. Patcharaporn Yaowasooth**, Department of Marine and Coastal Resources, MNRE, Thailand
	6) Outlook to marine fish diversity in Thai and adjacent waters **Dr. Chavalit Vidthayanon**, Seub Nakasathien Foundation, Thailand
	7) A decade of coral cultivation and reef restoration at Ko Man Nai: Lessons learned and future directions **Ms. Nitchanan Khaengkhan**, Department of Marine and Coastal Resources, MNRE, Thailand
17:30 - 18:30	**Poster session**
18:30 - 20:30	**Dinner**

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Session II: (Cont.)	**Marine Ecosystem Protection, Biodiversity Research and Marine Biotechnology R&D** **Conveners:** Dr. Zhang Xuelei, Ms. Tipamat Upanoi, Mrs. Ratchanee Puttapreecha, Dr. Faisal Hamzah
09:00 - 10:30	**Oral Presentations** 8) Smart perception of marine biodiversity and exploration of the deep-sea ecosystem **Dr. Zhang Xuelei**, First Institute of Oceanography, MNR, China
	9) The strait of Malacca: Hotspots of harmful algal blooms **Dr. Chui Pin Leaw**, Universiti Malaya, Malaysia
	10) Microplastics from surface to seafloor in the Indonesian throughflow **Dr. Corry Yanti Manullang**, Universitas Indonesia
	11) Unlocking the secondary metabolite potential of marine sinomicrobium sp. PAP.21 using genomic and metabolomic approaches **Dr. Riyanti**, Jenderal Soedirman University, Indonesia
	12) Integrating eDNA metabarcoding and reference collections to enhance marine biodiversity resources: A pilot study of fish in Cape Panwa, Phuket, Thailand **Ms. Surangkana Tuanapaya**, Phuket Marine Biological Center, MNRE, Thailand
	13) Deciphering the drivers of low-oxygen waters and their thresholds for deep-sea organisms in Western Indonesia **Dr. Faisal Hamzah**, National Research and Innovation Agency, Indonesia
10:30 - 11:00	**Coffee/Tea break**
Session III:	**Marine Geosystem Science and Disaster and Mitigation** **Conveners:** Mr. Sumran Praphat, Prof. Che Abd. Rahim Mohamed, Prof. Liu Zhifei, Dr. Liu Shengfa
11:00 - 11:20	**Keynote Presentation** Advancing Coastal Resilience under Sea-Level Rise: Coupled Coastal Processes, Adaptive Protection, and Pollutant Transport **Dr. Yuzhu Pearl Li**, National University of Singapore
11:20 - 12:20	**Oral Presentations** 1) Global seafloor substrate mapping **Prof. Shi Xuefa**, First Institute of Oceanography, MNR, China
	2) Long-term record of climate fluctuation in the eastern Sulawesi Sea, Indonesia **Dr. Rina Zuraida**, National Research and Innovation Agency, Indonesia
	3) Intensified coastal erosion alters sedimentary dynamics and marine ecosystem under global warming and sea-level rise **Dr. Hu Limin**, Ocean University of China

11:20 - 12:20	4) Coastal and estuarine sediment budget dynamics in Malaysian waters: Drivers, fluxes, and environmental impacts **Prof. Che Abd. Rahim Mohamed**, Universiti Kebangsaan Malaysia
	5) Paleoenvironmental evolution of small tropical estuary with sea level rising in the Holocene, Chanthaburi, Thailand **Dr. Chen Min**, Third Institute of Oceanography, MNR, China
12:20 - 13:30	**Lunch**
13:30 - 14:30	**Oral Presentations** 6) Discovery and characterization of submarine Cinder Cones and Guyot in the Sunda Strait: Insights from the Cinodex expedition **Dr. Priyadi Dwi Santoso**, IPB University, Indonesia
	7) Cenozoic tectono-stratigraphic evolution of the eastern Sunda Shelf: From tectonic to eustatic dominance **Dr. Wu Nan**, Tongji University, China
	8) Holocene monsoon driven sediment transport and iron-associated organic carbon burial in the Gulf of Thailand **Dr. Jirawat Deemuenwai**, Kasetsart University, Thailand
	9) Characteristics and Assessment of Coastal Erosion in the Yellow River and Chao Phraya River Deltas under the Dual Stress of Sea Level Rise and Human Activities **Dr. Qiao Shuqing**, First Institute of Oceanography, MNR, China
	10) Geo-accumulation Index of heavy metals in surface marine sediments of Chanthaburi Province, eastern Gulf of Thailand **Mr. Thawatchai Polsri**, Department of Mineral Resources, MNRE, Thailand
14:30 - 15:00	**Coffee/Tea break**
Session IV:	**Blue Economy and Sustainable Ocean** **Conveners:** Dr. Zhang Zhiwei, Ms. Suhatai Praisankul, Dr. Laddawan Sangsawang, Dr. Guan Song
15:00 - 15:20	**Keynote Presentation** From ocean observations to sustainable ocean economy: Bridging science, policy and society for resilient coastal communities **Dr. Nelly Florida Riama**, Agency for Meteorology, Climatology, and Geophysics, Indonesia
15:20 - 17:00	**Oral Presentations** 1) Charting an ocean sustainable future for Southeast Asia under the UN Ocean Decade framework **Dr. Guan Song**, First Institute of Oceanography, MNR, China
	2) Sustainable tourism for blue economy at Koh Mak, Trat province, Thailand **Ms. Suhatai Praisankul**, Department of Marine and Coastal Resources, MNRE, Thailand

15:20 - 17:00	3) Integrated coastal governance driven by marine spatial planning-cases and replicable regional models of China-Cambodia sustainable marine cooperation **Dr. Teng Xin**, National Marine Technology Center, MNR, China
	4) Lessons learned from Blue Economy Initiatives in Thailand **Dr. Laddawan Sangwang**, Department of Marine and Coastal Resources, MNRE, Thailand
	5) Blue citizen community framework for ocean literacy enhancement and blue economy development **Dr. Liu Zhenghua**, Third Institute of Oceanography, MNR, China
	6) Thailand Mangrove Alliance **Ms. Boonjira Phadermrod**, Department of Marine and Coastal Resources, MNRE, Thailand
	7) MSP for sustainable ocean **Dr. Zhang Zhiwei**, First Institute of Oceanography, MNR, China
	8) Practices of the "Island Governance Toolkit" project in advancing the implementation of the UN Ocean Decade **Dr. Ge Feiyang**, South China Sea Ecological Center, MNR, China
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I. Oral Presentation Session

1. Ocean and Climate Observation, Forecasting, Projection, and Application

1.1 Scientific breakthroughs for accurate typhoon intensity forecasting: A challenge for half century

Fangli Qiao[1], Songlin Li[1], Biao Zhao[2], Qi Shu[1], Vladimir Ryabinin[3], Dong Ji[1], Guomin Chen[4], and Ka-Kit Tung[5]

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[2]Uppsala University, Uppsala, Sweden. Now with Program in Atmospheric and Oceanic Sciences at Princeton University, New Jersey, USA.
[3]Former Secreatry General of UNESCO/IOC
[4]Shanghai Typhoon Institute, China Meteorological Administration, Shanghai, China
[5]Department of Applied Mathematics, University of Washington, Seattle, WA, USA

Abstract: Both China and Southeast countries have greatly suffered from Tropical cyclones, known as typhoons in the Northwest Pacific. Progresses in remote sensing and increasing computing power over recent decades have led to marked improvement in track forecasting. However, a Typhoon's destructive power depends on its intensity. Yet operational forecasts continue to severely underpredict the peak intensity of strong Typhoons, while overpredict weak ones. Under climate change, Typhoon intensity has been becoming more and more stronger. Current forecasting models include the coupling between the atmosphere and ocean but ignore the significant energy and momentum transfers from the ocean by breaking waves, and the effect of non-breaking waves on mixed-layer depths. Here we demonstrate that accounting for surface waves' effects on air-sea fluxes significantly improves the forecast of Typhoon intensities. Probability of detection for rapid intensification in Northwest Pacific increases to 90% compared to 10-50% from existing operational Typhoon forecasting systems. A long-awaited breakthrough in predictions of Typhoon intensity, especially for strong ones, becomes true. The technologiacal innovation on Typhoons and their related disasters has also been achieved through development of low-cost, high precision, multi-paraters Jingwei buoy. As both China and Southeast countries have been severly suffering from Typhoons, we propose to initiate cooperation as priority between China and Southeast countries on monitoring and forecasting of Typhoons and their related disasters.

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1.2 Coordinated regional climate downscaling over Southeast Asia under the CORDEX Southeast Asia (CORDEX-SEA) initiative

Fredolin Tangang[1]*

[1] *Universiti Brunei Darussalam, Brunei*

Abstract: This presentation highlights the regional climate downscaling activities of CORDEX Southeast Asia (CORDEX-SEA) since its establishment in 2013. CORDEX-SEA is one of the regional domains of the Coordinated Regional Climate Downscaling Experiment (CORDEX), an initiative of the World Climate Research Programme (WCRP). Since its inception, CORDEX-SEA has dynamically downscaled multiple CMIP5 and CMIP6 global climate models (GCMs) and archived the resulting datasets through the Southeast Asia Regional Climate Change Information System (SARCCIS), which serves as the Southeast Asian data node of the Earth System Grid Federation (ESGF). CORDEX-SEA was established to produce high-resolution (25 km) regional climate projections for Southeast Asia by dynamically downscaling outputs from multiple GCMs using regional climate models (RCMs). However, these simulations employ one-way coupling, in which atmosphere-only RCMs are driven by boundary conditions derived from GCMs, while sea surface temperatures are prescribed rather than interactively simulated. Given that Southeast Asia is characterised by extensive oceanic and coastal regions, a fully coupled regional atmosphere–ocean modelling system would provide a more physically realistic representation of air–sea interactions and regional climate processes. In this context, ongoing efforts in regional ocean modelling for Southeast Asian seas, particularly the South China Sea, are highly relevant. Strengthening collaboration and pursuing closer integration between the CORDEX-SEA community and the China–Southeast Asian Countries Marine Cooperation Forum (CSEA Forum) would therefore be both timely and beneficial, advancing the development of next-generation coupled regional climate projections for Southeast Asia.

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1.3 Channel-Attention U-Net Correction of GFS Sea Surface Winds over the South China Sea

Chang Zhao[1,2*]，Haodong Wang[1,2]，Liping Yin[1,2] Bin Xiao[1,2]

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Abstract: Accurate 10-m sea surface winds are essential for marine forecasting, wave and storm-surge modeling, and offshore risk management, yet Global Forecast System (GFS) winds retain systematic errors over marginal seas. This study develops an observation-constrained residual correction framework for GFS sea surface winds over the South China Sea using the NOAA/NCEI NBS v2.0 blended sea surface wind product as a gridded observational reference. The selected baseline is a lightweight U-Net with squeeze-and-excitation modules in the bottleneck and decoder paths (U-Net+B-SE+D-SE), which predicts residual zonal and meridional wind components and reconstructs corrected winds by adding the residuals to the original GFS field. In the 2025 independent test set pooled over 0-120-h forecast lead times, the baseline reduces wind-speed RMSE from 3.225 to 2.732 m s-1 (15.3%) and mean direction error from 23.48 to 20.04 deg (14.6%). Wind-speed MAE is also reduced by 22.8%, providing a supplementary metric for comparison with previous studies. Distributional and spatial diagnostics show that the correction contracts the error population and reduces persistent high-error coastal and open-sea regions, although lead-time-dependent residual offsets remain. A strong-wind-oriented FT1-lite experiment is reported as a diagnostic branch rather than a replacement for the routine baseline; it reduces high-wind bias above 15 m s-1 at the cost of modest all-regime degradation. These results support the channel-attention U-Net as the routine all-regime correction model and identify strong-wind correction as an application-specific extension.

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1.4 Rivers in the sea: Riverine freshwater pathways and their implications for ocean forecasting in the Indonesian maritime continent

Bayu Edo Pratama[1]*, Christophe Maes[2], Andri Ramdhani[1], Marine Herrmann[3], Rodrigo Duran[4]

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Abstract: River discharge is an important but still poorly quantified component of the freshwater budget in the Indonesian Maritime Continent (IMC), with potentially significant impacts on ocean variability and predictability in semi-enclosed seas. This study investigates the role of riverine freshwater in shaping the hydrography and upper-ocean circulation of the South Makassar Strait and East Java Sea. A high-resolution (5 km) SYMPHONIE ocean model is combined with satellite observations (SMOS and OSTIA) and Argo float data, with sensitivity experiments conducted with and without river discharge. The results show that river input reduces sea surface salinity by up to 1.3–1.7 PSU during the northwest monsoon (December–April), accounting for approximately 35–45% of the total freshwater anomaly, while inducing surface warming of up to 0.2 °C through enhanced upper-ocean stratification. Lagrangian particle tracking identifies rivers in southern Kalimantan, particularly the Barito system, as major sources of low-salinity waters. Finite-Size Lyapunov Exponents and Lagrangian Coherent Structures further reveal persistent transport barriers that regulate freshwater pathways and produce distinct “rivers in the sea”. These findings demonstrate that river discharge is a first-order driver of ocean variability in the IMC. Incorporating riverine freshwater into ocean observation, modelling and forecasting systems may therefore improve the representation and prediction of regional hydrographic variability, with implications for understanding the Indonesian Throughflow and future ocean changes under a changing climate.

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1.5 Progress and new puzzles in internal solitary wave dynamics in the Andaman Sea

Yanliang Liu[1]*, Yuchen Peng[1], Lina Sun[1], Chalermrat Sangmanee[2], Chunlin Ning[1], Chao Li[1]

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[2] Phuket Marine Biological Center, Department of Marine and Coastal Resources, Ministry of Natural Resources and Environment, Bangkok, Thailand

Abstract: The Andaman Sea is a global hotspot for internal solitary waves (ISWs), which play a critical role in rapid water renewal and coral reef ecosystems. However, the scarcity of in-situ observations hinders a comprehensive understanding of ISW dynamics. In recent years, significant progress has been made in the study of internal solitary waves, driven by the advancement of international collaborative observation efforts and the development of artificial intelligence-based remote sensing image recognition technologies. Mooring observations reveal that ISWs in the Andaman Sea are predominantly mode-1, with mode-2 coexisting. These waves exhibit pronounced seasonal variations, potentially linked to the monsoon cycle. Phenomena such as ISW reflection, spring-neap tidal variability, and the superposition of multi-source ISWs have all been captured by mooring data. Internal solitary waves can mitigate coral bleaching during high-temperature stress by driving the intrusion of deep cold water, although this protective effect is susceptible to disruption by the delayed onset of the monsoon. These findings have deepened our understanding of ISWs in the Andaman Sea while simultaneously raising new questions.

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1.6 Long-term warming strengthens Indian Ocean dipole air-sea coupling

Yanying Chen[1,2,3], Lei Zhang[1,2]*

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Abstract: The tropical Indian Ocean has warmed more rapidly than other tropical basins in recent decades, potentially enhancing the strength of air-sea coupling within the basin. Here we investigate changes in the precipitation-sea surface temperature (SST) relationship associated with the Indian Ocean Dipole (IOD) during its peak season in boreal autumn. Observations show that the western pole of the IOD exhibits a significant strengthening trend in the rainfall response to underlying SST anomalies, with a nearly doubled correlation from 1979 to 2023. Atmospheric model experiments demonstrate that this strengthening primarily arises from the long-term Indian Ocean warming trend, particularly in the western tropical Indian Ocean. In contrast, most CMIP6 models fail to reproduce this observed strengthening, consistent with their systematic underestimation of the Indian Ocean SST warming relative to the tropical Pacific. Our results highlight the importance of accurately representing interbasin warming contrasts for reliable projections of future climate variability and impacts.

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1.7 Assessment of atmospheric reanalysis data based on in-situ observations over the tropical Indian Ocean

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Abstract: The Indian Ocean is the least observed of the three oceans, and a large amount of reanalysis data has to be used to study the Indian Ocean. Observations of sea surface winds, temperature, and sea level pressure, measured from Bailong buoy system deployed in the western Indian Ocean and wind profiles from a shipborne coherent Doppler lidar (CDL) in the tropical Indian Ocean, are being used to assess the capabilities of major high-frequency atmospheric reanalysis products in the tropical Indian Ocean region. During the study period, the atmospheric reanalysis data can accurately reproduce the temperature and sea level pressure fields, but the surface wind fields, especially for the meridional winds, are poorly described. ERA5 provides a better description of temperature and sea level pressure among all datasets. The results also indicate that the zonal wind from ERA5 data significantly deviated from the CDL measurement data, and the overall ERA5 data are substantially weaker than the in-situ observations. Notably, ERA5 underestimates northwestward low level jets. This study suggests that the current high-frequency reanalysis data still have shortcomings in describing atmospheric parameters in the tropical Indian Ocean region.

