

Healthy, Productive and Sustainable Asian Marginal Seas: Understanding changes in the marine environment in response to global climate change

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IOC Sub-Commission for the Western Pacific (WESTPAC-XVI)
Hangzhou, China, 10-12 November 2026

Summary Outline

1. **Justification** and project/WG **duration**
2. Project/WG **objectives**
3. **Major activities and outputs** (particular those accomplished during 2025-2026)
4. **Anticipated activities and outputs** in 2027
5. **Biennial workplan and budget** for 2028-2029, structured around the IOC HLOs
6. **Strategic recommendations** for future development



1. Justification and project/WG duration

Origin, scientific rationale and the 2021-2030 three-stage pathway

Why this programme exists

1 Origin in WESTPAC WG06
The programme is a constructive extension of WESTPAC WG06 (2017-2021), which built regional cooperation and highlighted two shared needs: ocean mixing and long-term monitoring.

2 High relevance to society
Asian marginal seas support productive ecosystems, fisheries and densely populated coasts. Climate change and human activities are altering hydrological and biogeochemical cycles, ecosystems and fishery resources.

3 Transboundary science is essential
Water exchange, nutrient transport and ecosystem responses connect individual marginal seas, so coordinated observations, data exchange and interdisciplinary cooperation are required.

Programme duration

2021-2024 Stage 1
Cooperative interdisciplinary studies; coordinated observations and data sharing

2025-2027 Stage 2
Build on scientific findings and expand communication with fisheries, meteorology and social sciences

2028-2030 Stage 3
Integrate cross-sector communication and deliver recommendations for policy, society and the public

Research flow and timeframe

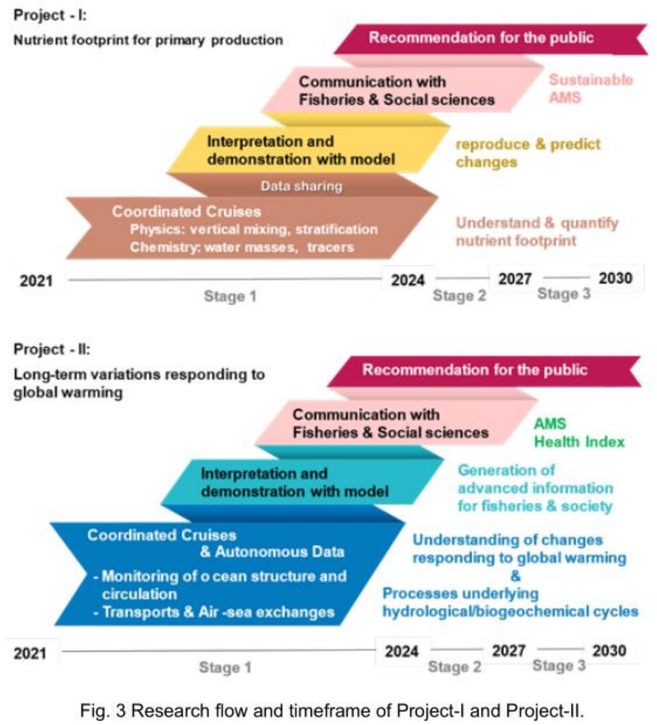


Fig. 3 Research flow and timeframe of Project-I and Project-II.

Both projects move from coordinated science (Stage 1), through cross-sector communication (Stage 2), to public recommendations (Stage 3).

2. Project/WG objectives

Three objectives supported by two science projects and shared regional tools

1

Advance scientific understanding

Biogeochemical processes and hydrographic/circulation change in the AMS under global climate change and warming.

