Typhoon-Induced variations in zooplankton populations on the central Guangdong coasts: real time data from the PlanktonScope

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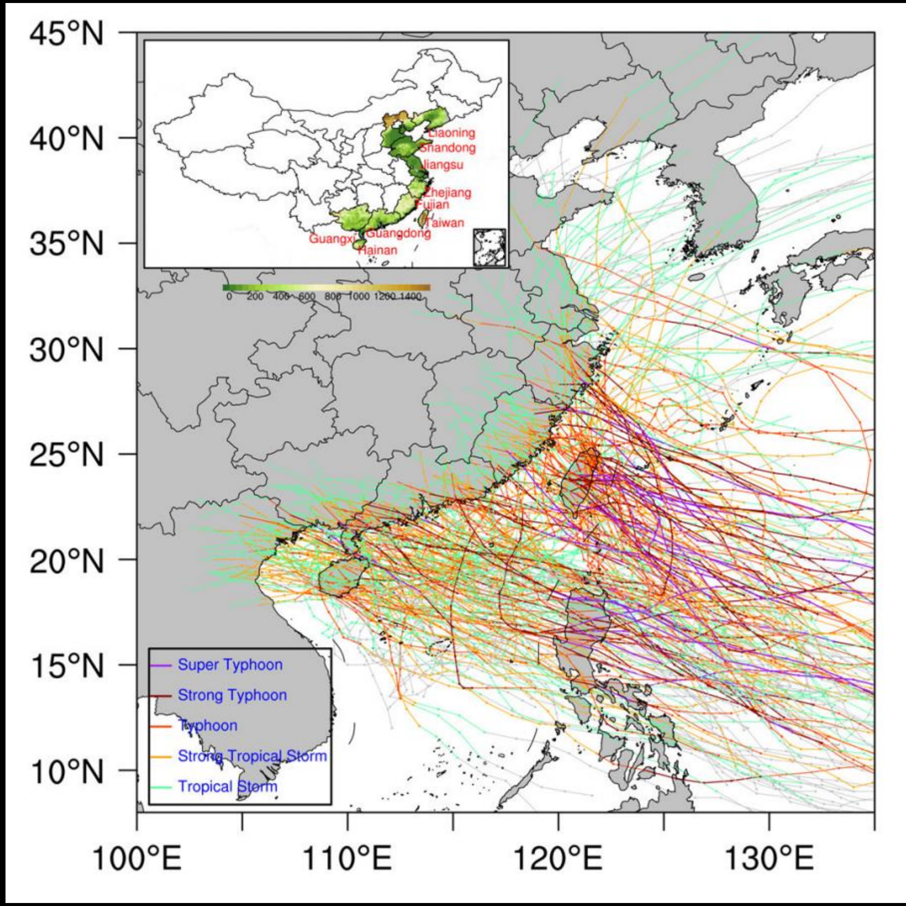
1.Research Background

- Frequency of typhoon events tripled since 2000 compared to the period from 1980 to 1999
- Impacts on the ecosystem are huge
- Studies on the impacts of pelagic ecosystem often occurred post-typhoon events

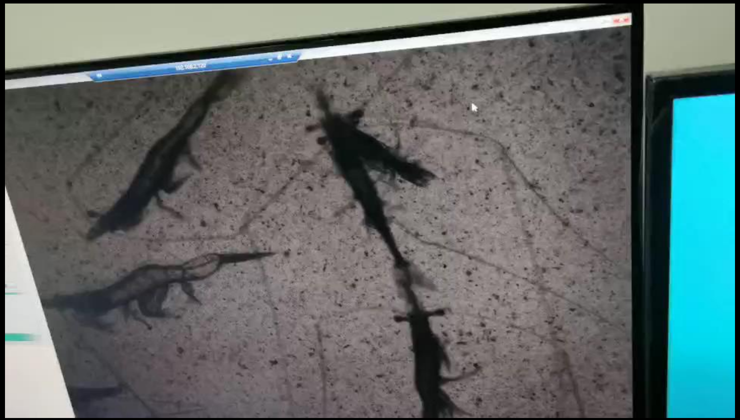


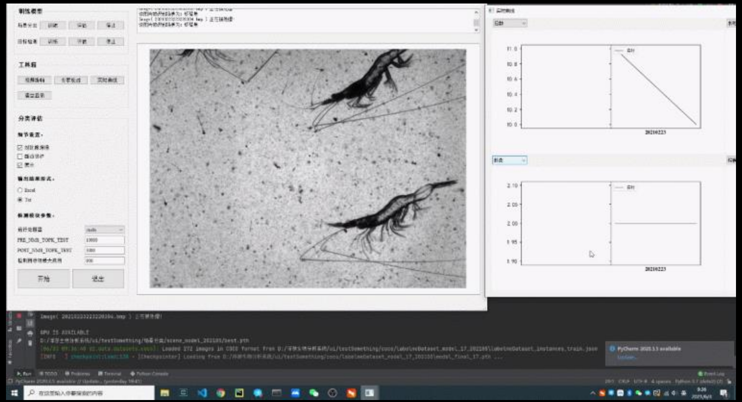
Mass die-offs

Severe coastal damage

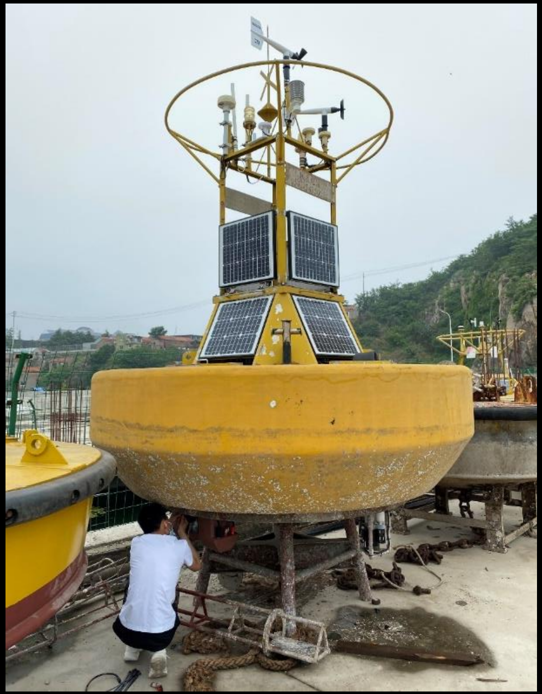
2.Data collection

- PlanktonScope, a shadowgraph underwater plankton imaging system
- Environmental data from a buoy at the same location
- Physical / model output for output

