

# Marine Environment Sensing Network:

Expanding Singapore's marine monitoring network for research, education, and collaborations

**International Seminar on UN-GGIM (10th May 2022)**

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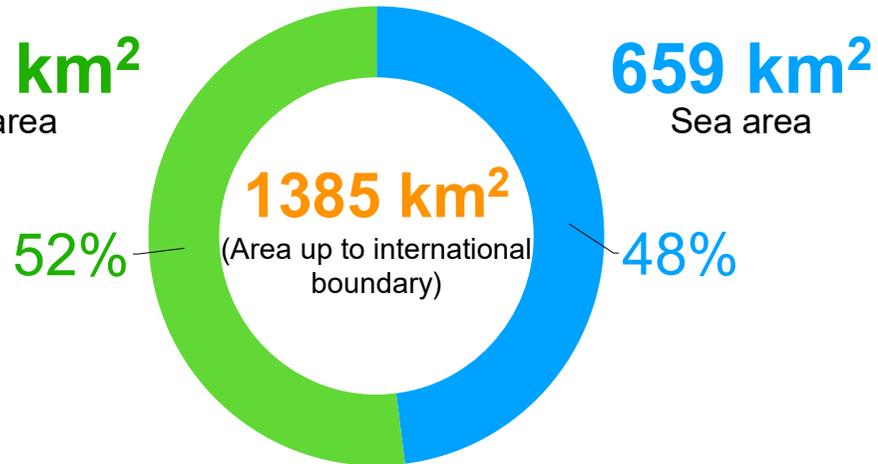


