

# Data and models to elucidate trends.

## The development of a marine research database

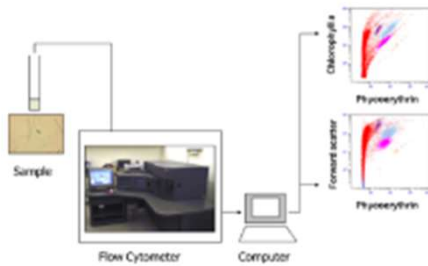
Oct 28, 2021

# Some background

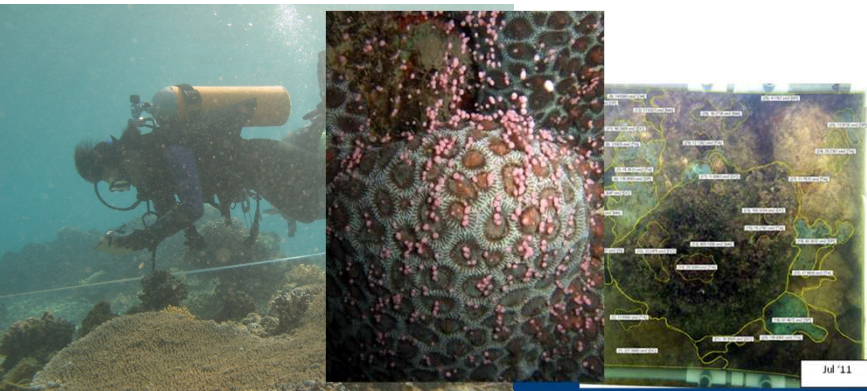
- All output presented are through the efforts of the Ecological Monitoring, Informatics and Dynamics Group within the Tropical Marine Science Institute of the National University of Singapore
- The group's main output focus is
  - On high quality cross-disciplinary research relevant to sustainable resource management
  - Applied research with strong focus on operations and management
- Enabling this output is the use of informatics to enable the 3 integrated themes shown



# The projects that bring the questions

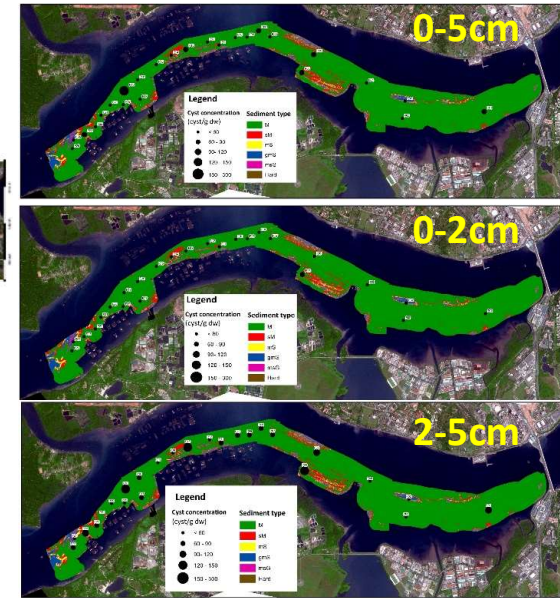
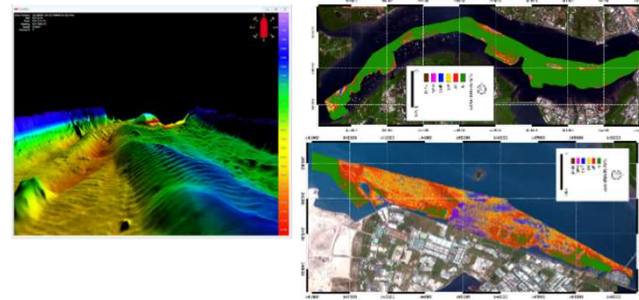


