

COLLABORATIVE RESEARCH SURVEY ON MARINE FISHERIES RESOURCES AND ENVIRONMENT IN THE GULF OF THAILAND 2018

Seasonal Change of Water Exchange System between the Gulf of Thailand and South China Sea

Jitraporn Phaksopa¹ and Hiroji Onishi²

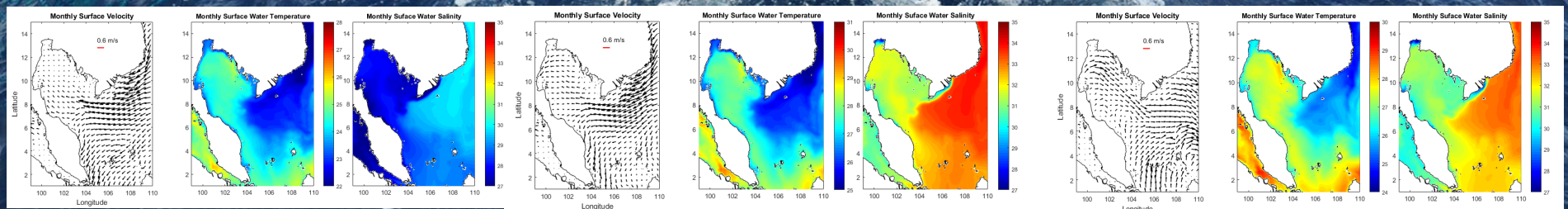
¹ Kasetsart University ² Hokkaido University



Supported by Southeast Asian Fisheries Development Center
Training Department, Samut Prakan, Thailand

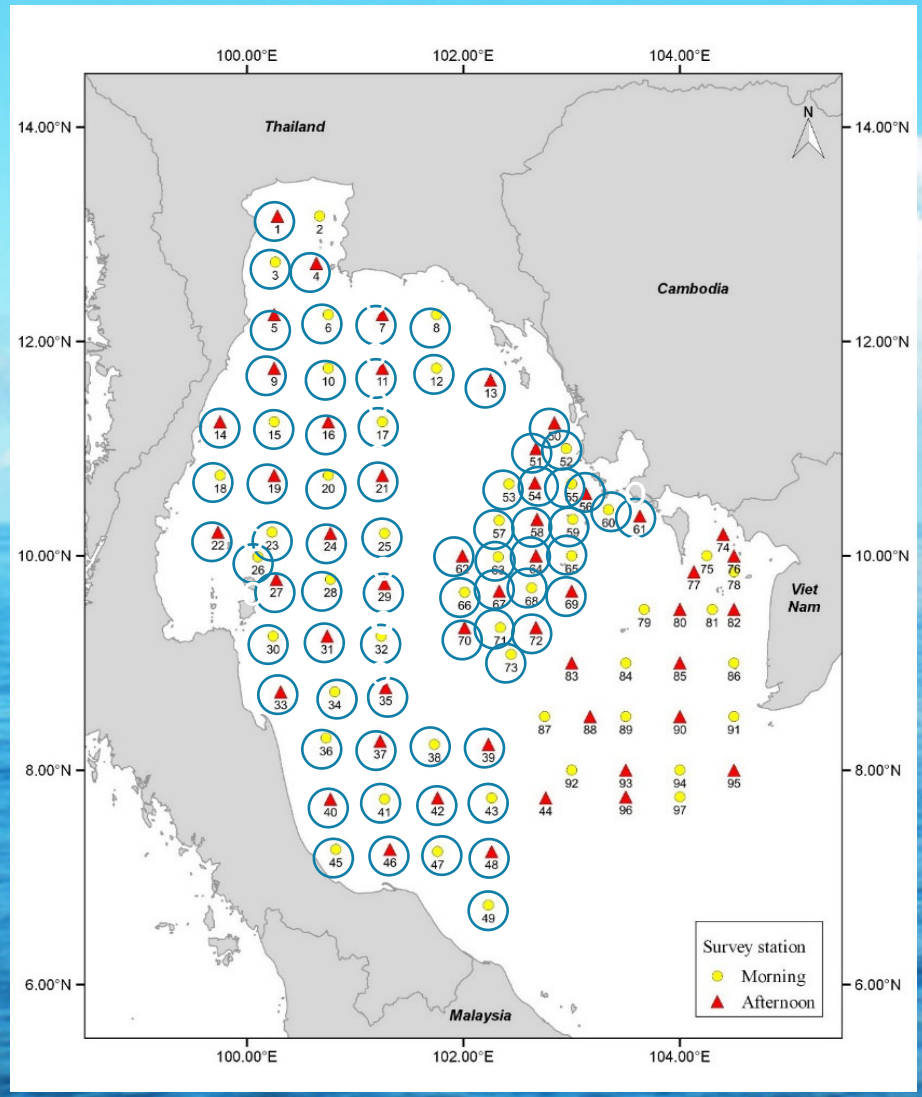
Outlines

- Introduction
- Material and Methods
- Results and Discussion



Study Area

Station map 72 stations



Material and Methods

- CTD data (Temperature, Salinity, Density, Pressure)
- Copernicus model (Temperature, Salinity, Density)
- Numerical Models (ROMS: Regional Ocean Model Systems)

CTD data (Temperature, Salinity, Pressure)

- Clarify water masses using TS-diagram
- Cross-section of Temperature, salinity and Density

Need to cut off many error data of CTD in surface layers,
(error data has still remained (in T-S diagrams))

** data correction must be done more carefully.

Copernicus model

- Reanalysis Copernicus model, which are assimilated by multi-satellite data and in situ observation data
- This data set is model base ($1/12 \times 1/12$ degrees, eddy-resolving)
- Averaged for 26 years from every month model results (for showing climatic condition of the GoT)

Numerical Models

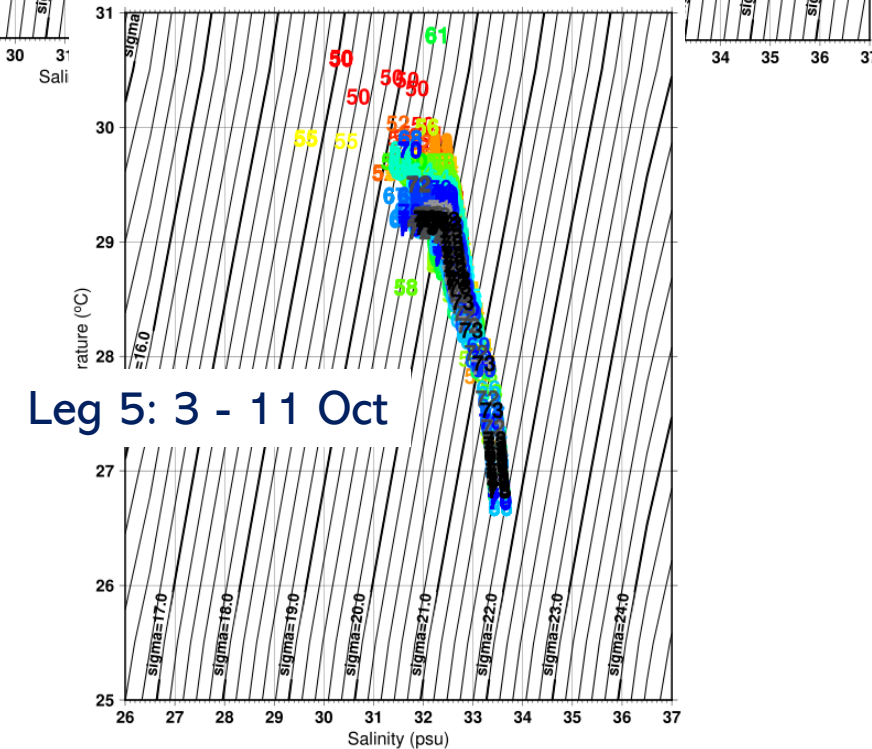
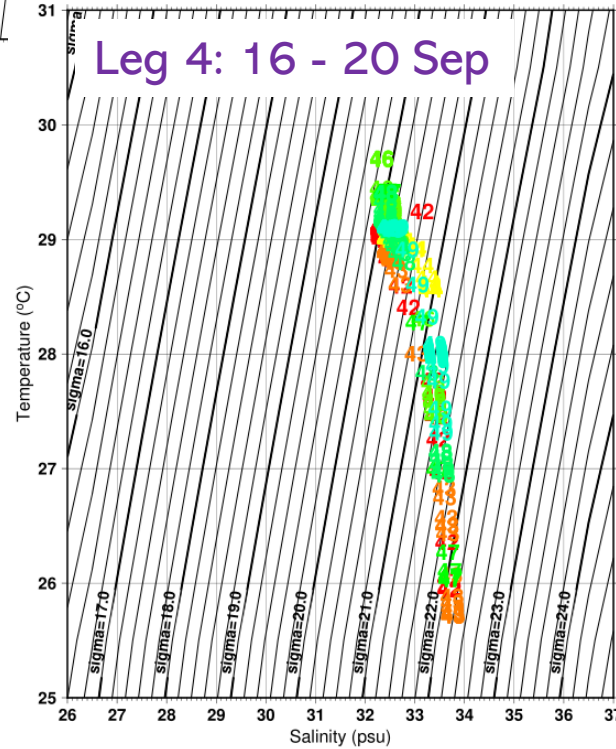
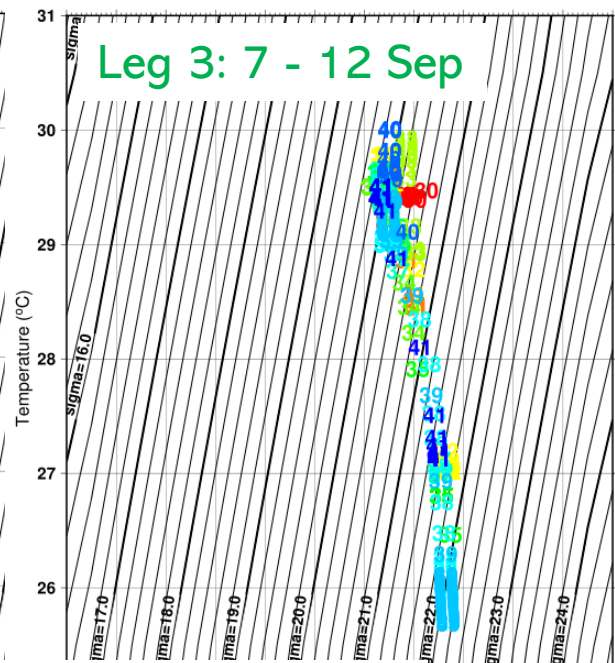
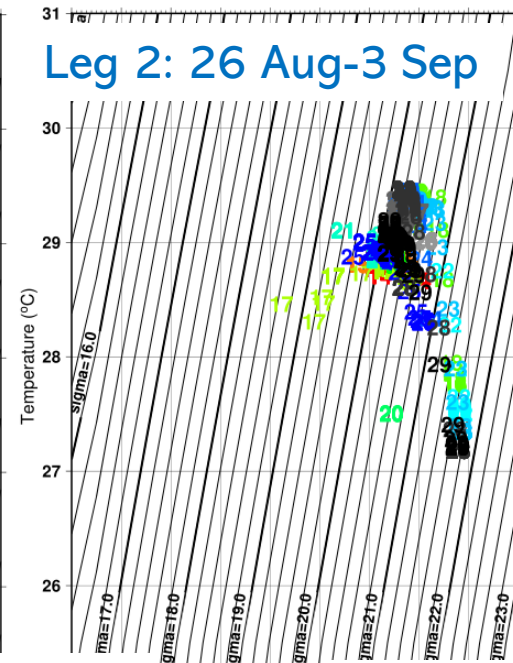
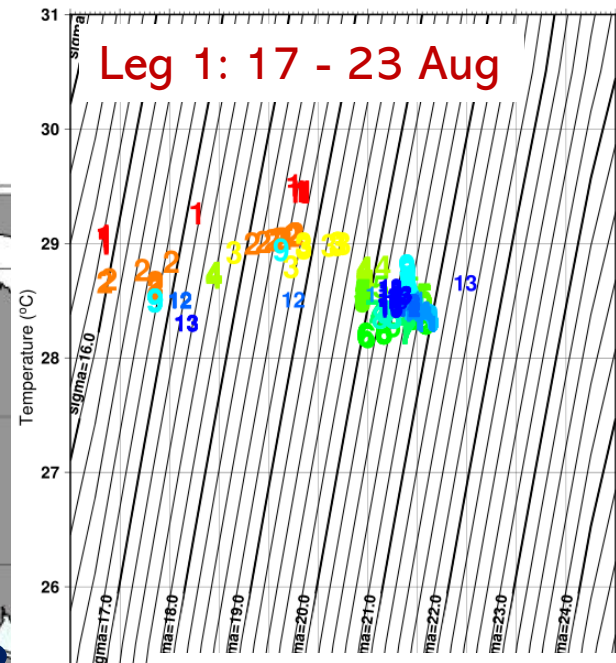
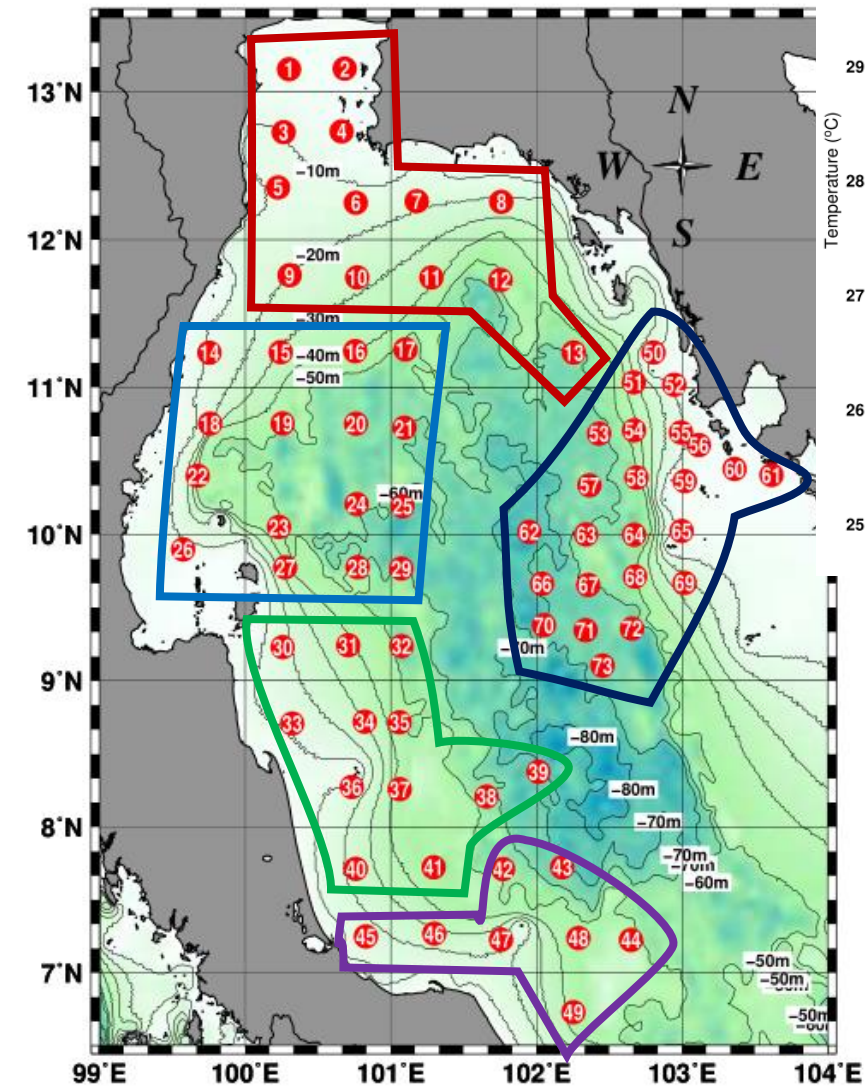
(ROMS: Regional Ocean Model Systems)