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1.8 Achieving Explainable ENSO Prediction Using Small Data Training

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Abstract: Accurately predicting the spatiotemporal structure of the El Niño-Southern Oscillation (ENSO) remains a persistent challenge for dynamical models due to parameterization deficiencies and the spring predictability barrier. While deep learning models offer improved skills, they often lack dynamic interpretability and inherit biases from climate model training data. Here, we construct a novel hybrid model integrating a ConvLSTM deep learning module into the LDEO5 dynamical model, enabling online information exchange. Trained exclusively on physical-informed data from observations and the dynamical module, this hybrid approach requires only a small volume of training data, effectively circumventing climate model biases. The model achieves unprecedented ENSO prediction skills, extending effective skill to 20 months and significantly overcoming the spring predictability barrier. Crucially, it excels in reproducing ENSO diversity, particularly Central Pacific El Niño events, outperforming state-of-the-art dynamical and pure data-driven models. Enhanced skills arise primarily from improved representation of leading dynamical feedbacks, including stronger Bjerknes feedback and thermocline processes. This study demonstrates that integrating artificial intelligence with physical dynamics using small data is an effective, explainable, and efficient pathway for advancing ENSO prediction.

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1.9 What sets the monsoon onset sequence over the Indo-Pacific Warm Pool Ocean?

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Abstract: Monsoon climate preveals over the Indo-Pacific Warm Pool Ocean and its neighborhood continents, shaping the rainfall seasonal cycle and loading footprints on the society. However, the various regional monsoons exhibit the significant non-synchronization on seasonal and interannual time scales. This complex and surprising sequence puzzles the community and is not reproduced well in the coupled climate models. Here it is reviwed the key progress on understanding the monsoon onset, where the roles of ocean and air-sea coupling are highlighted. Also, the connection between different regional monsoons are emphasized. The understanding helps better predict the monsoon onset and hence better prepare the associated risk with anomalous monsoon onset.

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1.10 Impacts of strong sea surface temperature diurnal variation on the Asian summer monsoon onset

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Abstract: Asian summer monsoon onset (ASMO) signals the seasonal transition of regional climate from a winter regime to a summer regime, and its timing exerts a profound influence on regional climate, especially summer rainfall. However, state-of-the-art climate models tend to simulate a delayed ASMO by 3 to 6 pentads. In spring, strong sea surface temperature (SST) diurnal variation accompanied by ocean surface warming modulates the ASMO. We incorporated a diagnostic sublayer parameterization into the climate model to realistically reproduce SST diurnal amplitude. Sensitivity experiments demonstrate that the simulated ASMO onset date is advanced by about 2 pentads over the Bay of Bengal and the South China Sea. Stronger diurnal variation enhances sea surface warming. Increased convective activity occurs in response to the warmer underlying surface. The resultant changes in monsoon circulation create favorable environmental conditions for an earlier ASMO. Furthermore, pronounced SST diurnal variation strengthens intraseasonal oscillation (ISO) signals. Adjustments in the air-sea coupled system establish favorable dynamical and thermodynamic conditions for earlier monsoon onset. Considering the effect of strong SST diurnal variation offers a solution to mitigating the typical biases of climate models in reproducing ASMO.

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1.11 A coupled ocean-wave-sediment modelling framework for assessing climate-driven extreme sea-level impacts on Brunei Darussalam's coastal-offshore zone

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Abstract: Brunei Darussalam's coastal and offshore areas host important ports, navigation channels, and oil and gas infrastructure, with the oil and gas sector remaining a major contributor to the country's economy. However, how extreme sea levels and seabed changes may respond to climate change in this region remains poorly understood. Extreme sea levels are influenced by mean sea-level rise, ocean dynamics, tides, storm surge, waves, and vertical land motion, while existing projections for the South China Sea are generally too coarse to resolve these processes at the scale needed for Brunei. This presentation introduces the proposed coupled ocean–wave– sediment modelling framework under Sub-Project 2 of the Universiti Brunei Darussalam Climate Change Modelling Consortium, established to support Brunei's National Adaptation Plan (NAP). The work is currently at the design stage. The proposed framework will use a nested regional-to- coastal ocean and wave model, forced by CORDEX–Southeast Asia climate projections. Mean sea-level changes will be included following IPCC guidance, and the modelling system will later be extended to include sediment transport and seabed changes. The framework is also intended to provide the ocean component needed for future regional climate projections over Southeast Asia. Key challenges include limited data on coastal bathymetry, sediments, tides, and vertical land motion in Brunei waters, as well as the need for reliable model validation in a data-sparse setting. We therefore present this work as an initial framework and an opportunity for collaboration on data sharing, model development, validation, and joint capacity building with colleagues across China and Southeast Asia.

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1.12 A Changing Southern South China Sea: Historical Trends and Climate Projections

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Abstract: The southern South China Sea (SSCS) is a dynamically active marginal sea where monsoon regulates seasonal circulation, mixing and coastal upwelling. This study synthesizes historical observations and reanalysis with climate-model projections to examine how key physical oceanographic parameters have evolved from the historical period toward the future climate. Historical analysis for 1982–2023 shows contrasting responses between the East Coast of Peninsular Malaysia (ECPM) and northwest Sabah. Upwelling along the ECPM remains relatively stable, whereas northwest Sabah exhibits a tendency toward weakening, closely associated with declining winter-monsoon wind speed. The historical period also shows significant SST warming, with stronger warming in northwest Sabah during the winter monsoon compared with the ECPM during summer. In contrast, Future CMIP6 projections indicate that this physical transition is likely to intensify, with southern SCS SST increasing by approximately 1.5, 2.0, and 3.5°C by the end of the century under all scenarios. These results indicate a transition from a predominantly monsoon-controlled physical regime toward an increasingly warming, stratified and weakly mixed SSCS, with important implications for the future strength and functioning of regional upwelling systems.

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1.13 Simulated ocean circulation in the Sunda Strait and water-mass exchange between the Indian Ocean and the Java Sea

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Abstract: The Sunda Strait plays an important role in facilitating the exchange of contrasting water masses between the Indian Ocean and the Java Sea. Remote forcing from the equatorial Indian Ocean, including the South Java Coastal Current and coastally trapped Kelvin waves at intraseasonal and semiannual timescales, may propagate through the strait and enter the Java Sea, particularly during the northwest monsoon from December to February. Conversely, warm and substantially fresher water from the Java Sea may flow more intensively toward the Indian Ocean during the southeast monsoon from July to September. This study investigates the circulation patterns, vertical current structure, temporal variability, and magnitude of water-mass exchange through the Sunda Strait. A high-resolution, eddy-resolving regional ocean circulation model was implemented using CROCO at a horizontal resolution of 1/36° for the period from January 2015 to June 2026. The model results were validated against in situ observations collected during the CINODEX Cruise in May 2026 in the Sunda Strait. The study provides new insights into the seasonal and remotely forced dynamics governing circulation and water-mass exchange between the Java Sea and the eastern Indian Ocean.

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1.14 Observation technique for marine CO_2 and their application

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Abstract: The ocean plays an important role in CO_2 circulation as well as in the global climate. The open oceans are generally important CO_2 sinks, whereas the coastal and estuary regions under anthropogenic influence generally act as CO_2 sources; therefore, estimation of CO_2 source and sink characteristics is an important work to evaluate the service function of marine environment and blue carbon ecosystem. Moreover, techniques of marine carbon dioxide removal (mCDR) have been put forward, which have potential to reduce the impact of anthropogenic carbon emission to the global climate. Hence, either estimating the CO_2 removal capability of an ecosystem or developing the mCDR requires the development of marine CO_2 monitoring techniques, especially low-cost CO_2 monitoring techniques. We hereby report our more recent progress on CO_2 monitoring techniques, which may be used in different marine environments for evaluation of air-sea CO_2 fluxes. These advances will further enhance our ability to more accurately assess the carbon budget of both marine environments and the associated engineering technologies.

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1.15 Ocean acidification in coral reefs around the Sichang Islands, Chon Buri Province, Thailand (2024-2025)

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Abstract: The release of carbon dioxide (CO_2) from human activities is a major factor driving global warming and contributing to the increase in ocean acidification. Department of Marine and Coastal Resources has been monitoring seawater acidification continuously over a two-year period (2024-2025) around the coral reefs of Sichang Islands, Chon Buri Province. Parameters measured included pH, total alkalinity (TA), and aragonite saturation state (Ω_{ar}), with pH and TA assessed using spectrophotometric and titration methods, respectively, and Ω_{ar} calculated using the CO2SYS program. The results revealed that pH ranged from 7.948 to 8.135, TA ranged from 2,091.12 to 2,165.34 μmol/kg and Ω_{ar} ranged from 2.94 to 3.98. Overall, these carbonate chemistry parameters remained relatively stable throughout the study period, although seasonal fluctuations were observed. No clear evidence of severe ocean acidification was detected in the study area. Continuous monitoring of seawater carbonate chemistry is therefore essential for detecting long-term changes associated with climate change and for supporting the conservation and sustainable management of coral reef ecosystems.

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2. Marine Ecosystem Protection, Biodiversity Research and Marine Biotechnology R&D

2.1 Hydrodynamic controls on coastal mangrove stability and protection strategies

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Abstract: Mangrove forests play a critical role in coastal protection by reducing hydrodynamic energy, stabilizing sediments, and promoting land accretion. This study investigates the role of hydrodynamic processes in shaping strategies for the protection and sustainable management of coastal mangrove ecosystems. Particular attention is given to the interactions among waves, currents, tides, sediment dynamics, and mangrove vegetation. Through numerical modeling combined with field observations from mangrove areas in Southern Vietnam, we examine how these hydrodynamic factors influence sediment transport, coastal stability, and the resilience of mangrove ecosystems, particularly under the combined pressures of climate change and human activities. The study highlights the important role of mangrove vegetation in enhancing sediment retention, promoting land accretion, and reducing coastal erosion. The results demonstrate that mangrove protection and restoration strategies should consider local hydrodynamic and sedimentary conditions rather than focusing solely on ecological factors. The findings underscore the need for integrated management approaches that account for hydrodynamic processes to enhance the effectiveness of conservation strategies for coastal mangroves, particularly in addressing the challenges posed by climate variability and human interventions.

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2.2 Shift of algal symbiont communities in the coral Acropora digitifera: Shuffling and switching during thermal stress and recovery

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Abstract: The algal symbionts (Symbiodiniaceae) of reef-building corals are known for their host-specific associations, yet they can undergo restructuring through shuffling and switching under environmental disturbances, particularly thermal stress. Following the 2019 thermal stress event (degree heating weeks, DHW = 2.43 ◦C-weeks), Acropora digitifera colonies were tagged and sampled over a seven-month period to examine the dynamics of algal sym-biont communities using high-throughput ITS2 rDNA amplicon sequencing. Several A. digitifera colonies exhibited signs of bleaching and reduced symbiont density but subsequently recovered once temperatures returned to normal. Molecular profiling revealed both symbiont shuffling and transient switching. Community restructuring included shifts among dominant Cladocopium ITS2 type profiles, the temporary appearance of Symbiodinium lineages, and the persistence of low-abundance Durusdinium during the recovery phase. Ordination analyses further indicated that symbiont community composition was significantly structured by sampling time, reflecting both the 2019 thermal anomaly and seasonal variability. Together, these findings indicate that A. digitifera can withstand moderate thermal disturbances through dynamic yet reversible restructuring of its symbiont community. By capturing these temporal shifts, this study highlights the ecological flexibility of coral–symbiont partnerships and provides baseline insights into coral resilience under increasing climate-driven thermal stress.

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2.3 Using ITS2 rDNA profiling to elucidate the coral symbionts composition in Scleractinian coral species

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Abstract: Scleractinian coral species are highly diverse in tropical shallow reef ecosystems. Some coral species have experienced severe recurrence of bleaching events over the years due to prolonged elevated seawater temperatures. Coral species host symbiotic algae of the genus Symbiodiniaceae with diverse genotypes, which play an important role in coral resilience to global warming. To assess the resilience of common coral species in Malaysia, coral fragments were collected from 14 reef sites of Perhentian and Redang Islands Marine Parks, and the associated Symbiodiniaceae communities were characterized using high-throughput next-generation amplicon sequencing on the ITS2 rDNA marker. A total of 64 coral-Symbiodiniaceae associations in 18 genera (10 families) of scleractinian corals were characterized using the SymPortal analytical framework. Our results revealed the predominance of *Cladocopium* (average 82%), followed by *Durusdinium* (18%), while other (Symbiodinium, *Breviolum*, *Fugacium*, and *Gerakladium*) are minor groups (<0.01%). A total of 19 and 13 *Cladocopium* and *Durusdinium* ITS2-type profiles were detected across the coral species. *Cladocopium* C3u as the predominant type (63.3%), followed by *Durusdinium* D1 (15%), C27 (10.1%), and C15 (6.9%). This study provides baseline data to assess the changes in Symbiodiniaceae communities in tropical coral species and to explore the potential adaptive roles of this coral-algal association.

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2.4 The prey, population age structure, and mating behaviors of Eden's whales around Weizhou Island, China

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Abstract: Eden's whale (*Balaenoptera edeni edeni*) is a nationally protected species in China, and the waters surrounding Weizhou Island represent the only currently known stable habitat of this species in Chinese waters. However, fundamental aspects of this population ecology, including age structure, prey composition, and reproductive behavior, remain poorly understood due to limited long-term ecological monitoring. Here, we integrated drone photogrammetry, fecal DNA metabarcoding, fishery surveys, and behavioral observations to investigate the ecology of this population.

Using 128 vertical drone images collected between 2019 and 2026, we identified 42 individuals based on dorsal-fin characteristics and estimated body length through three methods. The estimated mean body lengths of Eden's whales around Weizhou Island ranged from 10.37 to 10.79 m. Based on body size estimates, 11.90% of identified individuals were classified as calves, 28.57% as juveniles or sub-adults, and 59.52% as adults.

To investigate feeding ecology, we analyzed 16 fecal samples collected between 2021 and 2026 using COI, 12S MiFish, and 18S V4 metabarcoding markers. Molecular results were integrated with photographic evidence of feeding events and local fishery-market surveys. The 12S marker identified 41 fish-associated taxa, dominated by small coastal schooling fishes, including *Ilisha*, *Nematalosa*, *Thryssa*, and *Sardinella*. Two prey species, *Sardinella albella* and *Alepes djedaba*, were further supported by direct photographic observations. These results indicate that small nearshore schooling fishes represent the most likely primary prey resources of Eden's whales in the Beibu Gulf.

Furthermore, drone-based observations provided the first documentation of mating-related interactions in Eden's whales in the Beibu Gulf and revealed a potential association with bubble trails. The event recorded on 24 January 2025 showed the strongest evidence, including repeated approaches, vertical positioning, body overlap, ventral presentation, bubble production, and brief putative genital exposure. However, bubble trails were also observed during solitary activities, feeding, and non-mating interactions, indicating that they are not specific indicators of mating behavior. Overall, bubble production showed a temporal and contextual association with mating-related interactions, but its specific function remains unclear.

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2.5 From Poles to Asia: Exploring polar marine biodiversity through Thailand-China scientific cooperation

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Abstract: Polar marine ecosystems support highly specialized biodiversity adapted to low temperatures, strong seasonality and sea ice dynamics, yet rapid environmental change is reshaping species distributions, ecological interactions and food web processes. Thailand's research across the Arctic and Antarctic provides complementary perspectives on how polar biodiversity is responding to these changes. In the Arctic, observations highlight shifts in species distributions toward higher latitudes as environmental conditions change, potentially restructuring biological communities as species expand into new habitats and interactions among taxa are altered. Some species may benefit from changing conditions, whereas others may face increasing ecological constraints. In Antarctica, comparative studies of the fish Pseudotrematomus bernacchii across multiple expeditions have examined temporal variation in feeding ecology, while recent observations recorded increased occurrence of ectoparasites, including Cryobdella antarctica. Together, these observations demonstrate the importance of examining species redistribution, trophic interactions and host-parasite relationships alongside changes in sea ice, primary production, zooplankton dynamics and ocean biogeochemistry. Thailand–China cooperation has strengthened this research capacity through formal collaboration between the Polar Research Institute of China and five Thai institutions since 2016 and the establishment of the China–Thailand Antarctic Joint Laboratory in 2019. Building on these achievements, continued cooperation can advance long-term biodiversity monitoring, microbial ecology and comparative Arctic–Antarctic research, strengthening our understanding of marine biodiversity responses to accelerating environmental change.

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2.6 Visual aerial survey by helicopter for megafauna biodiversity of North Sulawesi's seamounts, Indonesia

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Abstract: A study of megafauna of North Sulawesi's seamounts were conducted from 4th to 24th January 2026. Visual observation was done by a helicopter at 400-700 m above the sea level altitude and using 80-110 km/hrs speed. A total of 25 flights, 10,017 km and 61.5 hrs of observation covering 38850 kmsq was done. The study recorded 10 species of marine mammals, 2 species of shark, and 2 species of sea turtles in 41 discrete sightings. The species list we currently have could potentially add a new record of species in Indonesian water, which is the longman's beaked whale. As it has never been recorded in a live sighting before within Indonesian water. If this can be confirmed, then this expedition added a new record of marine mammals in Indonesia. This finding may drive a significant insight for the government regarding policy of marine protected areas based on focal species.