**NATIONAL RESEARCH FOUNDATION**  
PRIME MINISTER'S OFFICE  
SINGAPORE

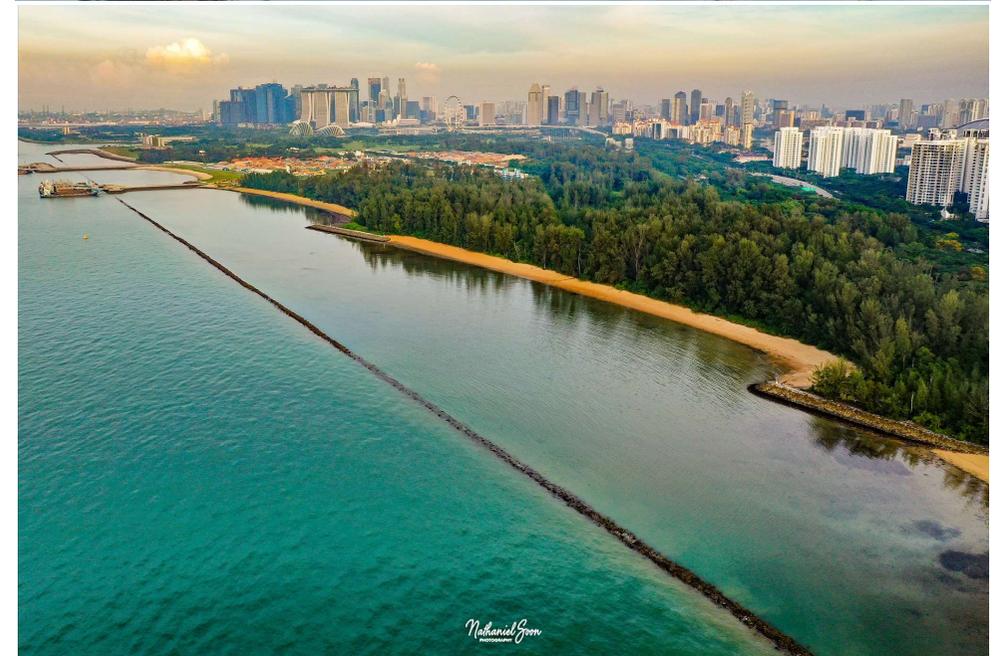
▶ Singapore



**726 km<sup>2</sup>**  
Land area



**659 km<sup>2</sup>**  
Sea area





Sentosa

St. John's Island National Marine Laboratory

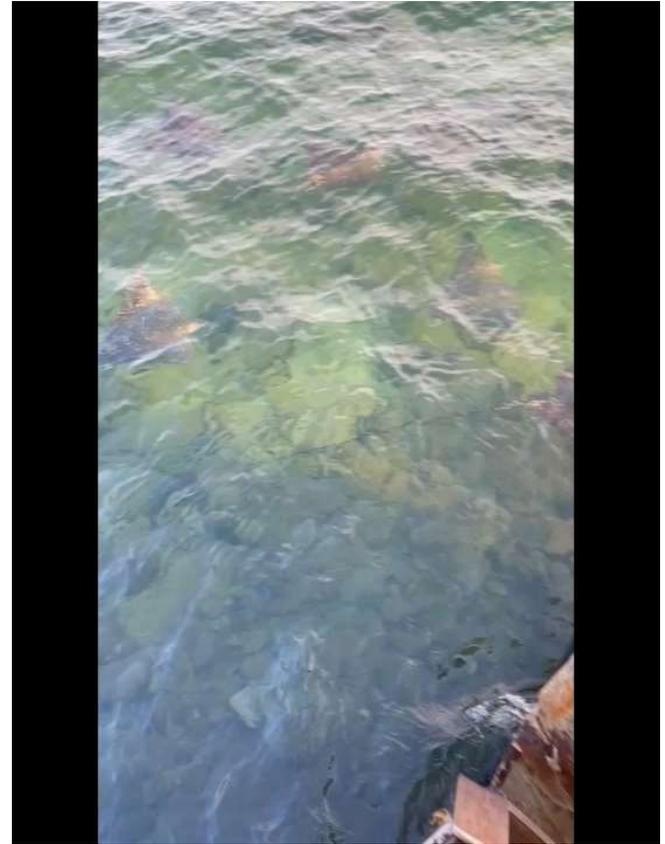


Nathaniel Zoon  
PHOTOGRAPHY



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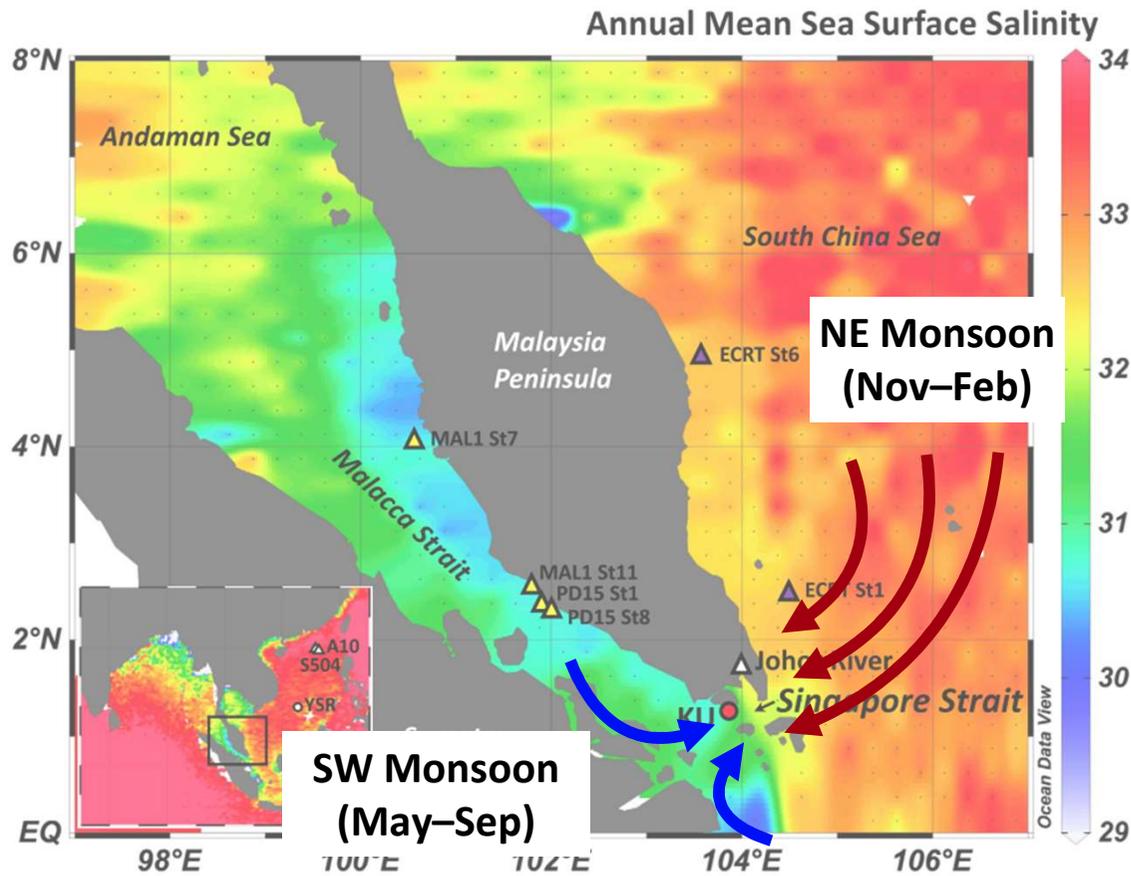
Photos by Jani Tanzil, Nicholas Chew



Nathaniel Zoon  
PHOTOGRAPHY

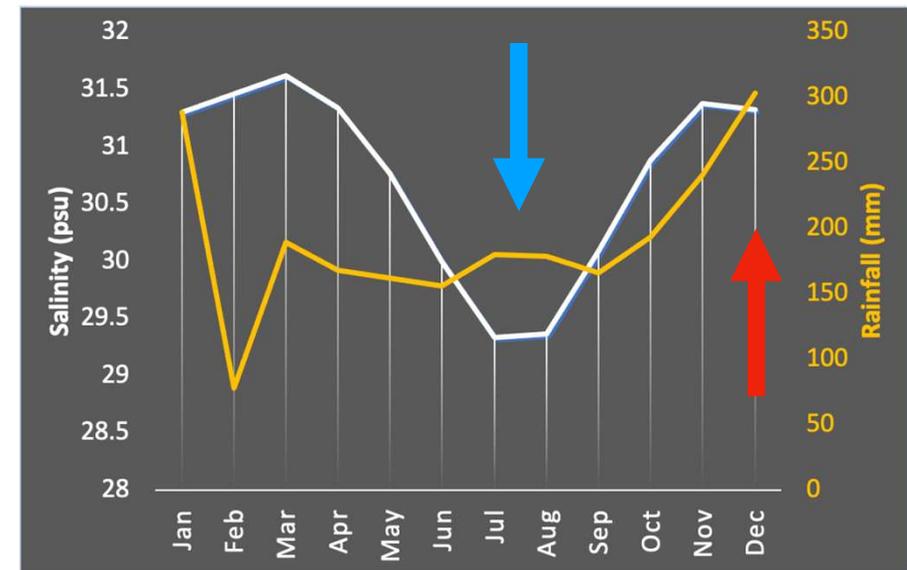
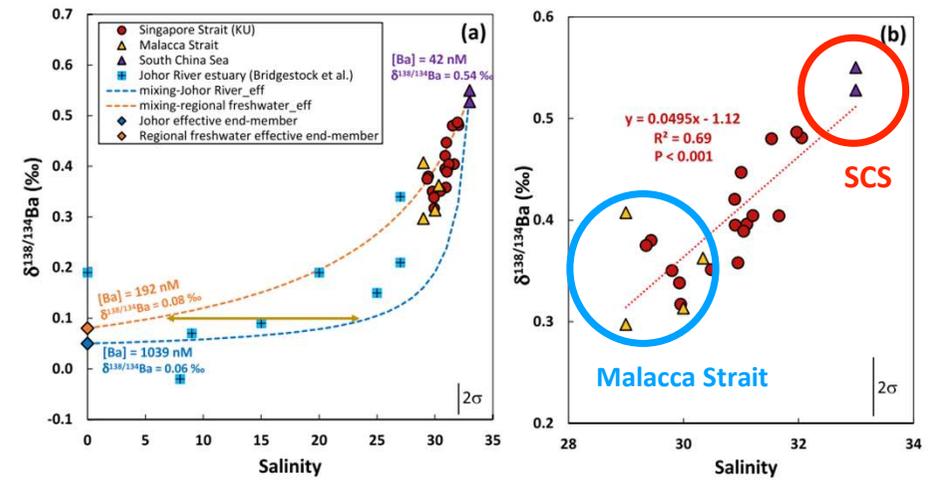
## Singapore's marine environment – Singapore Strait

- Confluence of multiple water bodies
- Monsoon wind-driven water mixing
- e.g. SG Strait salinity minima ~Jun–Sep (lower rainfall)