- Spin up: since January 2017
- Forcing function: Wind, Pressure from (ECMWF)
Heat Flux from ECMWF
- Bathymetry: ETOPO1
- Tidal forcing at open boundaries: TPXO9.0 (13 components)
- Horizontal Resolution: $3 \times 3 \text{ km}^2$
- Vertical 30 layers in sigma coordinates
- Initial data (SSH, temp and salinity): Hycom



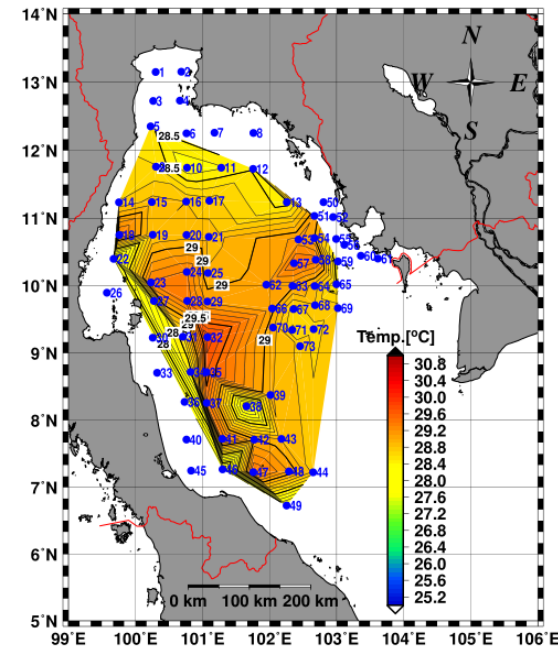
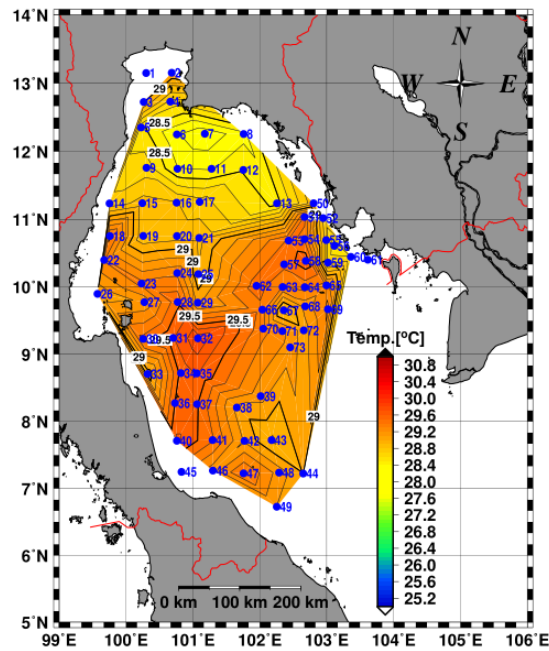
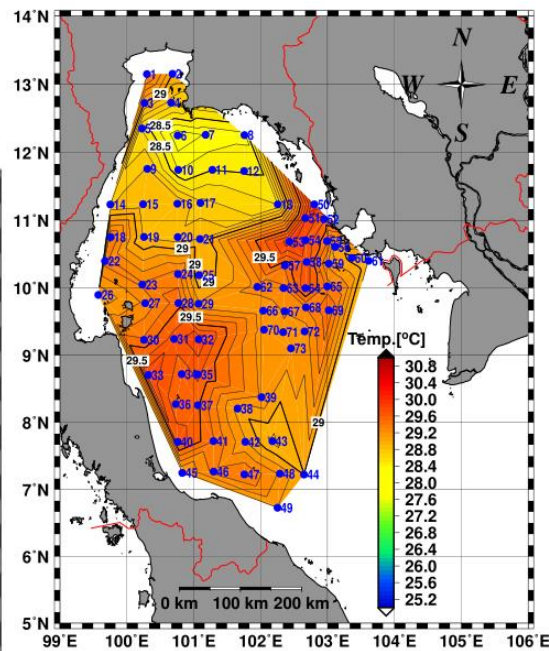
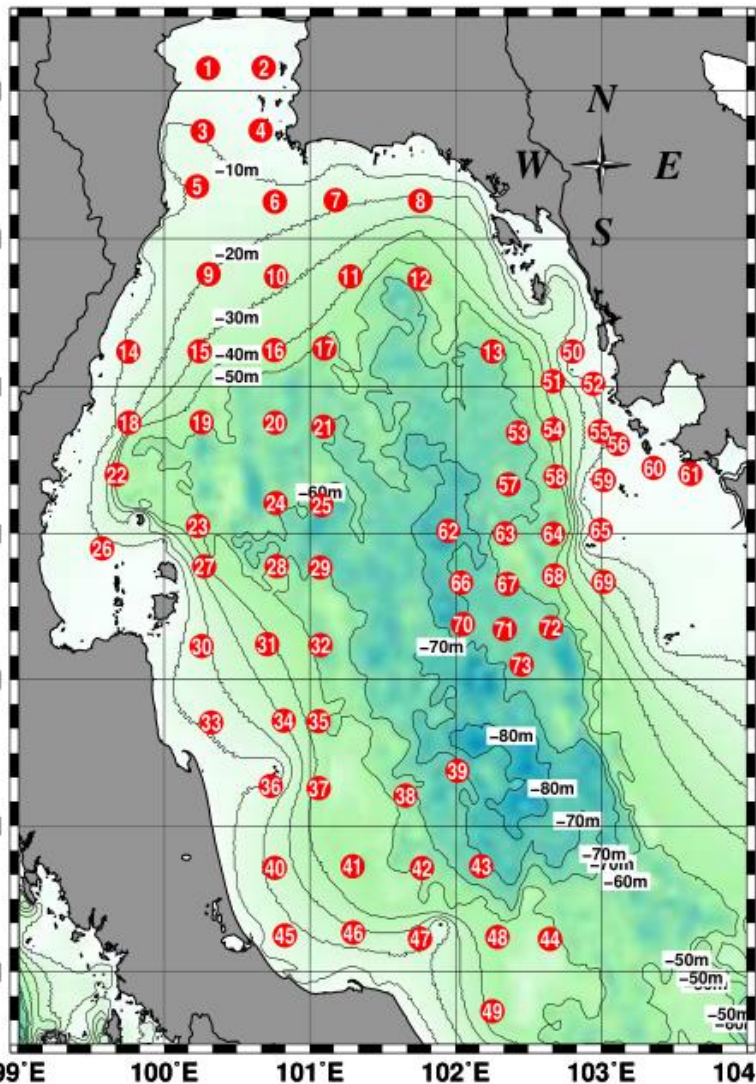
Results

Results

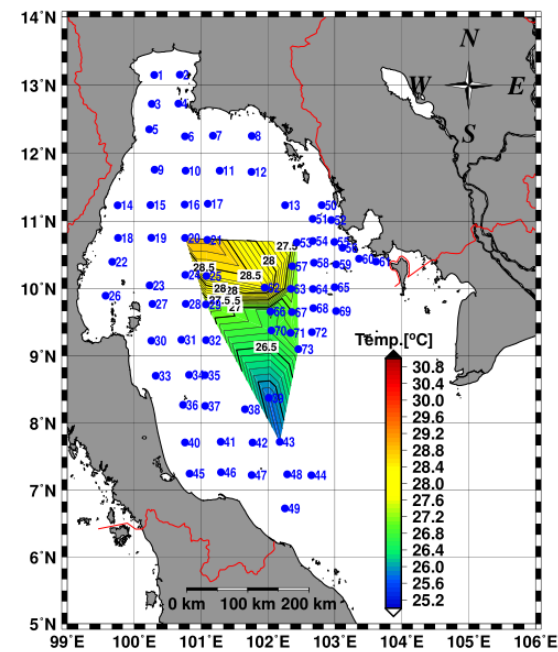
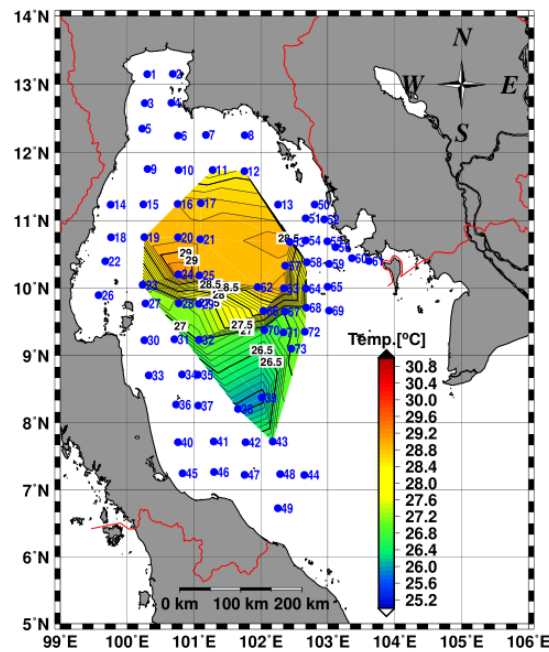
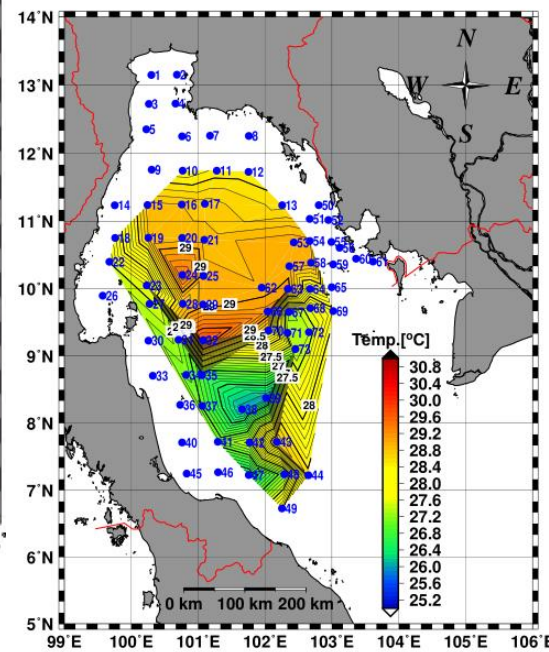


Horizontal distribution of Temp.[°C]