2

Strengthen regional networking

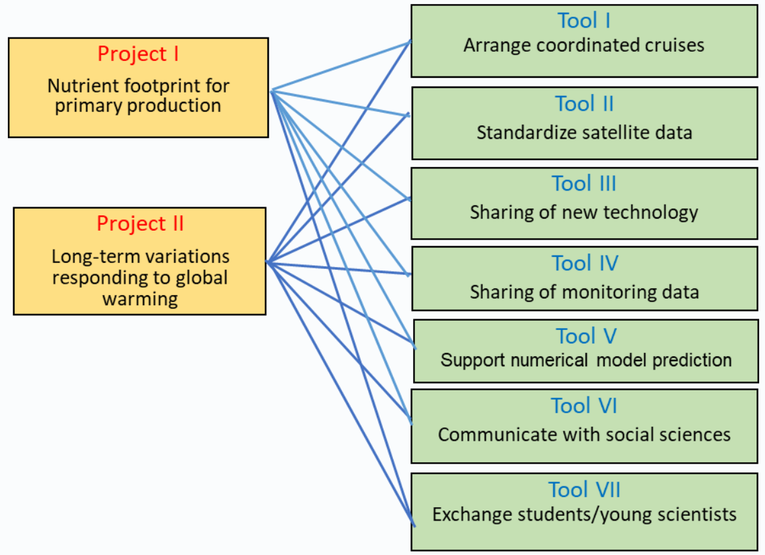
Foster interdisciplinary collaboration among oceanographers, biogeochemists, ecologists and climate scientists on region-specific pressures.

3

Connect science to sustainable management

Provide scientific inputs together with social sciences for policy development and sustainable management of WESTPAC marginal seas.

Implementation architecture: 2 Projects + 7 shared Tools

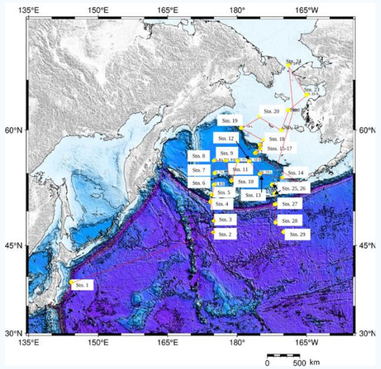


Core projects: land-ocean interaction • ocean mixing • satellite remote sensing

3. Major Activities and Outputs

Current cruise activities — North Pacific and Asian marginal seas (2025–2026)

North Pacific / Bering Sea



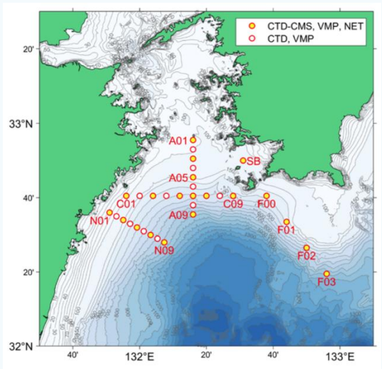
Hakuho-maru KH-25-3

11 Jun–2 Aug 2025

Subarctic oceanic processes, material cycling, and climate-change impacts on marine ecosystems.

N/P/Si • $\delta^{18}O$ • REEs • Nd & Ra isotopes

Kuroshio–Bungo Channel



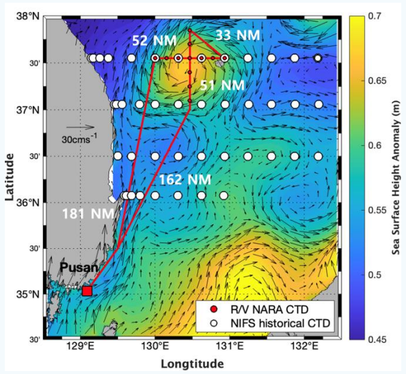
NS25-155, KG-25-14, KS-26-1, KS-26-7, and NS26-173

20-28 Jul 2025 | 28 Oct–6 Nov 2025 | 27 Feb–9 Mar 2026 | 6-12 Jun 2026 | 14-21 Jul 2026

Water-mass distributions, tidal current, turbulent mixing, nutrient supply into the Bungo Channel, and interaction with the Kuroshio Current.

Shared tracers: N/P/Si • $\delta^{18}O$ • REEs • Nd & Ra

Korean east coast



Nara-ho • Ieodo-ho • Onbada-ho

24–28 Mar 2025 | 6–11 Jul & 18–24 Aug 2026

Ulleung Warm Eddy structure, east-coast water masses, and deployment of a tall subsurface mooring.