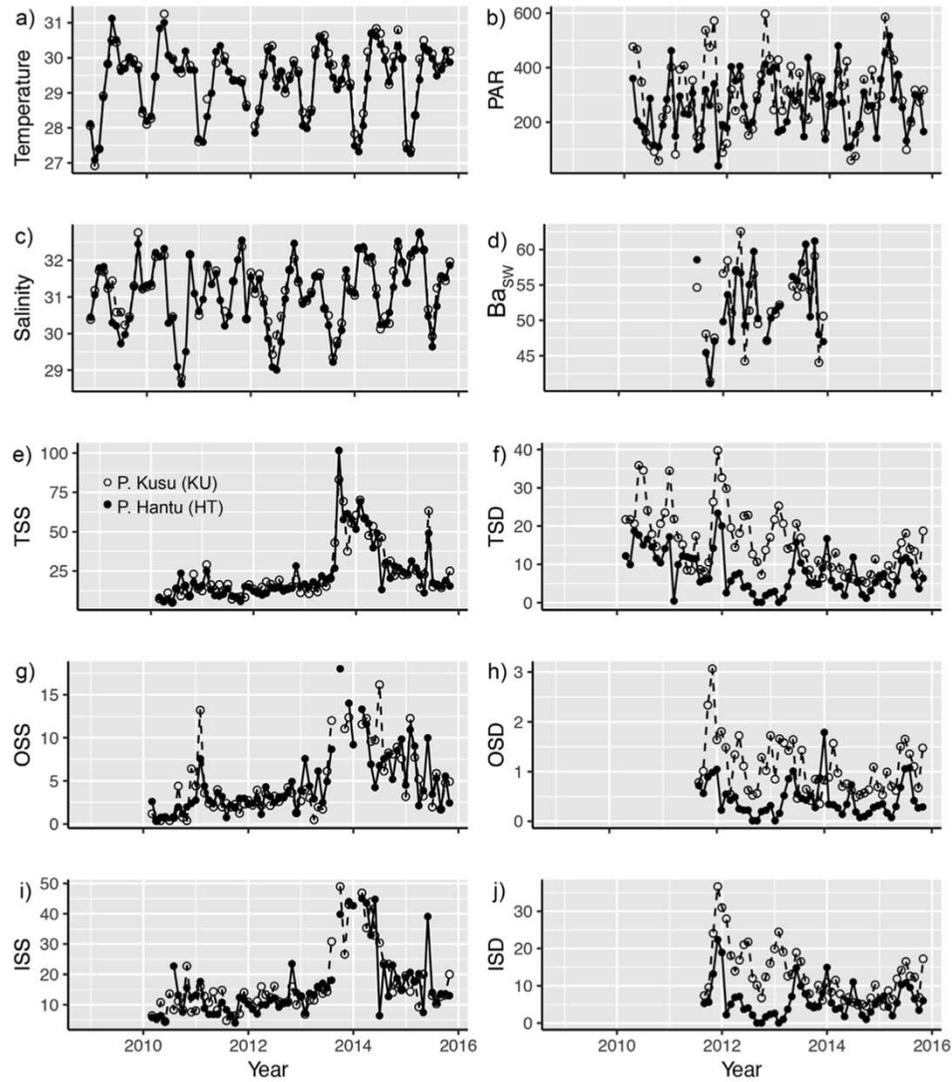


Bridgestock et al. (2021), Hsieh et al. (2022)

## Water mixing end members (Ba isotopic signatures)



# Singapore's marine environment – Singapore Strait

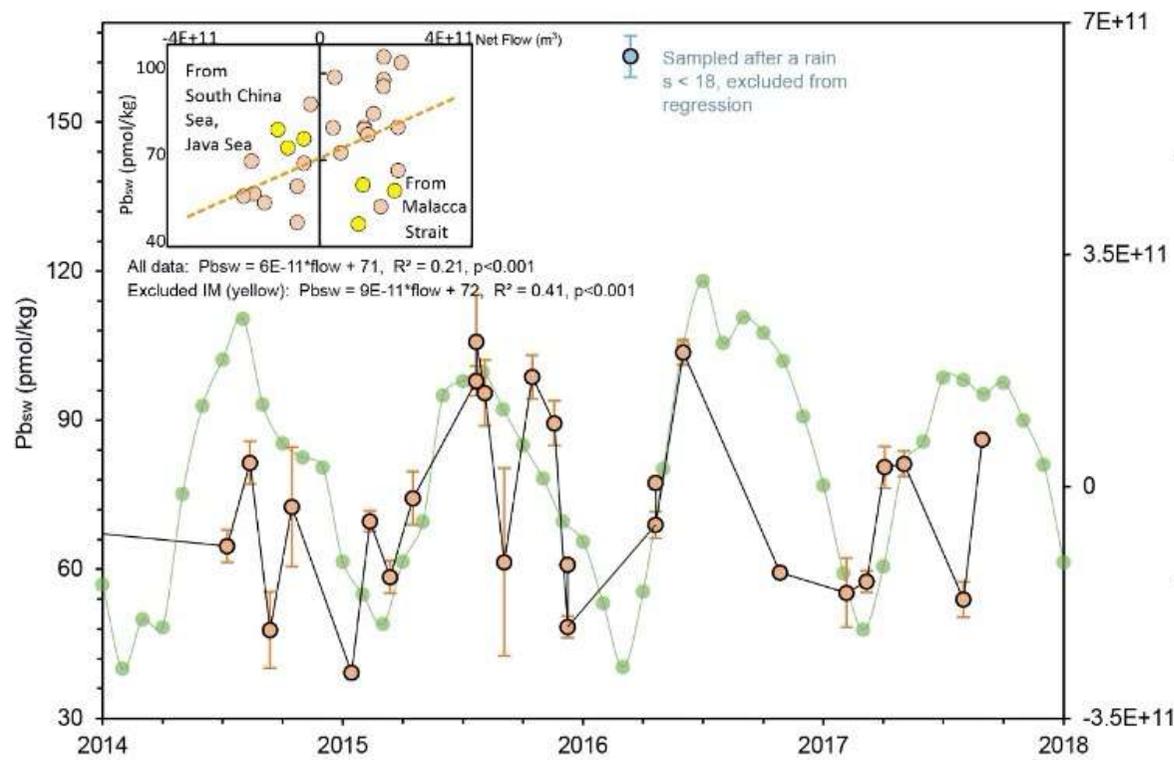


Tanzil et al. (2019)