Upper: 10, 20, 30m

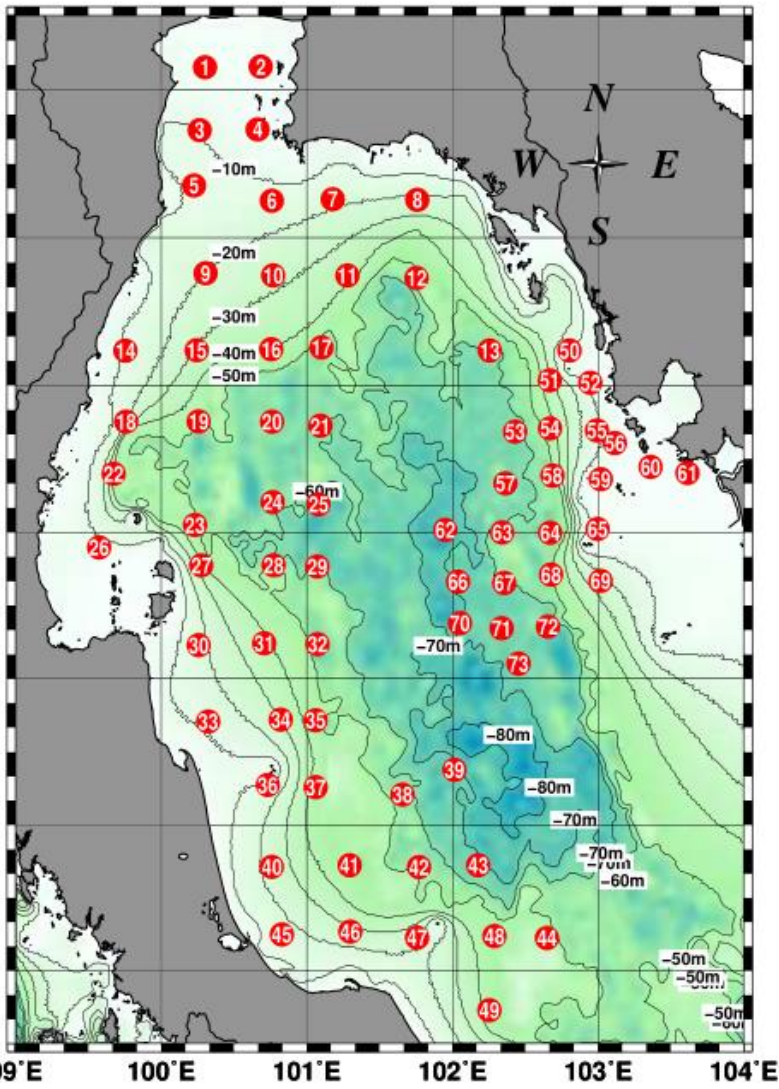


Lower: 40, 50, 60m

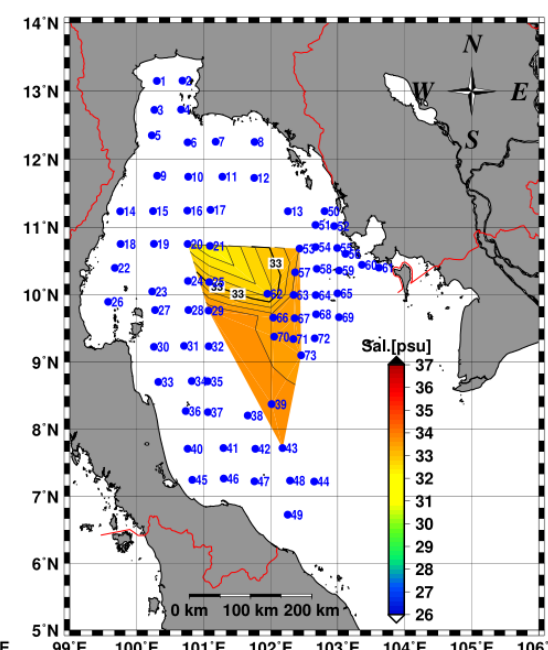
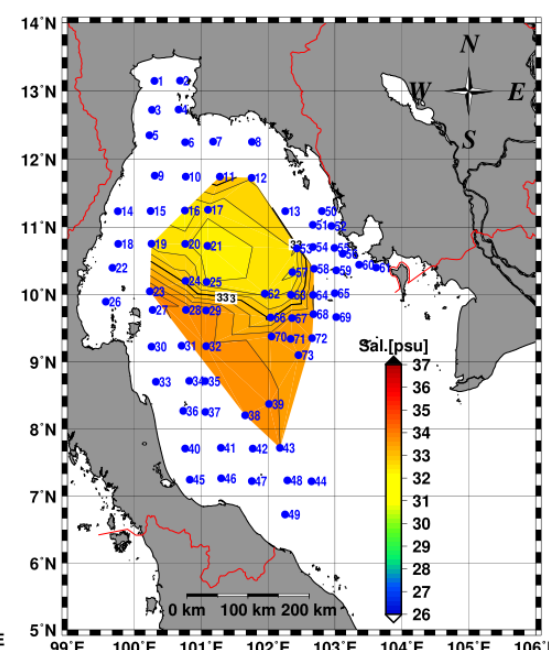
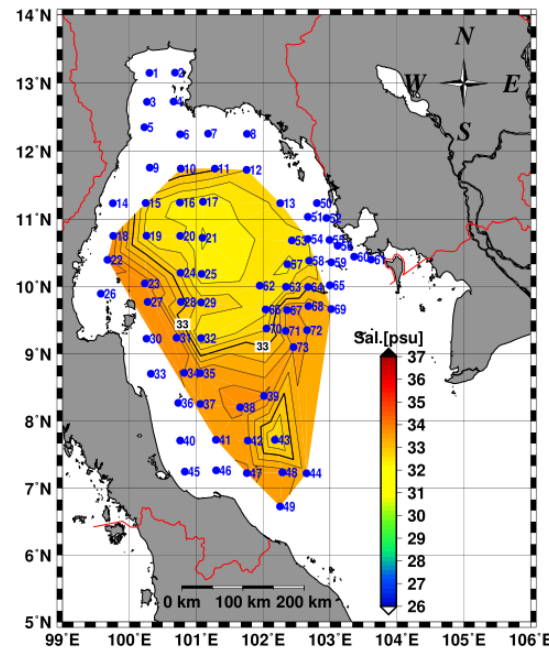
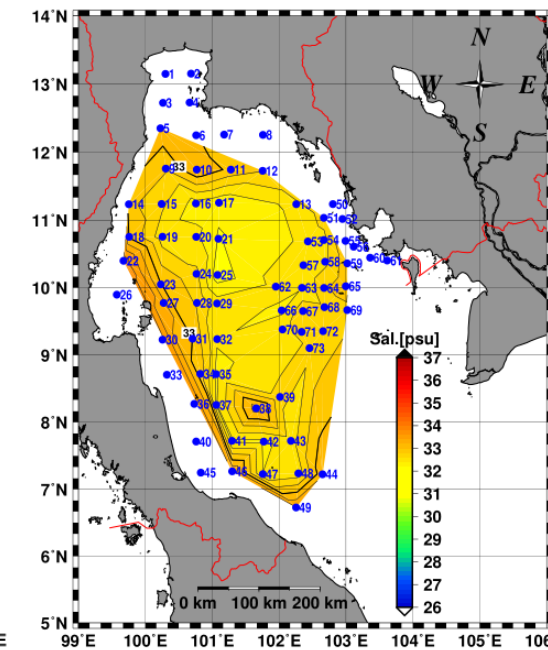
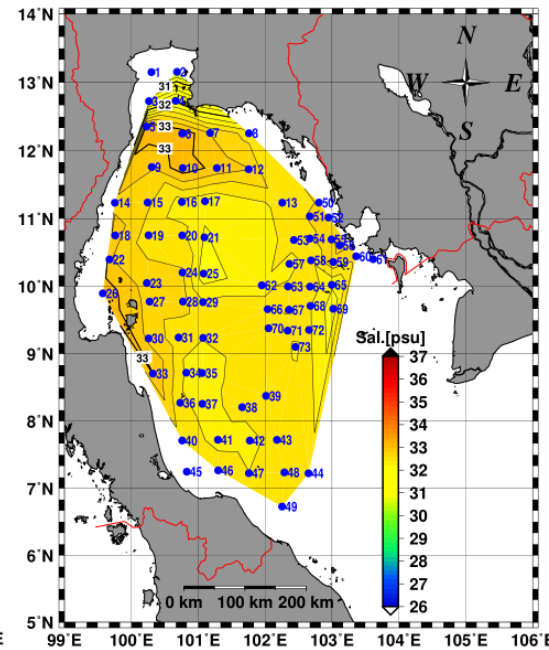
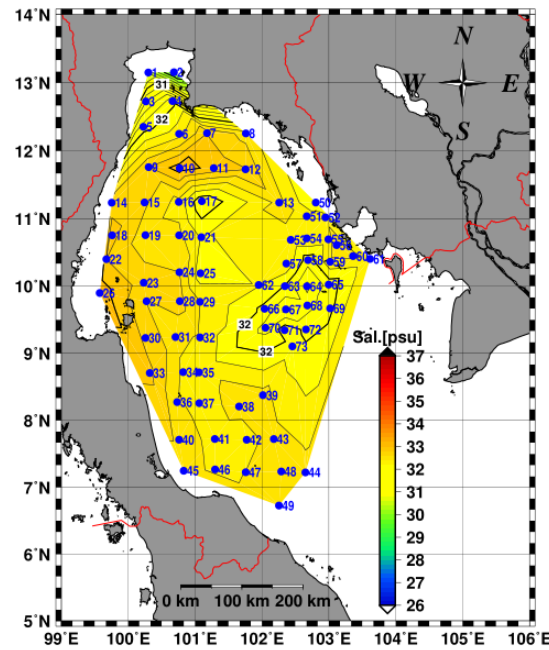


Horizontal distribution of Sal.[psu]