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2.7 Outlook to marine fish diversity in Thai and adjacent waters

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Abstract: Thai Waters consists of three Ecoregions, namely; Andaman Sea coral coast, Gulf of Thailand and Malacca Strait with 7 major ecosystems: Estuaries, Coral and rocky reefs, Coastal shores, Continental shelfs, Oceanic and Deep Sea. At least 2556 marine fishes (one hagfish, 189 elasmobranches and 2365 bony fishes) or 6.75% of global marine fishes (>35,000 species), from ca. 3320 Thai fish fauna known to date. The recent surveys for develop checklist of Thai marine fishes found significantly high taxonomic diversity of 61 Orders 283 Families. At least 42 new recorded from Thai waters, including 14 cartilaginous fishes and 28 bony fishes were obtained from several sources, through local fish landings, local aquarium trades and citizen scientists. At least 159 marine fishes are in Thai Red List threatened status down to Vulnerable, 148 sharks and rays, and 33 bony fishes. One species is Extinct (EX), *Urolophus javanicus*, and 4 Regionally Extinct (RE); 13 Critically Endangered (CR); 99 Endangered (EN); 49 Vulnerable (VU), with 16 Near Threatened (NT). Major threats to Thai marine fishes are habitat degradation and lost, Invasive Alien species/IAS, pollution, overfishing and coral bleaching; black-chin tilapia *Serotherodon melanopleuron* is major IAS impact to Thai coastal habitats. Participatory coastal management through several methods i.e. LMMA, OECMs are popularly carrying out recently, these practices are promisingly way to halting extinction of Thai marine ecosystems.

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2.8 A decade of coral cultivation and reef restoration at Ko Man Nai: Lessons learned and future directions

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Abstract: Coral reefs are among the most important marine ecosystems, supporting marine biodiversity and providing essential ecosystem services and coastal economic benefits. However, coral reefs in Thailand have experienced substantial degradation due to both natural disturbances and human activities. Since 2009, the Department of Marine and Coastal Resources (DMCR) has continuously implemented coral reef restoration through sexual coral propagation at the Ko Man Islands, Rayong Province, with the aim of advancing knowledge and techniques for coral propagation and nursery rearing. The restoration program includes sexual propagation, ex situ rearing of juvenile corals in land-based nurseries for 3–5 years, followed by transplantation to natural reefs. To date, three coral species have been successfully propagated: *Platygyra daedalea*, *Favites abdita*, and *Goniastrea aspera*. Survival of nursery-reared corals has been continuously monitored throughout the program.

Over more than 15 years of implementation, a total of 112,500 coral colonies have been propagated, of which more than 37,500 colonies have been successfully reared to a size suitable for transplantation onto natural reefs, representing approximately 33% of all propagated colonies. In addition, corals propagated in 2016 and outplanted in 2021 successfully released gametes in 2026, demonstrating that sexually propagated corals can survive to reproductive maturity and contribute to the establishment of a self-sustaining breeding population capable of enhancing natural larval recruitment.

The program has generated valuable knowledge, technical experience, and practical lessons regarding the achievements, limitations, and future development of sexual coral propagation. The results demonstrate that sexual propagation is a promising approach for increasing coral populations and supporting long-term coral reef restoration. Nevertheless, improving restoration effectiveness will require long-term monitoring, continued refinement of propagation, nursery, and outplanting techniques, together with strengthened collaboration among research institutions, government agencies, the private sector, and local communities. Such integrated efforts are essential for advancing the conservation and sustainable restoration of Thailand's coral reefs.

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2.9 Smart perception of marine biodiversity and exploration of the deep-sea ecosystem

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Abstract: The UN Decade of Ocean Science for Sustainable Development and Post2020 Global Biodiversity Framework requests smart perception, using unmanned automatic observation and AI empowered big data analysis to promote traditional labor intensive observation. We present reviews the international progress of smart perception of marine biodiversity and outline an integrated framework for smart perception of marine biodiversity, then summarized development and application of the framework. In addition, in light of the gap between high demand of deep-sea ecosystem exploration and week capacity in many developing countries, we introduce our breakthrough experience with the case of China-Indonesia joint exploration of deep-sea ecosystem in the Sunda Strait.

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2.10 The strait of Malacca: Hotspots of harmful algal blooms

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Abstract: Rapid urbanization and increased anthropogenic activities along the Strait of Malacca have led to severe coastal pollution and ecosystem health deterioration. In this study, we aim to examine the spatial distribution and diversity of micro-phytoplankton assemblages, with a focus on harmful algal bloom (HAB) species, using combined microscopic observation and high throughput molecular approaches. The micro-phytoplankton taxa were identified from 50 stations during a scientific research expedition in March 2022. Our results revealed 69 taxa (60 genera) of micro-phytoplankton, predominantly the diatom species. Harmful dinoflagellate species were associated with high nitrogen to phosphorus ratios. By applying next-generation amplicon sequencing and metabarcoding, a total of 27 HAB species, seven were recorded for the first time in Malaysian waters. It is noteworthy that higher abundance of HAB species was observed along the northern region of the strait. The species that associated with amnesic shellfish poisoning and bloom-forming species were mainly detected in the northern region, while paralytic shellfish poisoning (PSP)-causing species were found in the southern region of the strait. The unprecedented PSP events in Port Dickson reaffirmed the findings of this study. The findings emphasize the importance of continuous monitoring program using advanced molecular techniques to ensure seafood safety across the region.

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2.11 Microplastics from surface to seafloor in the Indonesian throughflow

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Abstract: Microplastics are increasingly recognized as contaminants that extend beyond surface waters into the ocean interior and deep-sea environments. Here, we synthesize complementary observations from the main western route of the Indonesian Throughflow (ITF) and its eastern route through the Banggai Sea to examine microplastic occurrence across the water column, planktonic biota, and deep-sea sediments. Along the main ITF pathway, microplastics were detected from 5 to 2450 m depth, with an average concentration of 1.062 ± 0.646 particles L^{-1}; temperature and water density were the environmental variables most strongly associated with their vertical distribution. Copepods collected along the ITF pathway contained microplastics at ingestion rates of 0.016–0.028 particles $individual^{-1}$, with fibers accounting for 87.22% of ingested particles. In the Banggai Sea, microplastics occurred from the surface to 1000 m depth, with the highest mean concentration in the thermocline (25.94 ± 10.79 particles L^{-1}). Thermocline concentrations were lower in upwelling than non-upwelling areas, suggesting vertical redistribution and dilution during upwelling. Deep-sea sediments contained 200–866.67 particles kg^{-1} dry weight, and abundance decreased significantly with increasing distance from the coast, while offshore occurrence suggested additional redistribution by regional currents. Together, these studies show that microplastic pollution in the ITF spans multiple environmental compartments and is shaped by water-column stratification, upwelling, regional circulation, and biological uptake. As the ITF connects Pacific and Indian Ocean water masses, integrated monitoring from surface waters to the deep seafloor is essential for understanding microplastic transport and ecological exposure across tropical marine systems.

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2.12 Unlocking the Secondary Metabolite Potential of Marine Sinomicrobium sp. PAP.21 Using Genomic and Metabolomic Approaches

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Abstract: The field of biotechnology continues to evolve, yielding many new discoveries that can be further developed. Bacterial secondary metabolites are among the most widely utilized products across various fields, including healthcare. The bacterial genus *Sinomicrobium*, first reported in 2013, became one of the findings that continues to be explored. *Sinomicrobium* sp. PAP.21, isolated from water sediments in Cendrawasih Bay National Park in this study, was analyzed using two approaches genomic and metabolomic to identify the secondary metabolites produced. Genomic analysis was conducted using the antiSMASH 7.1.0 web platform. Secondary metabolites were analyzed using Liquid Chromatography High Resolution Mass Spectrometry (LC-HRMS) combined with a molecular networking approach via GNPS and Cytoscape. Genomic analysis revealed a total of 11 regions, with 3 regions showing low similarity to the carotenoid, pinensin, and fulvivirgamide A2/fulvivirgamide B2/fulvivirgamide B3/fulvivirgamide B4 clusters, and 1 region showing high similarity to the icosalide A/icosalide B cluster. Metabolomic analysis identified one dereplicated compound, namely flavin mononucleotide (FMN), detected from a culture grown on Luria-Bertani (LB) medium and extracted using dimethyl sulfoxide (DMSO) and methanol (MeOH). The secondary metabolites produced by *Sinomicrobium* sp. PAP.21 can be utilized in the fields of health and food.

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2.13 Integrating eDNA metabarcoding and reference collections to enhance marine biodiversity resources: A pilot study of fish in Cape Panwa, Phuket, Thailand

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Abstract: Marine biodiversity monitoring increasingly uses environmental DNA (eDNA) metabarcoding as a rapid and non-destructive method for detecting species. However, reliable biodiversity assessment requires combining molecular data with voucher specimens and long-term monitoring records. This pilot study aims to develop a framework for integrating eDNA metabarcoding with existing reference collections and long-term monitoring data to enhance marine biodiversity reference resources for coastal fish in Thailand. Nine water samples were collected from Cape Panwa, Phuket, Thailand. Environmental DNA was analyzed using metabarcoding targeting the mitochondrial 12S rRNA gene with the Teleo marker, and sequence data were processed using the SWARM pipeline to generate a fish species list. Preliminary eDNA analysis detected 53 fish species, including the Sharpnose stingray (*Maculabatis gerrardi*), which is listed as Endangered (EN) on the IUCN Red List and Vulnerable (VU) in Thailand Red Data. Comparisons with the PMBC Reference Collection and historical monitoring records are ongoing to identify species shared among datasets, as well as species detected only by eDNA or conventional surveys. The comparison will help identify gaps in existing reference resources and guide future reference specimen collection and DNA barcode development. This approach combines molecular data, voucher specimens, and monitoring records to improve biodiversity reference resources and support long-term biodiversity monitoring in Thailand.

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2.14 Deciphering the drivers of low-oxygen waters and their thresholds for deep-sea organisms in Western Indonesia

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Abstract: Low-oxygen waters in the Malacca Strait, Sunda Strait, and along the western coast of Sumatra, Indonesia, result from the interplay of physical circulation, biogeochemical processes, and terrestrial organic matter inputs. Extensive peatlands surrounding major river systems supply substantial amounts of dissolved and particulate organic matter, enhancing microbial respiration and oxygen consumption, particularly in the Malacca Strait. Combined with strong stratification and restricted water exchange, these processes contribute to the development of a relatively shallow oxygen minimum zone (OMZ) at approximately 200-400 m depth. Along the western coast of Sumatra, low-oxygen conditions occur at greater depths (550-800 m) and are associated with regional circulation, including upwelling and the intrusion of oxygen-poor intermediate waters originating from the northern Indian Ocean. Despite the occurrence of distinct OMZs, dissolved oxygen concentrations throughout the investigated depth range did not reach anoxic conditions or the critical hypoxia thresholds generally associated with severe physiological stress in marine organisms. This suggests that the observed oxygen depletion remains within a range that can potentially support deep-sea organisms, although species-specific tolerance thresholds may vary. The contrasting depth distributions of low-oxygen waters highlight the importance of both terrestrial carbon loading and ocean circulation in regulating oxygen dynamics. These processes have important implications for deep-sea ecosystem resilience, organic carbon remineralization, and regional carbon cycling in western Indonesia.

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3. Marine Geosystem Science and Disaster and Mitigation

3.1 Advancing Coastal Resilience under Sea-Level Rise: Coupled Coastal Processes, Adaptive Protection, and Pollutant Transport

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Abstract: China and Southeast Asian countries share interconnected seas, coastal systems, climate risks, and environmental challenges. Sea-level rise, extreme waves, storm surges, coastal erosion, and marine pollution transcend national boundaries and therefore require coordinated regional responses. Our research works examine how multidisciplinary ocean science can support more resilient and sustainable coastal development, focusing on three closely connected challenges: coastal protection under rising sea levels; interactions among waves, structures, sediments, and seabeds; and the transport and accumulation of microplastic pollutants.

Drawing on recent research in breaking-wave turbulence, wave interaction with flexible and nature-based structures, coupled wave-seabed-sediment processes, and wave damping over muddy seafloors, our study advocates a shift from isolated coastal barriers towards adaptive coastal systems. Such systems should integrate physical processes, structural reliability, sediment dynamics, ecosystem services, and community needs. Research on the settling, burial, resuspension, and bed-load transport of microplastics further demonstrates the importance of connecting marine pollution studies with coastal hydrodynamics and sediment transport.

The presentation also discusses how Singapore's Research, Innovation and Enterprise 2030 strategy and the Coastal Protection and Flood Resilience Institute Singapore support use-inspired research, digital modelling, artificial intelligence, and the real-world deployment of climate-adaptation solutions. Building on the Forum Declaration, four areas for regional cooperation are proposed: shared coastal observation and modelling networks, living laboratories for hybrid green–grey protection, coordinated studies of microplastic pathways from rivers to seabeds, and open regional knowledge infrastructure.

Finally, the presentation will highlight education and talent development as the foundation of sustained cooperation. National University of Singapore (NUS) seeks to strengthen marine and coastal research training, attract more PhD researchers from Southeast Asian countries, and develop joint supervision, student exchanges, field campaigns, and long-term institutional partnerships across the region.

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3.2 Global Seafloor Substrate Mapping

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Abstract: Seafloor substrate maps are fundamental marine geological datasets that record sediment distribution, sedimentary dynamics and ocean-basin physiography. However, existing global maps are limited by inconsistent classification standards, inaccessible historical data and highly uneven spatial coverage. Thus, a unified, observation-based and dynamically updatable global substrate map is essential to support marine geological research, resource assessment, offshore engineering, navigation and ocean governance. Based on solid regional research achievements, we have published a 1:1,000,000-scale sediment-type map series for China's offshore seas (the Bohai, Yellow, East China and South China Seas), synthesized from 26,235 observations. This mapping work is now expanding to the western Pacific, where more than 2,800 in-situ sediment stations are being collated and standardized. Our global project systematically compiles, harmonizes and conducts quality control on historical and newly acquired data, together with reanalysis of archived samples. Machine learning models will integrate validated observations with bathymetric data, seafloor geomorphology and oceanographic parameters to predict substrate types and map predictive uncertainty. These uncertainty maps will identify poorly constrained regions, guide targeted sampling, and support iterative optimization of models and substrate maps. The project will deliver an open-access, interoperable and continuously updatable global seafloor substrate map and database. It has been endorsed as a Decade Action under the UN Ocean Decade Programme "Digital Deep-sea Typical Habitats", offering an international framework for implementation and collaboration.

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3.3 Long-term record of climate fluctuation in the eastern Sulawesi Sea, Indonesia

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Abstract: The temporal variation in geological scale of the Indonesian Throughflow (ITF) has been studied extensively from sediment cores in the main pathway (Makassar Strait) and eastern outflow (Timor Sea and Ombai Strait). However, our knowledge of the paleoceanographic conditions from the inflow into the Sulawesi Sea is very limited. Here, we present a long record of low sedimentation rate paleoceanography conditions from off Ruang Island, on the eastern border of Sulawesi Sea. The 197 cm gravity core sample was acquired onboard RV. Geomarin III in 2016 from 3009 m water depth at 2°20'11.78" N and 125°03'31.46" E. Before conducting laboratory analyses, the sample was scanned to measure the magnetic susceptibility, resistivity, and elemental composition of the samples. Laboratory analyses include grain size analysis, loss on ignition, and nannoplankton. The core spans from Late Pliocene (last occurrence of Discoaster brouweri at 120 cm) to Holocene (last occurrence of Gephyrocapsa paralela at 50 cm, and abundance of Emiliani Huxleyi). Warmer conditions, reduced coastal upwelling, and weaker ocean currents during the Late Pliocene created a low-energy environment conducive to clay deposition. Cooler temperatures and elevated primary productivity during the Pleistocene and Holocene reflect intensified coastal upwelling. Those periods also recorded stronger ocean currents than the previous period.

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3.4 Intensified coastal erosion alters sedimentary dynamics and marine ecosystem under global warming and sea-level rise

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Abstract: Accelerating global warming and sea-level rise drive widespread coastal retreat, reorganizing sedimentary systems through physically and thermally mediated erosion that reshapes submarine topography, shifts nearshore sediment dynamics, and alters sedimentation rates, grain-size distributions, and organic matter deposition. Focusing on climate-sensitive and human-impacted marginal seas across latitudes, this study assesses depositional and ecological responses to intensified coastal erosion, revealing that in actively eroding tropical and Arctic regions, coastal erosion now constitutes a major sediment source—driving increased sedimentation rates and systematic regime shifts in the Gulf of Thailand and Siberian Arctic shelves in recent decades. This erosion flux also delivers substantial terrigenous organic carbon and black carbon to the ocean, reshaping carbon burial budgets; while simultaneously enhancing nearshore primary productivity by over 25% and altering nutrient stoichiometry, thereby influencing phytoplankton community composition and modulating carbon sequestration in adjacent coastal margins.