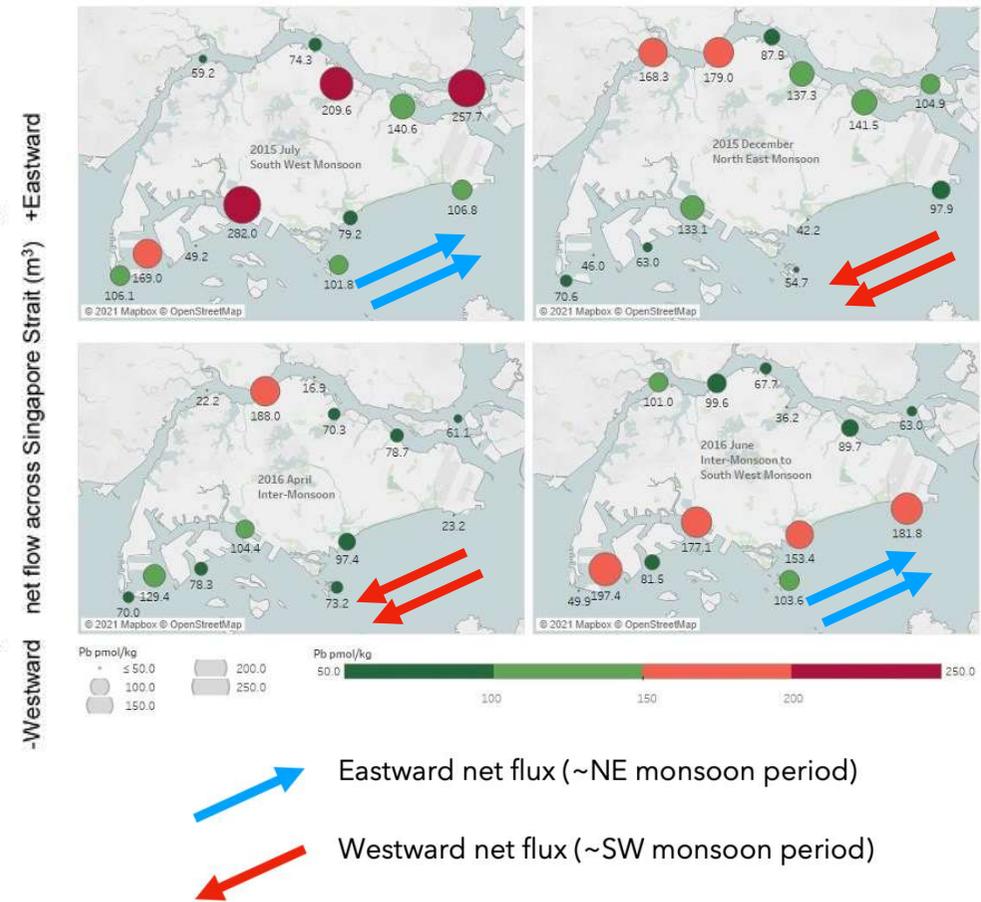


# Singapore's marine environment – Pb

The Pb concentration from Kusu, Singapore Straits from 2014 to 2017 (orange dots) vs. net flow across Singapore Strait (green dots).



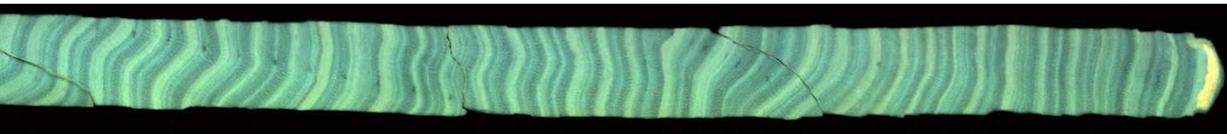
Chen et al. (2022)



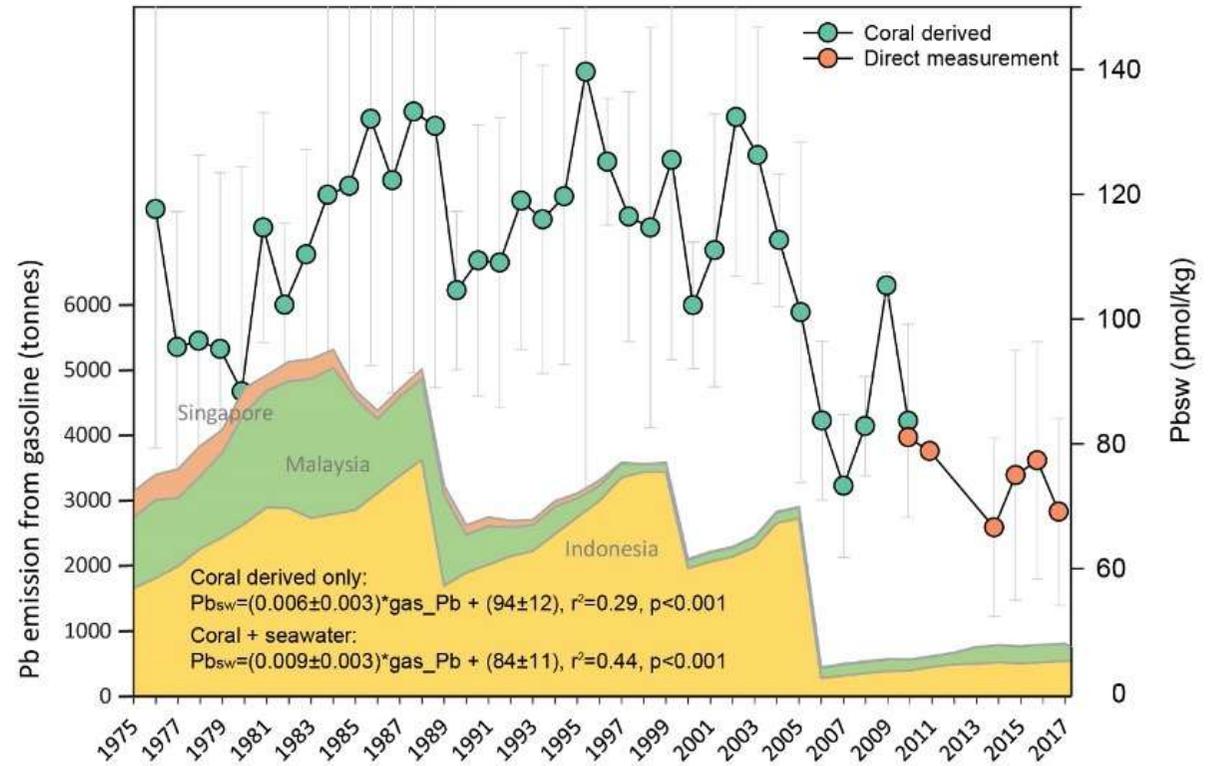
Eastward net flux (~NE monsoon period)  
 Westward net flux (~SW monsoon period)