Rapid enumeration of nuisance phytoplankton

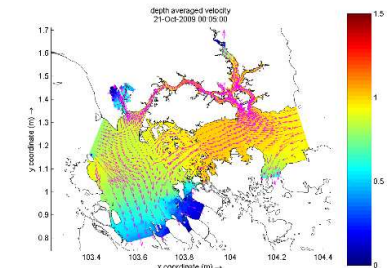


Multi-metric monitoring of coral reef and other benthic ecosystems

Seabed and habitat characterisation



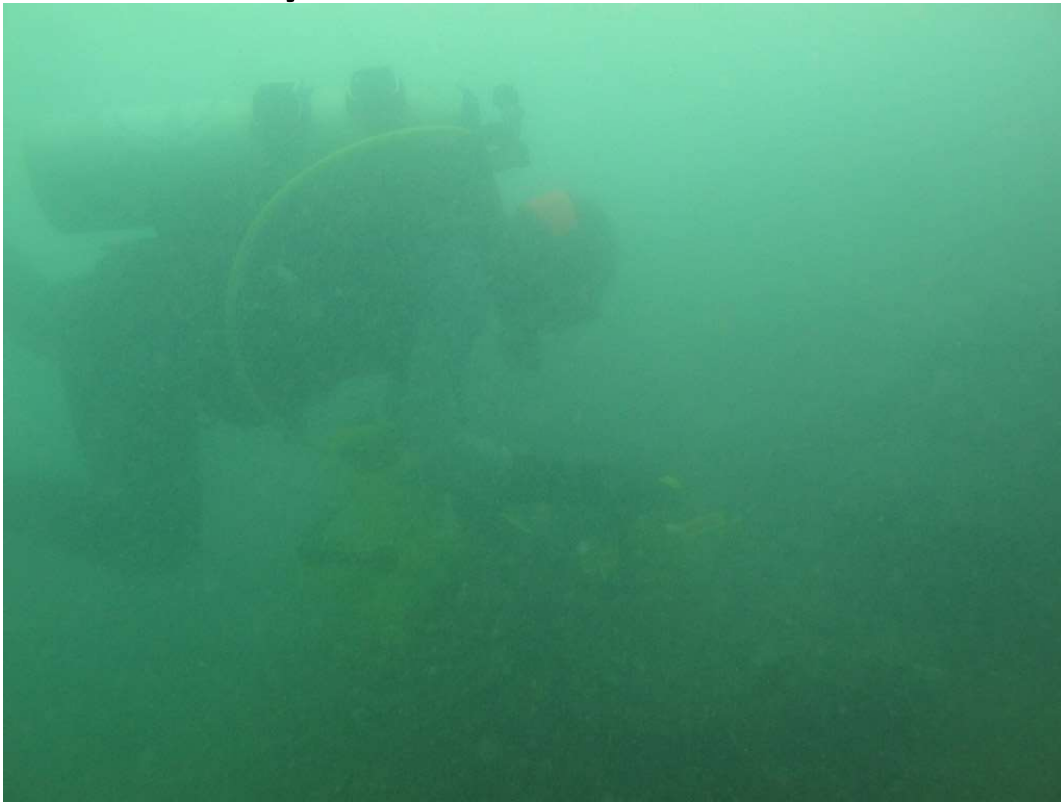
Database integration



Ecological monitoring and EIS

# What are some questions we seek to answer from the data we have?

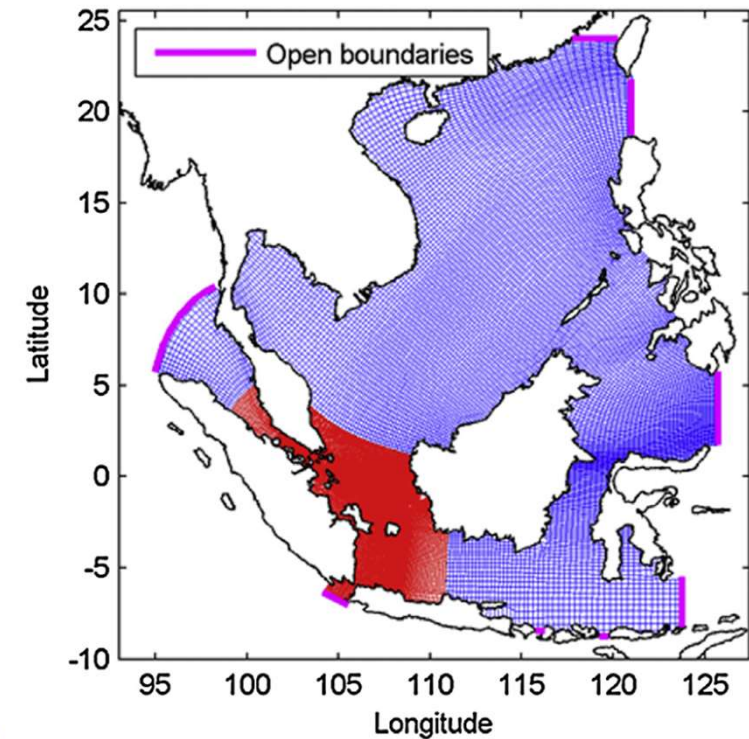
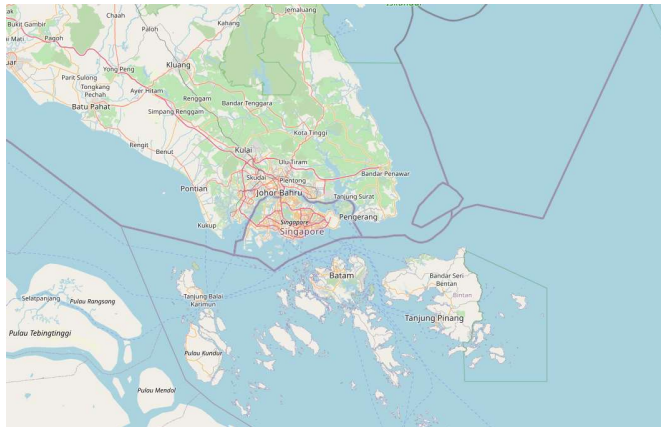
- Really?