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3.5 Coastal and Estuarine Sediment Budget Dynamics in Malaysian Waters: Drivers, Fluxes, and Environmental Impacts

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Abstract: Sediment transport dynamics in Malaysian waters are critical to understanding shoreline stability, coastal erosion, and ecological health across both Peninsular Malaysia and Malaysian Borneo. A comprehensive quantitative study on the sediment budget in Malaysian waters by evaluating sediment inputs, pathways, sinks, and net volumetric balances across estuarine and nearshore systems are needed. This driven by intense equatorial precipitation, seasonal monsoonal shifts (northeast and southwest monsoons), complex hydrodynamic forces (waves, tides, and longshore currents), land-use changes and coastal urbanization. The combination approach of high-resolution hydrographic surveys, spatial remote sensing, particle size distribution, and hydrodynamic transport modeling, sediment influxes and outflow pathways were quantified. Results indicate that high-energy monsoonal conditions significantly elevate suspended sediment concentration (SSC) and bedload transport rates, driving pronounced seasonal shifts between net erosion and accretion. Urbanized and agricultural catchments demonstrate heavily elevated sediment export compared to forested controls, contributing to reservoir siltation and severe coastal retreat at erosion-prone hot spots. Conversely, sheltered estuarine and mangrove environments act as vital sediment sinks, trapping significant fine-grained fraction loads. An establishing these localized mass balances provides critical baseline data for predicting coastal morphology and bathymetric changes. The findings offer practical frameworks for coastal zone managers, marine engineers, and environmental policymakers aiming to mitigate erosion, regulate dredging, and design sustainable coastal defense strategies along tropical, monsoonal coastlines.

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3.6 Paleoenvironmental Evolution of Small Tropical Estuary with Sea Level Rising in the Holocene, Chanthaburi, Thailand

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Abstract: Sea level changes are closely linked to the global climate system and play a critical role in shaping coastal and estuarine environments. The Gulf of Thailand (GOT) is a climatically sensitive, low-latitude region with limited high-resolution Holocene records, making it an ideal location to investigate climate-driven sea level and estuarine environmental evolution. This study investigates the paleoenvironmental evolution of a small tropical estuary along the Chanthaburi coast, Gulf of Thailand. Six sediment cores collected perpendicular to the coastline were analyzed using sedimentological, geochemical, mineralogical, micropaleontological, and chronological methods. The results reveal four distinct stages of relative sea level (RSL) evolution: from 8.3 to 7.2 cal ka BP, a low sea level period was associated with a flat landform and high fluvial input; Between 7.2 and 5.5 cal ka BP, the warm climate triggered a rapid RSL rise, leading to the formation of sandbars and enclosed lagoons; From 5.5 to 1 cal ka BP, a decline in the RSL under colder, drier climate conditions resulted in lagoon contraction and estuarine morphological changes; Since 1 cal ka BP, the RSL has gradually risen to its present level. This study demonstrates that in tectonically stable coastal settings, closure depth combined with Sr/Ba ratios serves as an effective proxy for paleo-sea level reconstruction. Overall, this study demonstrates the impact of climate-driven paleo-sea level changes on the evolution of small tropical estuaries, offering crucial insights into past environmental changes and providing a valuable reference for future coastal and estuarine evolution reconstructions in tropical regions.

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3.7 Discovery and characterization of submarine Cinder Cones and Guyot in the Sunda Strait: Insights from the Cinodex expedition

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Abstract: The Sunda Strait, a narrow passage within the Indonesian archipelago between Java and Sumatra, is shaped by complex tectonic interactions, energetic tidal currents, and persistent volcanism dominated by the Krakatau complex. While subaerial volcanic features are well documented, the submarine morphology of the strait remains significantly under-explored.

This study presents new findings from the Cinodex Expedition, a collaborative research effort involving China's First Institute of Oceanography (FIO), IPB University, and Indonesia's National Research and Innovation Agency (BRIN). Utilizing high-resolution Multibeam Echosounder (MBES) data and box corer sampling, we identified and characterized previously undocumented volcanic structures surrounding Krakatau. Morphological processing reveals a diverse volcanic field comprising distinct conical structures with well-defined craters (cinder/scoria cones) and strikingly flat-topped edifices identified as guyots in the south west of Krakatau. The recovery of basaltic fragments from these craters provides direct evidence of mafic volcanism, corroborating regional scoria and lapilli records. Collectively, these findings reveal a more extensive and complex submarine volcanic field than previously mapped, likely influenced by the strait's transtensional pull-apart tectonic regime. This discovery highlights the interplay between tectonic setting and seafloor morphology, emphasizing the value of regional scientific collaboration in refining bathymetry models critical for geohazard assessment, maritime safety, and understanding the geodynamic evolution of the Indonesian archipelago.

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3.8 Cenozoic Tectono-Stratigraphic Evolution of the Eastern Sunda Shelf: From Tectonic to Eustatic Dominance

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Abstract: The Sunda Shelf is the world's largest tropical epicontinental shelf. Its stratigraphic record archives paleoenvironmental, paleoclimatic, and sea-level changes, offering a critical opportunity to investigate tropical Earth system evolution. Unlike most of the Sunda Shelf, where Cenozoic strata were uplifted and eroded during the Miocene tectonic inversion, the eastern Sunda Shelf preserves a relatively intact succession. Consequently, this region serves a key archive for understanding regional geological history. Here, we integrate 2D/3D seismic reflection data with lithological and biostratigraphic constraints from industry wells to reconstruct the stratigraphic evolution of the eastern Sunda Shelf. Seven seismic units (SU-1-SU-7) are identified and grouped into four basin-scale evolutionary stages: (1) a tectonically dominated syn-rift stage (SU-1; Oligocene, ca. 34-23 Ma), characterized by lacustrine systems within fault-bounded half-grabens; (2) a post-rift thermal subsidence and transgressive stage (SU-2; late Oligocene to early Middle Miocene, ca. 23-16 Ma), marking a transition from lacustrine to shallow-marine settings; (3) a subsidence-driven carbonate platform dominated stage (SU-3; Middle to Late Miocene, ca. 16-11.6 Ma), featuring carbonate build-ups on structural highs and, mixed carbonate-siliciclastic deposits in adjacent depocentres; and (4) an inversion initiated to sea-level-dominated siliciclastic shelf stage (SU-4 to SU-7; Late Miocene to Quaternary, ca. 11.6 Ma to present), defined by renewed siliciclastic input and transgressive infill. Two pivotal depositional-environment shifts occurred: a Middle Miocene transition from siliciclastics to carbonates, driven by rapid subsidence near the Bunguran Trough, and a Late Miocene reversal, driven by uplift of the Natuna Arch and westward sediment flux. We attribute the exceptional preservation of this archive to strain partitioning across the Natuna Arch, which localized inversion uplift in the west while placing the east within a tectonic strain shadow. Collectively, our results provide a high-resolution tropical shelf archive relevant to future scientific ocean drilling, aiming to refine reconstructions of tropical climate change, Neogene-Quaternary sea-level history and stratigraphic models for hydrocarbon exploration.

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3.9 Holocene monsoon driven sediment transport and iron-associated organic carbon burial in the Gulf of Thailand

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Abstract: Understanding the processes that regulate sediment transport and organic carbon burial on continental shelves is essential for quantifying long-term organic matter preservation in marine sediments. We present a multiproxy reconstruction of Holocene sedimentary and biogeochemical evolution in the Gulf of Thailand based on sediment core SUT-04 spanning the last 6.8 kyr BP. Grain-size distributions, sortable silt parameters, carbonate mass accumulation rates ($CaCO_3$ MAR), and iron-bound organic carbon (Fe-OC) were integrated to evaluate the links between sediment dynamics and iron-associated organic carbon preservation. The sediments are predominantly fine grained (15.7–29.5 μm), dominated by silt, indicating hemipelagic deposition under low- to moderate-energy conditions. Relatively coarser sediments during 6.8–4.1 kyr BP followed by progressive fining reflect changing sediment supply, while sortable silt parameters indicate regulation of sediment transport by summer monsoon intensity. $CaCO_3$ MAR documents a transition from siliciclastic to calcareous sedimentation. Downcore Fe-OC variations show that Holocene Fe-OC accumulation was governed by summer monsoon intensity, sediment supply, and redox conditions. Intensified monsoon phases (6.8–5.8, 5.1–4.8, 4.4–4.1, 3.7–3.3, and 2.8–2.6 kyr BP) enhanced terrestrial organic matter and reactive iron delivery, promoting efficient Fe-OC preservation, whereas sea-level influence was significant only during 2.1–1.4 kyr BP. Overall, Fe-OC accumulation was primarily controlled by hydroclimate variability, highlighting the sensitivity of long-term organic carbon storage on continental shelves to changes in summer monsoon intensity.

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3.10 Characteristics and Assessment of Coastal Erosion in the Yellow River and Chao Phraya River Deltas under the Dual Stress of Sea Level Rise and Human Activities

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Abstract: Deltas are not only important cradles of human civilization but also critical habitats for biological communities. However, under the dual pressures of sea-level rise and intensified human activities, many of the world's major river deltas are facing severe coastal erosion, including the Yellow River Delta and Chao Phraya Delta. For the Yellow River Delta, its subaerial portion expanded from 3,884 km² to 4,441 km² between 1976 and 2014, with only a temporary shrinkage during 1996–2000. In stark contrast, the subaqueous Yellow River Delta suffered persistent and severe erosion during the same period. Approximately 2.3×10^8 t/yr and 1.1×10^8 t/yr of sediments were eroded and transported to adjacent offshore areas during 1996–2001 and 2002–2014, respectively. Research indicates that coastal erosion in this region is results from the interplay of multiple influences, including sharp reductions in riverine water and sediment discharge, water-sediment regulation schemes, shifts in the terminal channel, and the construction of artificial shorelines.The Chao Phraya Delta faces similarly daunting challenges. Shoreline change monitoring from 1979 to 2024 reveals that the shoreline change rate in this region ranges from -30 $m\cdot a^{-1}$ to 16 $m\cdot a^{-1}$, with significant erosion observed in certain coastal segments. Coastal erosion risk assessments further indicate that the Chao Phraya Delta constitutes the most concentrated coastal erosion risk zone in the northern Gulf of Thailand. The high risk level is not only attributable to intense erosion processes, but also closely associated with the region's high concentration of population, ecological resources, and land-use activities, resulting in a comprehensive risk level significantly higher than that of other coastal segments in the study area.

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3.11 Geo-accumulation Index of Heavy Metals in Surface Marine Sediments of Chanthaburi Province, Eastern Gulf of Thailand

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Abstract: Heavy metal contamination in marine sediments is major environmental concern. This study investigated heavy metal concentrations in surface marine sediments along the coastal area of Chanthaburi Province, Thailand. A total of 248 sediment samples were digested and analyzed using the ICP-OES. Elemental pollution was assessed using the Enrichment Factor (EF) and Geo-accumulation Index (Igeo). Concentration of As, Cd, Cr, Cu, Pb, and Zn ranged from 1.00 – 46.00, 0.15 – 0.40, 3.00 – 37.00, 1.00 – 16.00, 2.00 – 33.00, and 3.50 – 62.00 mg·kg-1, respectively. This study revealed that the marine sediments are predominantly by Zn > Cr > Pb > Cu > As > Cd. The highest EF values indicated very severe enrichment for As (34.13), severe enrichment for Cd (13.32) and Pb (10.49), minor enrichment for Zn (1.89) and Cu (1.61), and no enrichment for Cr (0.93). The highest Igeo values for As, Pb, Cd, Zn, Cr, and Cu are 4.09, 0.82, 0.42, -0.76, -2.02, and -2.37, respectively. According to the Igeo classification, As exhibited strong to extremely strong pollution, particularly downstream of the Weru river mouth, whereas Pb and Cd were unpolluted to moderately polluted in the Laem Sing area. In contrast, Cr, Cu, and Zn were unpolluted. The findings suggested that anthropogenic inputs transported by the major rivers were the principal contributors to heavy metal contamination in the coastal sediments of Chanthaburi Province. These results provide information for coastal pollution monitoring and management. Further studies in major rivers of Chanthaburi Province are needed to better understand heavy metal sources and transport

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4. Blue Economy and Sustainable Ocean

4.1 From ocean observations to sustainable ocean economy: Bridging science, policy and society for resilient coastal communities

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Abstract: A sustainable ocean economy cannot be built without understanding the ocean and anticipating its changes. Across our region, the ocean is a source of food, livelihoods, connectivity and economic opportunity, while also playing a major role in climate variability and exposing communities and economies to multiple hazards. Ocean observations are therefore not only a scientific investment; they are an investment in preparedness, resilience and sustainable development.

El Niño demonstrates this connection clearly. Changes developing thousands of kilometres away in the tropical Pacific can affect rainfall, water availability, agriculture, fisheries and food security across the region. Sustained observations of the ocean and air–sea interactions, combined with modelling and prediction, allow these changes to be detected and anticipated months before many of their impacts are felt. The real value of ocean observations lies in turning this lead time into action—enabling governments, economic sectors and communities to prepare before impacts become crises.

Drawing on Indonesia's experience, the pathway from observation to prediction, from prediction to early action, and from early action to resilience and prosperity demonstrates the broader value of sustained ocean observing systems. A sustainable blue economy requires not only healthy oceans, but also accessible data, reliable prediction and services, and strong science–policy–society connections that translate ocean knowledge into decisions and action. Strengthened China–Southeast Asia collaboration in ocean observations, data sharing, prediction and capacity development can make this knowledge a shared foundation for a more resilient, equitable and sustainable regional ocean economy.

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4.2 Charting an ocean sustainable future for Southeast Asia under the UN Ocean Decade framework

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Abstract: Southeast Asia's marine and coastal ecosystems—supporting the world's most extensive coral reefs, 28% of global mangrove resources, and a blue economy that drives livelihoods for millions—face escalating, transboundary threats: overexploitation of fisheries, growing plastic and chemical pollution, climate-driven sea-level rise, and persistent habitat fragmentation. Addressing these interconnected challenges requires a coordinated, long-term regional response—and yet, existing regional marine governance mechanisms remain fragmented, handling issues in isolation rather than as a cohesive whole. This makes a unified regional ocean sustainability roadmap an urgent strategic priority.This report advocates for the development of a dedicated, comprehensive Regional Ocean Sustainability Roadmap for Southeast Asia—an instrument currently absent from the region's collective governance framework. It examines the structure, institutional architecture, and operational effectiveness of successful regional roadmaps from other ocean basins, including the Ocean Decade Africa Roadmap and Building a Roadmap for the implementation of the Ocean Decade in the Tropical Americas and Caribbean (TAC) Region. It then proposes a participatory, context-tailored approach to co-designing and implementing the Southeast Asia roadmap under the UN Ocean Decade framework, one that aligns with the region's unique cooperative norms, builds on existing initiatives, and unlocks the full potential of shared regional action.

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4.3 Sustainable tourism for blue economy at Koh Mak, Trat province, Thailand.

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Abstract: Koh Mak, Trat Province, recognized as Thailand's first low-carbon tourism island, relies largely on marine tourism and small-scale fisheries that depend on healthy coral reefs, seagrass beds, and coastal ecosystems. These resources are increasingly affected by climate change, ocean warming, marine pollution, and tourism-related pressures. In this context, the Blue Economy, particularly through Blue Tourism, provides an approach for linking sustainable tourism with marine ecosystem conservation and restoration.

This practice-based case study examined how low-carbon tourism, community-based marine restoration, and multi-stakeholder collaboration can support Blue Economy development on Koh Mak. Low-carbon practices include the use of electric vehicles, solid-waste management, environmentally responsible hotel practices, and the gradual adoption of cleaner and more energy-efficient systems. Building on these practices, the Department of Marine and Coastal Resources (DMCR) has supported local capacity building in marine conservation through training on coral reef ecology and restoration techniques, participatory mapping of coral reef and diving areas, community-based coral restoration, and the establishment of a seagrass restoration learning site that integrates restoration with environmental education.

The Koh Mak case shows that low-carbon tourism and marine ecosystem restoration can be integrated as complementary components of Blue Economy development. Strong community engagement and collaboration among government agencies, the private sector, local communities, and academic institutions are important mechanisms for sustaining marine conservation and responsible tourism at the island level.