## Singapore's marine environment – Pb

### Corals as natural archives of the marine environment



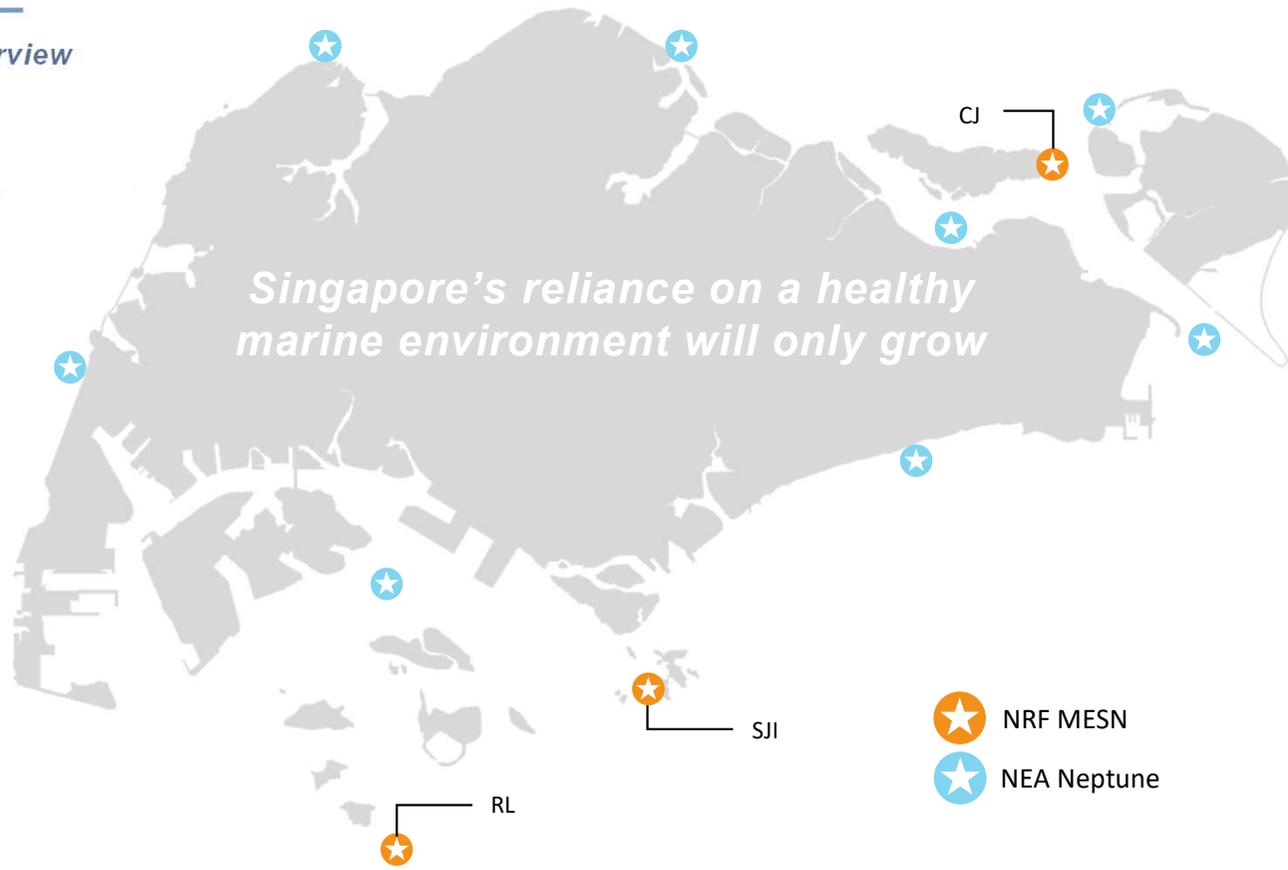
Lee et al. (2014); Chen et al. (2022)



Annually averaged Pb concentration in seawater derived from coral Pb/Ca records (SG coral) and direct measurements (SG Strait) vs. estimated Pb emissions from regional Pb gasoline use.

# MARINE ENVIRONMENT SENSING NETWORK

Overview



CLIMATE CHANGE

NATIONAL & INTERNATIONAL GOALS

MARINE SCIENCE & TECH R&D

## MESN:



**SJINML Stakeholder Meeting, 2018**  
Access to quality long-term, continuous data for research use  
Test-bedding platform for R&D