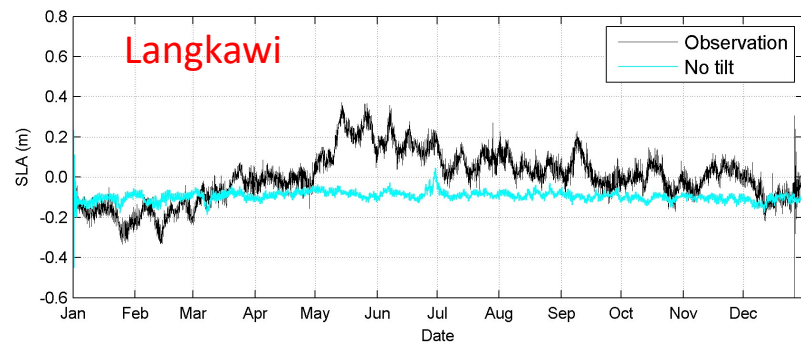
- Is it easy to answer?



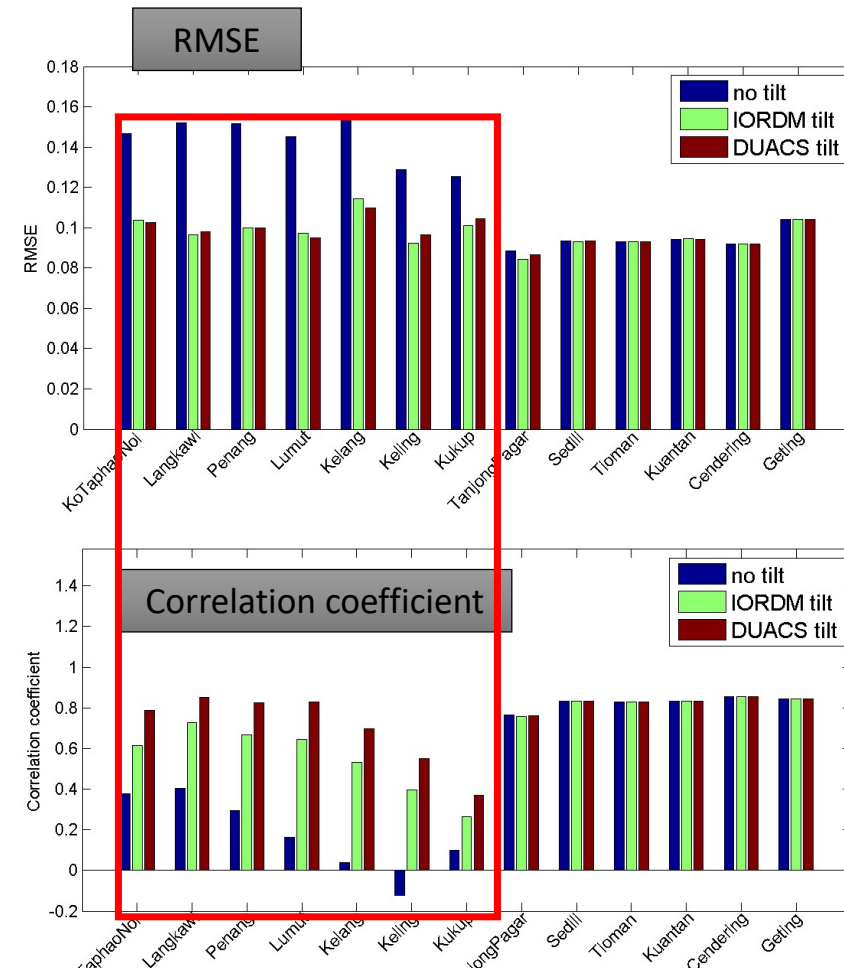
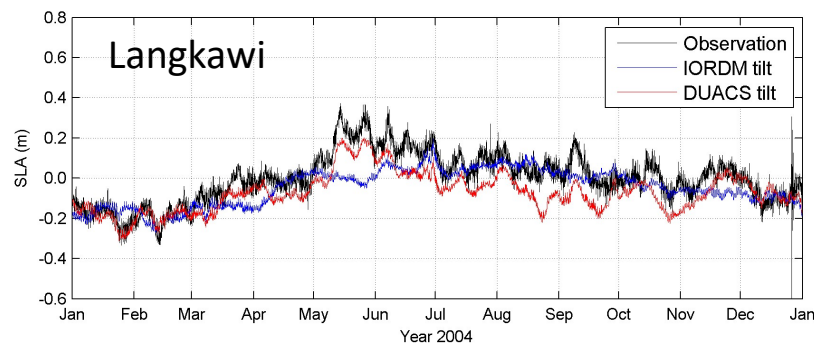
# The problem for Singapore's marine science related questions ...