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4.4 Integrated Coastal Governance Driven by Marine Spatial Planning - Cases and Replicable Regional Models of China-Cambodia Sustainable Marine Cooperation

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Abstract: Marine Spatial Planning serves as an effective tool to balance ecological conservation and blue economic development. Drawing on the practical cooperation carried out by the National Ocean Technology Center (NOTC) in Cambodia, this presentation shares practices covering Marine Spatial Planning, marine park zoning plan, sustainable island management and coastal ecological restoration. It further summarizes the replicable cooperation model suitable for Southeast Asian coastal countries to advance sustainable ocean development.

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4.5 Lessons learned from Blue Economy Initiatives in Thailand

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Abstract: Thailand has promoted the Blue Economy since 2017 through a pilot initiative under the Thailand–China Cooperation on Marine, aimed at advancing the sustainable management of marine and coastal resources and supporting socioeconomic development of local communities. The pilot initiative in Trat Province was jointly undertaken by the Department of Marine and Coastal Resources (DMCR), Thailand, and the Third Institute of Oceanography (TIO), China. The initiative focused on fisheries and tourism and incorporated stakeholder engagement, baseline assessments, capacity building, ecosystem restoration, livelihood development, and policy support. Project outcomes were assessed through a combination of documentary analysis and questionnaire surveys involving 258 respondents from coastal communities. The findings indicated that improvements in marine and coastal environmental conditions and household income were constrained by external factors, particularly the COVID-19 pandemic. Nevertheless, the initiative contributed to significant improvements in community awareness and positive attitudes toward marine and coastal conservation. The experience demonstrates that effective community participation, cross-sectoral collaboration, and science-based approaches are important for advancing Blue Economy implementation. Key lessons emphasize the need to integrate ecosystem conservation with sustainable livelihoods, strengthen stakeholder engagement, and establish sustained policy and institutional support. These experiences provide practical insights for strengthening Blue Economy implementation in Thailand and may inform similar initiatives in other coastal regions.

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4.6 Blue citizen community framework for ocean literacy enhancement and blue economy development

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Abstract: Ocean literacy enhancement will lead to the key competences essential for sustainable blue economy growth.The presentation proposed the framework of Blue Citizen Community characterized by the cultivation of blue citizens, centered on improving residents' & visiters' ocean literacy, and committed to enhancing community livelihoods and human well-being from the benefits of the ocean conservation and sustainable development. The five action areas will be introduced with the case studies of the blue citizen community development, which are promoting the ocean literacy for the public, promoting the blue economy with the inclusive and balance maner, promoting the local knowledge and marine culture exchange, promoting the ocean conservation and restoration, and promoting the ocean governance and coorperation. More Blue Citizen Communities are encouraged to develop for best practices sharing through networking.

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4.7 Thailand Mangrove Alliance

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Abstract: The Thailand Mangrove Alliance (TMA) is a national collaborative mechanism established under the guidance of the Department of Marine and Coastal Resources (DMCR). By integrating over 100 partner organizations across the public, private, academic, non-governmental, and local community sectors, TMA operates under the core philosophy "Go Beyond Carbon Credits," striving to forge a sustainable synergy between environmental conservation, community empowerment, and economic growth.

The key accomplishments across three primary dimensions include: environmental progress through the restoration of over 201,000 rai (~32,160 hectares) of mangroves across 18 coastal provinces alongside active T-VER carbon credit projects; social transformation by shifting local communities into empowered "forest guardians" supported by a network of over 31,000 marine conservation volunteers; and economic enhancement through a green economy framework that drives ecotourism and elevates local products across 130 communities via the dedicated TMA Platform.

TMA's strategic five-pillar roadmap spans conservation, innovative research, community engagement, economic development, and legal financial mechanisms. This structured roadmap serves to achieve the ambitious target of restoring 500,000 rai (~80,000 hectares) of mangrove forests by 2030, directly propelling Thailand toward its long-term Net Zero emissions goals.

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4.8 Marine Spatial Planning (MSP) for Sustainable Ocean: Regional Practices and Challenges

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Abstract: Southeast Asia's marine and coastal areas are under mounting pressure from rapid blue economy growth—fisheries, aquaculture, tourism, shipping and coastal development—intensifying user conflicts and accelerating the degradation of critical ecosystems such as coral reefs, mangroves and seagrass beds. Marine Spatial Planning (MSP) has emerged as a powerful, ecosystem-based governance tool to allocate marine space among competing uses and reconcile economic development with ecological conservation, directly contributing to SDG 14 and the UN Decade of Ocean Science for Sustainable Development. Under coordination of IOC-WESTPAC, the UN21 project has been advancing regional MSP implementation since 2022. Guided by the regionally adopted Action Framework for MSP in the Western Pacific (2025–2030), the project promotes ecosystem-based MSP through: (i) developing regionally customized MSP toolboxes that integrate planning tools such as Marxan and InVEST; (ii) building demonstration sites across the region, including Qinzhou (China), Chonburi (Thailand), Jeollanam-do (Republic of Korea) and Koh Rong (Cambodia); (iii) supporting marine surveys and data provision for planning; and (iv) delivering technical training and regional dialogue to strengthen institutional capacity. This work also reflects the progress, key lessons and practical challenges of these regional and national MSP practices and discusses how MSP can serve as an enabling framework to balance blue economy development with ecosystem conservation, ultimately securing a sustainable ocean for the region.

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4.9 Practices of the “Island Governance Toolkit” project in advancing the implementation of the UN Ocean Decade

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Abstract: As China's first project under the UN "Ocean Decade" focusing on island nations, the IGT is dedicated to the core mission of empowering the modernization of island governance. It targets key areas including policy planning, ecological early warning and monitoring, ecological conservation and restoration, disaster prevention and mitigation, regulatory technologies, practical application of innovative technologies, and science communication. By developing a modular, collaboratively open, and standards-compliant smart governance toolkit, the IGT aims to build a "global think tank" for sustainable island development solutions. It provides end-to-end technical support to help island nations tackle climate change and ecological crises, fosters a new paradigm for sustainable development by building a "Human-Island-Ocean" Community with a Shared Future, and ultimately contributes the solution to global ocean governance.

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II. Poster Presentation Session

1. Ocean and Climate Observation, Forecasting, Projection, and Application

1.1 Bailong Buoy's Ocean Observation Solutions

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Abstract: Bailong buoy is China's first 6000-meter deep ocean climate observation system which is independently developed by the First Institute of Oceanography, MNR. As a platform for deep-sea climate observation, Bailong buoy, equipped with multi-element sensors, can acquire high-frequency sampling of the sea surface weather, oceanographic elements and internal marine elements. It also uses various communication methods such as Iridium/Beidou/Tiantong/4G to transmit observation data in real time to the data center. Bailong Buoy is committed to providing customers with diversified marine observation solutions, including: (1) integrated buoy system solutions covering customized design and delivery of buoys; (2) buoy system upgrading services for retrofitting the control and communication systems of customers' existing buoy platforms; (3) marine data subscription services to supply required observational data for clients. In addition, drawing on years of technological accumulation, we offer customized hardware and software for control systems of various marine observation platforms as well as data analysis services. The scope covers intelligent subsurface buoys, seabed platforms, shipborne underway CO_2 observation systems, buoy data quality control and more.

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1.2 Bailong Buoy in the Indian Ocean

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Abstract: Bailong buoy is China's first 6000-meter deep ocean climate observation system which is independently developed by the First Institute of Oceanography, MNR. As a platform for deep-sea climate observation, Bailong buoy, equipped with multi-element sensors, can acquire high-frequency sampling of the sea surface weather, oceanographic elements and internal marine elements. In recent years, we have independently developed key technologies such as buoy data acquisition controllers, inductively coupled data transmission modules, and high elastic nylon ropes. At the same time, a multimode bidirectional data communication system has been established, and the buoy can communicate using various methods such as Iridium/Beidou/Tiantong/4G to transmit real-time observation data to the data center located in Qingdao. Since 2010, Bailong buoy has been successfully deployed in the Indian Ocean and Andaman Sea, becoming the third deep-sea climate observation buoy system after NOAA's TAO buoy and JAMSTEC's TRITON buoy. As of 2026, we have deployed more than 20 sets of Bailong buoys at 7 stations in the Indian Ocean and established friendly cooperation with many coastal countries, including Thailand, Indonesia, Kenya and Australia. Through nearly 16 years of observation in the Indian Ocean, the Bailong buoy has obtained a wealth of valuable data. Many scientists have conducted research on the Indian Ocean monsoon and climate using buoy's real-time data and recovered data, and have achieved many valuable research results.

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1.3 The origin of summer high-salinity water in the southern Bay of Bengal and its interannual variabilities

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Abstract: This research investigates the origins of high-salinity water in the southern Bay of Bengal (SBHSW) in summer (June to August) and its interannual variabilities associated with El Niño-Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD). The two distinctive sources of the SBHSW, including the eastern Arabian Sea (AS) origin and the western equatorial Indian Ocean (EIO) origin mentioned in the previous studies are identified. The eastern AS origin has much higher salinity (35.5 PSU vs 35.2 PSU), shallower isopycnal layers (1023.0 - 1023.5 kg m^{-3} vs 1024.0 - 1024.5 kg m^{-3}), and intrudes into the Bay of Bengal (BOB) approximately one month later compared to the western EIO origin, while accounting for 53% of the total salinity variability compared to 47% contribution from the WEIO origin. The interannual variabilities of SBHSW are closely linked with ENSO and IOD events, with contributions of approximately 47% and 41%, respectively. During El Niño decaying years, high-salinity water export from the western EIO origin into the southern bay (< 7°N) is enhanced due to the anomalous strong spring Equatorial Undercurrent (EUC) associated with El Niño; while in the north of 7°N, the SBHSW was freshened both by the increased rainfall and by the downwelling associate with the anomalous anticyclonic wind. Similar processes operate but in an opposite direction during La Niña decaying years. In contrast, IOD exerts its influence on the SBHSW primarily through modulating the strength of SMC. Positive (negative) IOD caused the anomalous freshening (salty) SBHSW by weakening (enhancing) SMC and consequently advecting less (more) saline water into the BOB.

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1.4 How High Salinity and Low Oxygen of Indian Ocean Deep Water Entering Sunda Strait and Adjacent Waters

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Abstract: The complex bathymetry of the Sunda Strait, particularly at its boundary with the Indian Ocean, exerts a critical influence on current circulation at depths exceeding 150 meters. The occurrence of high salinity (34.8 - 35 PSU) and low oxygen concentration (< 60 μmol/kg) (HSLO) deep water mass of Indian Ocean has detected several times at 400 - 600 meter depth in Eastern Indian Ocean south of Sumatera and Java Island and entering semi-closed basin of the boundary area at depth of 250 - 450 meter. This study will investigate the occurrence of HSLO deep water mass of Indian Ocean in the Sunda Strait Basin and mechanism of the deep water entering shallow water area. Historical CTD cast data from 2011 to 2026 in collaboration between the FIO and Indonesian Counterpart (Project: MOMSEI, JUVO, SITE, TRIUMPH, CINODEX) were used for occurrence investigation and to validate the 1/36° ROM-CROCO Model that will used to study the pumping of deep water to shallow area through the shelf. The study will increase our understanding of near-bottom ocean circulation and effect of pumping for the ecosystem in Sunda Strait and adjacent waters.

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1.5 Estimation of interannual along-strait flow in the Malacca Strait

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Abstract: The Malacca Strait (MS), located between the Malay Peninsula and Sumatra Island, serves as an important conduit for water exchange between the South China Sea (SCS) and the Andaman Sea (AS). In this study, we formulate a quasi-steady model for an idealized narrow, constant-depth channel to estimate the interannual along-strait flow. Although this simplified framework does not fully resolve the complex geometry, shallow bathymetry, and frictionally dominated local dynamics of the Malacca Strait, it is designed to capture the first-order basin-scale response to sea-level slope forcing. The results suggest that the along-strait velocity varies interannually from -10 to 20 cm/s (positive northwestward), primarily driven by the sea-level difference between the two sides of the MS.

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1.6 Seasonal circulation and water exchange with the Southern South China Sea of the Gulf of Thailand

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Abstract: The Gulf of Thailand (GoT) is a shallow gulf with strong stratification, even during the monsoon prevailing period, indicating the invasion of high-density water from the Southern South China Sea (SSCS). Here, we established a numerical model based on the Coastal and Regional Ocean COmmunity (CROCO) to reveal the seasonal characteristics of the three-dimensional circulation and water exchange with the SSCS of the GoT. We selected a transect across the mouth of the GoT to evaluate the transport between the two sea areas quantitatively. The model results showed that the direction of water exchange changes twice annually, i.e., in March (inward→outward) and October (outward→inward), and that summer (winter) is the season with the strongest outward (inward) transport. Additionally, the upper layer (depth: <30 m) dominates in terms of the main features of water exchange, whereas the lower layer (depth: >30 m) forms a compensatory flow. The meridional SSCS wind is the driving force of the direction of water exchange. During the period of SSCS northerly wind (SNW; November to the following March), inward (outward) transport occurs in the upper (lower) layer, whereas the situation is reversed during the period of SSCS southerly wind (SSW; April–October). Water exchange across the mouth of the GoT is dictated by the circulation patterns between GoT and the SSCS. A seasonal rotating circulation is found in both regions. In the GoT, a basin-scale anticyclonic gyre exists during both periods; in the SSCS, a cyclonic circulation and an anticyclonic gyre exist during the SNW and SSW periods, respectively. Additionally, frontal zones induced by the dipole current structures are simulated during both periods.

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1.7 Ocean Current Dynamics OF LOMBOK STRAIT Revealed by Vessel-Mounted ADCP Measurements from the 2025 MarExplore Cruise

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2. Marine Ecosystem Protection, Biodiversity Research and Marine Biotechnology R&D

2.1 An AI-agent system for coral reef heat-stress assessment and bleaching early warning

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Abstract: Satellite thermal-stress products support coral-bleaching early warning, but local management requires transparent baselines and reproducible analysis. We analysed NOAA Coral Reef Watch 5-km annual products for a 0.4° × 0.4° area around Koh Hae, Thailand, from 1986 to 2025. For each year, we calculated maximum degree heating weeks (DHW) among 57 ocean pixels and assessed trends using Mann–Kendall and Theil–Sen methods. We also implemented a modular Python workflow for data retrieval, reef masking, thermal-stress classification, mapping and narrative reporting, designed for use as a reusable GenericAgent skill. The case study uses CRW thermal-stress products; the architecture can incorporate reanalysis SST, wind and radiation, wave and current fields, in-situ temperature, reef masks and imagery. A companion toolkit provides reproducible acquisition and validation scripts for reef extent, thermal stress, threats, species occurrences and more than 9,000 open-access papers. Annual maximum DHW increased by 0.47 °C-weeks per decade (Theil–Sen 95% CI: 0.10–0.92; Mann-Kendall p = 0.008). Mean annual maximum DHW was 1.11 °C-weeks in 1986–2005 and 3.19 °C-weeks in 2006-2025 (two-sided Mann–Whitney U, p = 0.037). DHW reached at least 4 °C-weeks in six years and exceeded 12 °C-weeks in 2010 and 2024; 2024 had the record maximum of 14.89 °C-weeks. The resulting baseline provides managers with a local reference for interpreting future bleaching risk. Field bleaching and coral-cover observations are needed to assess ecological impacts and quantify the predictive value of wind, waves, currents and radiation.

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2.2 Global Priority Areas and Potential Refugia for the Conservation of Threatened Marine Rays

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Abstract: Marine chondrichthyans face severe extinction risk, with rays particularly threatened by overfishing and habitat degradation. However, the global distribution of priority habitats for threatened rays and their coverage by international conservation frameworks remain poorly understood. We assembled occurrence records for 85 declining threatened ray species and used stacked species distribution models to predict suitable habitats and species richness. By integrating fishing pressure, shipping activity, and coastal disturbance into a composite cost layer with Zonation, we identified global conservation priorities. Hotspots are predominantly in coastal and continental shelf waters, especially the Indo-West Pacific transition zone, Caribbean Sea-Gulf of Mexico, Mediterranean and northeastern Atlantic coasts, East Asian marginal seas, and Australian coastal waters. Coverage by existing frameworks is limited: Ecologically or Biologically Significant Marine Areas (EBSAs), marine protected areas (MPAs), and Key Biodiversity Areas (KBAs) cover only 23.8%, 21.7%, and 11.9% of the top 5% priority areas, respectively. Overlaying distribution records of 17 Critically Endangered ray species with conservation gaps revealed six priority areas for immediate action. Our findings show that critical habitats for threatened rays are highly localized yet remain insufficiently safeguarded under current systems. This study provides a scientific basis for identifying conservation gaps and informing marine spatial planning from regional to global scales.