Upper: 10, 20, 30m

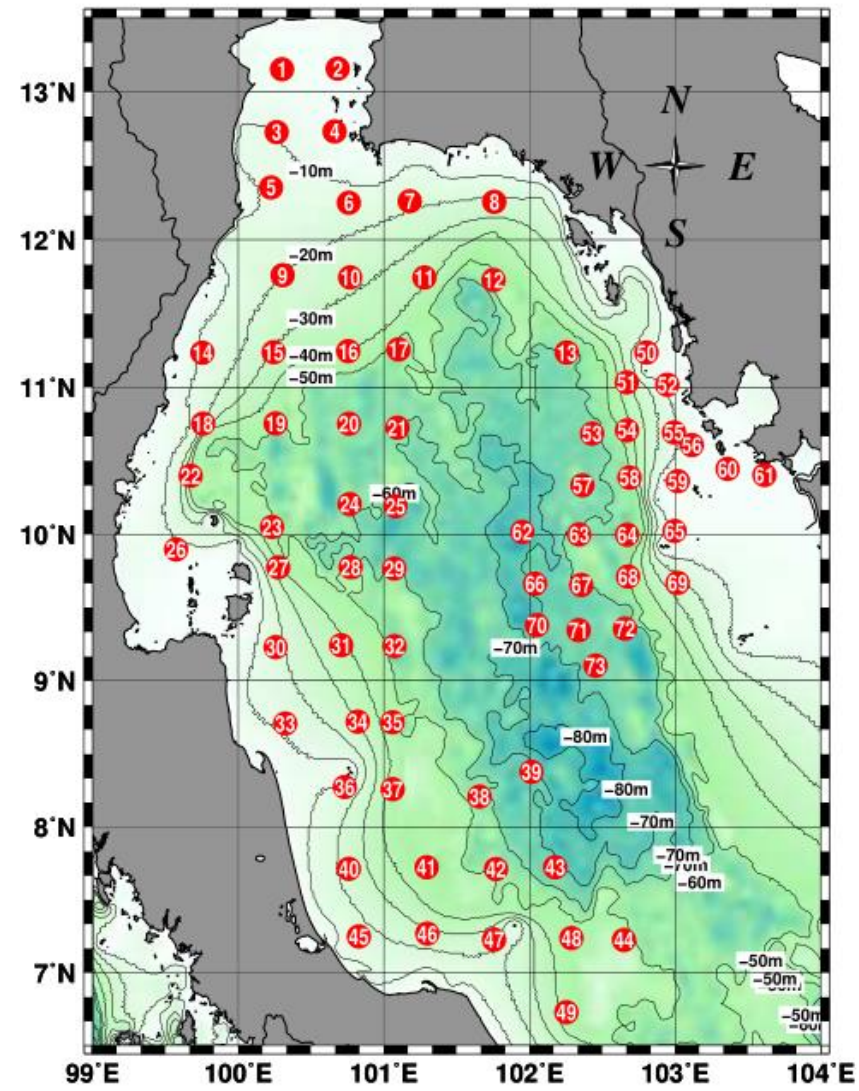


Lower: 40, 50, 60m

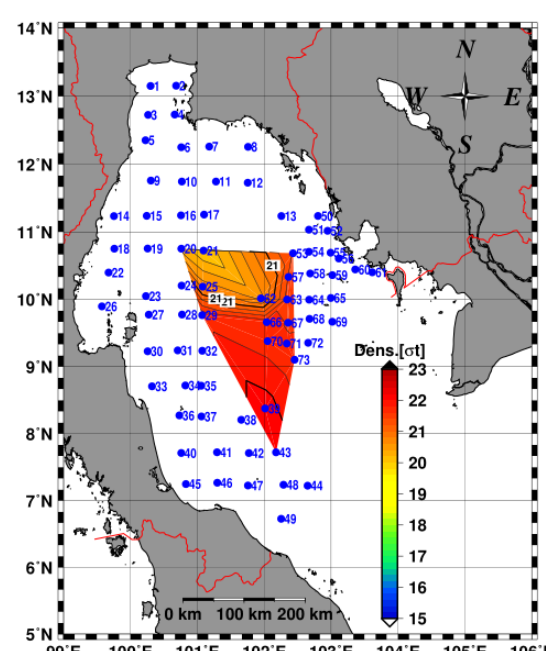
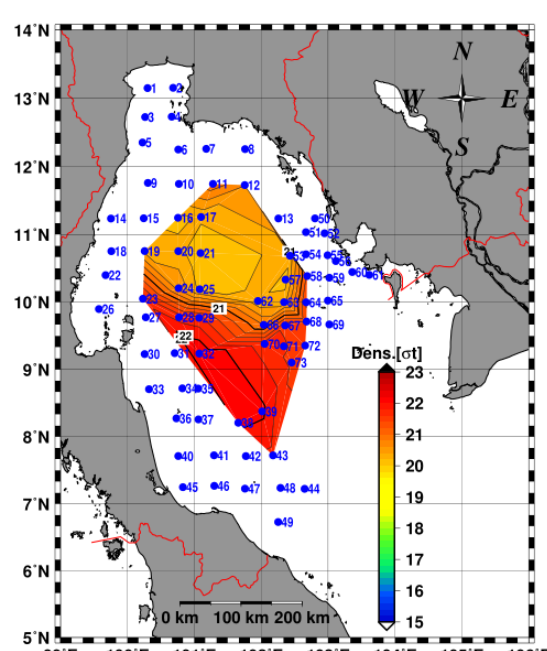
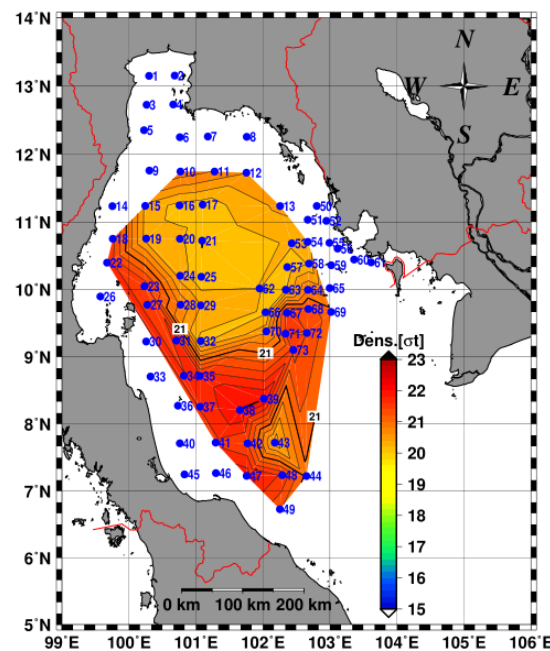
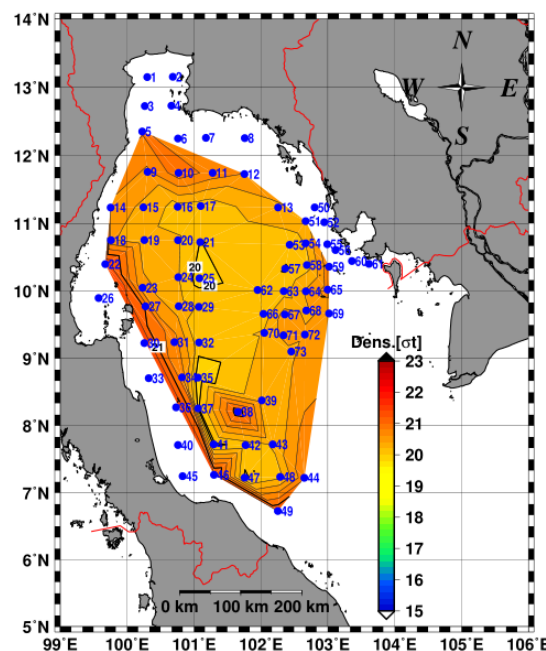
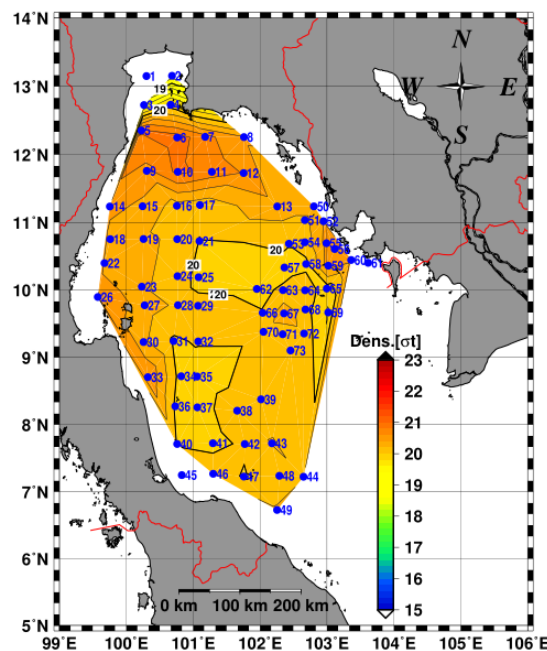
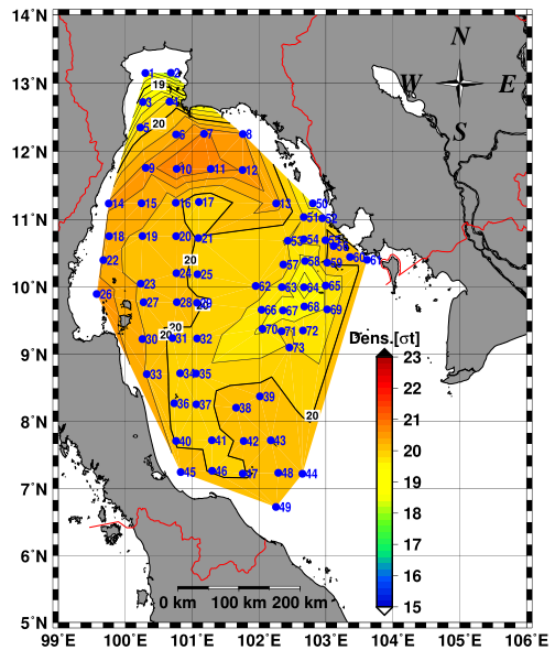


Horizontal distribution of Dens.[σ_t]

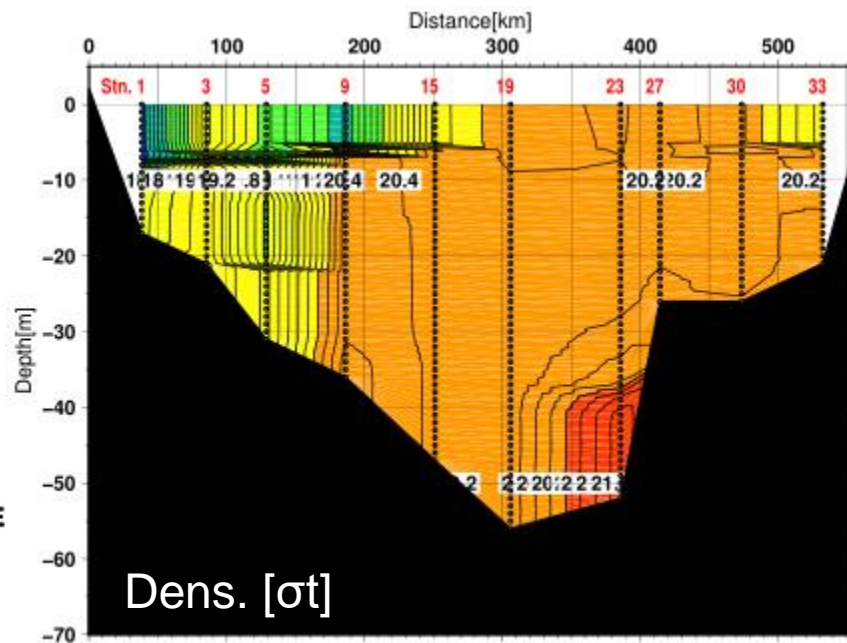
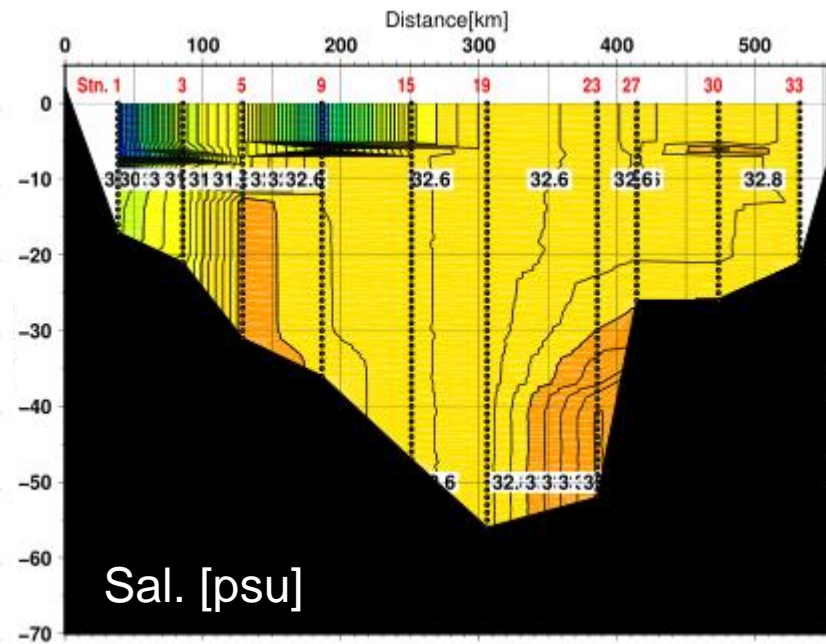
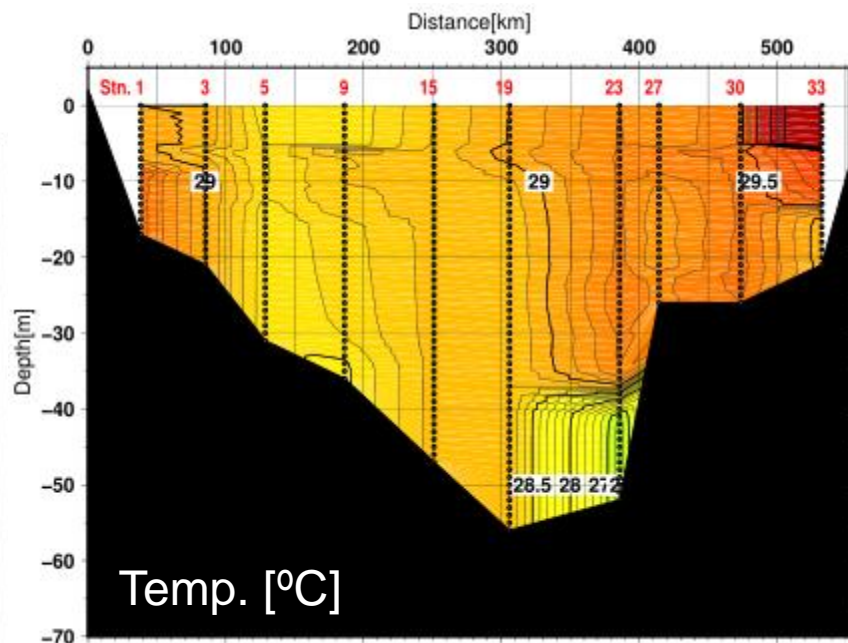
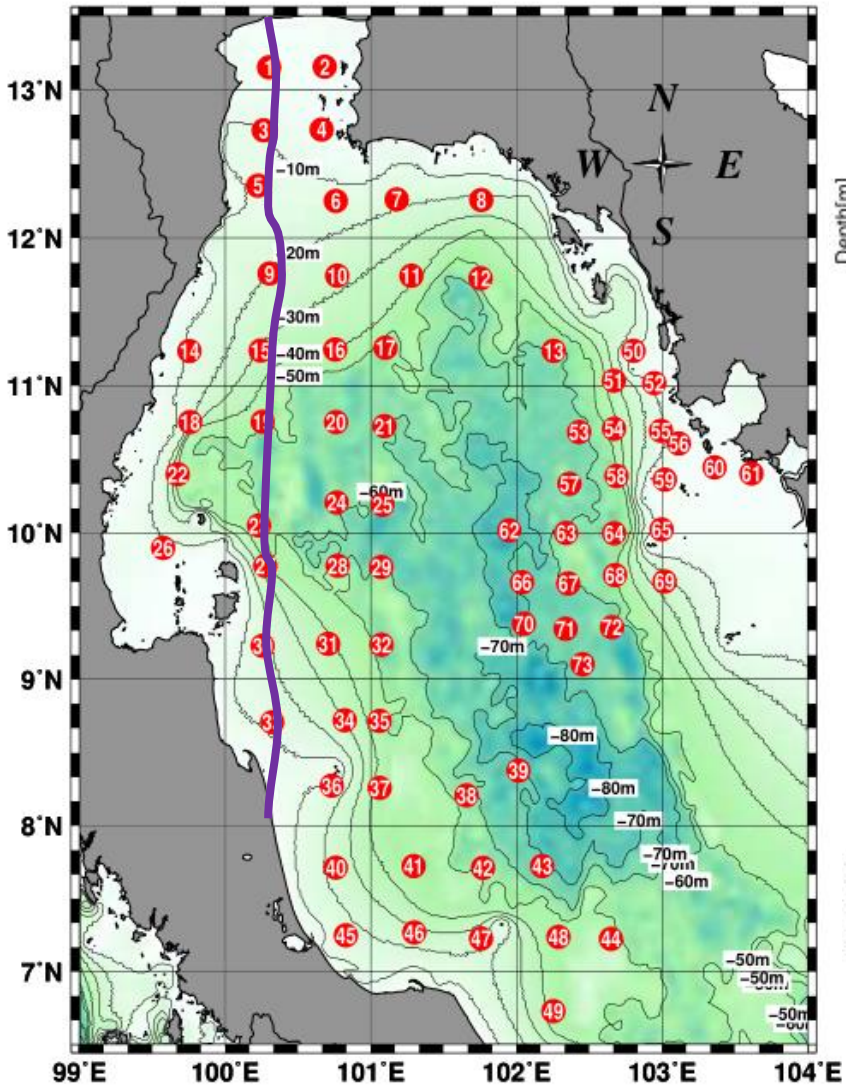
Upper: 10, 20, 30m