# Can we account for the Indian Ocean's impact to the Singapore Straits?



Incorporating Indian Ocean

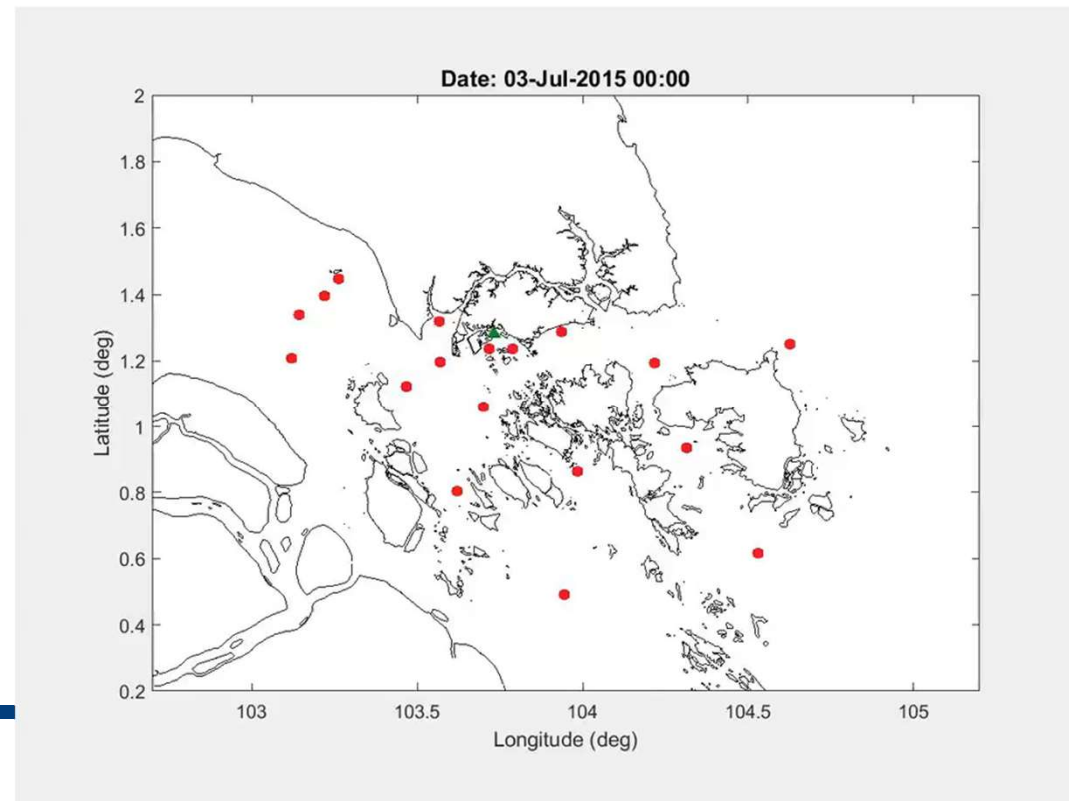


# Does this help?

- Putting the seasonal residuals in properly is useful to explain some events ...