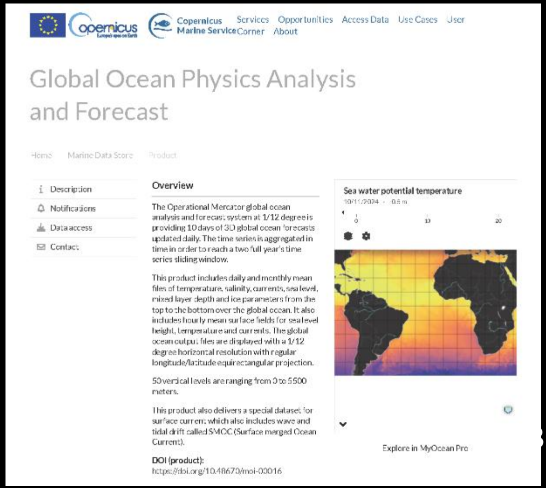




Environmental data
Temp, sal, chl, pH,
Oxy, Turb

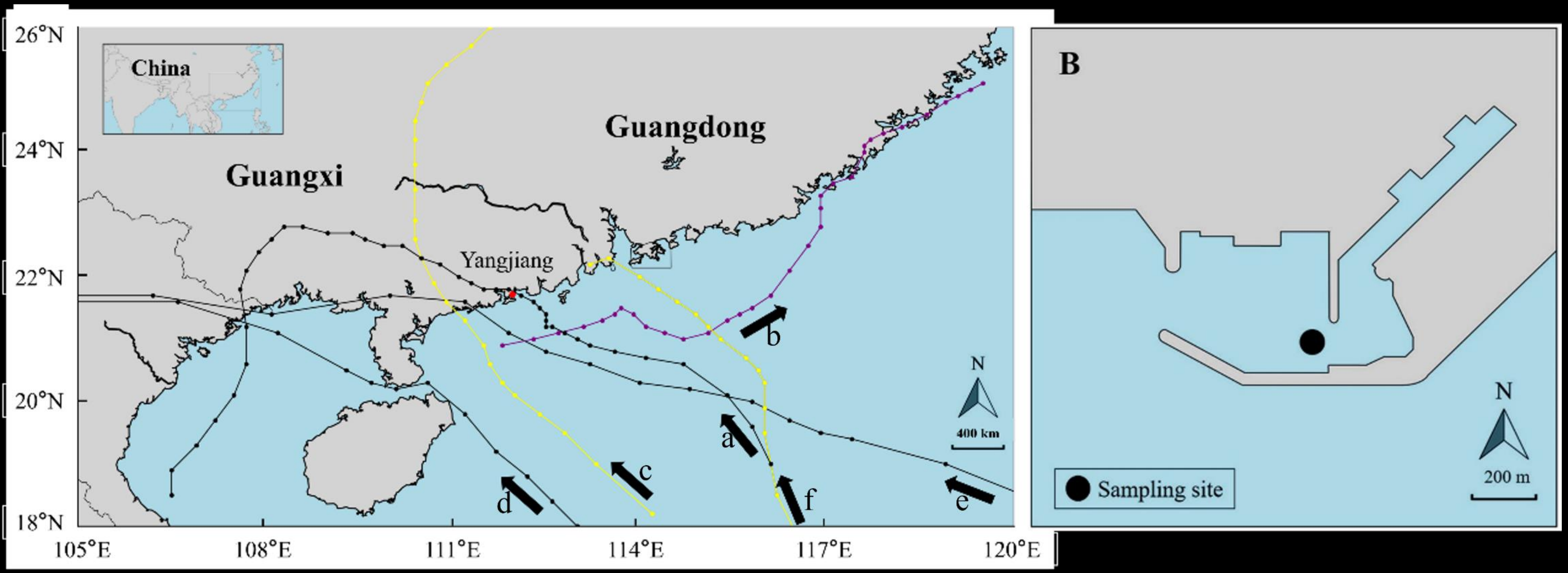


Ocean currents
Atmospheric



3.Hypothesis

- Strong typhoon events have negative impacts on zooplankton, while weak typhoon events have positive impacts on zooplankton
- Six typhoon events :
  - 2021: a. Cempaka; b. Lupit;
  - 2022: c. Chaba; d. Mulan; e. Ma-on; f. Nalgae

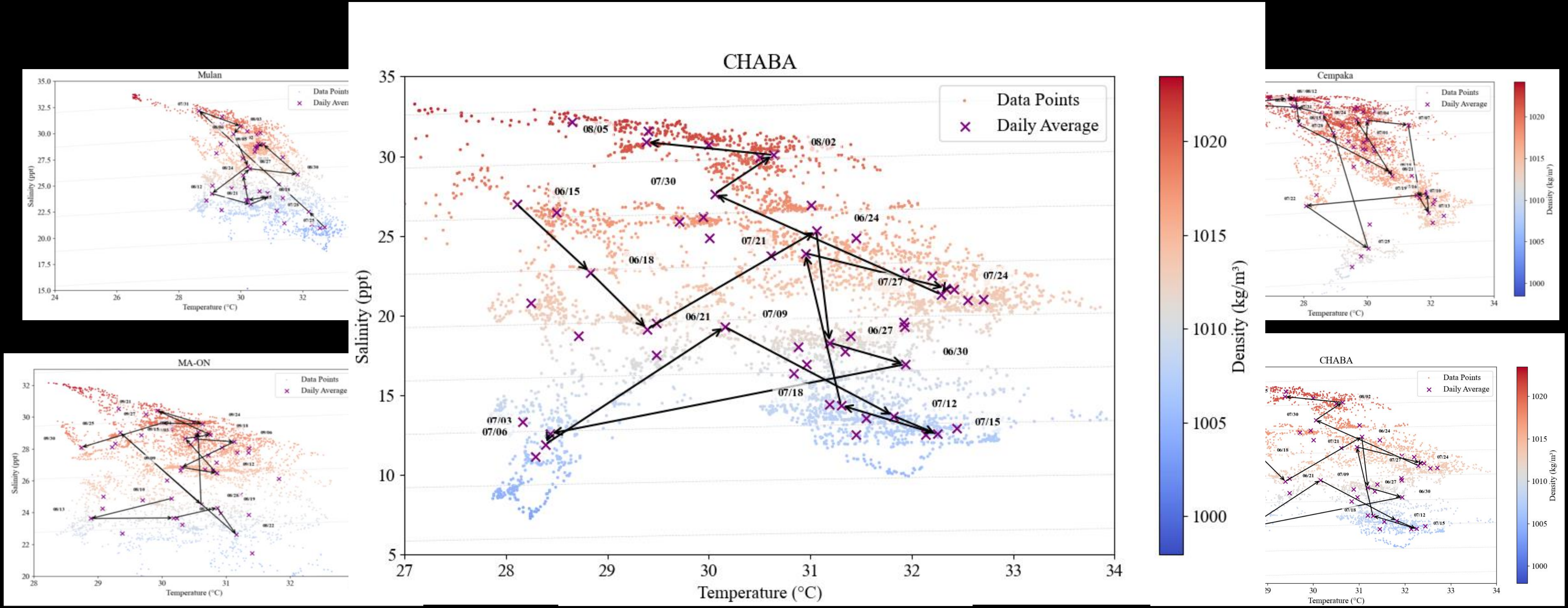


4.Results: T-S diagram

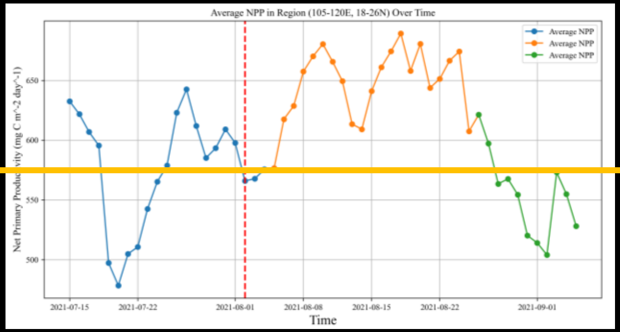
Water Mass

Changes over time

Pre-, intra-, post- typhoon



4. Results



Determining Typhoon Intensity: Typhoon Ratio Model + Chlorophyll Variation Patterns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3 Ocean College, Zhejiang University, Zhoushan 316022, China
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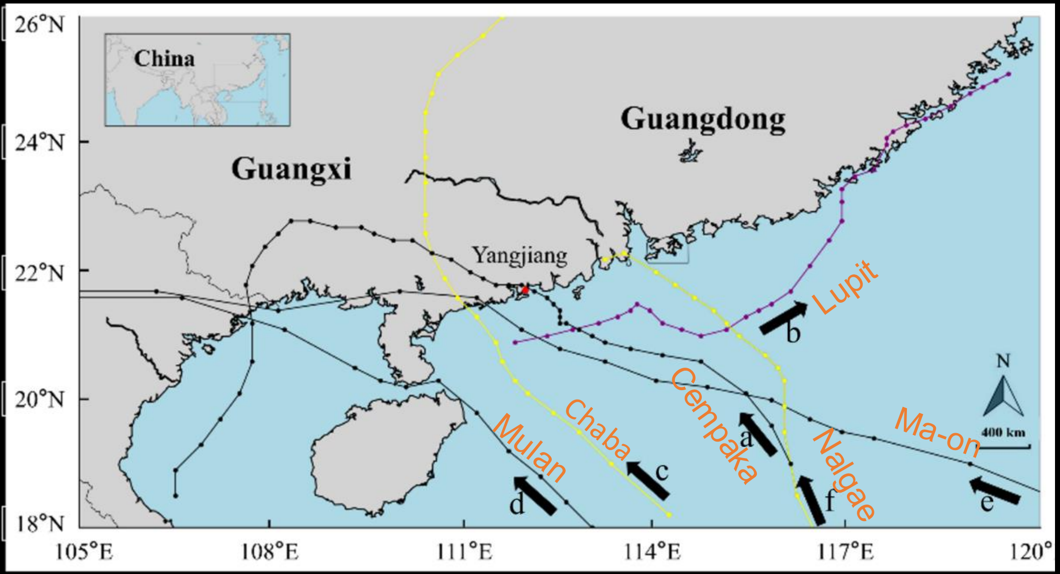


Typhoon Intensity (I) and Distance (D)

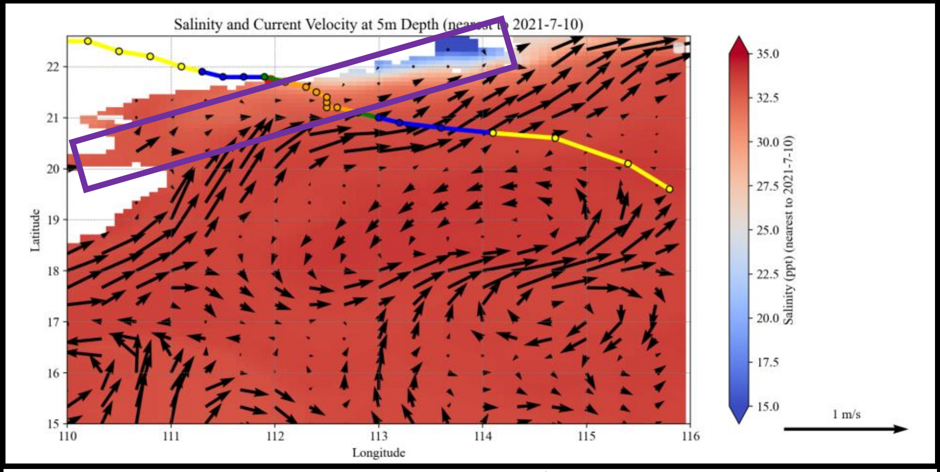
I: Maximum sustained wind speed at the lowest central pressure