Mesoscale eddies • boundary current • frontal instability

3. Major Activities and Outputs

2025 — scientific synthesis, publication and regional coordination

2025 at a glance

2 **DAYS**
PICES scientific session

7 **TALKS**
AMS scientific presentations

1 **MEETING**
Business meeting & programme coordination

Follow-up: 2026+ cooperation • data sharing • Steering Group renewal

PICES-2025 Annual Meeting

11–12 November 2025
Yokohama, Japan

Session

Changing ecosystem structure under global climate change: monitoring, detecting, modelling, and socio-ecological impacts

Output: regional synthesis and stronger links with AP-CREAMS and related ecosystem-change research.

2025 AMS Workshop

13 December 2025 • Online

Scientific session

Projects I & II: nutrient footprint, long-term variation, land–ocean interaction and ocean mixing

7 scientific presentations covering the Okhotsk Sea, MSJRK, East China Sea, South China Sea and AMS science history

Sungeun Kim (Maritime geopolitics) presented AMS science history

Business meeting

Agreed follow-up on 2026+ activities, PICES/AP-CREAMS & CSK-II cooperation, data sharing and Steering Group renewal.

3. Major Activities and Outputs

Regional meeting — AOGS 2026 / OS41

2–7 August 2026 • Fukuoka, Japan



OS41

Marine Environmental Changes in the Western Pacific and Its Marginal Seas: Roles of Global Climate Change Versus Anthropogenetic Impacts

Conveners

Jing Zhang • SungHyun Nam • Qian Liu • Chih-Chang Hung • Eisuke Tsutsumi

Focus: separating global climate-change effects from direct anthropogenic impacts on physical, biogeochemical and ecological conditions.

3. Major Activities and Outputs

Regional meeting — 22nd PAMS / 8 Sessions

16–18 June 2026 • Sapporo, Japan

The Pacific-Asian Marginal Seas Meeting 2026

June 16 to 18, 2026 Sapporo, Japan



Keynote Speakers

Vyacheslav (Slava) Lobanov
Hiroyasu Hasumi





Conveners

H-W Shu • J Nishioka • T Nakamura • M Imai • S Cheung • S Otosaka • X. Guo • HK Ha • M Kim • T Senjyu • H Na • B Qiu • H Yang • Y Konodo • SH Nam • S Kida

Presentations

Totally 58 oral talks & 86 posters

Focus: High- and mid-latitude marginal seas, North Pacific, coastal system, Kuroshio and its extension, tropical Pacific

3. Major Activities and Outputs

Academic output — Progress in Oceanography special issue

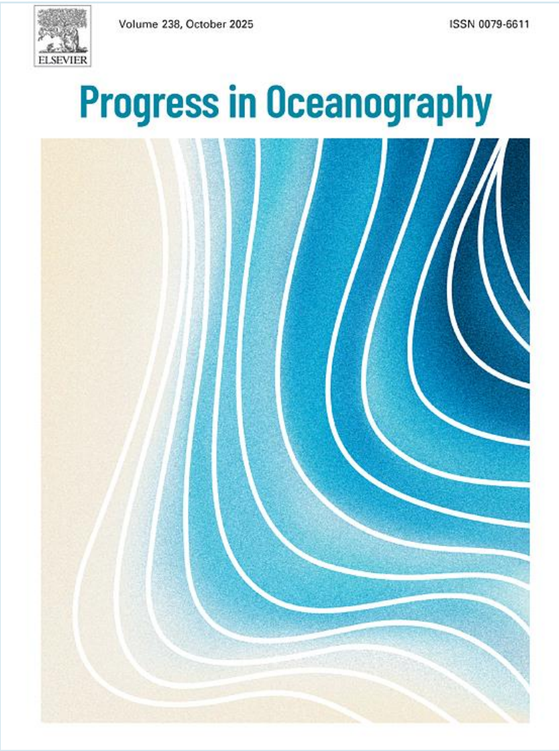
PUBLISHED

Healthy, Productive and Sustainable Asian Marginal Seas: Understanding changes in the marine environment in response to global climate change