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2.3 Cumulative Impact Assessment of Multiple Human Pressures on Global Ecologically Critical Areas

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Abstract: Understanding the cumulative impacts of climate change and human activities on marine ecosystems is critical for effective ocean governance, yet spatially explicit assessments within ecologically critical areas remain scarce. Here we apply a cumulative impact assessment framework integrating 11 anthropogenic and climate stressors across 15 marine habitat types to map global cumulative impact distributions and evaluate their magnitude within Marine Protected Areas (MPAs), Ecologically or Biologically Significant Marine Areas (EBSAs), and Important Marine Mammal Areas (IMMAs). High-impact regions are concentrated along the Pacific and Atlantic coasts. Climate change contributes over 73% of global cumulative impacts, with ocean acidification, primary productivity shifts, and sea temperature rise as dominant drivers; among human activities, shipping contributes the most (12%). Within ECAs, cumulative impacts in MPAs fall below the global average, while EBSAs and IMMAs approximate global levels. However, pressure patterns diverge: fishing impacts are significantly reduced in MPAs; shipping impacts are slightly elevated in EBSAs; and demersal destructive fishing impacts are notably higher in IMMAs. These findings support differentiated management strategies: restricting demersal destructive fishing in IMMAs, implementing dynamic shipping regulations in EBSAs, and expanding MPA networks around climate refugia to enhance ecosystem resilience and contribute to the "30×30" target.

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2.4 Microbial pterins indicating organic carbon dynamics in estuarine and coastal environments

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Abstract: This study investigates the distribution, regulation, and ecological significance of pterins in marine environments. Pterins, a class of small organic molecules widely present in organisms, play critical roles in key metabolic processes such as light harvesting, redox reactions, and carbon-nitrogen cycling, serving as essential precursors for microbial growth and physiological regulation. By analyzing the spatiotemporal distribution characteristics of pterins in water and sediment samples from typical coastal areas of the southeastern China Sea, this study reveals that pterins during flood periods primarily originate from phytoplankton (e.g., freshwater algae and cyanobacteria), while heterotrophic microbial contributions become significantly more pronounced during dry seasons. In reductive sedimentary environments, dihydroneopterin and neopterin are more abundant, whereas pterin and its metabolite isoxanthopterin tend to remain in the aqueous phase. Our study further elucidates the close relationship between pterins and phytoplankton growth. The strong correlation between chlorophyll-a and pterin levels suggests that the bioavailability of pterins may promote phytoplankton proliferation, making their concentration variations a potential indicator for algal bloom occurrences. Additionally, the sediment C/N ratio and isoxanthopterin levels indirectly reflect changes in coastal carbon sequestration capacity, providing novel biomarker-based evidence for assessing marine carbon sink functions. This work represents the first systematic investigation into the distribution patterns, sources, and transport processes of pterins in coastal waters and estuarine sediments, highlighting their pivotal role in marine carbon and nitrogen cycling. The findings not only provide theoretical support for the application of pterins as biomarkers of marine carbon sequestration but also establish a scientific foundation for coastal ecosystem health assessment and algal bloom early-warning mechanisms.

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2.5 Mapping Floating plastic debris from space with deep learning

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Abstract: Floating plastic debris poses a major threat to the global marine environment. Accurate detection using remote sensing is essential for effective monitoring and management. However, the accuracy of satellite-based detection remains limited. Using high-spatial-resolution Sentinel-2 multispectral imagery and deep learning method, we developed the Floating Plastic Debris Network (FPDNet) for automated detection of floating plastic debris. Across independent images from five continents, FPDNet achieved high detection accuracy, with a mean Kappa coefficient of 0.90 ± 0.10. FPDNet was then applied to Sentinel-2 imagery during 2019–2025 over the waters off northwestern Java, where plastic debris is a major concern. Beyond the recognized hotspot in the Jakarta Bay, FPDNet identified a hotspot in the waters off northern Banten Province that had not previously been well documented. This finding demonstrates the value of satellite remote sensing for large-scale, long-term monitoring.

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2.6 Stable isotope fractions of dissolved organic nitrogen in South China Sea: Biological controls and terrestrial input controls

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Abstract: Nitrogen (N) regulates marine primary productivity, yet the cycling of dissolved organic N (DON) and δ^{15}N-DON remains poorly constrained relative to inorganic N, particularly in subtropical and tropical marginal seas. This knowledge gap limits our understanding of the role of DON in marine N budgets and ecosystem functioning. To address this, we investigated DON dynamics across a transect spanning the Zhujiang Estuary (ZJE), South China Sea (SCS), and Strait of Malacca (MS). Surface water samples were analyzed for DON concentrations, δ^{15}N-DON, nutrients, dissolved organic carbon, phytoplankton pigments, and selenium to elucidate the biogeochemical controls on DON cycling. Marked spatial variability was observed. In the ZJE, high DON (4.4-56.5 μM) with low δ^{15}N-DON (1.9-3.1‰) reflected terrestrial inputs and phytoplankton-derived production. In the oligotrophic SCS, DON decreased (3.1-6.1 μM) while δ^{15}N-DON increased to 4.7‰, indicating DON degradation with an isotopic fractionation. The MS exhibited intermediate characteristics with strong DON-Chl-a coupling (R = 0.77; 0.90), suggesting monsoon-driven regulation of primary production. A consistent negative correlation between DON concentration and δ^{15}N-DON across all systems (R = -0.30 to -0.92) provides strong evidence for DON degradation processes that preferentially remove light isotopes. Phytoplankton community structure, particularly Prochlorophytes and Prymnesiophytes, exerted significant control on DON dynamics. This study demonstrates that DON is an actively cycling N component rather than a passive reservoir, with δ^{15}N-DON serving as a sensitive tracer of N transformation pathways. These findings advance our mechanistic understanding of organic N cycling in marginal seas and contribute to global constraints on marine N budgets.

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2.7 Venomous Jellyfish in Thailand: Impacts & Management

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Abstract: The distribution of venomous jellyfish conducted between 2010 to 2026 reveal along both the Gulf of Thailand and the Andaman coasts. Five families of venomous jellyfish have been identified, box jellyfish (Chirodropidae, Carukiidae, and Chiropsalmidae), True jellyfish (Pelagiidae) and the Portuguese man-o'-war (Physaliidae). Among these species, some pose fatal threats to human life. Between 1999 to 2025, venomous jellyfish stings accounted for 10 fatalities and 41 severe injuries. The most recent severely injured occurred in 2025 on Koh Phangan in Surat Thani Province, caused by a highly venomous box jellyfish from the family Chirodropidae. In response, the Department of Marine and Coastal Resources, key mitigating measures have been implemented, including: Installing warning signs in high-risk areas, particularly during peak box jellyfish seasons. Conducting public awareness campaigns for local communities and tourism operators regarding box jellyfish and initial first aid. Training rescue personnel and medical teams on proper first-aid and treatment guidelines. Deploying jellyfish protection nets in high-risk zones during critical periods. Although jellyfish populations have trended upward over the past two years, the number of severe injuries has decreased, reflecting the efficacy of local preventive measures and first-aid education in tourist destinations. Developing advanced early-warning systems remains crucial to ensuring sustainable tourism confidence.

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2.8 Seagrass Meadows Degradation and Dugong Population Changes Along the Andaman Coast of Thailand

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Abstract: The degradation of seagrass ecosystems in Thailand has become a major challenge for coastal biodiversity conservation and ecosystem resilience. Between 2020 and 2025, seagrass meadows along the Andaman coast declined from approximately 120 km² to 90 km², with mean seagrass cover decreasing from 32.6% to 21.6%. *Enhalus acoroides,* a key food source for dugongs, experienced the most severe decline. This degradation has resulted from multiple interacting natural and anthropogenic drivers. Climate change has increased sea surface temperatures and caused unusually low sea levels, while monsoon-driven erosion and sediment deposition have destabilized seagrass habitats. Coastal development and dredging have further increased sediment resuspension, reducing water clarity and light availability for photosynthesis. In addition, imbalances in grazing pressure have contributed to localized overgrazing of seagrass meadows. The decline of seagrass ecosystems has reduced habitat quality and nursery grounds for marine organisms and has directly affected dugong populations. Dugong numbers along the Andaman coast declined from 223 individuals in 2020 to 188 in 2025, while increasing observations in Phuket and Phang Nga suggest a shift in distribution as dugongs search for alternative feeding grounds. Although seagrass meadows remained degraded in 2026, with *E. acoroides* showing poor health and damaged leaves, signs of natural recovery have been observed in some locations. Small- and medium-sized seagrass species have begun to recolonize areas such as Ao Nam Mao, Krabi Province, and parts of Libong Island, Trang Province, where dugong feeding trails have also been recorded. These findings highlight the urgent need for continuous monitoring of seagrass ecosystems and dugong populations to support adaptive conservation strategies, improve ecosystem resilience, and safeguard Thailand's coastal biodiversity under increasing environmental change.

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2.9 Marine Resources at Submerged rocky reefs in Koh Tao, Surat Thani Province, Thailand

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Abstract: Submerged rocky reefs are vital marine ecosystems that provide shelter, spawning grounds, nursery areas, and feeding habitats for many sea creatures. They also play a key role in supporting ecotourism. This study assessed rocky reef condition, marine life, and water conditions at 2 sites near Koh Tao, Surat Thani: Hin Bai (Sail Rock), Koh Tung Ku, the survey was conducted during the summer and rainy seasons of 2025. Our results showed that live coral cover was over 38% at Koh Hin Bai and over 27% at Kong Tung Ku. Dominant coral species, including *Porites lutea*, *Goniopora columna*, *Tubastraea micranthus*, and *Pavona decussata*. We also observed important marine invertebrates, such as sea urchins (*Diadema setosum*), thorny oysters (*Hyotissa hyotis*), and sea whips (*Junceella* sp.). Over 65 species of reef fish from 18 families were recorded, with Kong Tung Ku exhibiting higher fish species richness than Hin Bai. Furthermore, the presence of whale sharks (*Rhincodon typus*) endangered species listed on the IUCN Red List. Overall, oceanographic characteristics and water quality was found to be suitable for marine life, although we did notice some changes in nutrient levels, chlorophyll-*a*, and plankton between seasons, which were likely due to environmental shifts and water circulation. This study demonstrates that the submerged rocky reef around Koh Tao is ecologically valuable and are prime locations for conservation and ecotourism. These findings will serve as a useful reference for long-term ecological monitoring, marine spatial planning, conservation management, and sustainable use.

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2.10 A Dacade of Practice in Microplastic Research: Experience from the Department of Marine and Coastal Resources, Thailand

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Abstract: Since 2017, the Department of Marine and Coastal Resources (DMCR), Thailand, has progressively strengthened national capacity for marine microplastic research through three development phases. During the first phase (2017-2019), efforts focused on establishing harmonized methodologies for sampling, laboratory analysis, and quality assurance for microplastics in seawater and sandy beach sediments through regional collaboration, particularly with IOC/WESTPAC and the Thailand-China Joint Laboratory for Climate and Marine Ecosystem.

The second phase (2020-2024) established a long-term monitoring network covering coastal and offshore waters in the Gulf of Thailand and the Andaman Sea, including 30 seawater stations, 10 sandy beach stations, and six regional research centers. The average microplastic abundance in seawater during 2021-2024 was 1.24 items m^{-3}, with higher concentrations during the southwest monsoon (0.11-9.06 items m^{-3}) than the northeast monsoon (0.23-3.50 items m^{-3}). Polyethylene, polypropylene, polyethylene terephthalate, and polystyrene were the dominant polymers, while expanded polystyrene flotation devices used in marine aquaculture were identified as a major potential source of PS contamination in the Andaman Sea.

Since 2025, DMCR has expanded national and international collaborations to harmonize analytical quality and monitoring practices. These efforts contributed to Thailand's national guidelines for microplastic analysis and the establishment of a national proficiency testing programme, strengthening quality assurance, evidence-based environmental management, and regional scientific cooperation.

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2.11 Land-to-Sea Microplastic Accumulation in Map Ta Phut, Thailand

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Abstract: Microplastic contamination in the marine environment is a widespread threat affecting both ecosystem balance and human health. This study aimed to investigate the quantity of microplastics at the Nam Hu Canal mouth, Rayong Province, a critical transitional area among the Map Ta Phut Industrial Estate, adjacent communities, and shellfish farming areas, in order to support policy formulation and sustainable management measures. Seawater samples were collected twice a year, once in the dry season and once in the wet season, from 2022 to 2024, applying the standard NOAA (2015) methodology, with polymer identification conducted using Fourier-Transform Infrared Spectroscopy (FTIR). The results showed that microplastic density increased significantly ($p<0.05$) throughout the study period. During the dry season, the highest average density was recorded in 2023, at 1.93 ± 0.75 particles/m³, while during the wet season, the highest average density was likewise recorded in 2023, at 2.30 ± 3.23 particles/m³. Analysis further revealed that during the dry season, microplastics were predominantly fragments, blue in color, whereas during the wet season, microplastics were predominantly fragments, clear/white in color, with polypropylene (PP) identified as the most abundant polymer type in both seasons.

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2.12 Relationship Between Water Quality and Hypoxia in Five River Mouths of the Upper Gulf of Thailand

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Abstract: This study aimed to investigate the relationship between water quality and hypoxia in five river mouths of the Upper Gulf of Thailand, including the Bang Pakong, Chao Phraya, Tha Chin, Mae Klong, and Bang Taboon river mouths. A total of 353 water quality samples collected between 2020 and 2025 were analyzed. Hypoxia was defined as dissolved oxygen (DO) concentrations below 2 mg/L. Water quality data were analyzed using descriptive statistics, Pearson's correlation analysis, and multiple linear regression. The results showed that hypoxia occurred in 28 samples (7.9%) and was detected only at the Tha Chin and Chao Phraya river mouths, with the Tha Chin River exhibiting the highest frequency of hypoxic events. No hypoxia was observed at the Bang Pakong, Mae Klong, and Bang Taboon river mouths. Pearson's correlation analysis indicated that dissolved oxygen was positively associated with pH and salinity, whereas negative relationships were observed with water temperature and phosphate concentrations. Multiple linear regression identified pH as the most influential factor affecting dissolved oxygen, and the regression model explained 59% of the variation in DO. These findings demonstrate that variations in water quality, particularly pH, salinity, nitrate concentrations, and total suspended solids, are closely associated with reductions in dissolved oxygen and the occurrence of hypoxia in the study area. The results provide valuable baseline information for water quality monitoring, hypoxia risk assessment, and coastal water quality management in the Upper Gulf of Thailand.

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2.13 Monitoring Spatial and Temporal Changes of Seagrass in Nam Mao Bay, Krabi, Thailand (2022-2026) Using Sentinel-2 Imagery

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Abstract: This study aimed to monitor and assess the spatial changes of seagrass beds in Ao Nam Mao, Krabi Province, during the period 2022-2026. Sentinel-2 satellite imagery was integrated with field survey data to analyze changes in seagrass distribution and evaluate the application of remote sensing technology for coastal resource monitoring. The field survey data were used as Ground Truth data for training and validating the satellite image classification using the Maximum Likelihood Classification method. The field survey results showed that the seagrass area in Ao Nam Mao gradually decreased during the study period. The seagrass area declined from 0.59 km² in 2022 to 0.28 km² in 2026, representing a reduction of approximately 52.5% from the initial area. The field survey data played an important role in validating the classification results from the Sentinel-2 imagery, improving the reliability of the spatial analysis and providing a better representation of the actual changes in the study area. The results indicate that integrating field survey data with Sentinel-2 satellite imagery is an effective approach for monitoring spatial changes in seagrass beds. This approach can reduce the time, cost, and frequency of field surveys while supporting continuous monitoring of coastal resources. The findings provide useful baseline information for seagrass conservation, coastal resource management, and policy development to support the sustainable management of marine and coastal resources.

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2.14 A study on the effectiveness of high-frequency acoustic devices in preventing dolphin entering the Bang Pakong River, Chachoengsao Province, Thailand

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Abstract: Accidental dolphin entry into the Bang Pakong River, Chachoengsao Province, Thailand, has been reported annually and has occasionally resulted in stranding events and mortality. To reduce the risk of dolphins entering the river system, high-frequency acoustic deterrent devices (pingers) were deployed at the river entrance. This study aimed to conduct a preliminary assessment of the effectiveness of pingers in deterring dolphins from entering the Bang Pakong River. Four pingers were installed on bridge pillars at Bridge, the Bang Pakong River, Chachoengsao Province, with approximately 100 m spacing between adjacent devices, creating an acoustic deterrent zone across the river entrance. Monitoring was conducted from November 2025 to May 2026. Dolphin occurrence was assessed using passive acoustic monitoring (PAM) with F-POD devices, supplemented by reported dolphin sightings from local stakeholders and field personnel. Dolphin echolocation clicks were detected throughout the study period in the vicinity of the pinger deployment area, indicating the continued presence of dolphins near the river mouth. However, no confirmed records of dolphins entering the Bang Pakong River were documented during the monitoring period. These findings suggest that pinger deployment may be a mitigation measure to reduce dolphin intrusion into the river system while allowing dolphins to remain in adjacent coastal habitats. As this study represents a preliminary assessment, additional long-term monitoring and comparative studies are required to validate the effectiveness of pingers and to evaluate potential behavioral responses of dolphins to acoustic deterrent devices. The results provide important baseline information for the development of conservation and management strategies aimed at reducing dolphin stranding risk and mortality in the Bang Pakong River estuary and other similar coastal-riverine environments.