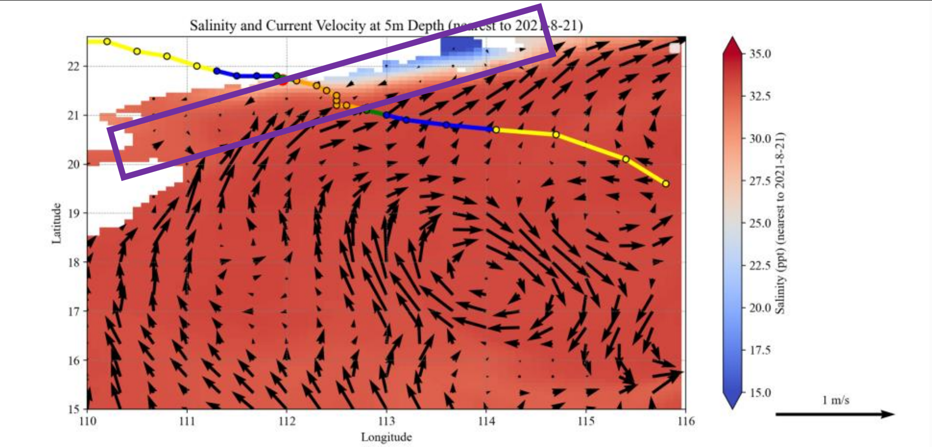
D: Distance between the sampling site and the typhoon center

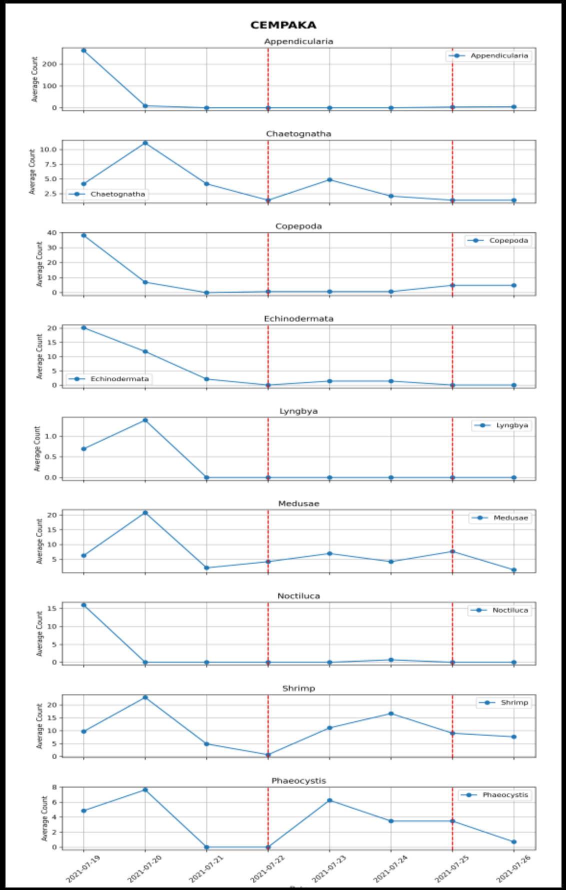
	Start date	End date	Temperature (°C)	Salinity (ppt)	Dissolve oxygen (mg L⁻¹)	Turbidity (NTU)	Chlorophyll(mg L⁻¹)
Cempaka	17 July 2021, 08:00	24 July 2021, 20:00	↓	↓	↓	↑	↑
Lupit	2 August 2021, 20:00	16 August 2021, 20:00	↓	↑	↓	↓	↑
Chaba	29 June 2022, 08:00	7 July 2022, 20:00	↓	↓	↓	↑	↑
Mulan	8 August 2022, 20:00	11 August 2022, 14:00	↓	↓	↓	↑	↓
Ma-on	21 August 2022, 08:00	26 August 2022, 08:00	↓	↓	↓	↑	↑
Nalgae	26 October 2022, 14:00	3 November 2022, 08:00	↓	↓	↓	↑	↓

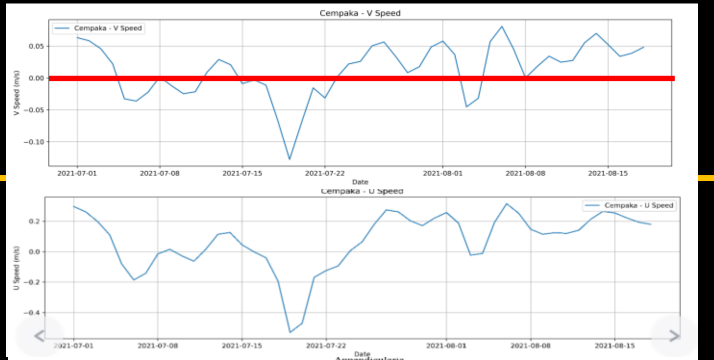
4 Results - Cempaka

- Pre-typhoon: 7/13-7/18; Active Phase: 7/19-7/22; Post-typhoon: 7/23-7/28
- Recovery period ~5 days.
- Impacts: strong, shifting nearshore currents from northeast to southwest.
  Zooplankton, particularly copepods, rapidly declined, recovered after 5- 6 days.