45 submissions **22 papers published**

Guest editors

Jing Zhang	University of Toyama, Toyama, Japan,
SungHyun Nam	Seoul National University, Republic of Korea
Qian Liu	Ocean University of China
Akihiko Morimoto	Ehime University, Japan
Vyacheslav B. Lobanov	FSBSI V I Il'ichev Pacific Oceanological Institute, Russia



Progress in Oceanography

Stage 3: from AMS science to management solutions

A problem-driven pathway back to river basins, groundwater and human communities

To achieve Stage 3 impacts, AMS needs to move from broad environmental diagnosis to specific problems that can support government and social management.

1 Stage 3 target

Translate AMS knowledge into policy- and society-oriented recommendations.

2 Specific problems

Focus on heavy metals, nutrients, microbial risks, groundwater vulnerability and exposure pathways.

3 Return to communities

Study where pressures originate and management decisions are made: river basins, aquifers and communities.

Land use / mining / cities → rivers & groundwater → estuaries & coasts → Asian Marginal Seas

3. Major Activities and Outputs

Capacity building — field work across the Asia-Pacific



Mongolia

Oct 2025 & Jul 2026

Atmosphere → NW Pacific

Mining-related pollution, soil contamination and ecosystem impacts



Fiji

Dec 2025 & Jul 2026

River (Tuvatu, Nadi) & groundwater (Nukudamu, Udu Point) → Coast

Pollution from copper and gold mines



Malaysia

May 2026

Sg. Terengganu River Basin → South China Sea

Coliform pollution



National Central University

Dec 2024 & Feb 2026

Groundwater (Taoyuan–Chungli) / Datan Algal Reef

Land-to-ocean material transport via SGD

3. Major Activities and Outputs

Capacity building — workshop at the University of Toyama

Environmental Challenges and Climate Risks in the Asia-Pacific: Material Transport from Land to Ocean

23 September 2026 • University of Toyama, Japan

✓ **Mechanisms & Biogeochemical Processes**

Material transport and biogeochemical cycles from atmosphere to oceans using environmental chemistry.

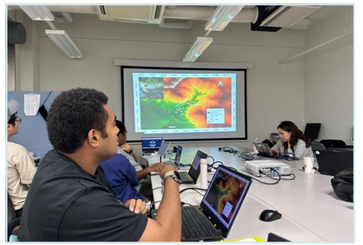
✓ **Societal Development & Regional Risks**

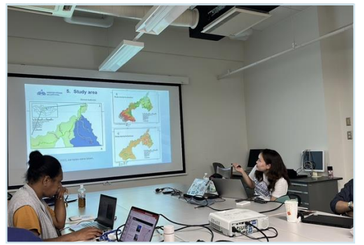
Environmental challenges and pollution risks linked to socio-economic development across the Asia-Pacific.

✓ **Peer-Led Dialogue & International Networking**

Cross-disciplinary networking led by Master's, Ph.D. candidates and early-career scholars.







3. Major Activities and Outputs

Capacity building — regional dialogue and workshop outcomes

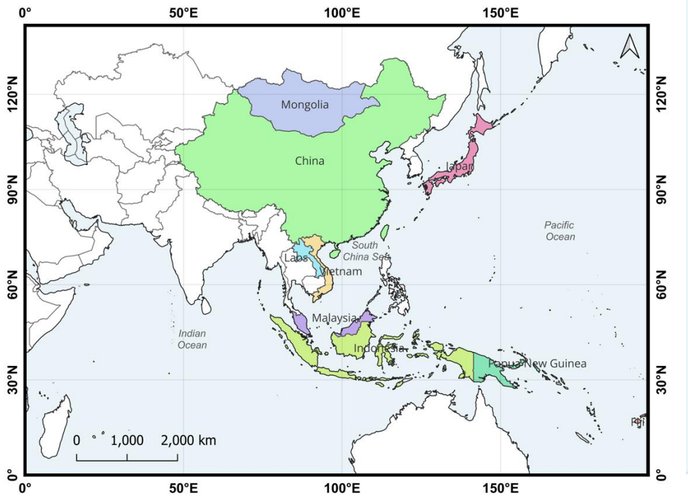
Regional participation

Japan • China • Mongolia • Indonesia • Malaysia • Vietnam • Fiji • Papua New Guinea • Malawi



Co-Chairs

Hirota Katsuda & Batkhuyag Enkhuchral
(PhD candidates)



1 Data access & collaboration

Strengthen regional data sharing through standardized protocols, improved data access, and closer collaboration among participating countries.