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2.15 Comparative Impacts of Marine debris on Sea turtle in the Gulf of Thailand and the Andaman Sea

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Abstract: Marine debris is an escalating global conservation challenge and a major anthropogenic threat to marine biodiversity. Its impacts are particularly severe for endangered sea turtles, whose depleted populations and limited recovery potential make them exceptionally vulnerable. Marine wildlife is primarily affected through plastic ingestion and entanglement in debris or lost fishing gear—two major causes of injury and mortality. Thailand's marine environment comprises two distinct regions: the Gulf of Thailand and the Andaman Sea, which differ in physical features, oceanography, and human activities. This study compared marine debris impacts on sea turtles between these two regions using stranding records collected from 2021 to 2025. Along the Gulf of Thailand, 1,947 stranded sea turtles were recorded, with 636 individuals (32.67%) affected by marine debris. Plastic ingestion was the predominant threat in this region, accounting for 452 turtles (71.07%), followed by entanglement (111 turtles; 17.45%) and combined ingestion and entanglement (73 turtles; 11.48%). In contrast, 800 stranded sea turtles were documented along the Andaman Sea coast, with 293 individuals (36.63%) impacted by debris. Entanglement was the primary pathway in the Andaman Sea, affecting 143 turtles (48.81%), followed by plastic ingestion (113 turtles; 38.57%) and combined impacts (37 turtles; 12.63%). These findings highlight clear regional variations in marine debris impacts on sea turtles in Thailand. Plastic ingestion dominated in the Gulf of Thailand, whereas entanglement was the primary threat in the Andaman Sea. These contrasting patterns likely stem from regional differences in oceanographic dynamics, habitat structures, debris composition, and local human activities. Ultimately, these results provide vital scientific evidence to support region specific marine debris management and mitigation strategies such as targeted waste prevention, debris removal, and fisheries-related interventions to reduce wildlife impacts and strengthen long term sea turtle conservation.

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2.16 Coal Reefs Acidification Monitoring Network

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Abstract: Ocean Acidification (OA) has been reconized as a vital climate change problem, it will alternate the balance of seawater carbonate system, lead the decrease of pH and other parameters, and then impact the marine biodiversity and ecosystem safety. It is well known that coral reef ecosysytems are among the most severely affected ecosystems by OA. However, coral reefs are also the regions with the least amount of acidification observation data. We present a new endorsed United Nation Ocean Decade Project "Coral Reefs Acidificaiton Monitoring Network" (CRAMN) to call more countries and areas to participate in order to protect coral reef ecosystems and achieve the sustainability goals.

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2.17 Introduction of China-ASEAN Countries Joint Research and Development Center of Marine Science and Technology

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Abstract: Fourth Institute of Oceanography (4IO), also known as China-ASEAN Countries Joint Research and Development Center of Marine Science and Technology is jointly established by the Ministry of Natural Resources and the People's Government of Guangxi Zhuang Autonomous Region. Facing the Beibu Gulf, 4IO takes serving the improvement of marine ecological conservation, practicing the "21st-century Maritime Silk Road" initiative, and facilitating the high-quality development of Guangxi's marine economy as the mission. 4IO mainly carries out scientific research on marine ecosystem dynamics as the core; undertakes technical research focusing on marine ecological environment monitoring and prediction, marine big data and blockchain technology and smart application; conducts application services of the comprehensive management of coastal zone, protection and restoration of tropical and subtropical marine natural resources, protection and utilization of marine biological resources, marine economic development planning, etc. Besides, 4IO attaches importance to enhancing the comprehensive innovation capabilities in personnel training, scientific research, technology research and application services. Striving to be an international messenger for promoting marine ecological civilization, 4IO makes great efforts to establish a scientific and technological personnel training base, a scientific and technological innovation platform and a practical demonstration area of marine ecological civilization.

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2.18 China-Thailand Cooperation in Marine Ecological Conservation and Mangrove Community Development

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Abstract: Leveraging the China-Thailand Joint Laboratory, China and Thailand have carried out systematic cooperation in mangrove ecological conservation and community-based sustainable development along the Andaman Coast. This cooperation began with a science-based assessment that developed a multi-dimensional Mangrove Coastal Vulnerability Index (M-CVI), integrating ecological resilience, physical exposure, and anthropogenic disturbance, which revealed that 18.6% of the total mangrove area is in high-to-very-high vulnerability states (M-CVI > 0.70) with pronounced spatial heterogeneity-Ranong Province exhibits acute hydrological stress and habitat fragmentation due to its highest concentration of construction land, whereas Satun Province, protected under the Tarutao National Park framework, maintains better integrity with only 17.6% of its area vulnerable. This assessment enabled the precise identification of 311 hectares of vulnerable zones and the scientific siting of conservation demonstration areas. As the collaboration's most iconic physical outcome, the China–Thailand Nature Education Center was inaugurated in Phang Nga Province in November 2025 as a hub for science popularization, community engagement, and youth exchange, with its activities featured in multiple special reports by Xinhua News Agency exceeding 2 million total views; meanwhile, community livelihood transformation training, mangrove planting and cleanup activities, and technical training workshops reached over 400 participants, with training manuals compiled and a regular bilateral knowledge-sharing mechanism established. Looking ahead, both countries will deepen joint research, expand the Nature Education Center network, strengthen community partnerships, and innovate diverse youth exchange and public engagement initiatives, aiming to amplify the demonstration effect across the region and inject sustained vitality into the shared endeavor of building the Blue Partnership. This cooperation establishes a replicable and scalable pathway from scientific assessment through targeted identification and on-the-ground implementation to community empowerment, offering a transferable framework for vulnerability mitigation in similar tropical estuarine environments.

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2.19 China-Thailand Joint Research on Parasites in Marine Economic Species

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Abstract: *Portunion* (Isopoda, Epicaridea, Entoniscidae) is an extremely rare endoparasitic isopod genus that is found mainly in the blood cavity of decapod crustaceans, such as true crabs and hermit crabs. The mud crab (*Scylla paramamosain*) is one of the most economically important crab species in south China and Asia. In this study, we identified a new endoparasitic isopod species, *Portunion sinensis* sp. nov., from the hemocoel of *S. paramamosain*. *P. sinensis* sp. nov. is similar to Portunion conformis in having the anterior vertical to thorax, the posterior directed backwards for Female's ventral processes. However, the new species can be distinguished from Portunion conformis by the rudimentary abdominal spines present on segment IIIIV in males. Herein we describe a detailed morphological description of this new species and conduct an extensive comparison with related species. This study marks the first description *P. sinensis* sp. nov. of an endoparasitic isopod species found in *S. paramamosain* in China. The findings expand the known biodiversity of parasitic isopods and contribute to understanding the host-parasite associations within this commercially significant crab species in the region.

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2.20 Construction and Application of Coastal Remote Sensing Monitoring Datasets for the China-ASEAN Cooperation

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Abstract: To address the challenges of insufficient ecological monitoring, unclear shoreline evolution patterns, and inadequate coordinated marine disaster management in the coastal areas of the Beibu Gulf and ASEAN regions, this study adopts multi-source remote sensing observation technology to systematically construct a series of remote sensing datasets for the Beibu Gulf and ASEAN areas. The core achievements include three key aspects. Firstly, it provides coastal remote sensing datasets, such as mangrove, tidal flat and marshes. Secondly, it offers long-term dynamic monitoring datasets of coastline evolution. Thirdly, it sorts out and analyzes the evolution of marine disaster prevention and control policies. These results have launched cross-border scientific cooperation between China and ASEAN. It provides reliable data support and practical methods for coastal ecological restoration, rational shoreline resource utilization and joint marine disaster prevention in China and ASEAN. It also promotes in-depth maritime cooperation and helps build a sustainable cross-border marine ecological community between China and ASEAN.

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2.21 Enzymes shape organic and inorganic carbon pools in seagrasses: implications for blue carbon

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2.22 From Trash to the Policy Table: Leveraging Marine Debris Data for EPR and Plastic Waste Management

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Abstract: Marine debris is one of Thailand's most pressing coastal environmental challenges, requiring evidence-based policies that address plastic pollution at its source. The Department of Marine and Coastal Resources (DMCR) has established an integrated nationwide marine debris monitoring program comprising standardized beach litter and brand audit surveys, floating debris monitoring, river-mouth plastic monitoring, assessments of impacts on endangered marine species and coral reef ecosystems, and marine microplastic monitoring. Together, these complementary datasets characterize debris abundance, composition, sources, leakage pathways, and environmental impacts while supporting Thailand's reporting under SDG indicator 14.1.1b.

Beach litter and brand audit surveys conducted across 20 representative sandy beaches identified 1,606 brands during 2024-2025, with the top 20 brands accounting for approximately 32% of all branded litter, highlighting priority products and producers for targeted interventions. River-mouth monitoring estimated an average annual leakage of 1,274 tons (104.8 million items) of floating debris from five major rivers into the Upper Gulf of Thailand, providing evidence for upstream waste interception and evaluation of Extended Producer Responsibility (EPR) measures. Monitoring of stranded marine animals revealed that 21.5% were affected by marine plastic debris in 2025, while coral reef surveys identified debris types and associated human activities requiring site-specific management.

Collectively, these monitoring programmes provide the scientific foundation for Thailand's forthcoming EPR legislation by identifying priority materials, products, leakage pathways, and responsible stakeholders, thereby supporting evidence-based plastic waste management, circular economy strategies, and long-term policy evaluation.

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3. Marine Geosystem Science and Disaster and Mitigation

3.1 A Record of Clay Mineral Sources and Environmental Changes in the Sunda Strait Since the Early Holocene: A Multi-Indicator Study of the BS-5 Core

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Abstract: As a key conduit linking the South China Sea and the Indian Ocean, the Sunda Strait preserves sedimentary archives critical for understanding tropical seaway water-mass exchange, sea-level fluctuations, and monsoon evolution. This study proposes a high-resolution multi-proxy investigation of Core BS-5 from the Sunda Strait, aiming to reconstruct provenance evolution and its driving mechanisms since the Early Holocene. We will systematically analyze clay mineral assemblages (primary proxies), supplemented by major/trace elements and grain-size distributions, to distinguish sediment sources from adjacent river systems (e.g., Sumatra rivers, Java rivers) and surrounding shelves, and to assess variations in chemical weathering intensity and sedimentary dynamics under different climatic phases. A robust chronological framework will be established using AMS ^{14}C dating, and end-member modeling of grain-size components will be applied to link mineralogical signatures to seaway closure/opening, sea-level oscillations, and monsoon circulation changes. Although final results are pending, we anticipate that clay mineral ratios (e.g., illite/smectite, kaolinite content) will reveal changes in terrigenous input during the Early Holocene transgression, with a potential peak in chemical weathering during the Holocene Climatic Optimum (~9-8 ka BP) followed by a gradual decline thereafter. Furthermore, elemental proxies (K/Al, Ti/Ca) are expected to further constrain the response of sediment source-to-sink processes in the strait to regional hydrodynamic conditions. This work will provide new insights into sedimentary responses of tropical straits under the Holocene highstand system tract.

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3.2 Sea-level changes control coastal organic carbon burial in the southern East China Sea during the late MIS 3

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Abstract: Coastal depositional systems are major sinks for terrigenous organic carbon (OC), with deltas and coastal mud belts representing some of the most efficient global OC burial hotspots. However, understanding long-term variations in coastal OC burial remains challenging because modern observations capture only present-day conditions. Marine Isotope Stage 3 (MIS 3), a distinctive interval of the last glacial period marked by a prolonged sea-level fall and millennial-scale climate oscillations, provides an opportunity to investigate how sea-level and climate variability regulate coastal OC burial. Here, we investigate late MIS 3 strata beneath the southern East China Sea using total organic carbon, total nitrogen, stable carbon isotopes, and major and trace element geochemistry. Our results show that relative sea-level changes govern sediment provenance and depositional processes, which together exert primary control on coastal OC burial. Contrary to the conventional view that OC burial is enhanced during transgression or high sea-level conditions, sediments deposited during relatively high sea-level intervals of late MIS 3 contain the lowest OC contents and burial fluxes, reflecting long-distance transport from distal sources. In contrast, the highest OC burial occurs during sea-level lowstands, when short-distance transport, greater contributions from local sources, and sediment delivery by monsoon-driven mountainous rivers with frequent flooding maximize OC accumulation. Short-lived warming events further enhanced OC burial by intensifying precipitation and increasing nutrient and organic matter supply from both terrestrial and marine sources. These findings challenge the traditional paradigm linking high sea level with enhanced carbon burial and demonstrate that the interaction of sea-level fluctuations, sediment routing, and abrupt climate events controlled coastal OC burial during late MIS 3.

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3.3 Machine Learning Reveals Spatial Patterns and Stocks of Surface Sedimentary Organic Carbon in the South China Sea

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Abstract: Organic carbon in marine sediments represents an important component of regional carbon inventories, yet its spatial distribution among geomorphic units remains poorly resolved in low-latitude marginal seas. We integrated 3,382 surface-sediment total organic carbon (TOC) observations with environmental predictors in a machine-learning framework to map TOC across the South China Sea and estimate its stock in the upper 10 cm. Predicted TOC ranged from 0.03% to 2.02% and averaged 0.63 ± 0.26%. Mean TOC differed markedly among geomorphic units: 0.51% on the shelf, 0.74% in the deep-sea basin, and 0.83% on the slope. Rather than declining monotonically offshore, high-TOC areas formed multiple enrichment centers in subaqueous deltaic and shelf-mud depocenters, localized slope zones, and the central deep-sea basin. Predictor importance and model responses indicated contrasting depositional regimes. Shelf TOC was primarily associated with grain-size sorting and shallow-water hydrodynamics; slope TOC with particulate organic matter supply, hydrodynamic redistribution, and water-mass structure; and deep-sea basin TOC with marine productivity, fine-particle settling, and depositional stability. The estimated stock was 1.94 Pg C (95% uncertainty interval: 1.21-2.83 Pg C), with the shelf, slope, and deep-sea basin accounting for 45%, 39%, and 16%, respectively. These findings provide a quantitative characterization of surface-sediment organic carbon distribution and stocks in the South China Sea and a basis for comparable assessments in other geomorphically heterogeneous marginal seas.

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3.4 Sedimentary environment changes in Chinese continental margin during the Quaternary period

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Abstract: The sedimentary environment of the shallow continental shelf offers key insights into past sea level changes, climatic fluctuations, and regional tectonic activity at orbital timescales. In this study, we conducted detailed chronological and sedimentological investigations on sediment cores from the Bohai Sea and the Yellow Sea. By applying astronomical tuning techniques, we constructed high-resolution age frameworks spanning the last ~1 million years. Analyses of sediment characteristics and environmental proxies reveal cyclic transitions between shallow marine and coastal/alluvial depositional settings, primarily driven by glacial-interglacial sea-level oscillations. These findings support previous models that emphasize sea-level variation as the primary control on sedimentary succession in this area. Notably, while only long-period (~100 kyr) sea-level signals are recorded in the South Yellow Sea cores, both 100 kyr and shorter-term (~40 kyr) cycles are evident in the shallower Bohai Sea sediments. Although regional differences exist, this study indicates that the sedimentation patterns across the eastern Chinese continental margin have consistently responded to sea-level dynamics over the past million years.

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3.5 Subaqueous delta evolution of Minjiang River estuary and its response to human activities

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Abstract: The river delta is a sensitive area of land-ocean interaction and also the area with the most intensive human activities. With further economic and social development, the estuaries have become a key area for development and utilization of resources. This study takes the Minjiang River Estuary in China as the research object and analyzes the characteristics of erosion and accretion processes of the Minjiang River estuary subaqueous delta over the past 40 years by comparing the water depth data of different periods extracting from nautical charts. The research results indicate that the subaqueous delta of the Minjiang River estuary experiences erosion first, accretion later, and then erosion again since 1983. In terms of spatial scale, overall, nearshore areas exhibit accretion, which gradually transforms into erosion as the distance from the coast increases. In recent years, due to intensive human activities, the sediment flux discharged into the sea by the Minjiang River has gradually decreased, leading to erosion in the subaqueous delta of the Minjiang River. The extraction of marine sand in the estuary area has further intensified the erosion of the subaqueous delta. However, the construction of dyke has led to accretion near the dyke.hts into sedimentary responses of tropical straits under the Holocene highstand system tract.