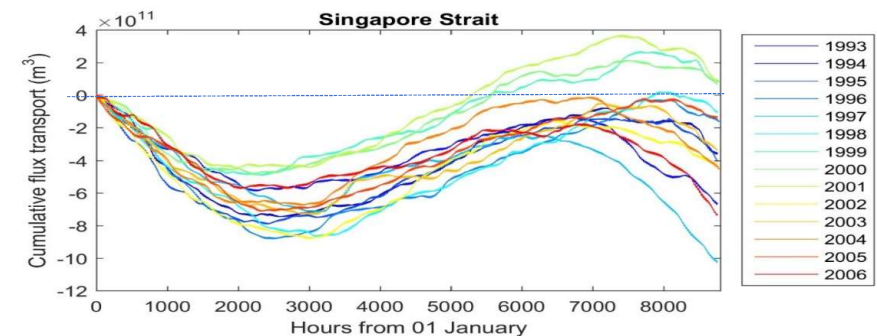
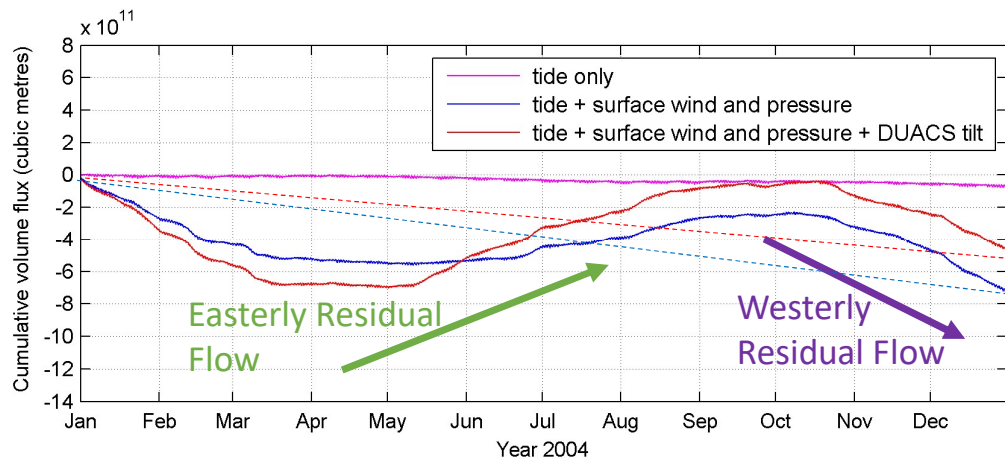
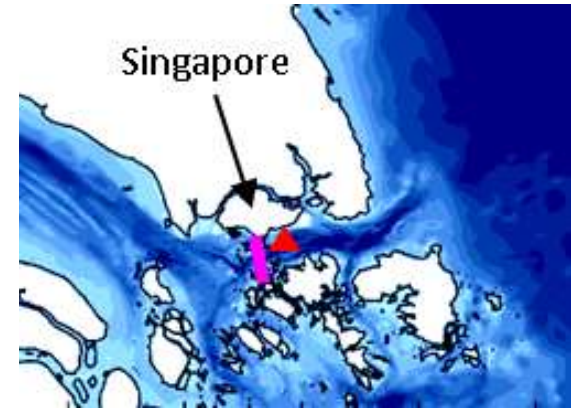
<https://www.straitstimes.com/singapore/environment/dead-whale-jubi-lee-found-in-singapore-tells-tale-of-scientific-discovery>

Chua MAH, Lane DJW, Ooi SK, Tay SHX, Kubodera T. 2019. Diet and mitochondrial DNA haplotype of a sperm whale (*Physeter macrocephalus*) found dead off Jurong Island, Singapore. *PeerJ*:e6705 <https://doi.org/10.7717/peerj.6705>