2 Capacity building

Build regional capacity through joint field surveys, technical workshops, laboratory training, and exchanges for students and early-career researchers.

3 Science–society engagement & social impact

Connect scientific findings with communities, stakeholders, and decision-makers through outreach, data visualization, and policy-oriented communication.

4. Anticipated activities and outputs in 2027

Three priority activities for 2027

1 Conference

12th WESTPAC International Marine Science Conference & 3rd UN Ocean Decade Regional Conference

20–23 April 2027

Manila, Philippines

AMS-organized Special Session

The Asian Marginal Seas: Key Findings and Integrated Research Perspectives

Conveners

SunHyun Nam — Seoul National University, Korea
Jing Zhang — University of Toyama, Japan
Vyacheslav Lobanov — V.I.Il'ichev Pacific Oceanological Institute, Russia
Eko Siswanto — Japan Agency for Marine-Earth Science and Technology, Japan
Qian Liu — Ocean University of China

2 Capacity building

Regional activities in

Malaysia | **Mongolia** | **Papua New Guinea** | **Malawi**

Joint field work • technical workshops • laboratory training

3 Special issue publication

Target Wiley journals

- *Journal of Geophysical Research: Oceans*
- *Journal of Geophysical Research: Biogeosciences*
- *Global Biogeochemical Cycles*

5. Biennial Workplan for 2028-2029

Source-to-Receptor research on heavy-metal pollution, nutrients, groundwater and climate risks

01 Sources, transport & fate

Trace heavy metals (Pb, Cd, As, Hg) and nutrients (N, P, Si) across atmospheric deposition, runoff, groundwater, rivers and suspended sediments — from source areas to estuaries and coastal waters.

02 Climate–groundwater interactions

Quantify how warming and hydrological extremes alter groundwater recharge, heavy metal and nutrient transport, oxygen depletion and saltwater intrusion; strengthen long-term monitoring and adaptive management.

03 Regional network & policy translation

Expand joint field surveys, monitoring and analytical capacity, technical workshops, laboratory training and student exchanges; convert evidence into water-resource and environmental policy support.

INTEGRATED SOURCE-TO-RECEPTOR FRAMEWORK

ATMOSPHERE
Deposition
Metals & nutrients

›

WATERSHED
urban • mining • agriculture
Metal & nutrient inputs

›

GROUNDWATER + RIVERS
recharge • runoff • metal
Metal & nutrient transport

›

ESTUARY + COAST
sediment • nutrients • hypoxia • salinity

›

ECOSYSTEM + PEOPLE
food web • exposure • health risk

OUTCOME Integrated evidence for sustainable water-resource management, climate adaptation and environmental policy across the Asia-Pacific.

5. Biennial Workplan for 2028-2029

- Detailed outline of planned activities, and deliverables for the next intersessional period