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3.6 Storm-induced diverse morphological and sedimentary processes of sandy-muddy transitional beaches

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Abstract: Sandy-muddy transitional beaches (SMT-Beaches), widely distributed along mid- to low-latitude coasts, are a special type of beaches between sandy beaches and tidal mudflats, characterizing by the exposed sand-mud transition (SMT) boundary during low tidal periods. Considering the resuspension and transport of both cohesive mud and non-cohesive sand during SMT migrations, the morphodynamic processes of SMT-Beaches are anticipated to present diverse responses to various storms that are still poorly understood. This study mainly focuses on the diverse morphological changes of SMT-Beaches and their contrast responses to different storms. Based on repeated monitoring of beach profile morphology and SMT distributions before and after multiple typhoon events along the western coasts of the Taiwan Strait, Southeast China, we quantitatively analyze the SMT migration magnitude, beach profile volume changes, and their relationships with sediment grain-size composition variations. During Typhoons Maria (No.201810), Gaemi (No.202403), and Kong-rey (No.202421), the SMT-Beach profiles at the Min River estuary were dominated by upper erosion and lower accretion, and present increased change magnitude with typhoon intensity. The SMT boundary mainly migrated seaward with some specificity of no significant correlation with beach erosion/accretion. In contrast, a SMT-Beach at the Jiulong River estuary experienced overall accretion during the passage of Super Typhoon Doksuri (No.202305), followed by a morphological transition with upstream erosion and downstream accretion. Preliminary results indicate that the variability of SMT-Beach morphological responses to storm events is influenced by typhoon intensity, headland-bay morphology, and sediment characteristics, and is also partly correlated to water levels at the time of storm landing. These new findings are of great significance for better understanding the morphodynamic processes and evolutionary patterns of SMT-Beaches.

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3.7 Intensified coastal erosion enhances black carbon release and offshore burial on continental margins

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Abstract: Black carbon (BC) is an important refractory component of the global carbon cycle and is traditionally considered to reach marine sediments through riverine transport and atmospheric deposition. However, the contribution of coastal erosion to sedimentary BC burial remains poorly constrained. We developed a regional BC mass-balance framework by integrating measured BC concentrations with independently constrained sediment accumulation rates and river sediment fluxes in the Inner Gulf of Thailand (IGoT). The results indicate that riverine input alone cannot account for the observed BC burial, with shoreline erosion contributing approximately 14.8% of total sedimentary BC burial. Application of the same framework to the East China Sea yielded a comparable contribution (12.4%), suggesting that erosion-derived BC represents a consistent rather than site-specific component of vegetated coastal systems. A first-order global extrapolation based on shoreline retreat rates, vegetated coastal distributions, sedimentary organic carbon inventories and compiled sedimentary BC abundance further suggests that approximately 0.97 ± 0.28 Tg BC yr^{-1} may be mobilized from vegetated coastlines worldwide. Extension of the framework to the East Siberian Arctic Shelf indicates a comparable contribution of erosion-derived BC in the non-vegetated but permafrost-dominated coasts and suggests a pan-Arctic BC mobilization of approximately 3.08 ± 1.84 Tg yr^{-1}. These findings identify coastal erosion in the global-scale as a previously overlooked pathway linking terrestrial BC reservoirs with long-term marine sedimentary sinks and provide a more complete framework for understanding sediment source-to-sink processes and land-ocean carbon transfer under accelerating coastal change.

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3.8 Uranium Comminution Ages as Denudation Chronometer in Tectonically Active Orogens

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Abstract: Physical denudation couples mechanical erosion with chemical weathering and exerts a primary control on long-term carbon cycling. Nonetheless, quantifying denudation in quartz-poor, tectonically active terrains is hindered by the inapplicability of cosmogenic 10Be. Uranium-series comminution ages offer an alternative, yet their accuracy is compromised by pre-existing bedrock 234U depletion and spatial source heterogeneity. We develop a flux-weighted effective initial ratio ($A0^{eff}$) that integrates discrete bedrock measurements along the contributing reach. Applied to 12 detrital samples from the Asahan and Batang Toru rivers (Sumatra), $A0^{eff}$ correction collapses comminution ages from 11-250 kyr to 0-52 kyr, yielding catchment-scale denudation rates of 0.08-2.29 $mkyr^{-1}$ assuming steady-state regolith thickness. Inverse application of the same steady-state relationship to a 75-ka sediment core from Taiwan reconstruct transient residence times that lengthen markedly during East Asian Summer monsoon intensification. This framework establishes uranium comminution ages as a quantitative denudation chronometer for quartz-poor active orogens.

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3.9 Investigating the Supply-Demand Transmission Mechanism of Ecosystem Services in Mitigating Soil Erosion through Ecological Measures and Its Implications for Ecological Engineering

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Abstract: Soil erosion is a major environmental challenge in the Three Gorges Reservoir Area (TGRA), posing serious threats to agricultural productivity, water quality, and ecosystem sustainability. This study investigates the supply-demand transmission mechanism of soil erosion risk mitigation based on ecological measures and applies it to identify ecological compensation priority zones. The Revised Universal Soil Loss Equation (RUSLE) model was employed to evaluate the benefits of ecosystem restoration and rehabilitation in reducing soil erosion risk, while regional socio-economic targets were integrated to quantify demand. The results reveal pronounced spatial heterogeneity in the supply-demand characteristics of soil erosion mitigation services. Higher supply levels were observed in the central mountainous areas, whereas demand was concentrated in downstream plains, particularly around reservoirs and densely populated zones, leading to an overall surplus in supply. The transmission flow model further indicates that soil erosion risk mitigation services generated by ecological measures are transferred across watersheds along hydrological pathways. Key transmission nodes are mainly located in the central mountainous regions of the TGRA, while major transmission corridors follow L2-level and higher rivers extending from the central mountains to the downstream plains. By constructing an ecological compensation priority map based on both stock and flow dimensions of soil erosion risk mitigation, the study identifies the central TGRA as a high-priority compensation zone. It is recommended that compensation funds be allocated preferentially to these areas, as this could enhance vegetation management and transmission efficiency, improving ecological benefits by approximately 60% compared with average funding distribution. Overall, the findings provide important insights for optimizing land management strategies and ecological compensation policies in the TGRA and comparable regions worldwide. Furthermore, the study proposes a combined approach of dynamic transmission modeling and compensation strategies to address spatial mismatches between ecosystem service supply and demand, thereby supporting the development of more effective ecological compensation mechanisms.

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3.10 Sedimentary evolution and its response to climate and sea level changes in the northern South China Sea over the past 60 ka

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Abstract: The South China Sea (SCS) is a key archive for reconstructing past climate variability and air-sea interactions, yet its sedimentary records often yield complex and ambiguous paleoenvironmental signals. This study presents a high-resolution chronological and geochemical reconstruction of Core SCS A01 from the northwestern SCS continental slope, integrating sedimentation rate, mass accumulation rate (MAR), grain size, and elemental proxies to elucidate depositional evolution and its driving mechanisms over the past 60 ka. Three distinct stages are identified. From 60-22 ka BP, fine-grained deposition dominated, with high MAR, elevated K/Al, and low Ca/Ti ratios indicating strong chemical weathering and robust terrestrial supply. Between 22-11.7 ka BP, grain size coarsened while MAR paradoxically decreased; stable K/Al reflected direct shelf erosion, whereas sharply declining K/Ti (18-12 ka BP) and rising Ca/Ti indicate nearshore retention and outer-slope starvation, driven by weakened suspension transport, intensified winter monsoon bottom currents, and transgressive trapping of weathering products on the flooded shelf. Since 11.7 ka BP, fine-grained clay end members again dominated; MAR remained low in the Early Holocene before stabilizing, while K/Ti peaked at 9-8 ka BP during the Holocene Climatic Optimum before gradually declining, reflecting non-linear weathering evolution. Overall, sedimentary evolution in the northwestern SCS since 60 ka BP reflects dynamic coupling among sea-level fluctuations, Red River source-to-sink variability, and monsoon intensity, with millennial-scale events (Younger Dryas, Bølling-Allerød, Heinrich Events 1-2) further modulating short-term depositional patterns. These findings offer new insight into climate-environment-sedimentary coupling on the northwestern SCS continental slope.

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3.11 Integrated assessment of future coastal flood risk from sea-level rise based on shared socioeconomic pathways and storm surge effects in Rayong Province, Thailand

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Abstract: Sea-level rise from climate change is expected to significantly increase coastal flood risks for low-lying communities under the Shared Socioeconomic Pathways (SSPs). Rayong Province in Thailand's Eastern Economic Corridor (EEC) is particularly vulnerable because of its high population density and concentrated economic activity, which may cause substantial future losses. This study assesses spatial coastal flood risk under the climate scenarios SSP2-4.5 and SSP5-8.5 for 2050 and 2100, considering both normal conditions and storm-surge scenarios. Geographic Information System (GIS) integrated with the Analytic Hierarchy Process (AHP) was used to evaluate hazard, vulnerability, exposure, and adaptive capacity. In addition, a sensitivity analysis was conducted to identify the variables that affect overall risk. The results indicate that storm surge is a key factor intensifying coastal flood risk. Scenarios including storm surge (S5–S8) resulted in a significant expansion of high- and very high-risk areas, covering up to 134.60 km² within the total inundated area of 282.37 km² under the SSP5-8.5 in 2100 (S8). These areas were concentrated mainly in Klaeng District, where the exposed population is projected to reach 30,570 people in 2050 (S5). In contrast, although Mueang District had a smaller extent of high-risk areas, it recorded the highest economic losses, reaching US$2,080 million. Moreover, the most influential factors determining coastal flood risk are elevation, followed by land use and household density. Therefore, prioritizing spatial risk management, adaptive planning, and greenhouse gas emissions reduction is essential for strengthening long-term resilience and mitigating the impacts of climate change in coastal areas.

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3.12 Mechanical control of invasive vegetation in China promotes tidal channels development: A case study of the Huanghe (Yellow River) mouth wetland

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Abstract: Invasive species, particularly *Spartina alterniflora*, significantly contribute to the degradation of ecosystem in coastal wetlands. To address this issue, the Chinese government initiated a nationwide *S. alterniflora* mechanical control program in 2020, with the Huanghe Delta designated as a priority region. This intervention profoundly altered boundary conditions for tidal channel networks dynamics. However, the geomorphic response of tidal channel to such intensive anthropogenic forcing remains insufficiently understood. Integrating multi-temporal Sentinel-2 imagery (2019-2023) with comprehensive field surveys, we quantified spatiotemporal evolution patterns of tidal channel networks and their response mechanisms to the mechanical control in the Huanghe mouth wetland. Our findings reveal that mechanical control shifted tidal channel networks from a state of dynamic equilibrium to a phase of rapid development, with accelerated changes in key morphometrics (number, length, frequency, bifurcation ratio, density) exhibiting significant spatial heterogeneity. These transformations were driven by three synergistic mechanisms: (1) Mechanical plowing created numerous depressions that initiated new channels; (2) The altered sediment properties (median grain size coarsened by >100%, clay content reduced to 15.27%) weakened erosion resistance, facilitating channels initiation and expansion; (3) Vegetation removal and elevation loss expanded tidal inundation, promoting channels elongation and bifurcation in mid-upper intertidal zones. This study reveals rapid response of tidal channel networks following large-scale mechanical control, which has not been documented in previous studies. Our findings also provide a transferable framework for predicting geomorphic responses to invasive species management in global deltaic wetlands.

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3.13 Integrated Land-Sea Interaction Monitoring and Its Implications for Coastal Hypoxia in the Upper Gulf of Thailand

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Abstract: Seawater-groundwater interaction is a typical marine geological process occurring in the land-sea transition zone, mainly including seawater intrusion (SWI) and submarine groundwater discharge (SGD). While SWI degrades coastal groundwater quality through salinization, SGD serves as an important pathway transporting freshwater, nutrients, carbon, and redox-sensitive metals from land to the coastal ocean. However, the role of SGD in the development of coastal hypoxia remains poorly understood. Here, we quantified the SGD fluxes across estuarine zones and evaluated the contribution of SGD to oxygen depletion in the Upper Gulf of Thailand (UGOT) using a ^{222}Rn mass balance model and geochemical observations. Our result showed that SGD exhibited strong spatial variability, with a hotspot at the Tha Chin River estuary, where SGD flux reached 0.0312 $m^3/m^2/d$. SGD can directly contribute anoxic groundwater to the nearshore area, thereby reducing the seawater DO concentration. Furthermore, oxidation of SGD-derived redox-sensitive elements and nutrient represents an additional, previously underappreciated oxygen sink. At the Tha Chin River estuary, oxidation of SGD-derived Fe and Mn alone consumed up to 0.795 ± 0.11 mg O_2 m^{-2} d^{-1}. As a dominant but often overlooked driver of hypoxia, SGD should be given due attention in global typical anoxic estuaries. This investigation provides a scientific basis for understanding land-sea interactions in the UGOT and highlights the potential impacts of SGD-derived nutrients, carbon, and redox-sensitive metals on coastal biogeochemical cycles and hypoxia.

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3.14 High-Resolution Inversion of Sub-Bottom Profiling for Subsea Engineering Geological Assessment

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Abstract: The stability assessment of subsea engineering foundations and the safety planning of route corridors urgently require high-precision sediment mechanical parameters. To address the limitations of existing survey methods-such as sparse borehole data and the non-uniqueness of geophysical inversion-this study proposes a Bayesian adaptive weighted fusion inversion method for sub-bottom profiling constrained by borehole data. Within a Bayesian inference framework, the method employs an adaptive weighting algorithm to dynamically balance uncertainties between centimeter-scale borehole measurements and sub-bottom profiles with high lateral continuity, establishing a joint inversion model for acoustic impedance and mechanical parameters of sediment layers. A case study from engineering surveys on the northwestern shelf of the South China Sea demonstrates that the proposed method reduces the acoustic impedance inversion error of sub-bottom profiles to 1.2%, achieving a 75% improvement in accuracy compared to conventional deterministic inversion approaches. The vertical uncertainty in sediment layer interface identification is less than 0.15 m, and the constructed 3D models of compressional wave velocity, density, and shear strength attain sub-meter spatial resolution, meeting the requirements for submarine pipeline burial design and seabed bearing capacity evaluation. This study verifies the efficacy and reliability of the technique as an efficient engineering survey tool, providing critical geological support for optimizing submarine cable routes, selecting offshore platform sites, and assessing the safety of carbon storage locations.

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4. Blue Economy and Sustainable Ocean

4.1 The Modernization and Transoceanic Networks of Chilean Whaling in the Early Twentieth Century

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Abstract: Whaling was one of the major maritime industries along Chile's southern coast. Since the late 18th century, foreign whalers have frequently called at Chilean ports, laying the foundations for the development of Chile's modern whaling industry. In the early 20th century, Norwegian whalers introduced advanced whaling techniques, specialised fleets and industrial modes of production to Chile. Norwegian capital established a number of whaling companies in Chile, contributing to the transformation of Chilean whaling from a regional and coastal activity into a modern industry with the capacity for pelagic operations. This extended the operational range of Chilean whalers further into the South Pacific and the Southern Ocean, gradually creating a transoceanic network of maritime routes, whaling stations, and production activities. The navigational experience, geographical knowledge and spatial practices accumulated by whalers in the Antarctic and its surrounding waters were subsequently incorporated Chilean state policy and territorial discourse concerning Antarctica, becoming part of the historical precedents invoked in Chile's Antarctic territorial claim of 1940. The extension of commercial whaling into Antarctic waters thus forged a distinctive connection between maritime practices and spatial knowledge generated through commercial activity and the state's subsequent perception and articulation of Antarctic territory. Chile's modern whaling industry therefore provides an important case for examining the intersections between global whaling networks, maritime spatial knowledge, and the territorial claims of modern nation-states.

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4.2 Fishing Ground, Periphery, Springboard: Okinawan Fisheries, Southeast Asia, and the Colonial Roots of Ocean Governance (1890s-1945)

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Abstract: From the 1890s to the 1910s, Okinawan fishermen, driven by subsistence needs, spontaneously expanded their operations southward, establishing a civilian fishing network across the Philippines, Borneo, and the Dutch East Indies. After World War I, these fisheries were absorbed into Japan's colonial governance system, systematically integrating Southeast Asian marine resources into Japan's supply chains. From the 1930s onward, under the rhetoric of the "Greater East Asia Co-Prosperity Sphere" and state-sponsored enterprises like Taiyo Fishery Company, Okinawa was repositioned as the "southern gateway" for imperial expansion, and fishing became fully embedded in wartime mobilization, turning Southeast Asian grounds into a frontier of resource plunder. While the southward movement initially arose from market-driven civilian activity, it was instrumentalized by state power after the 1930s for aggressive purposes—a distinction that must not be blurred. More critically, this process inflicted lasting resource deprivation and livelihood disruptions on Southeast Asian coastal communities. Its structural effects—encroachment on indigenous fishing grounds, displacement of traditional tenure, and extreme concentration of marine resource control—persisted well beyond the war, quietly sedimenting into the contemporary maritime order. If the "sustainable production" and "equitable prosperity" championed by today's blue economy ignore this colonial legacy of resource distribution, they risk perpetuating historical injustices under a neutral facade. For Sino-Southeast Asian maritime cooperation, acknowledging this history is indispensable to any genuine commitment to equitable prosperity.

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