# What is the impact locally?

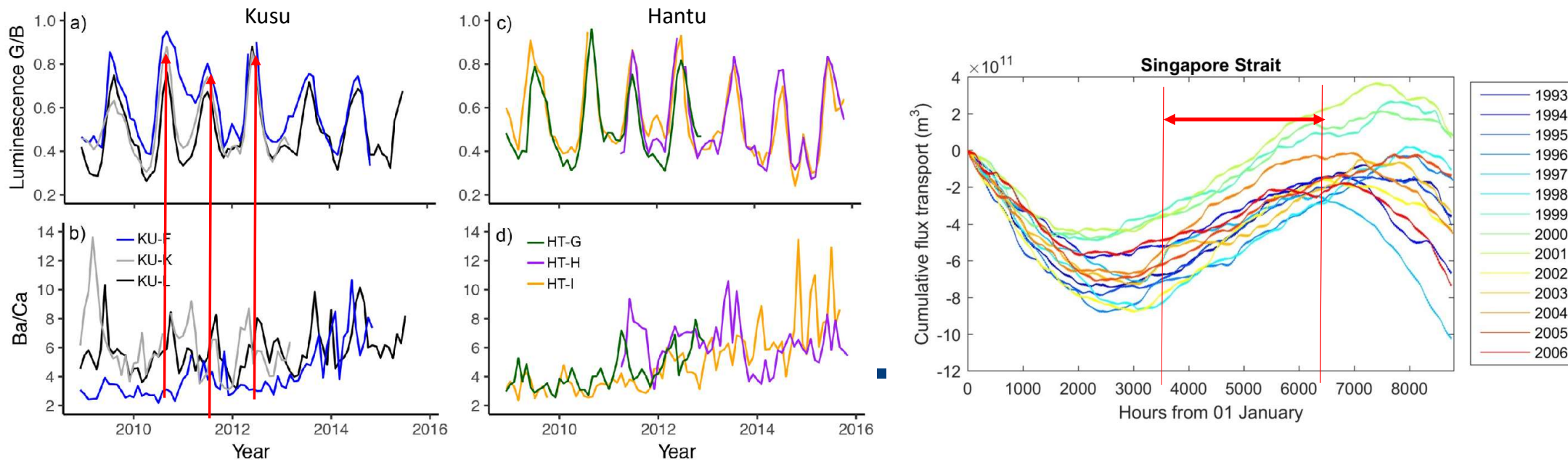
- When corrected, the residual flow patterns change.
  - Seasonal effect, SW and NE monsoons relatively equal in strength, slightly longer duration of SW Monsoon
- When expanded to multi-year evaluation, model suggests that a potential exists for an eastward going residual for certain years.





# Questions from data?

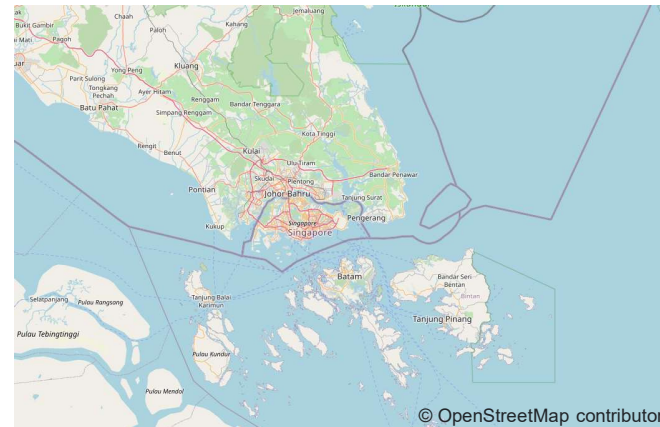
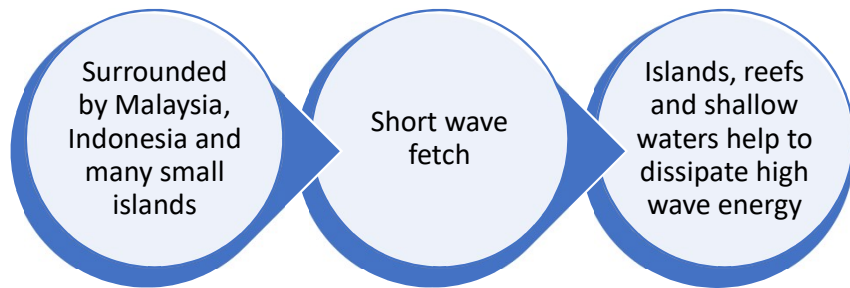
- Geo-chemical and water quality data have patterns that go with the biological data (luminescence bands )
- Is there a linking physical phenomenon?