Appendicularia

Chaetognatha

Copepoda

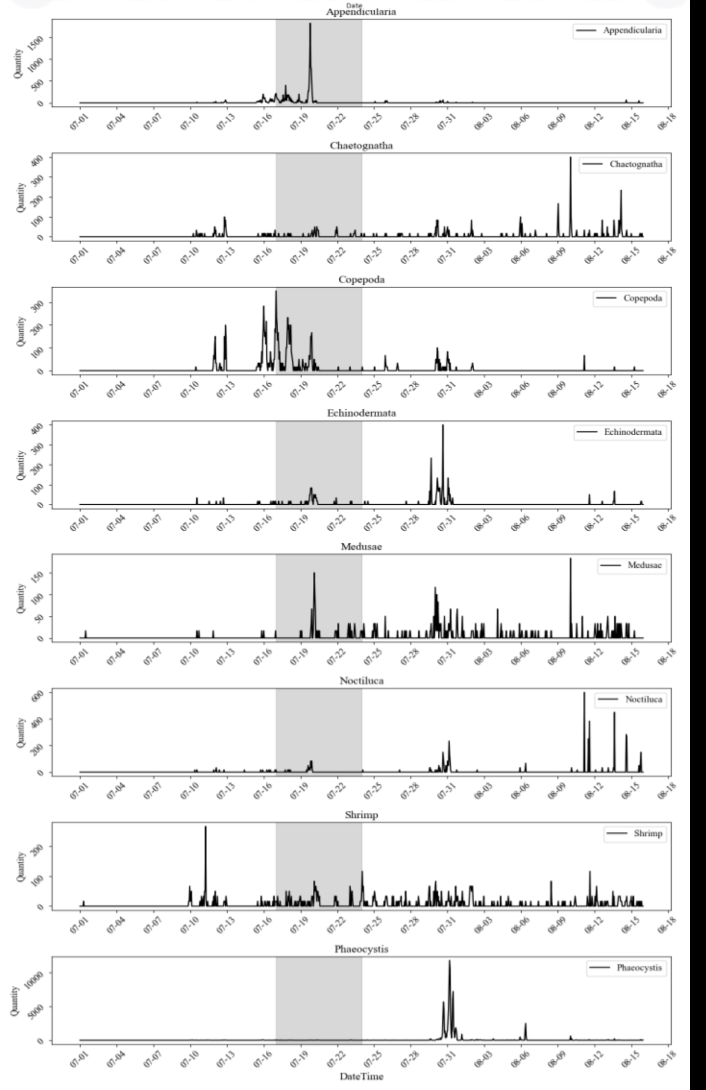
Echinodermata

Medusae

Noctiluca

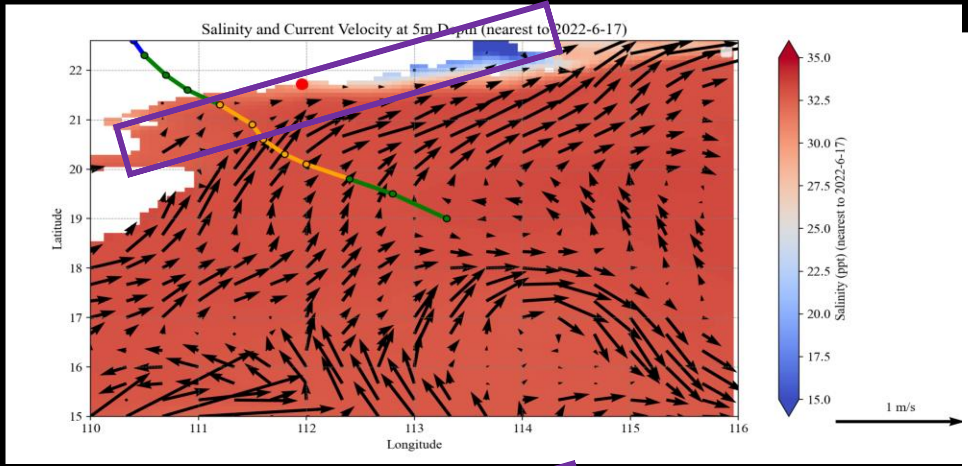
Phaeocystis

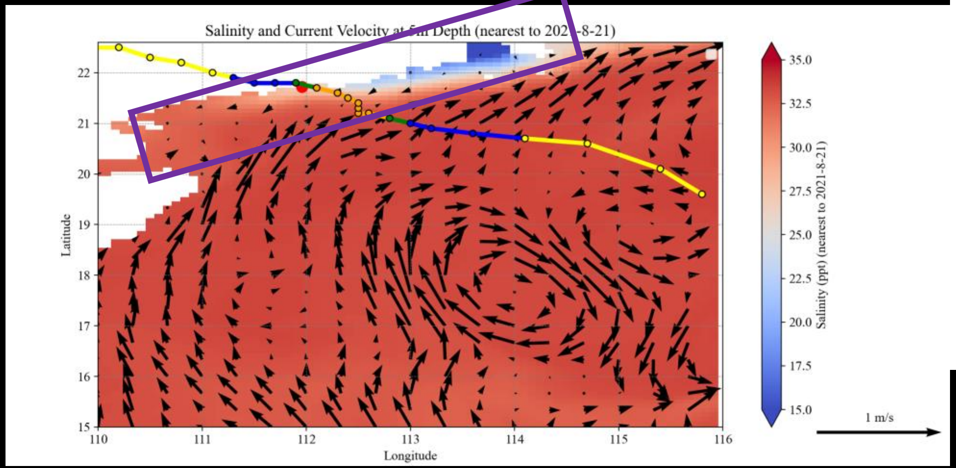
Shrimp

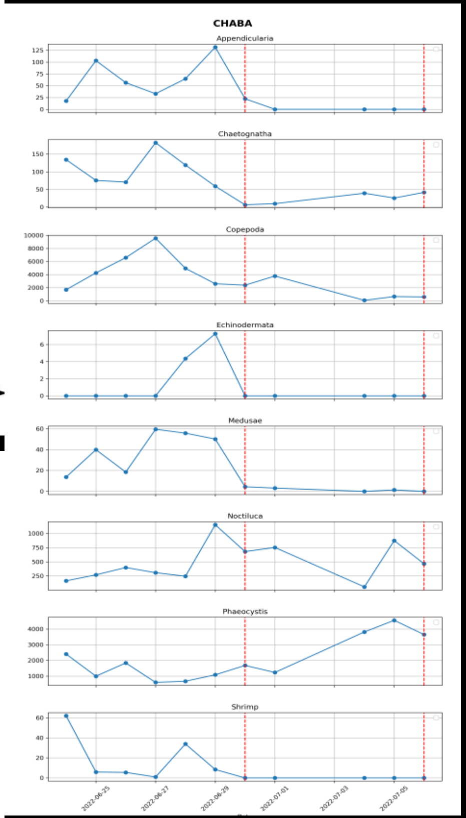


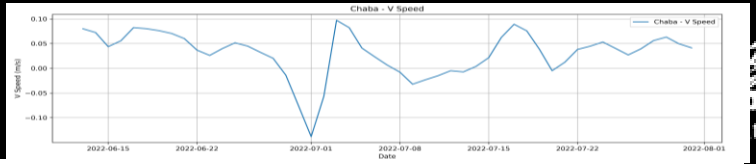
4.Results - Chaba

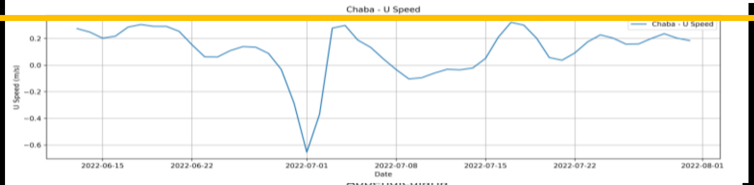
- Pre-typhoon: 6.24-6.30; Active Phase: 6.30-7.6; Post-typhoon: 7.6-7.20
- Recovery period ~14 days.
- Impacts: Strong, a shift in nearshore currents from northeast to southwest. Zooplankton, particularly copepods, rapidly declined, recovered after ~6 days.











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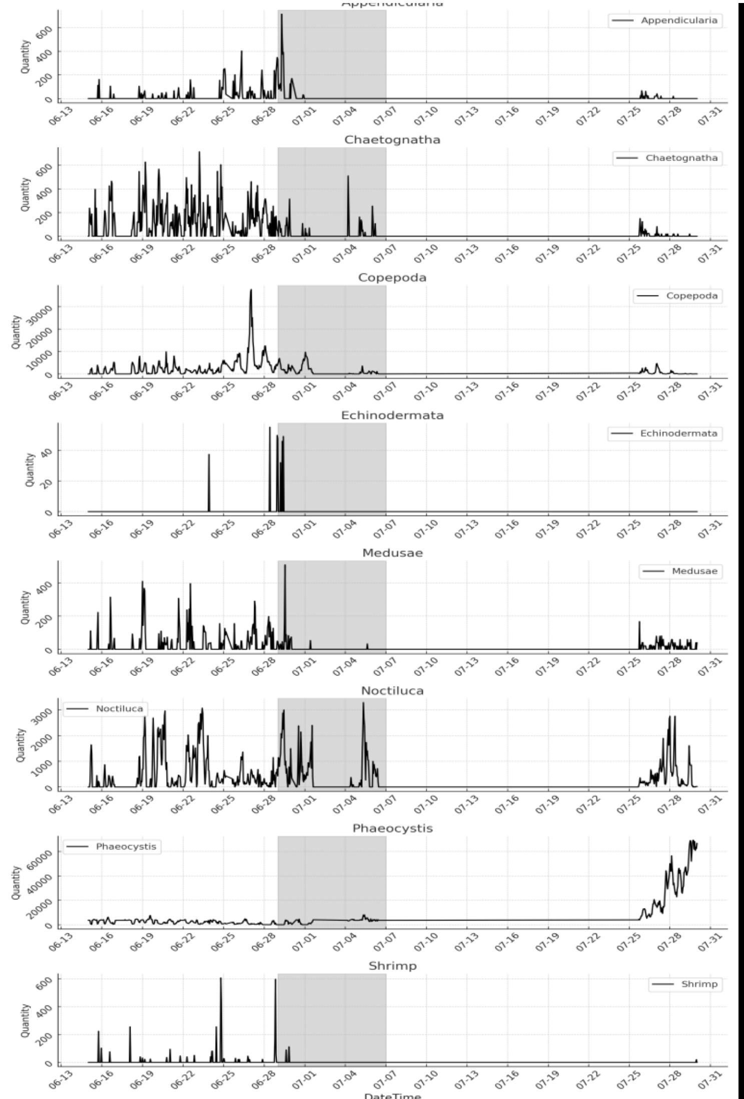
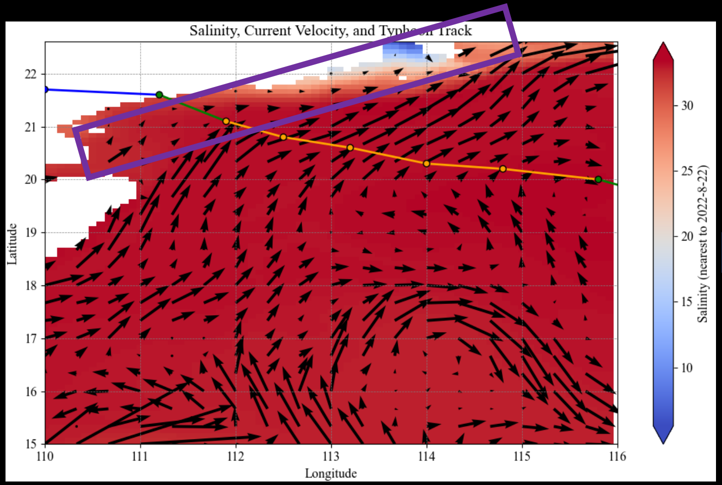
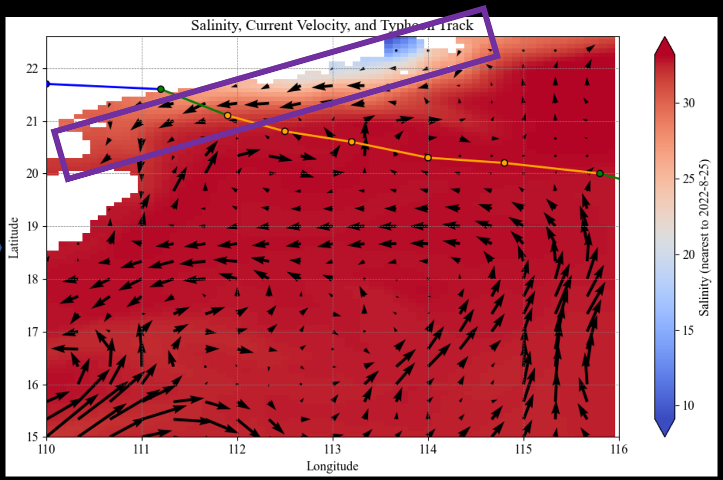
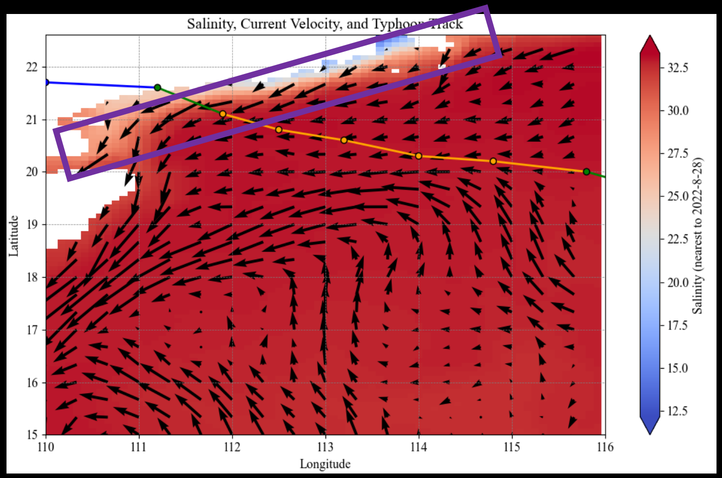