**Multi-agency workshop, 2019**  
R&D for agencies for future operations  
Baselines & benchmarking

**MESN, 2020–2025**  
Expands SJINML capabilities as NRI  
Expand international research collaborations



### Monitoring and R&D

Buoys for research & test-bedding; complement existing programmes



### Baselines & protocols

Key parameters & emerging threats



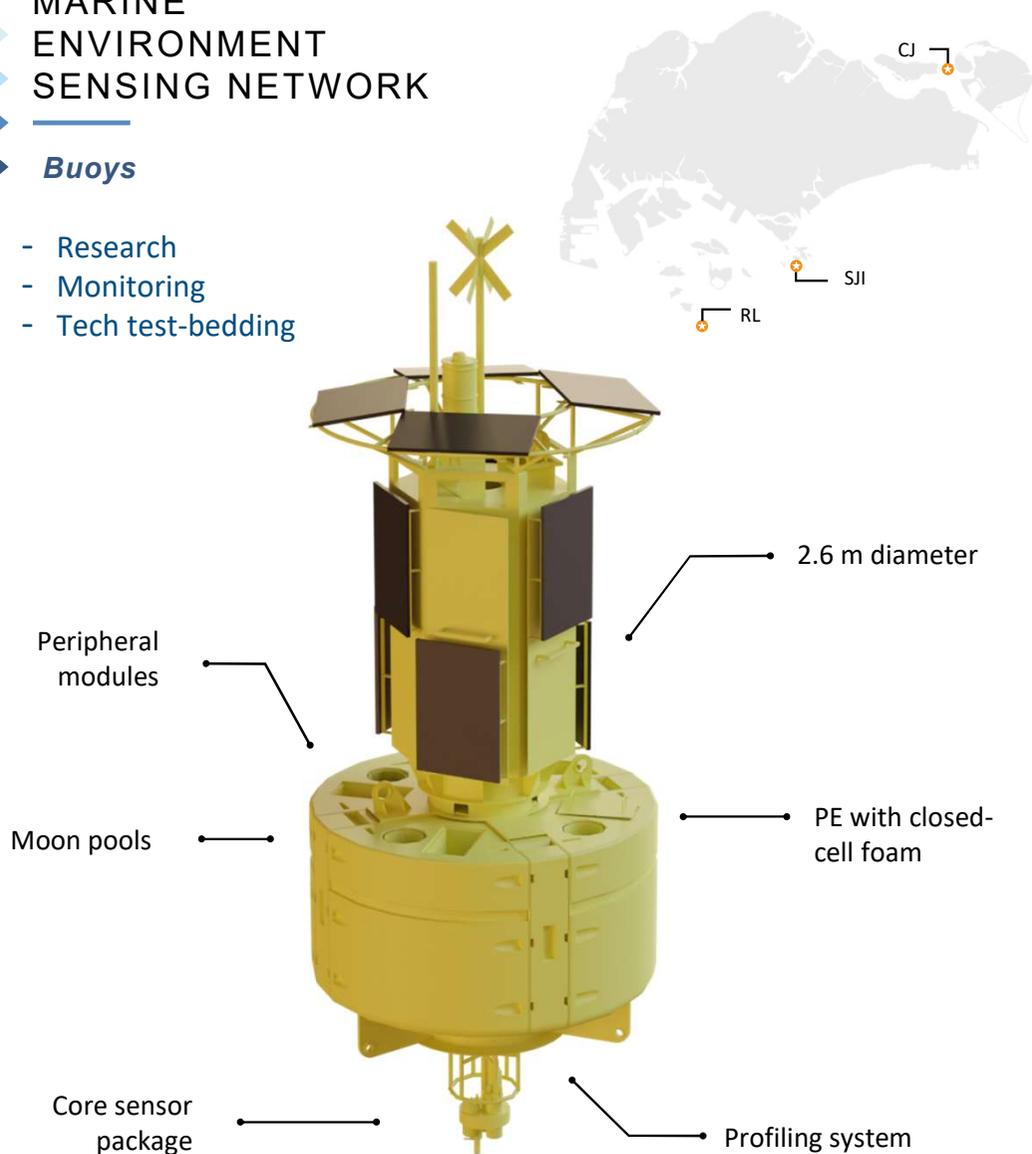
### Data platform for research

Tiered access; catalyse research collaborations

# MARINE ENVIRONMENT SENSING NETWORK

## Buoys

- Research
- Monitoring
- Tech test-bedding



## MESN parameters (real-time sensing)

No.	Parameter
1	Temperature
2	Salinity
3	Dissolved oxygen (DO)
4	Turbidity
5	Hydrocarbon
6	Nitrate
7	Chlorophyll-a
8	Meteorological parameters (pressure, wind velocity, solar irradiance)
9	Current profiling
10	Wave height
11	pH
13	Marine noise (acoustics)
14	CDOM
15	$p\text{CO}_2$

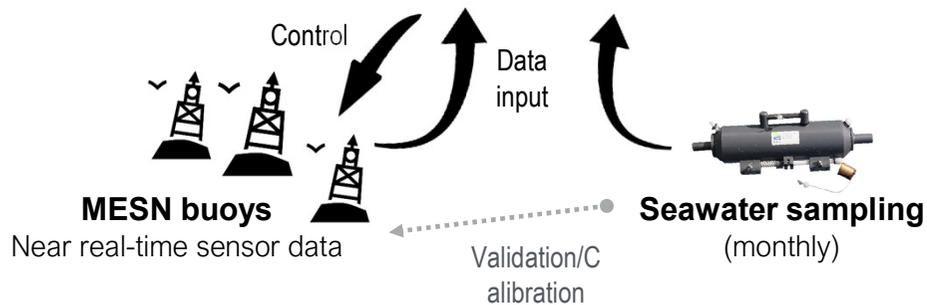
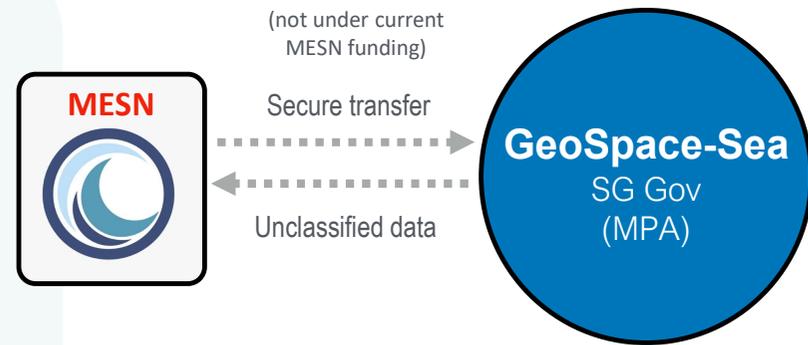
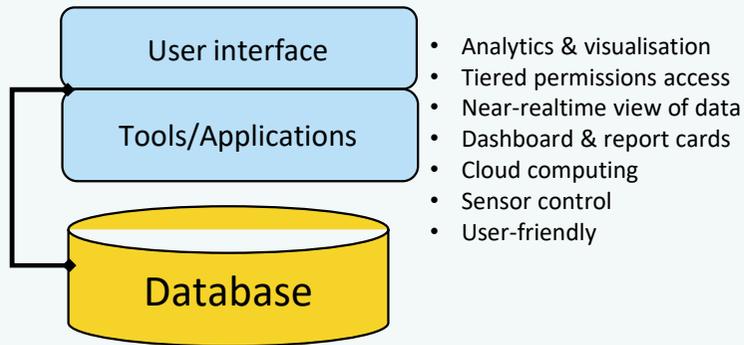
MARINE  
ENVIRONMENT  
SENSING NETWORK

Data platform



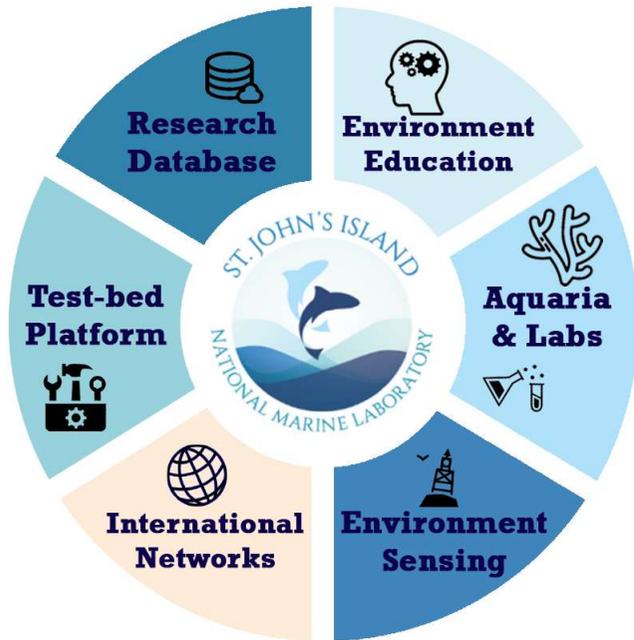
“wave” in Malay

MESN Research Data Platform



# MARINE ENVIRONMENT SENSING NETWORK

## Timeline & Project Team



NATIONAL RESEARCH FOUNDATION  
PRIME MINISTER'S OFFICE  
SINGAPORE

[www.sjinml.nus.edu.sg](http://www.sjinml.nus.edu.sg)