# Other stressors

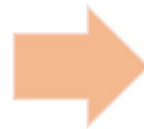
## - Wakes and waves in Singapore

- Wind waves are traditionally considered unimportant



- What about ship wakes?

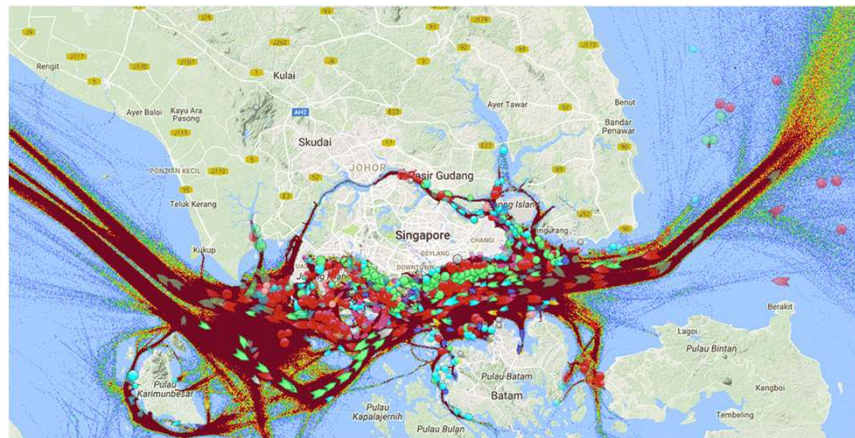
Effect of ship traffic on hydrodynamics generally insignificant in areas influenced by natural wave energy



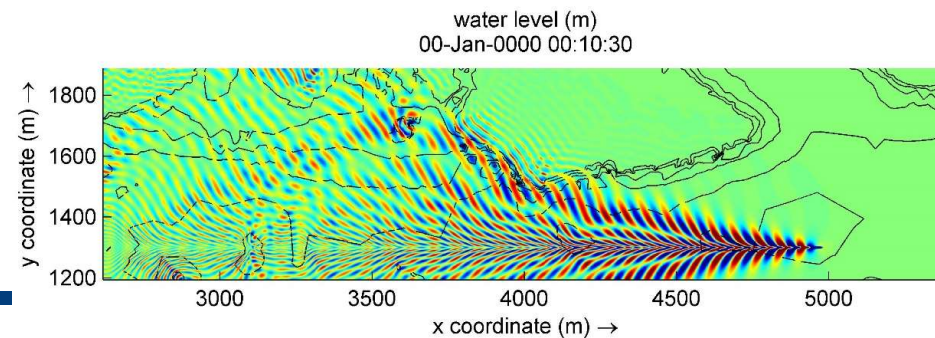
**BUT** becomes critical in confined, calmer and shallower waters