4.Results – Ma-on

- Pre-typhoon: 8.19-8.22； Active phase: 8.22-8.25; Post-typhoon: 8.25-8.28.







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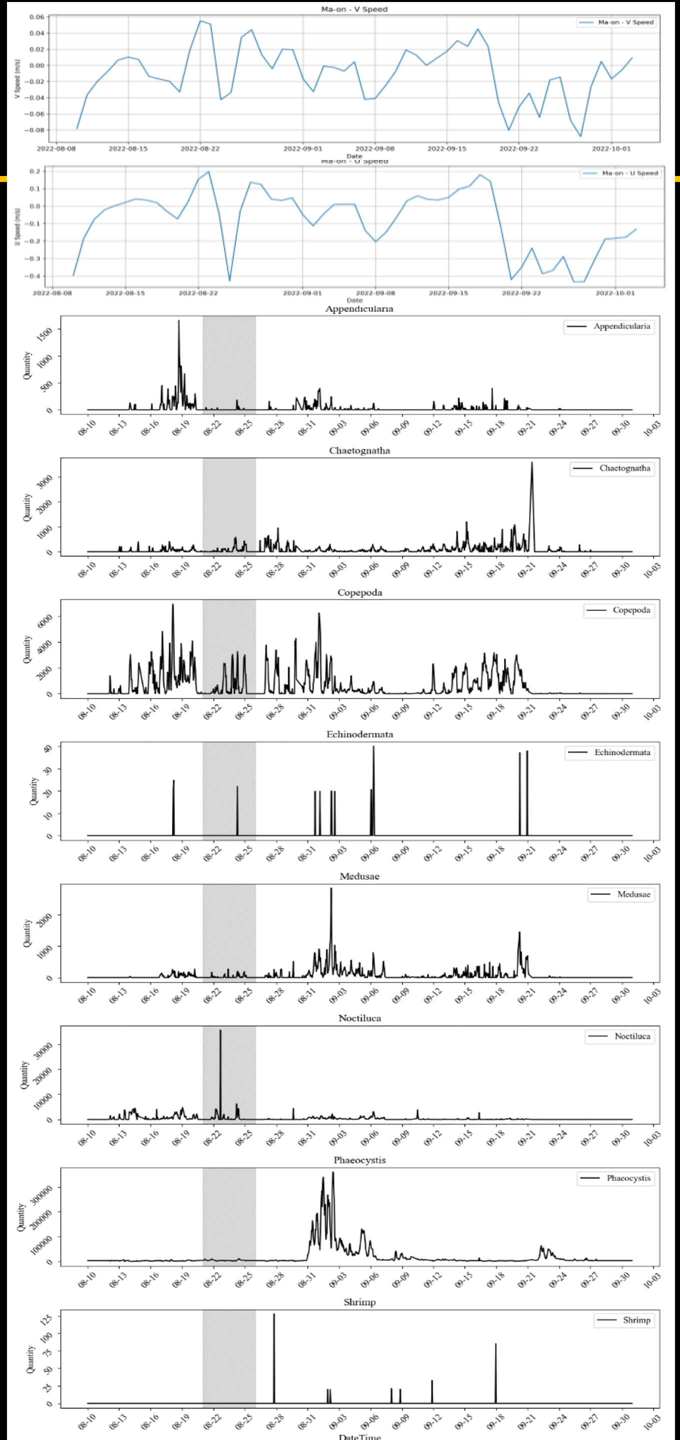
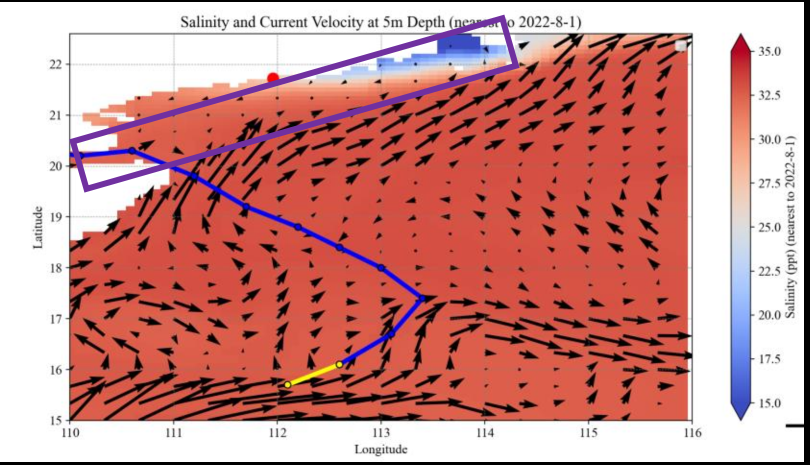
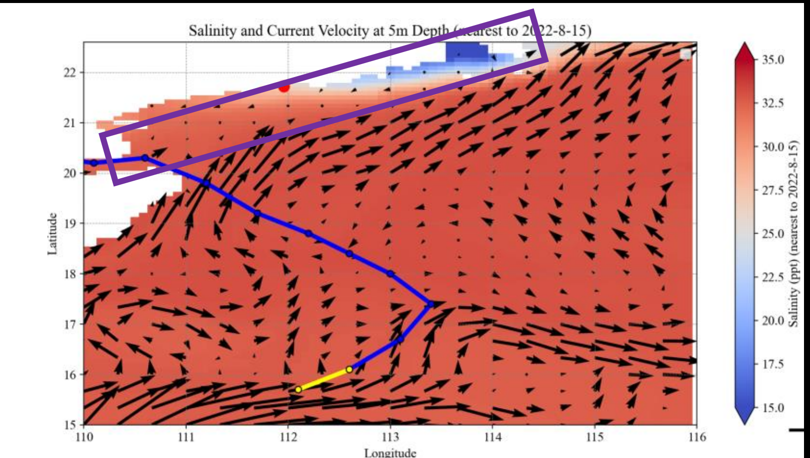
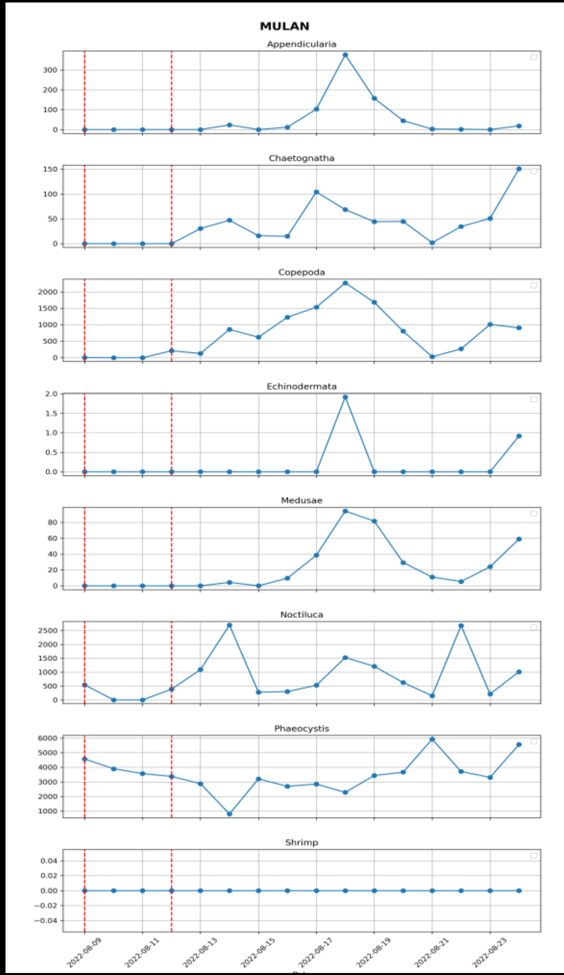


4.Results – Mulan (weak response)

1. Pre-typhoon: 8.6-8.9; Active Phase: 8.9-8.12; Post-typhoon: 8.12-8.24
2. Recovery ~12 days.
3. Impacts: weak impact (likely early), nearshore currents remaining unchanged. Zooplankton density, particularly copepods, increased ~two days post typhoon.