<https://www.nrf.gov.sg/programmes/national-research-infrastructure>

## MESN Team



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SJINML, TMSI, NUS



**Mandar Chitre**  
Co-PI  
ARL, TMSI, NUS



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Lead Engineer  
ARL, TMSI, NUS



**Ooi Seng Keat**  
Co-PI  
EMID, TMSI, NUS



**Choo Hengkek**  
Lead IT Architect  
EMID, TMSI, NUS



**Joleen Chan**  
Project Manager  
TMSI, NUS



**Eddie Tan**  
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I2R, A\*STAR



**Patrick Martin**  
Co-PI  
ASE, NTU



**Wang Xian Feng**  
Co-PI  
EOS, NTU



**Chu Jian**  
Collaborator  
CEE, NTU

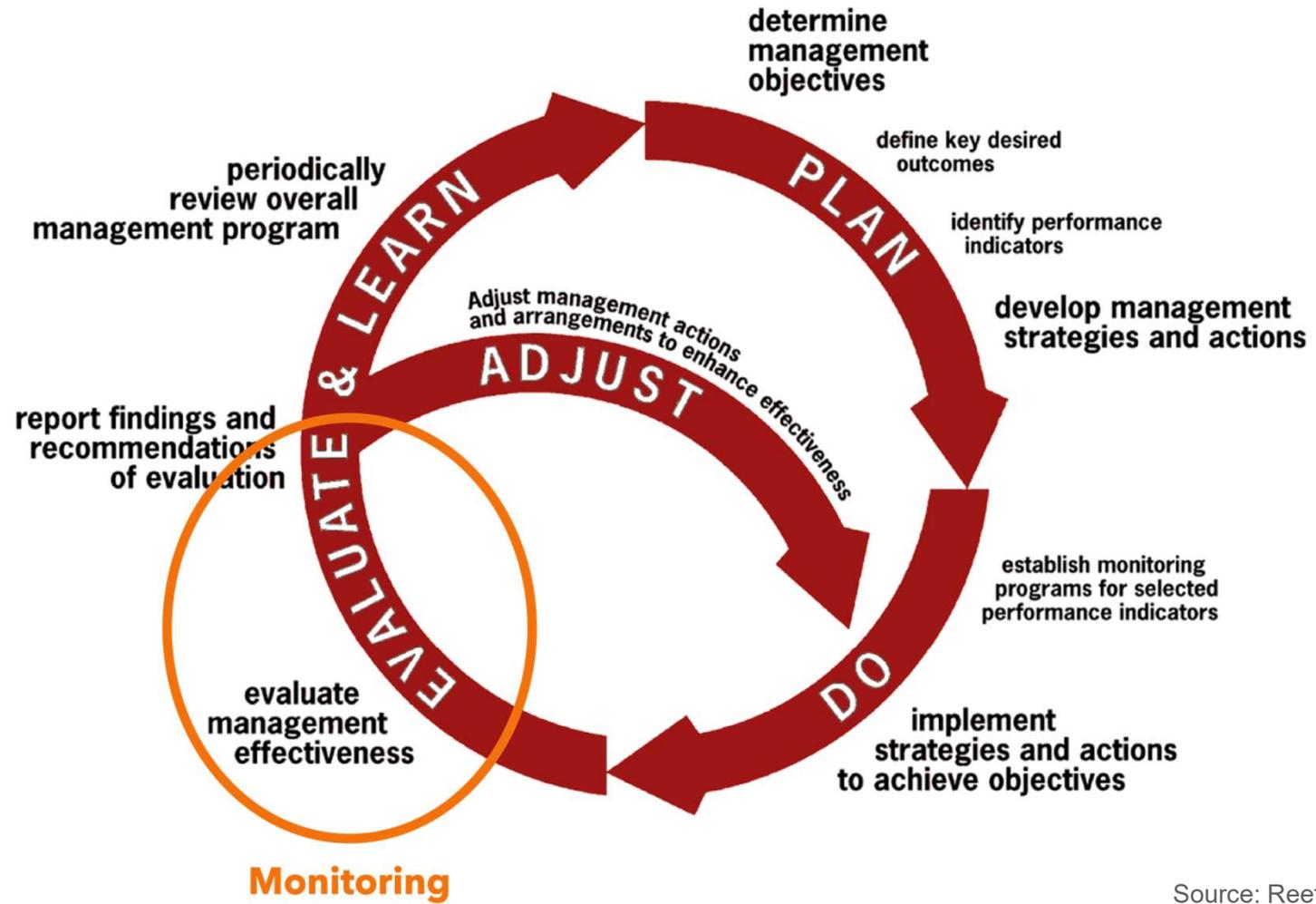


**Pablo Valdivia**  
Collaborator  
SUTD



**Malika Meghjani**  
Collaborator  
SUTD

# Adaptive management & the importance of sustained long-term monitoring

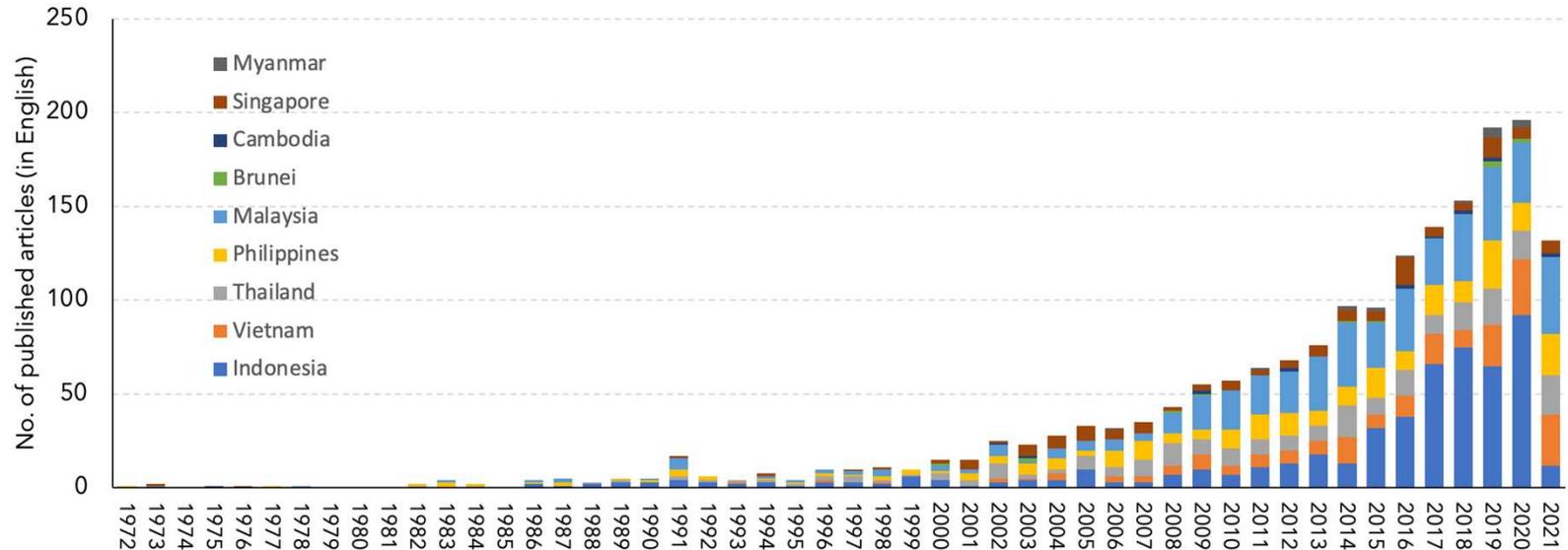
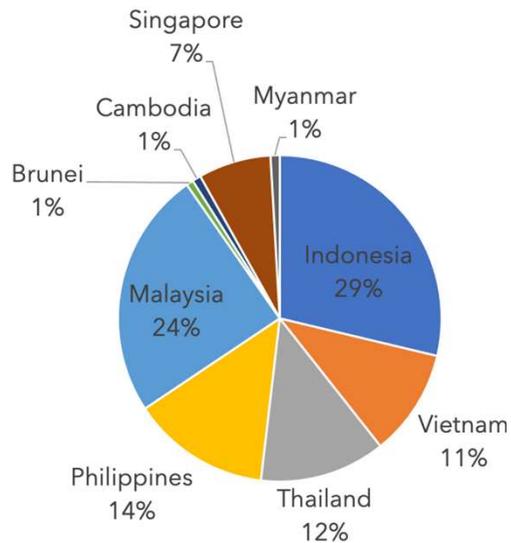


Source: Reef Resilience Network

## Regional efforts

### Review of marine environment research and monitoring efforts in Southeast Asia

Published articles by country (in English)



Review and consolidate past and ongoing regional efforts in marine environmental studies and monitoring (as part of MESN research project). Summarise efforts – research, governmental, NGOs/citizen science.

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# Towards a research inventory (e.g. Marine Plastics)

<https://mapla-riv.web.app/>

## Data & Analytics

Click on the tiles below to explore the RRI 2.0, featuring charts and graphs that were generated to visualise the data.

The data included in RRI 2.0 are constantly evolving. Your participation is essential to making this resource more accurate, comprehensive and useful. You can do that by providing feedback on existing data, or sending any other queries or suggestions.

The RRI 2.0 can be accessed [here](#).