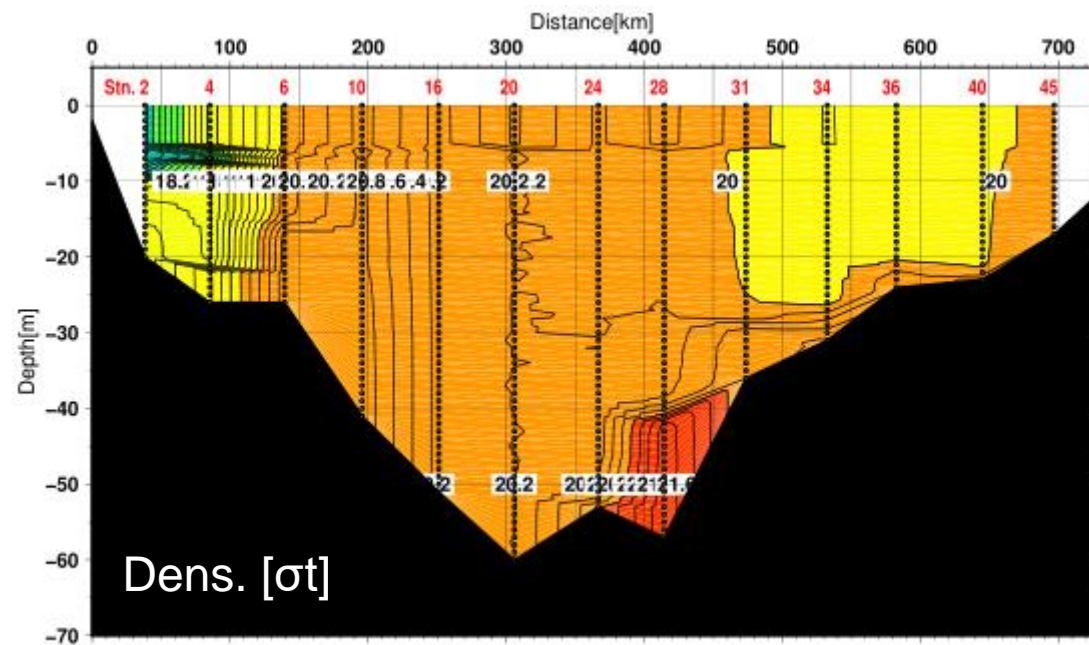
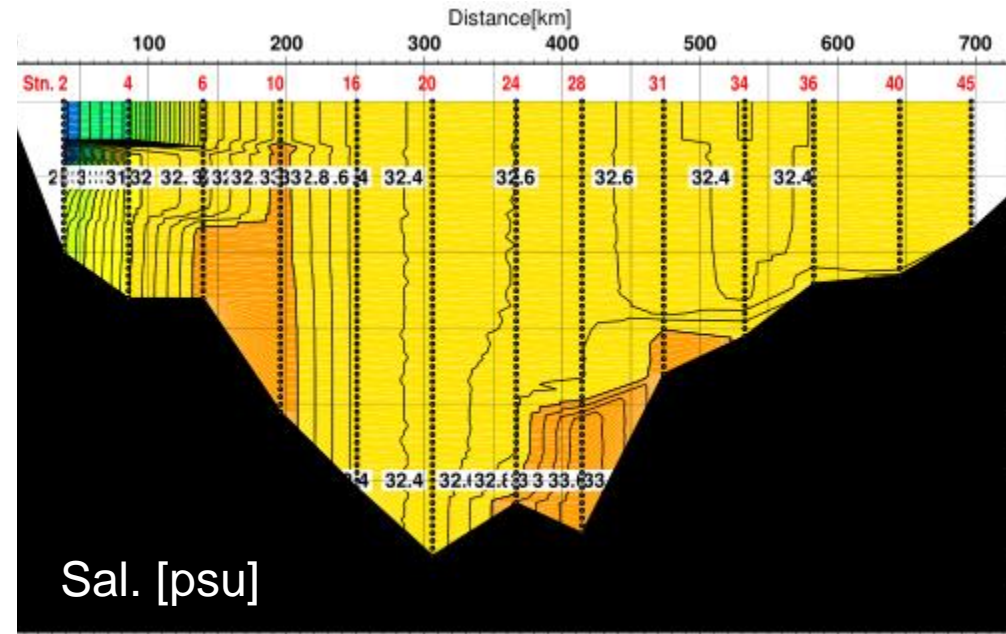
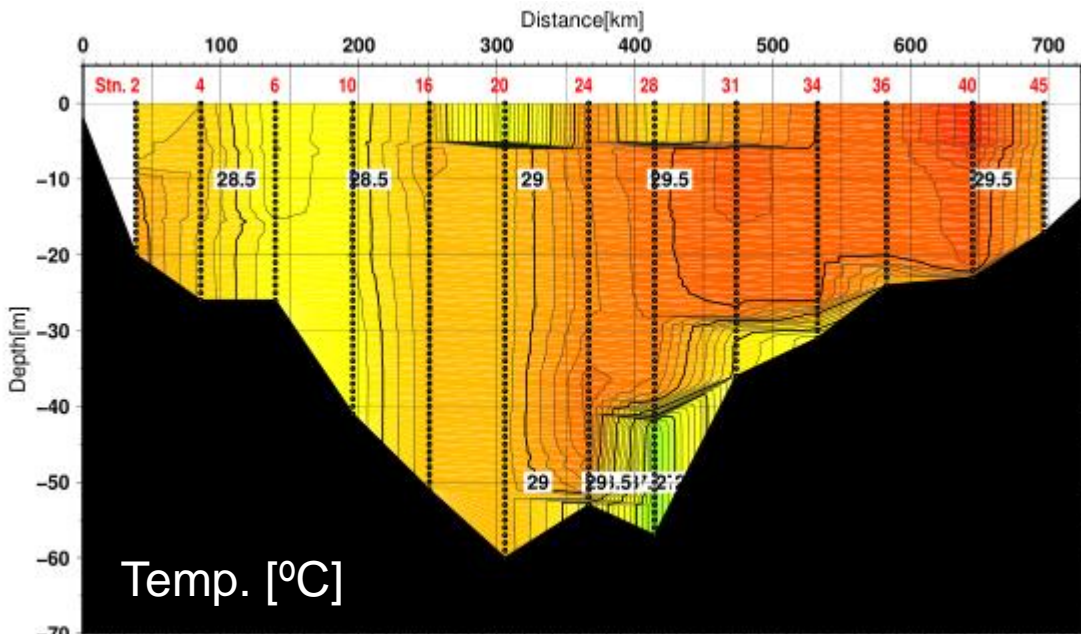
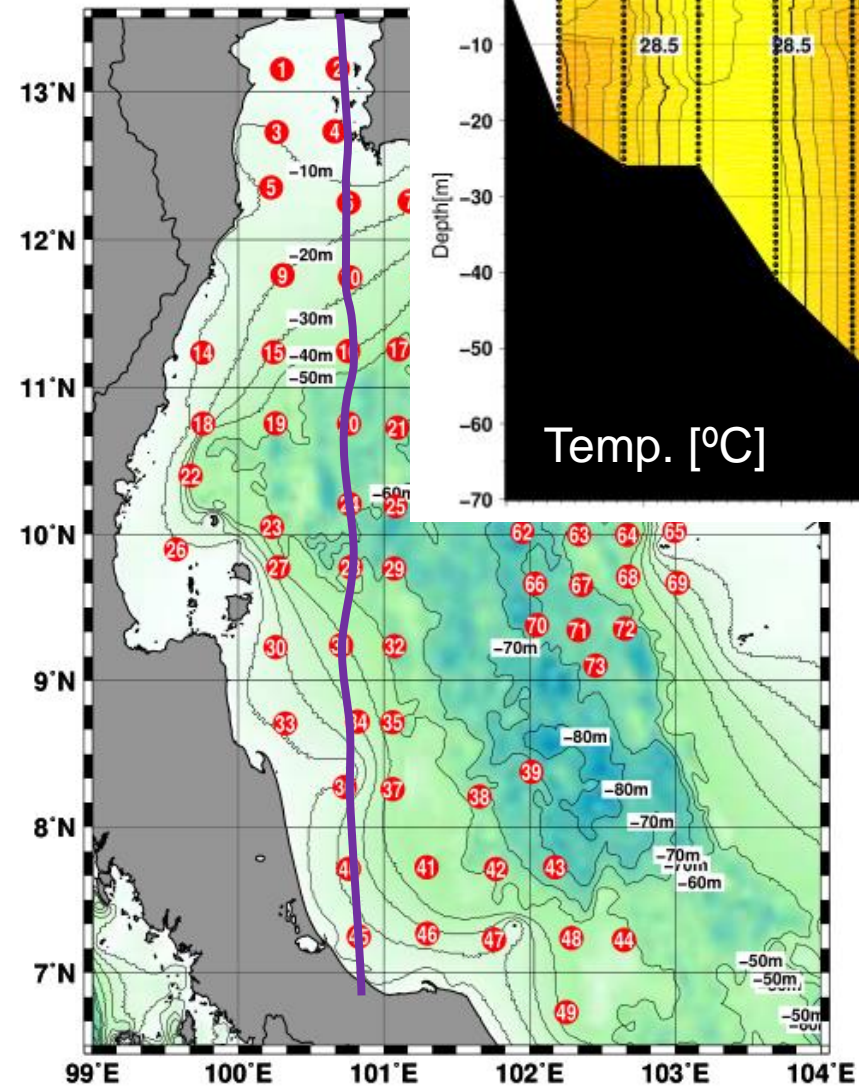
Lower: 40, 50, 60m



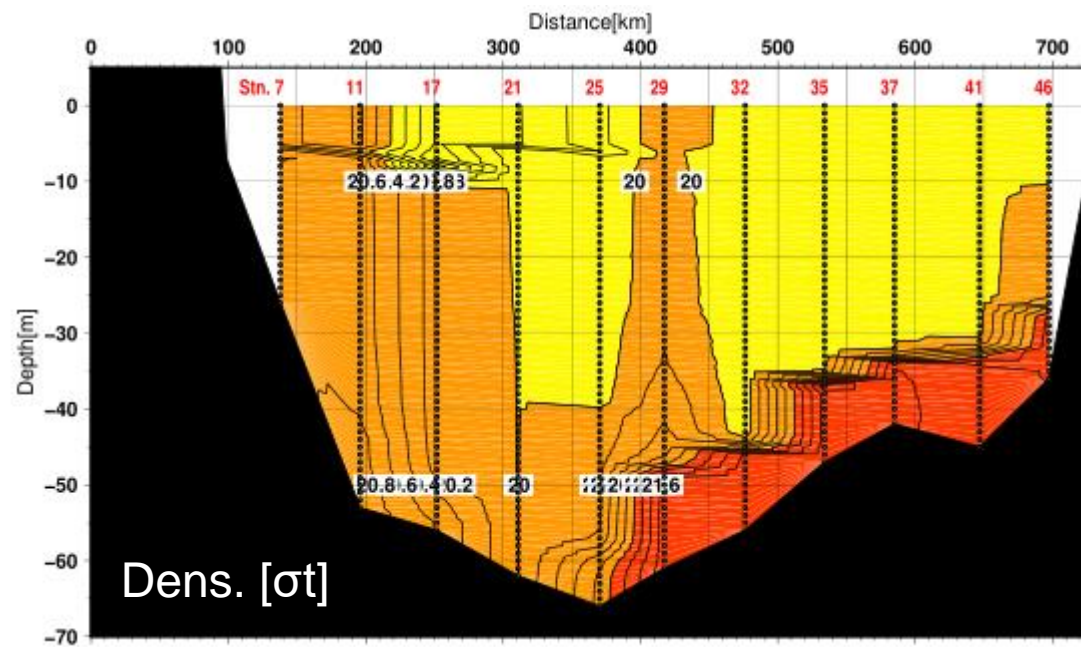
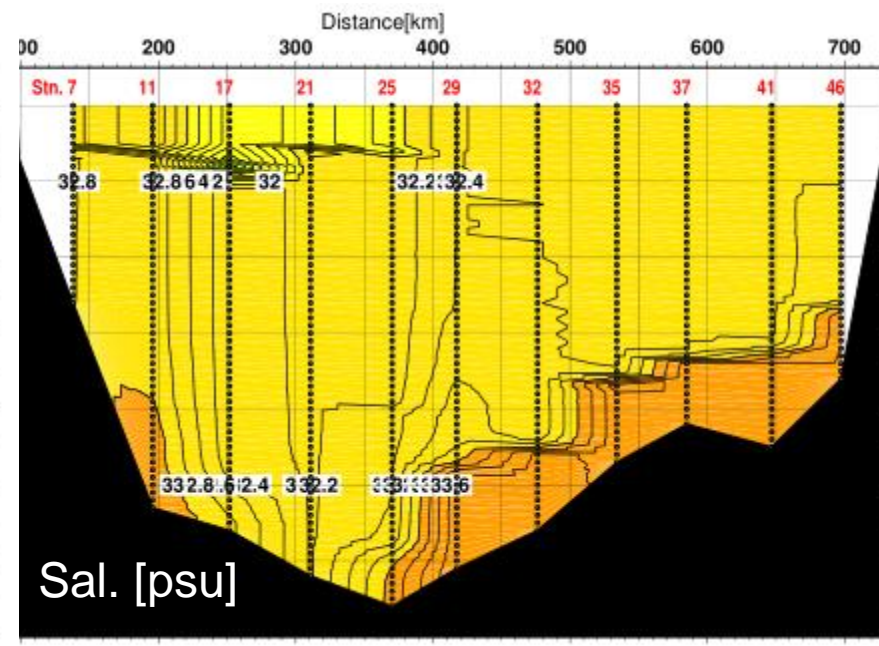
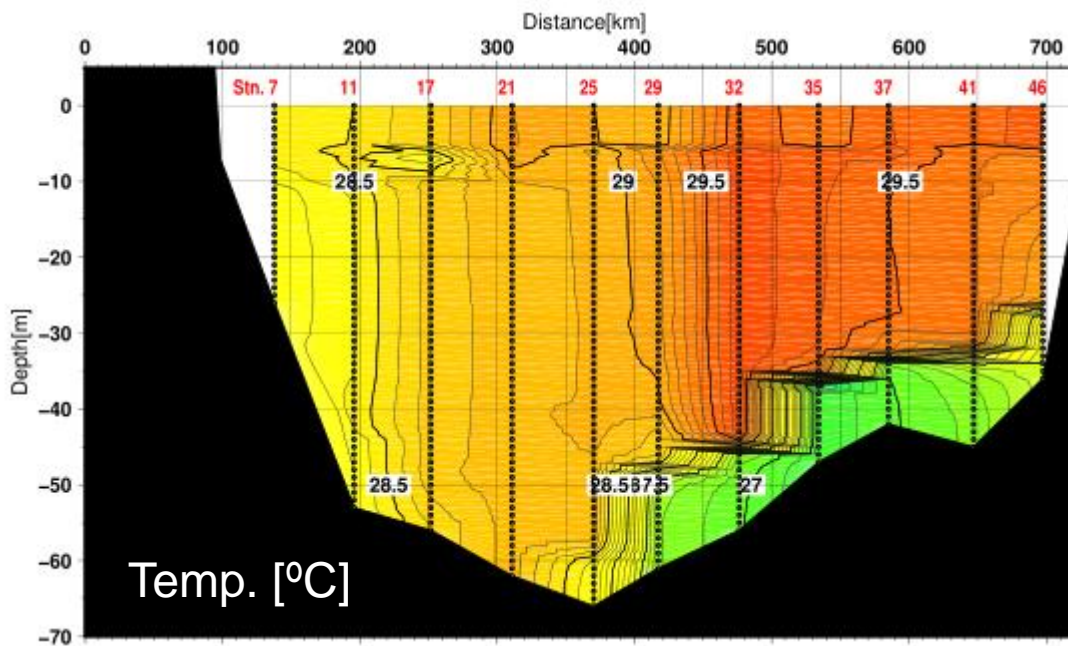
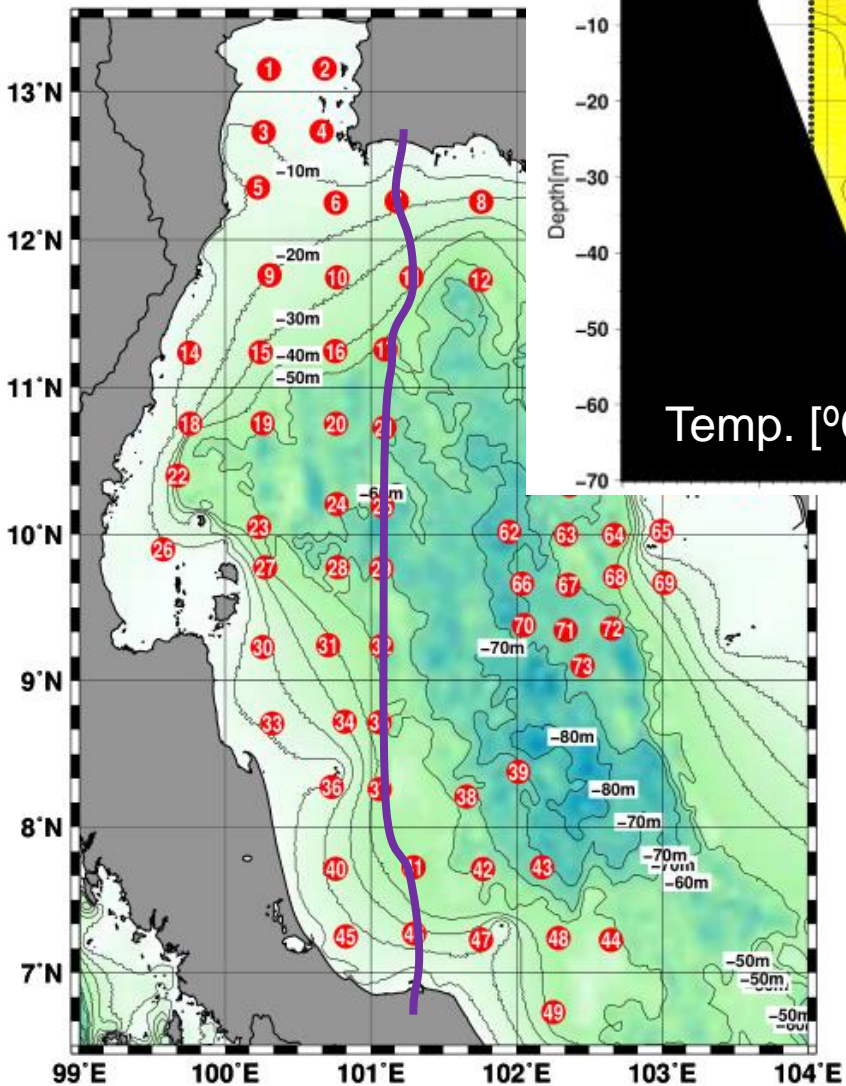
Sections
along this line