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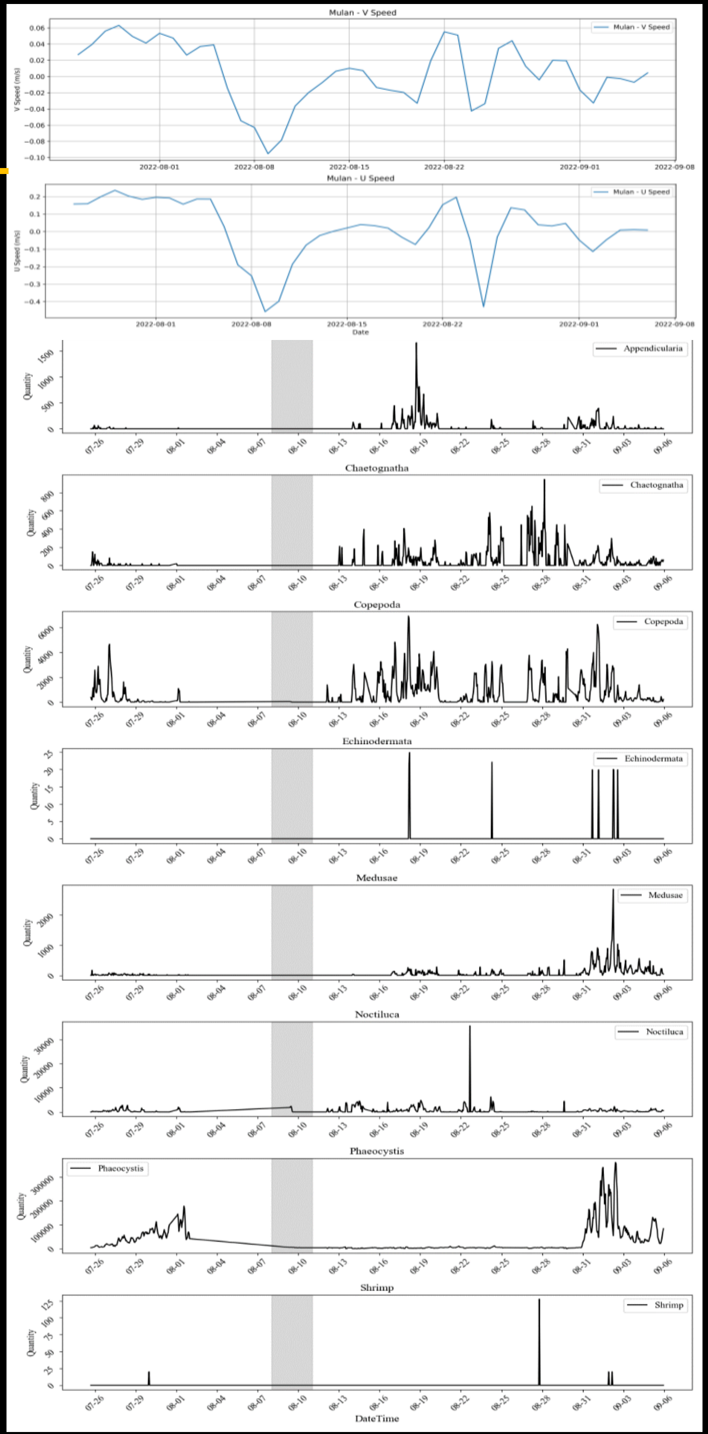
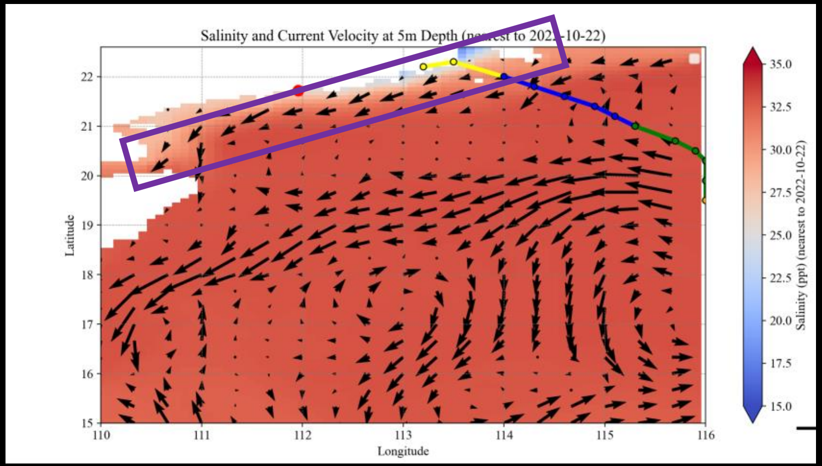
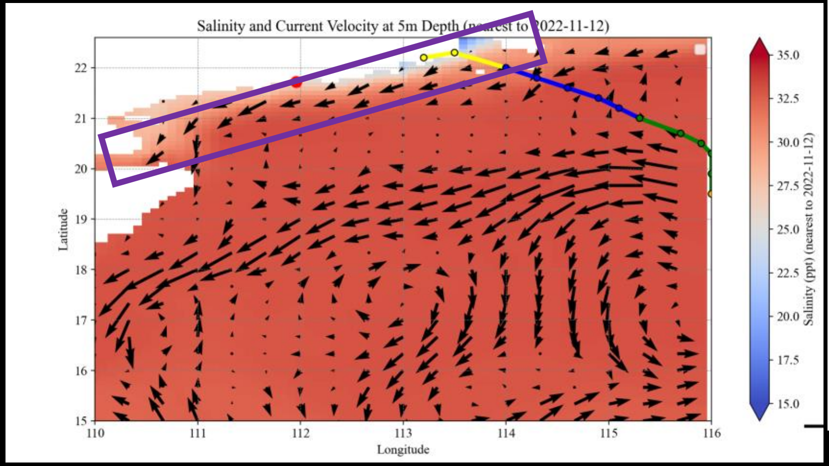
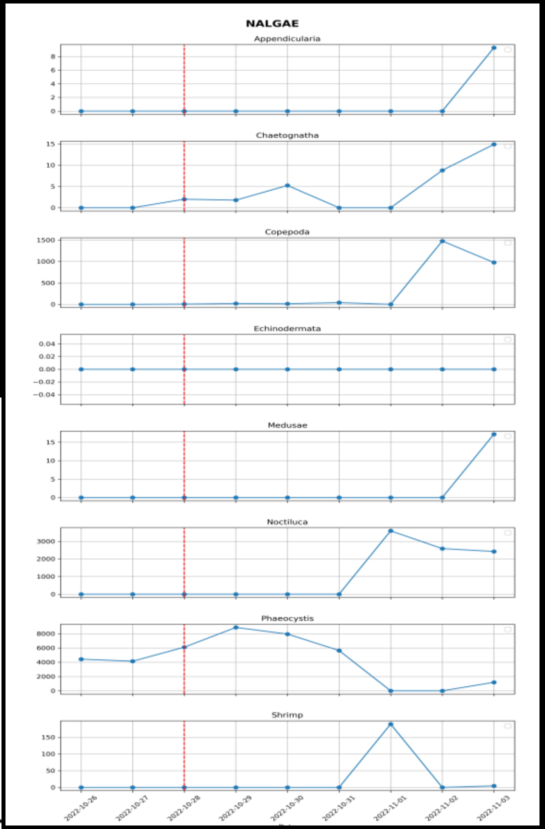


4.Results –Nalgae (weak response)