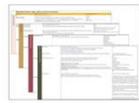
Custom Data-Substet

Search and filter through a sub-section of the data contained in RRI 2.0 which best respond to your interest



Research Landscape

Explore charts and graphs on the profile of research conducted on marine plastics in the seas of Southeast and East Asia, including research areas and capability



Methodology and Ontology

Consult the methodology and database ontology adopted to develop RRI 2.0



Scientific Research

Explore charts and graphs on the characteristics of scientific research publications



Research in Humanities

Explore charts and graphs on the characteristics of research publications in the legal, policy, socio-economic and cultural fields of research



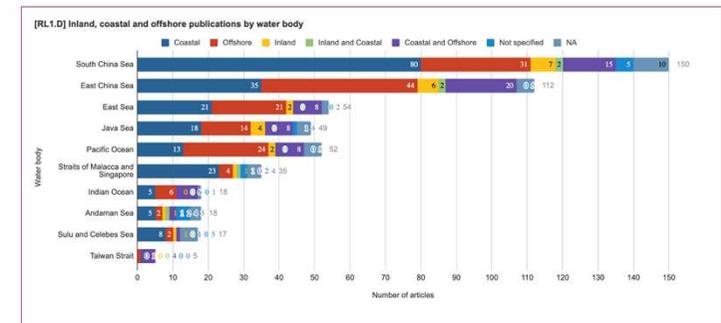
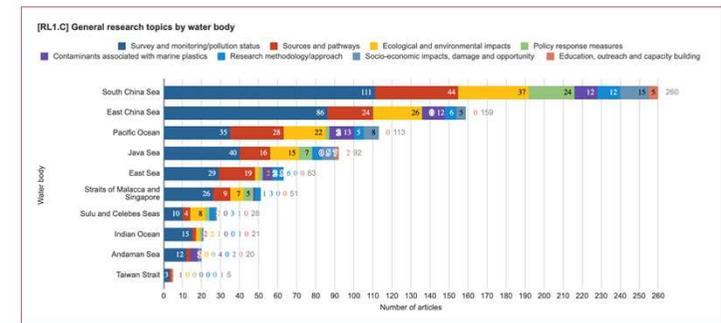
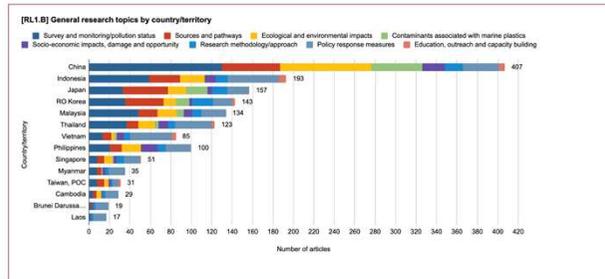
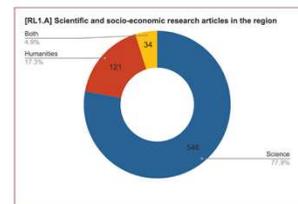
Information for Policy-Making

Explore charts and graphs on insight that may be gained from RRI 2.0 for policy-making purposes

## Research Landscape

Explore charts and graphs on the profile of research conducted on marine plastics in the seas of Southeast and East Asia, including research institutions, researchers and their respective areas of research.

RL1. Research profile of the region



**Regional Research Inventory 2.0 of marine plastics research in the seas of East Asia.**  
 Completed in November 2021 (coordinated by NUS), the MAPLA-RIV aims to support the development of a regional node of the Global Partnership for Marine Litter (GMPL) under the leadership of the Coordinating Body for the Seas of East Asia (COBSEA).

2023

# APCRS

5<sup>th</sup> Asia-Pacific Coral Reef Symposium

NUS, SINGAPORE | 19<sup>TH</sup> - 23<sup>RD</sup> JUNE 2023

## Looking forward to reef you in 2023!

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Thank you!

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