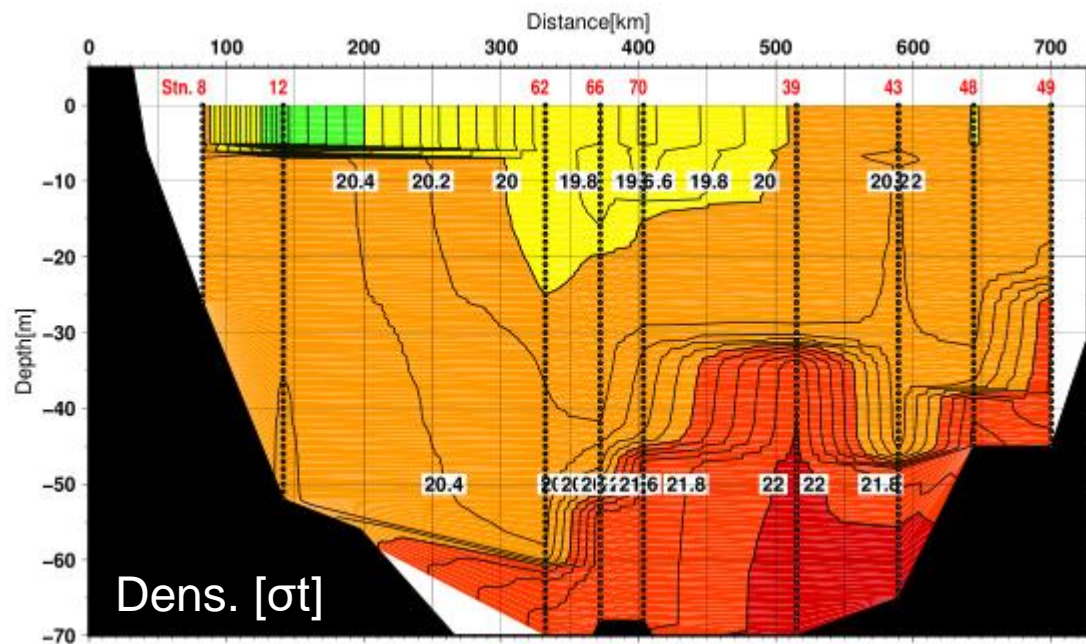
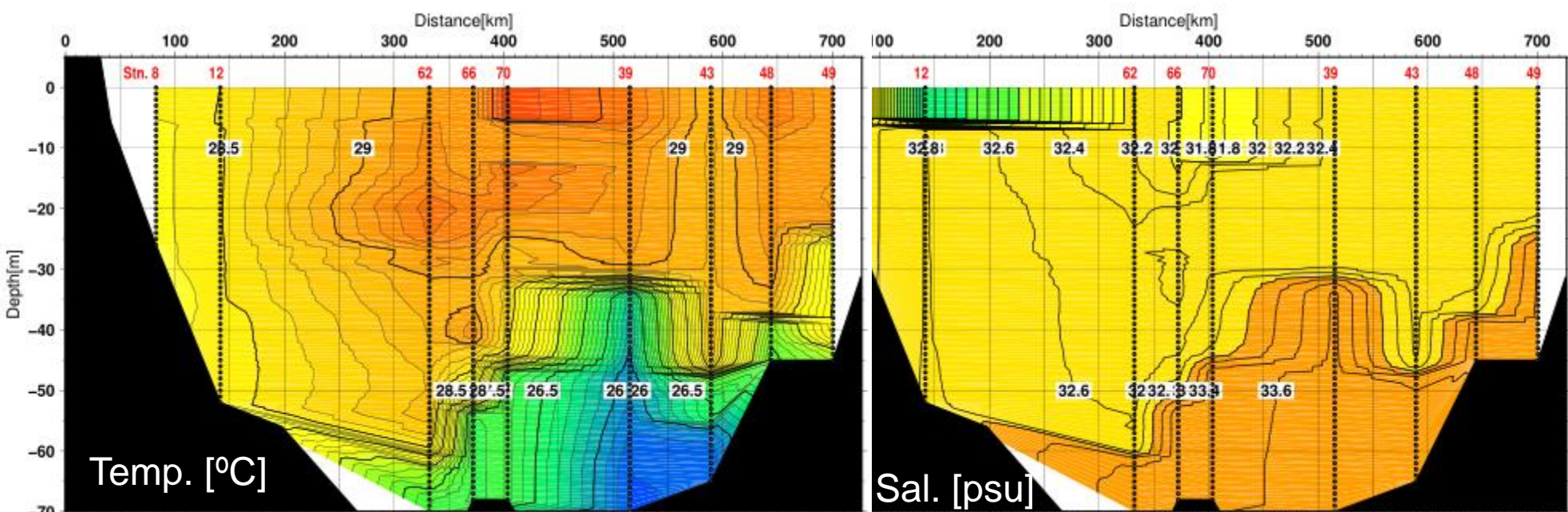
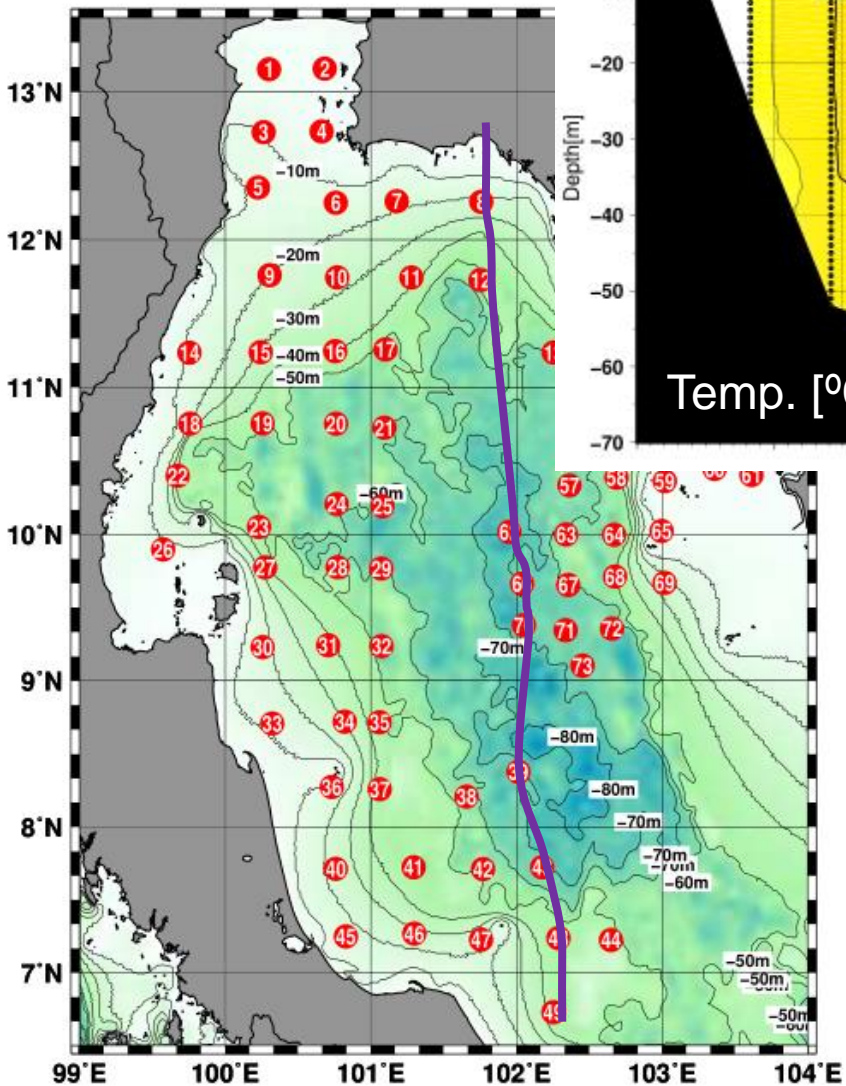
Sections along this line