No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2nd H	Y2-1st H	Y2-2nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 1 — HEALTHY OCEAN AND SUSTAINED OCEAN ECOSYSTEM SERVICES									
Expected Result 1.1 (Sub-obj. 1.1): Regional ocean biodiversity and ecosystem observations and FAIR data strengthened									
1.1.1	Harmonize Source-to-Receptor monitoring of Pb, Cd, As, Hg and nutrients across catchments, groundwater, rivers, estuaries and coastal sediments.	Regional sampling/QA-QC protocol, FAIR-ready baseline dataset and metadata package.	•	•	•	•	2000	2250	
1.1.2	Use hydrogeochemical tracers and source apportionment to quantify pollutant pathways and fate from source areas to coastal waters.	Comparable source inventories, pathway maps and cross-basin transport datasets.		•	•	•	1250	1500	
Expected Result 1.2 (Sub-obj. 1.2 + 1.3): Scientific knowledge for ecosystem management developed and ecosystem-based management applied									
1.2.1	Assess contaminant accumulation, food-web transfer and ecosystem / human-health risks at selected watershed-to-coast sites.	Case-study risk maps, exposure indicators and ecosystem / health assessment briefs.		•	•	•	1250	1500	
1.2.2	Synthesize pollution, nutrient and ecosystem responses into indicators for integrated watershed-to-coast management.	Management-relevant indicators and recommendations for healthy, productive coastal ecosystems.			•	•	1000	1250	

5. Biennial Workplan for 2028-2029

- Detailed outline of planned activities, and deliverables for the next intersessional period

No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2nd H	Y2-1st H	Y2-2nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 2 — EFFECTIVE WARNING SYSTEMS AND PREPAREDNESS FOR TSUNAMIS AND OTHER OCEAN-RELATED HAZARDS									
Expected Result 2.1 (Sub-obj. 2.1+2.3): Regional tsunami and multi-hazard early warning systems maintained and strengthened									
2.1.1	Monitor extreme rainfall, floods, droughts, groundwater level / salinity and pollutant pulses at selected coastal basins to complement multi-hazard awareness.	Event-linked time series and environmental indicators that can complement existing regional warning information.	•	•	•	•	1400	1600	
2.1.2	Quantify warming- and extreme-event-driven remobilization of legacy contaminants, including mercury stored in coastal sediments.	Priority-site scenarios and maps of contaminant remobilization under hydrological extremes.		•	•	•	1250	1500	
Expected Result 1.2 (Sub-obj. 2.2 + 2.3): Coastal hazard information products and Tsunami Ready preparedness and enhanced									
2.2.1	Assess groundwater decline, pumping imbalance and saltwater intrusion under sea-level rise and changing recharge conditions.	Coastal-aquifer vulnerability maps and thresholds for water-security risk communication.		•	•	•	1250	1500	
2.2.2	Co-design concise coastal-hazard information products and preparedness / adaptation guidance with local agencies and communities.	Risk briefs, training materials and locally usable response / adaptation recommendations.			•	•	1100	1400	

5. Biennial Workplan for 2028-2029

- Detailed outline of planned activities, and deliverables for the next intersessional period

No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2nd H	Y2-1st H	Y2-2nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 3 — RESILIENCE TO CLIMATE CHANGE AND CONTRIBUTION TO ITS MITIGATION									
Expected Result 3.1 (Sub-obj. 3.1+3.2): Regional ocean-climate observations, data and scientific knowledge enhanced									
3.1.1	Expand long-term monitoring of groundwater level, recharge, hydrochemistry and salinity in snow-fed alluvial plains and coastal aquifers.	Comparable groundwater-climate time series and recharge / water-balance datasets.	•	•	•	•	1500	1650	
3.1.2	Quantify shifts from snowfall- to rainfall-dominated recharge and effects of drought, extreme rainfall, sea-level rise and pumping.	Recharge assessments, climate-sensitivity analyses and groundwater vulnerability maps.	•	•	•	•	1500	1650	
3.1.3	Quantify turbulent mixing under strengthened stratification associated with global warming and/or marine heatwaves.	Establish a water-mass transformation framework for future climate and ecosystem studies.	•	•	•	•	1500	1650	
Expected Result 3.2 (Sub-obj. 3.2 + 3.3): Ocean science integrated into Member States' climate adaptation and mitigation frameworks									
3.2.1	Link climate-groundwater change with nutrient / contaminant transport and coastal responses such as oxygen depletion and oligotrophication.	Coupled watershed-groundwater-coast case studies and process-based synthesis.		•	•	•	1500	1650	
3.2.2	Co-develop adaptive groundwater-management options for industrial, agricultural and municipal water use under climate change.	Management scenarios and adaptation briefs for sustainable groundwater use.			•	•	1100	1300	