1. Pre-typhoon: 10.22-10.26； Active phase: 10.26-10.28； Post-typhoon: 10.29-11.6,
2. recovery shortly post typhoon.







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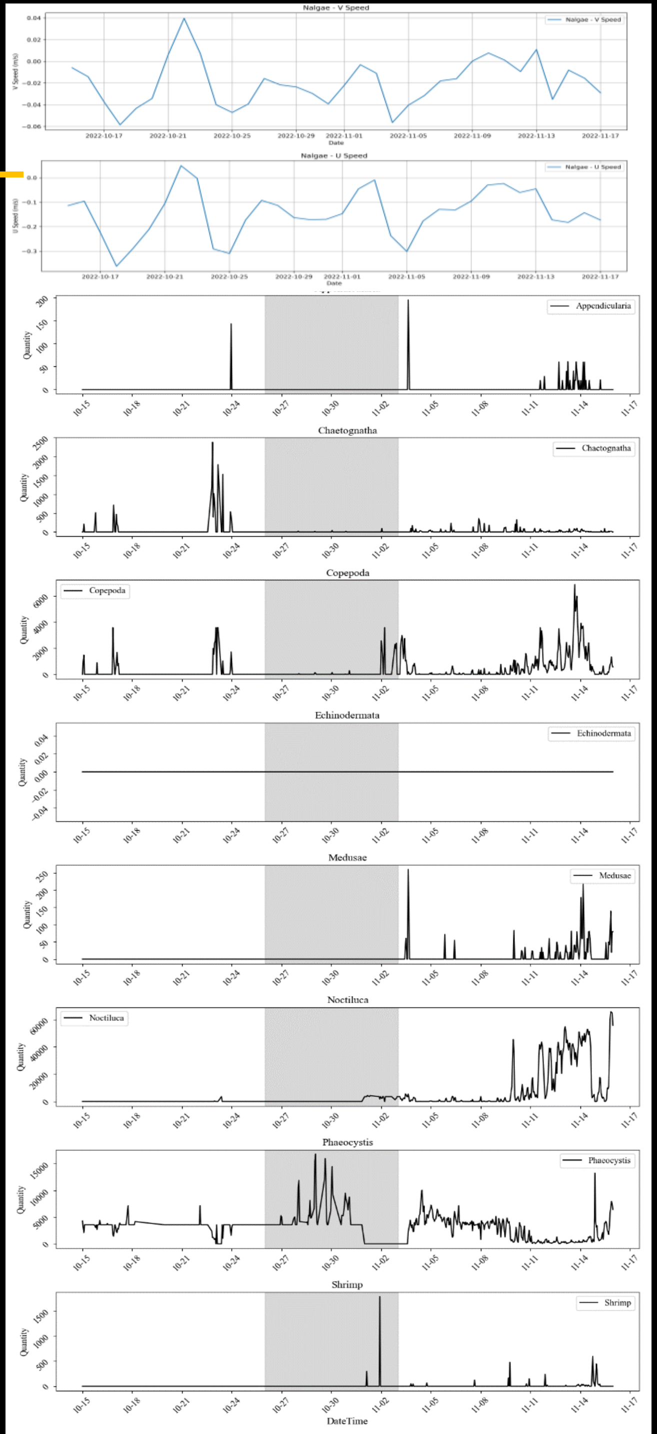

4.Results – What about Lupit

	Start date	End date	Temperature (◦C)	Salinity (ppt)	Dissolve oxygen (mg L^{-1})	Turbidity (NTU)	Chlorophyll(mg L^{-1})
Cempaka	17 July 2021, 08:00	24 July 2021, 20:00	↓	↓	↓	↑	↑
Lupit	2 August 2021, 20:00	16 August 2021, 20:00	↓	↑	↓	↓	↑
Chaba	29 June 2022, 08:00	7 July 2022, 20:00	↓	↓	↓	↑	↑
Mulan	8 August 2022, 20:00	11 August 2022, 14:00	↓	↓	↓	↑	↓
Ma-on	21 August 2022, 08:00	26 August 2022, 08:00	↓	↓	↓	↑	↑
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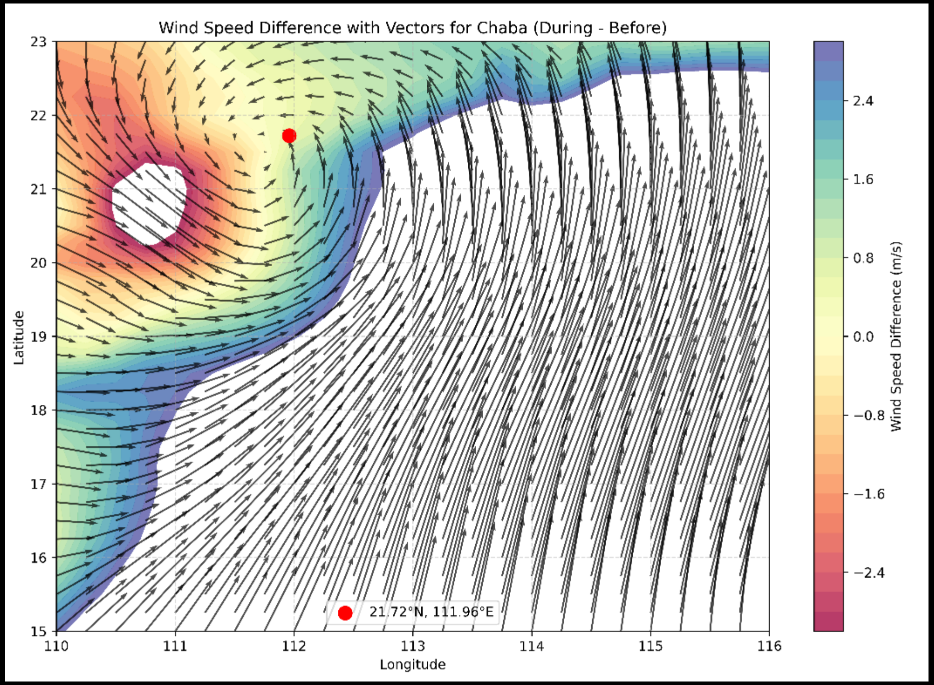
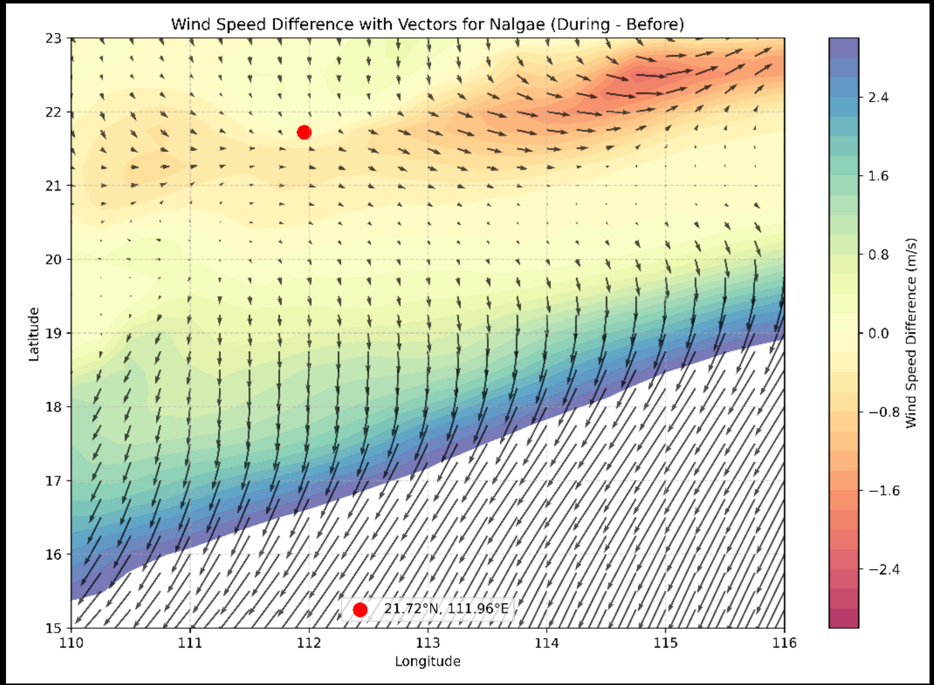
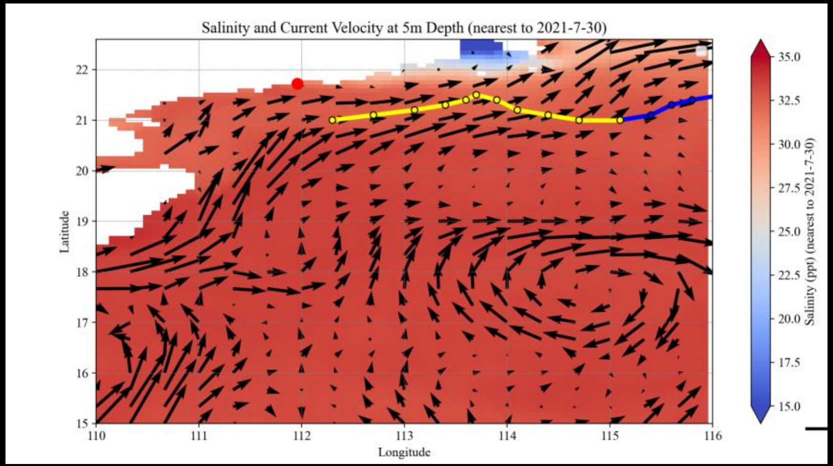
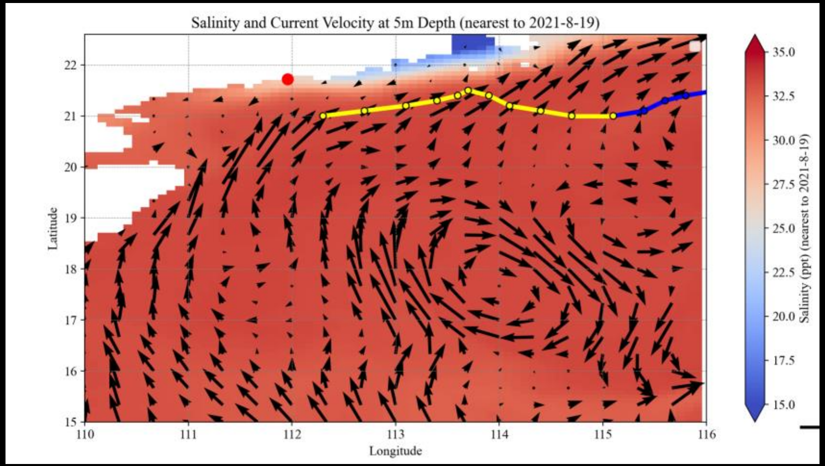