Sections along this line



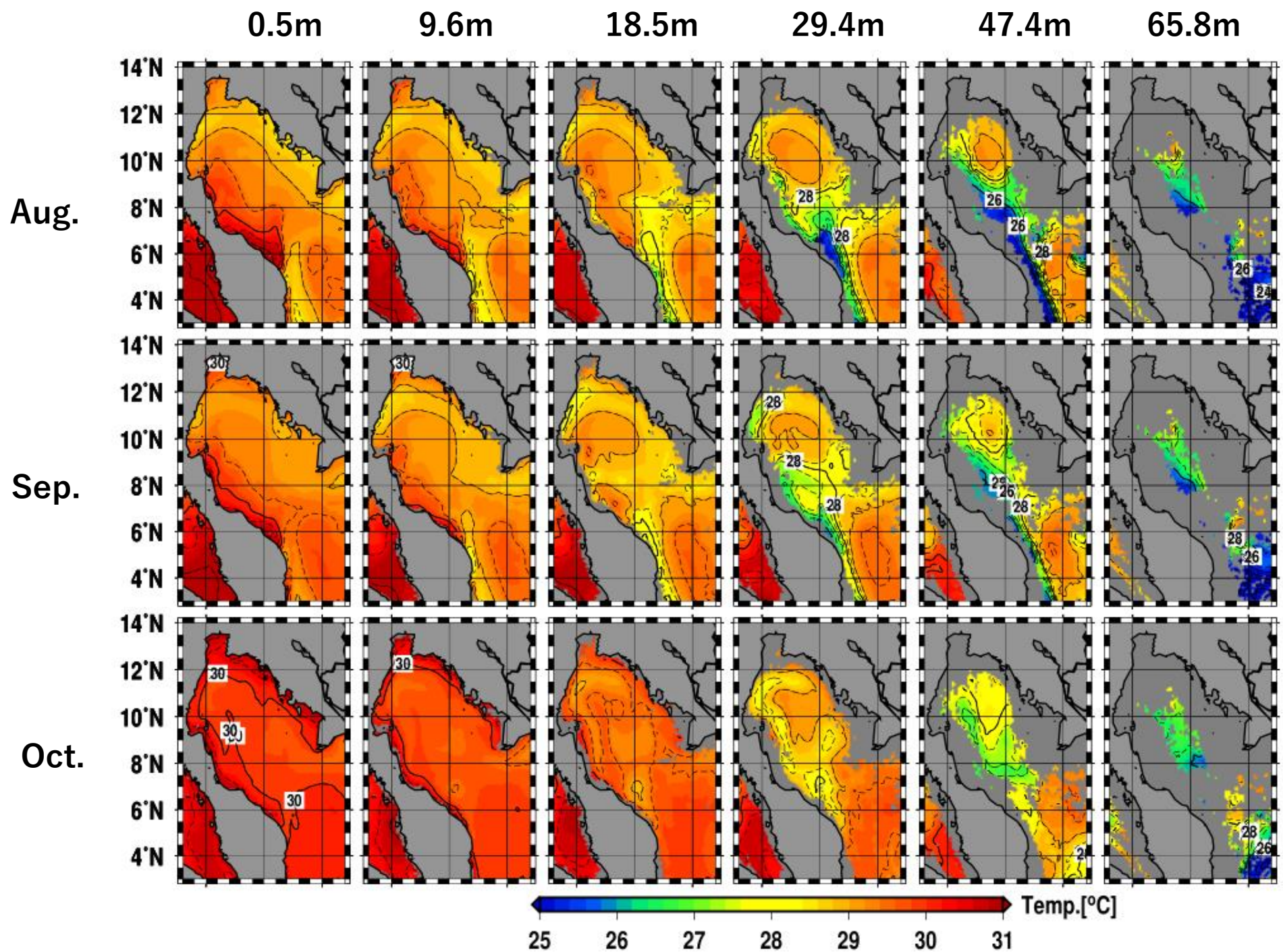
Sections
along this line



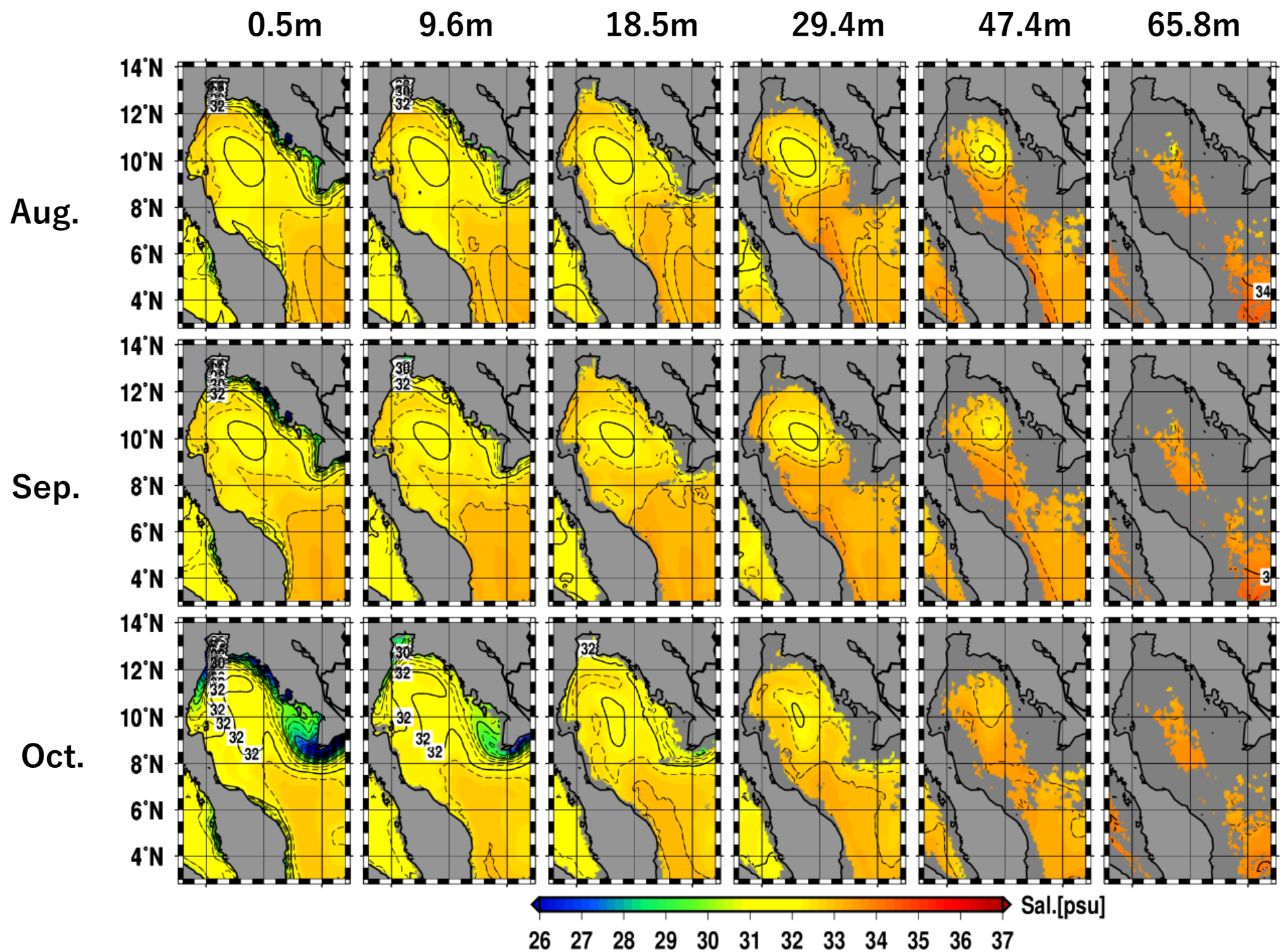
Interesting point from CTD Data

- In some sections, cold dense water can be recognized in deepest central area and western coastal area along Malay peninsula. These water may intrude by surface water outflow (estuarine water exchange). These water exchange process (dense, cold, saline water distributed along Malay peninsula) can be also recognized in COPERNICIS data set.

Copernicus
1/12° x 1/12°
gridded from
Model results



Copernicus
1/12° x 1/12°
gridded from
Model results



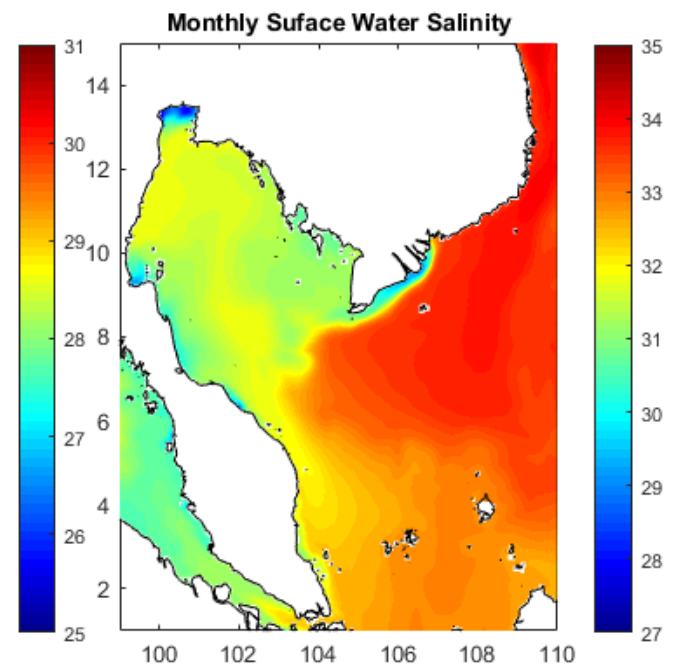
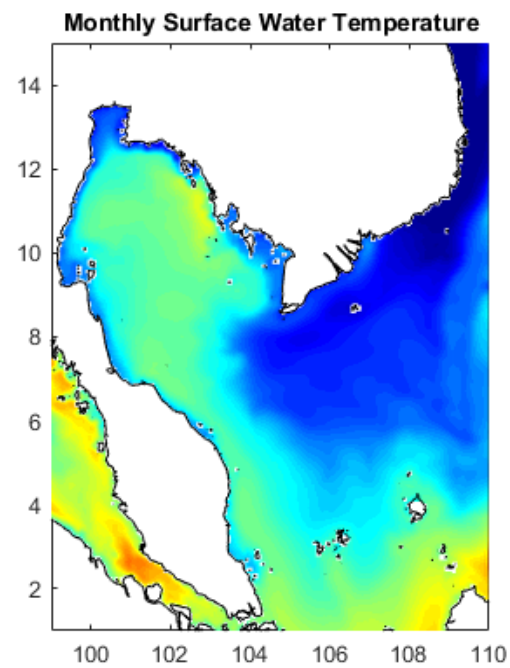
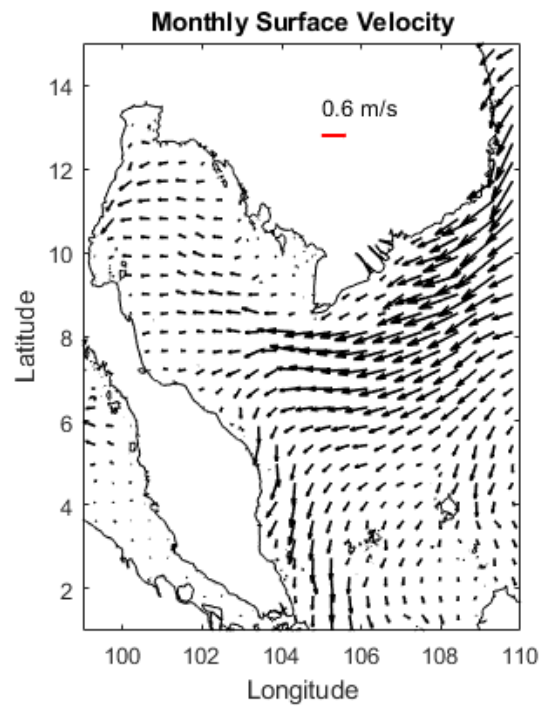
Interesting point from Copernicus data

- August: Relatively cool and saline water distribution at mouth area of UGOT(Stns. 5, 6, 8, 9, 10), these water may be up-welled by strong SW monsoon wind.
- September: the wind got more gentle
- October: NE monsoon had started already

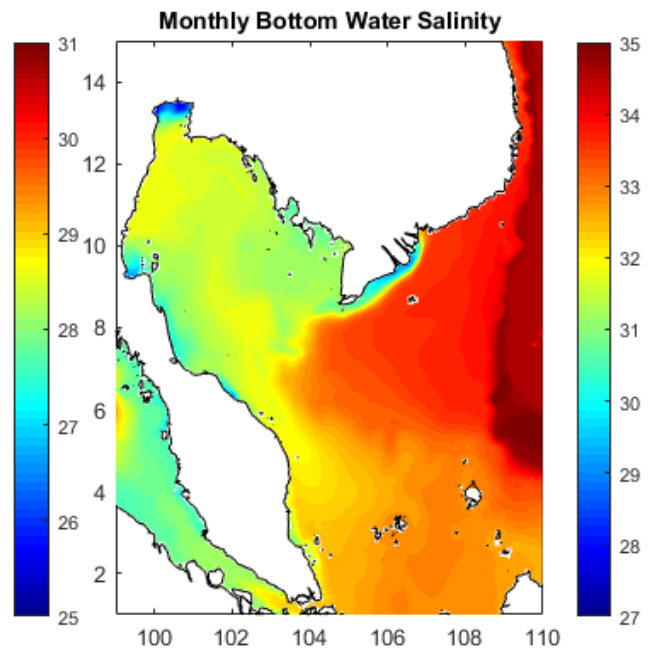
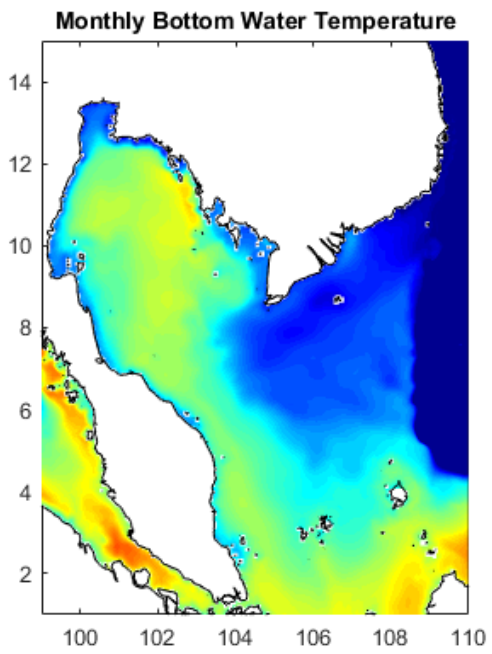
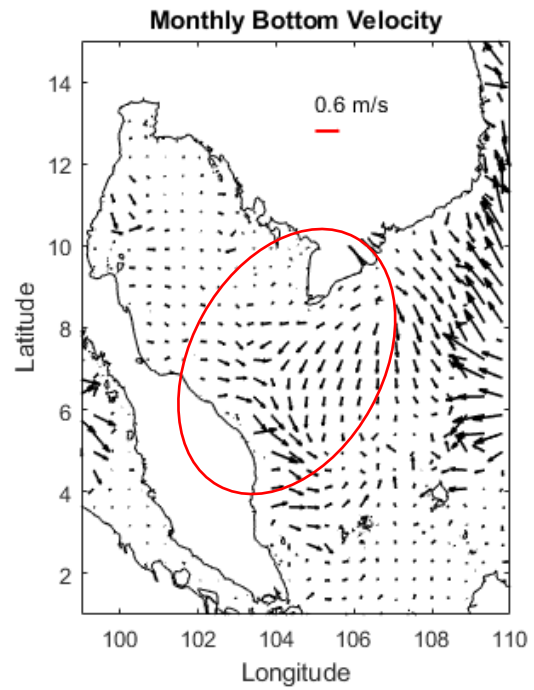
Numerical Model: ROMS