5. Biennial Workplan for 2028-2029

- Detailed outline of planned activities, and deliverables for the next intersessional period

No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2nd H	Y2-1st H	Y2-2nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 4 — SCIENTIFICALLY FOUNDED SERVICES FOR THE SUSTAINABLE OCEAN ECONOMY									
Expected Result 4.1 (Sub-obj. 4.1+4.2): Scientific evidence base and knowledge dissemination for the sustainable ocean economy enhanced									
4.1.1	Translate heavy-metal source, transport and exposure evidence into risk profiles for drinking water, fisheries and food security.	Decision-ready risk profiles and priority management actions for water and coastal resources.		•	•		1100	1400	
4.1.2	Develop watershed-to-coast assessments balancing groundwater use, nutrient supply, pollution control and ecosystem conservation.	Case-study management frameworks linking water-resource use with coastal ecosystem condition.	•	•	•		1100	1400	
Expected Result 4.2 (Sub-obj. 4.3): Knowledge-based sustainable ocean planning and management tools developed and applied									
4.2.1	Engage environmental, water-resource and coastal-management agencies in co-designing policy-relevant indicators and recommendations.	Policy briefs, management indicators and stakeholder consultation outputs.			•		1000	1200	
4.2.2	Demonstrate transferable Source-to-Receptor decision-support products across selected partner countries.	Pilot maps / dashboard-style products and a replicable workflow for regional application.			•		1000	1200	

5. Biennial Workplan for 2028-2029

- Detailed outline of planned activities, and deliverables for the next intersessional period

No.	Activity / Output Description	Expected Result / Output	Y1-1st H	Y1-2nd H	Y2-1st H	Y2-2nd H	IOC RP Budget (USD)	XB Required (USD)	Lead Responsibility
HLO 5 — FORESIGHT ON EMERGING OCEAN SCIENCE ISSUES									
Expected Result 5.1 (Sub-obj. 5.1+5.2): Regional foresight capacity on emerging ocean science issues strengthened and communicated									
5.1.1	Establish a regional foresight process for emerging risks at the climate-groundwater-pollution interface across Asian marginal seas.	Biennial horizon scan, priority science questions and a forward research agenda.	•				1000	1200	
5.1.2	Expand joint field surveys, technical workshops, laboratory training and student / early-career researcher exchanges.	Shared methods, training modules and a broader regional network with strengthened analytical capacity.	•	•	•		1100	1400	
Expected Result 5.2 (Sub-obj. 5.2+5.3): Emerging ocean science issues integrated into regional governance and decision-making									
5.2.1	Build FAIR metadata and data pathways linking pollutant, groundwater, river and coastal observations across partner countries.	Discoverable regional data catalogue and comparable synthesis products for emerging issues.	•	•	•		1100	1400	
5.2.2	Translate new evidence into policy dialogues and public-facing communication with governments, stakeholders and regional partners.	Policy briefs, stakeholder dialogues, visibility products and a post-2030 cooperation roadmap.			•		1000	1200	

6. Strategic recommendations for future development

Key insights, lessons learned, and specific recommendations for enhancing the project's impacts and visibility

1 Build a clear Source-to-Receptor identity

Use the atmosphere–watershed–groundwater–river–coast continuum as the project's distinctive scientific narrative.

2 Make regional evidence comparable

Harmonize sampling, QA/QC, tracers and indicators so results from different Asia-Pacific basins can be synthesized.

3 Link climate and pollution risks

Pair groundwater/recharge monitoring with contaminant transport and extreme-event analysis to reveal compound risks.

4 Design policy translation from the start

Co-develop risk maps, groundwater-management briefs and coastal water-quality guidance with relevant agencies and partners.

5 Invest in capacity and co-ownership

Use joint surveys, laboratory training, workshops and student exchanges to build durable partner capability and leadership.

6 Increase visibility with targeted communication

Publish synthesis/data products and use maps, visualizations, conference sessions, web/social media and partner-country stories.