# Other stressors – Modelling with limited data

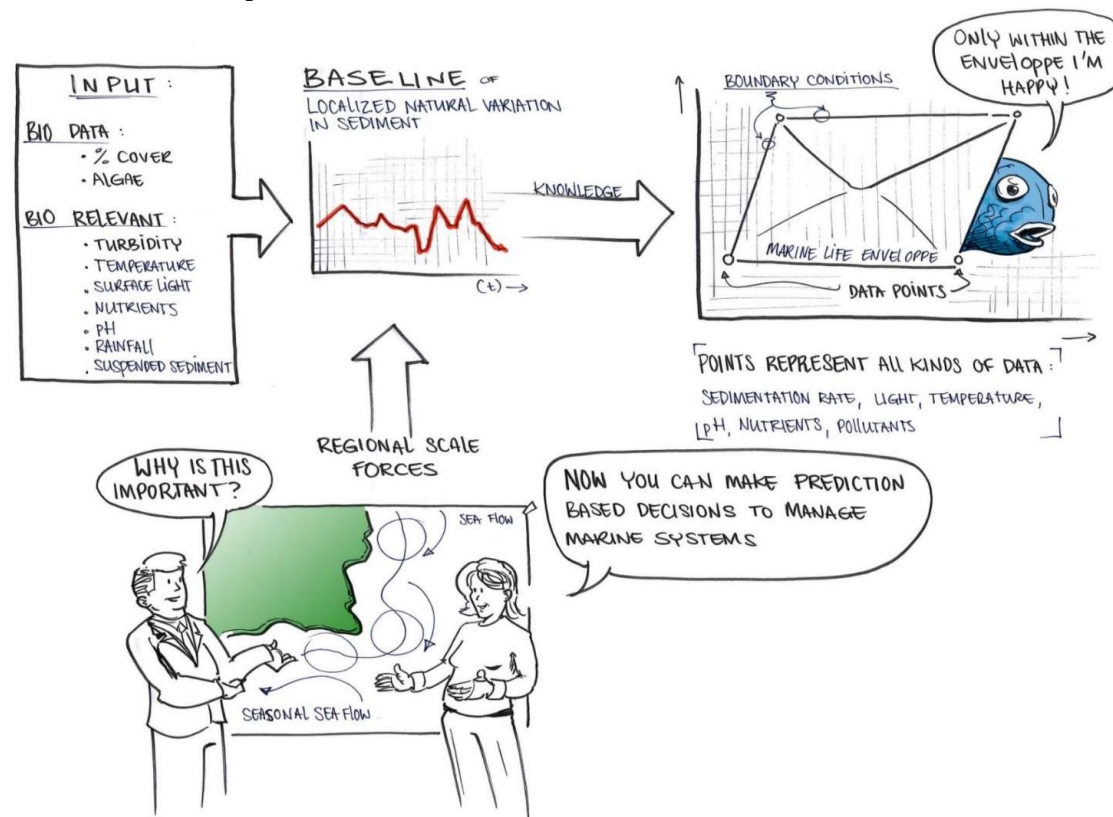
- If wakes and waves are important, then there is the issue of their interaction with ecology and sediment transport.



	Sentosa Island	Pulau Hantu	<i>Largest wakes occurs when:</i>
Highest max. wake height	0.46 m	0.91 m	
$F_L$	0.52		<i>"Hump speeds" (<math>F_L \sim 0.4 - 0.6</math>)</i>
$F_h^*$	0.51 – 0.78	0.57 – 0.81	<i>Trans-critical speeds (<math>F_h \sim 0.84 - 1.15</math>)</i>



# To carry out something like this requires an integrative platform..





# This led to the creation of



Funded by the National Research Foundation (Singapore) under the Marine Science Research & Development Programme (2016-2021)

# Vast range of data types

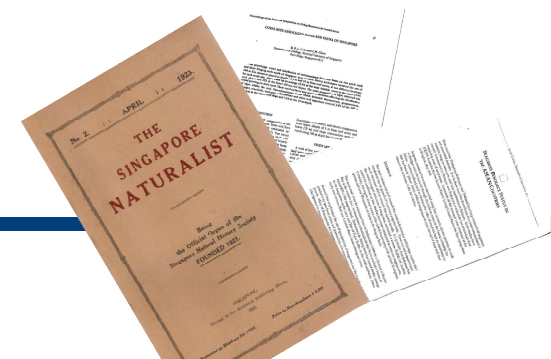
- Biology
- Genetic
- Biochemical
- Physical
- Water quality
- Nutrients
- Acoustic
- Gridded numerical models
- Geospatial (vector, raster)
- Images/video/sound

## Types of projects that were funded under the Marine Science R&D Programme

- Adaptation and resilience of coral reefs to environmental change in Singapore.
- Biota effects on the environment: an impact source neglected in EIAs
- Ecologically engineering Singapore's seawalls to enhance biodiversity
- Tropical Model Marine Organisms for Experimental Marine Science
- Physical and biogeochemical effects of sediment transport on coral reefs
- Microbially Induced Corrosion
- Understanding the viral composition of phytoplankton blooms in Singapore coastal waters
- Genomic and Metabolomic Approach to the Discovery of Functional Metabolites from Marine Actinomycetes

But not only that, behind the scenes...

Acquisition, collation and upload of publically available datasets & metadata:  
Electronic online sources  
Digitisation of Historic data museum archives (Also Prof Chou LM's sets)



# Let's do this ...