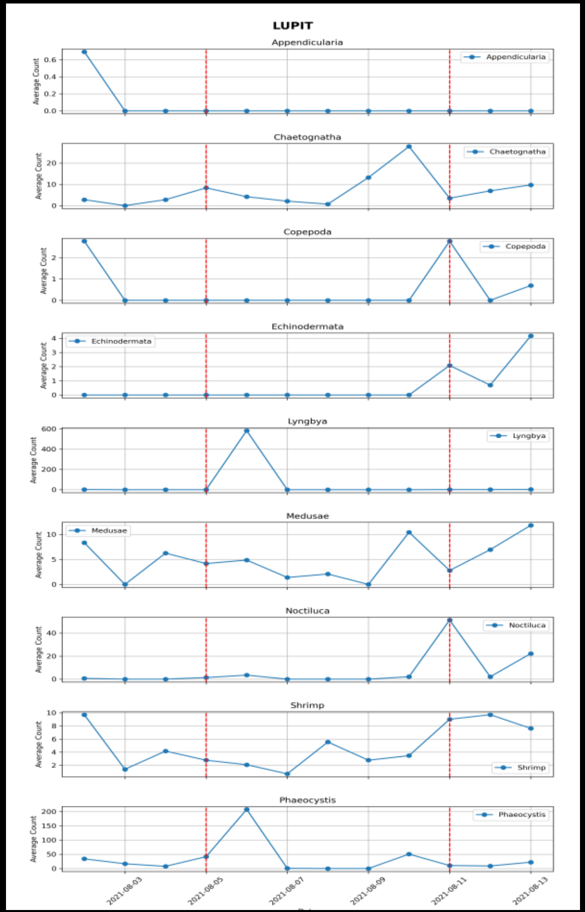


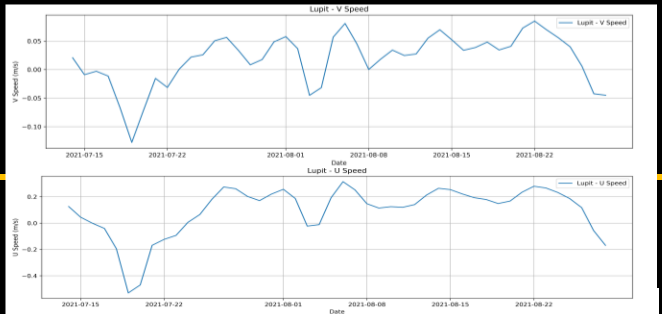
4.Results –Lupit

- From 8.2 to 8.13:Pre-typhoon: 8.2-8.5； During typhoon: 8.5-8.11；
  Post-typhoon: Recovery from 8.11-8.13.









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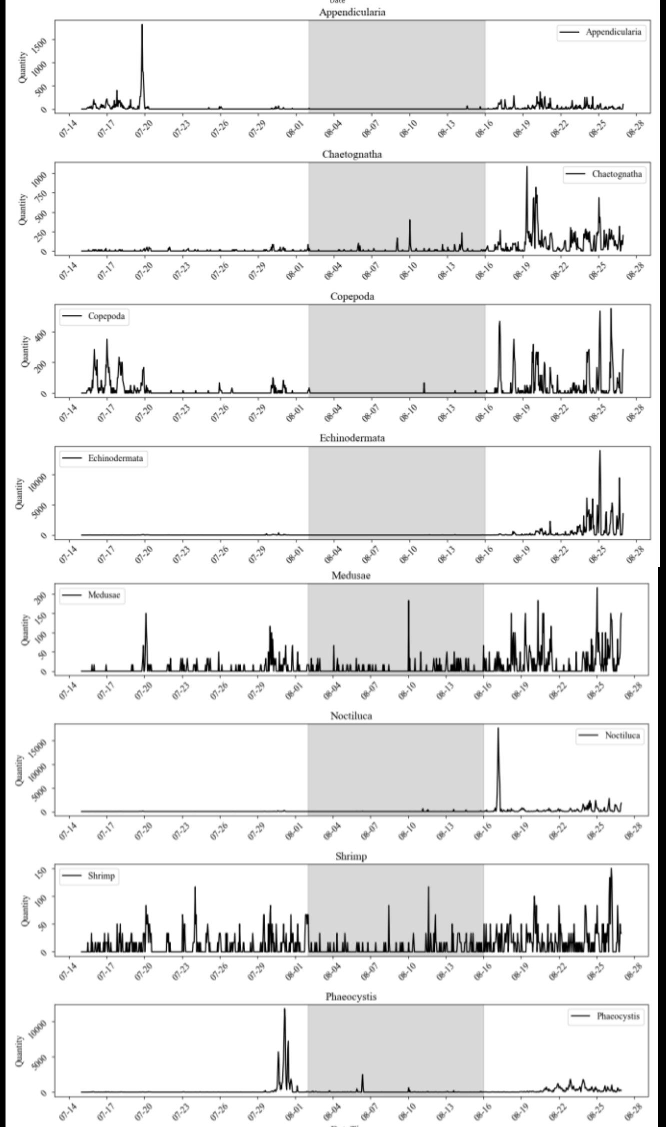


5.Summary: Strong versus weak/early

Strong offshore eddies

Significant changes in ocean currents, including sharp reversed and accelerated alongshore current. Alongshore currents returned to normal in ~7 days. Zooplankton density plummeted within36 hours, and started to recover after 5-14 days.

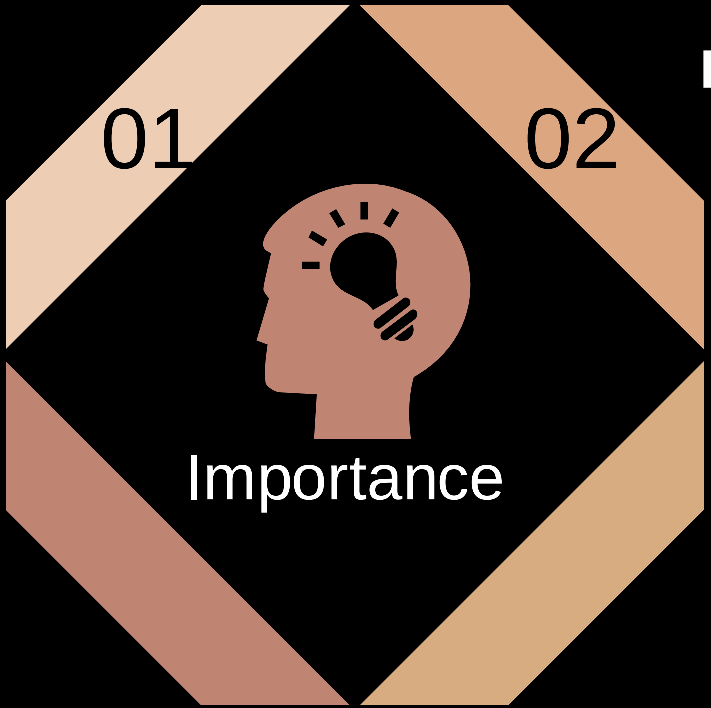
Weak response

Ocean currents remained relatively stable.

Impacts likely first occurred in original landing site and propagated to the sampling site.

Monitoring System

Utilize weather forecasts, satellite monitoring, and ocean observation stations to track typhoon paths, wind speeds, and ocean currents, and in situ underwater plankton imaging system in real-time.



Ecosystem Monitoring

Impacts on the pelagic ecosystem, pelagic-benthic coupled process, nutrient dynamics, phytoplankton, zooplankton, to fish.


高清
Questions?
Thanks!