- NE monsoon: Dec2017-Feb2018
- SW monsoon: Aug-Sep18
- Onset monsoon: Oct18

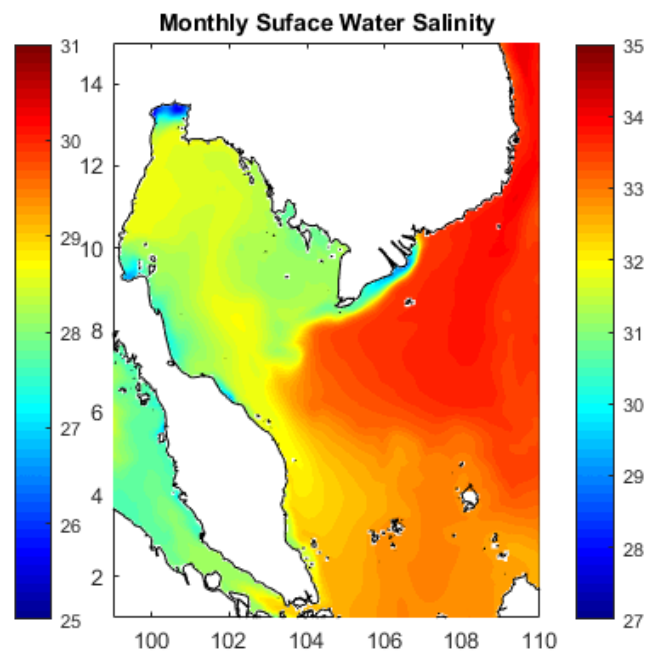
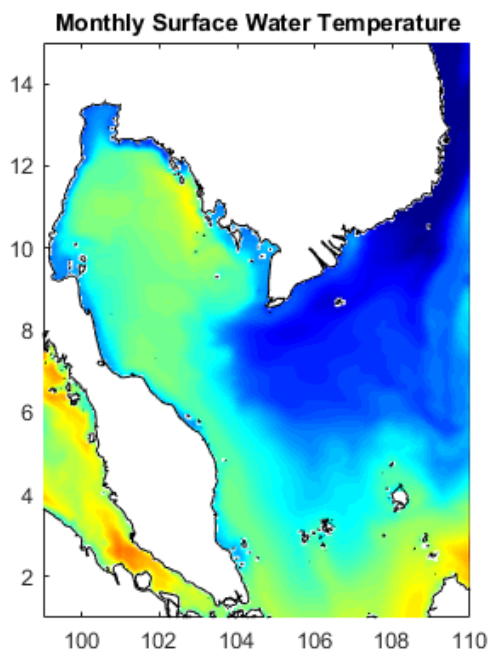
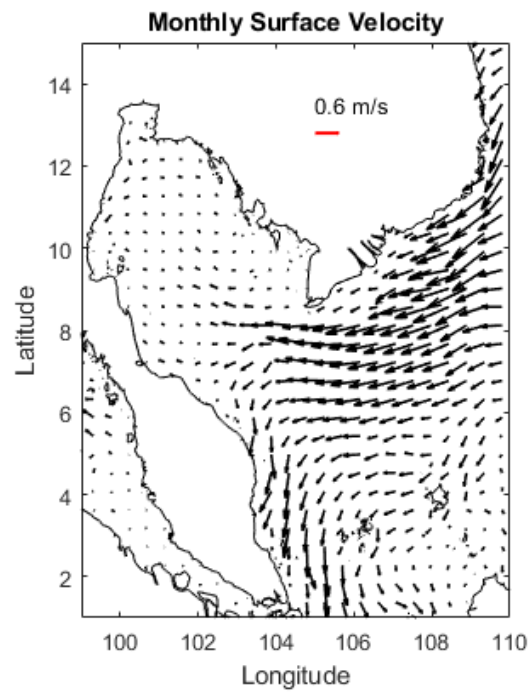
December 2017-Surface



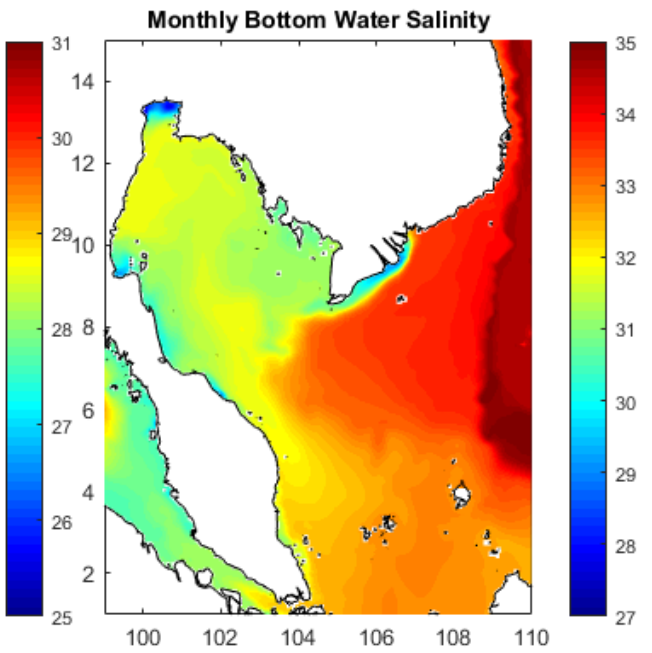
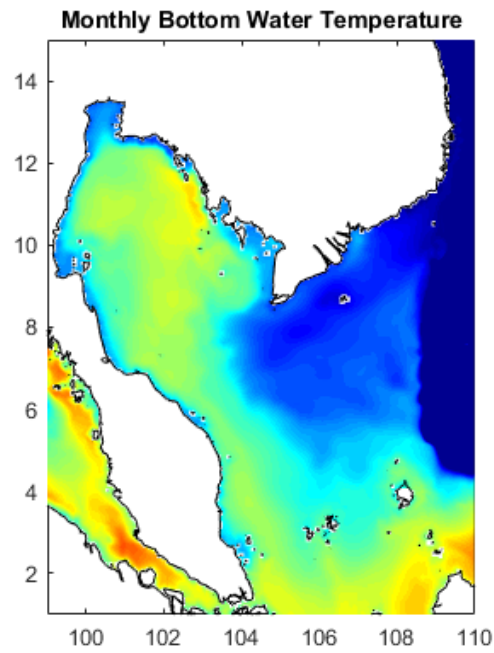
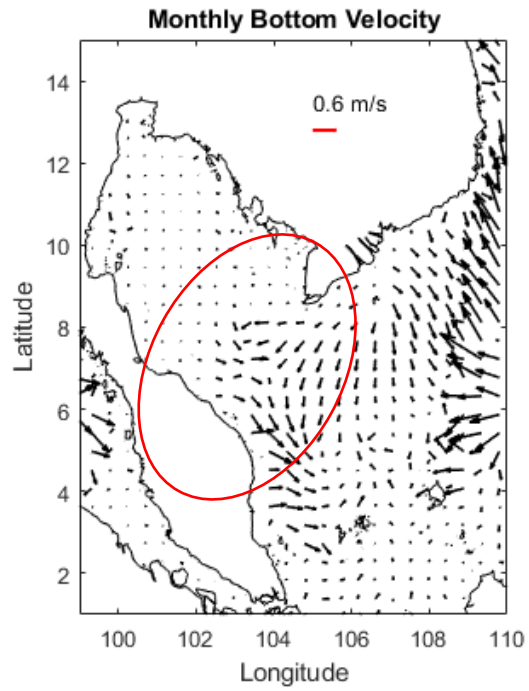
December2017-Bottom



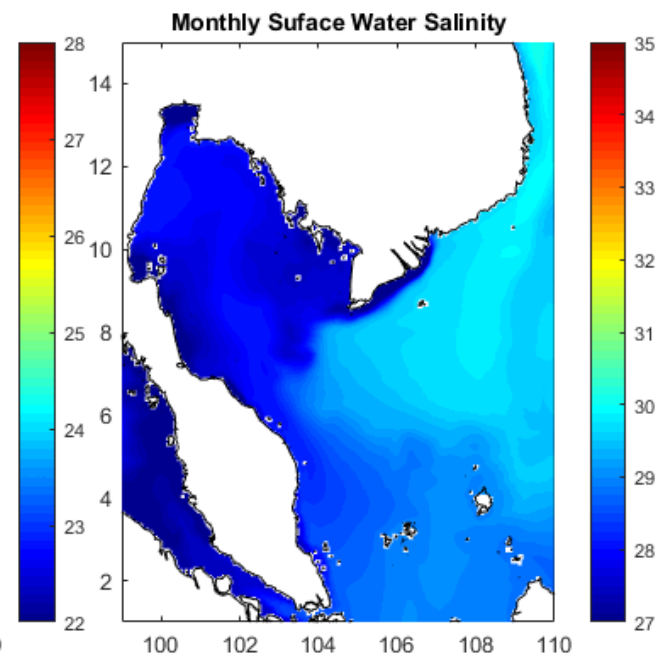
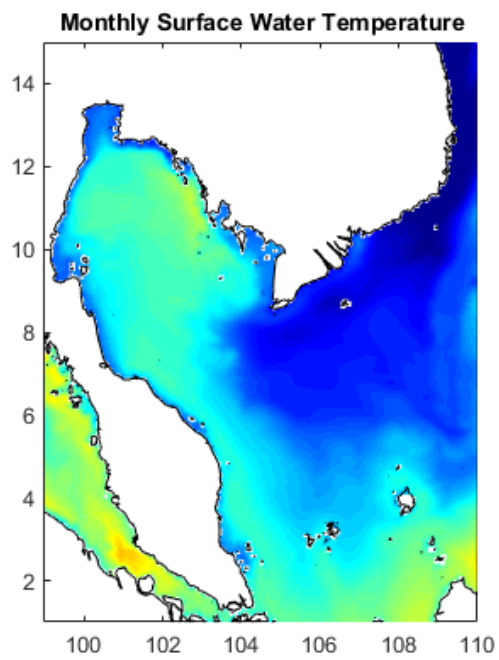
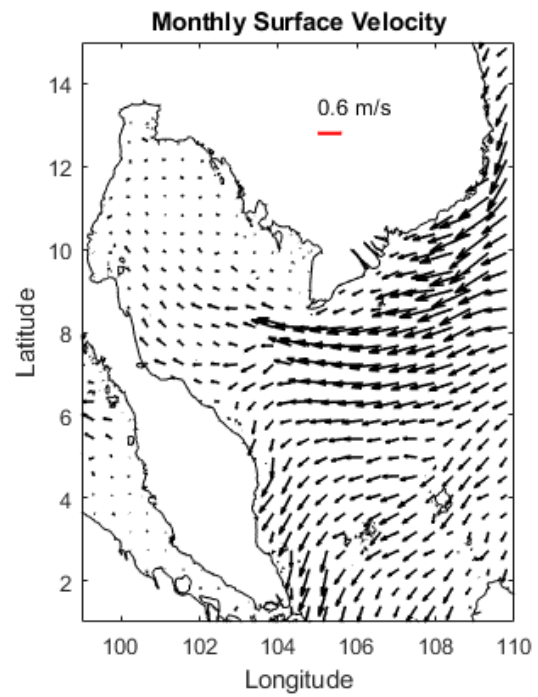
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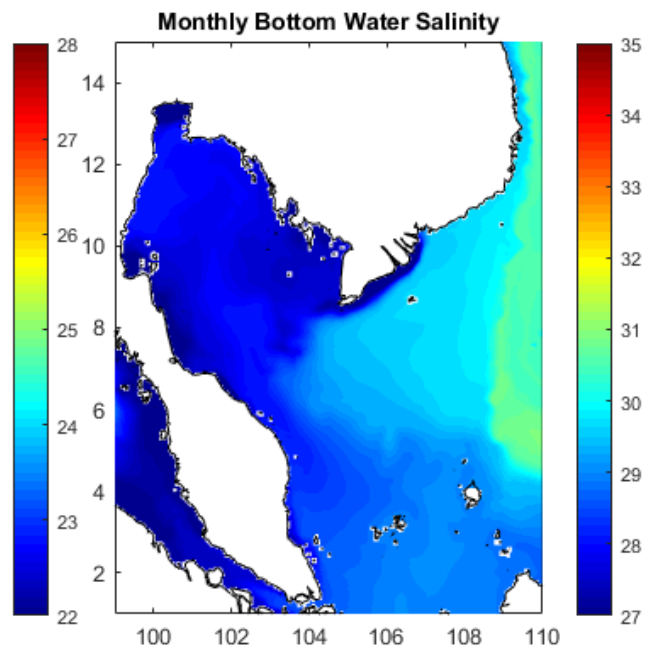
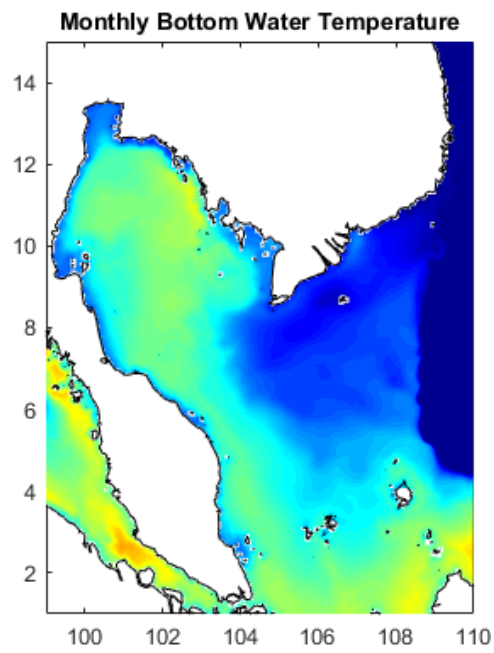
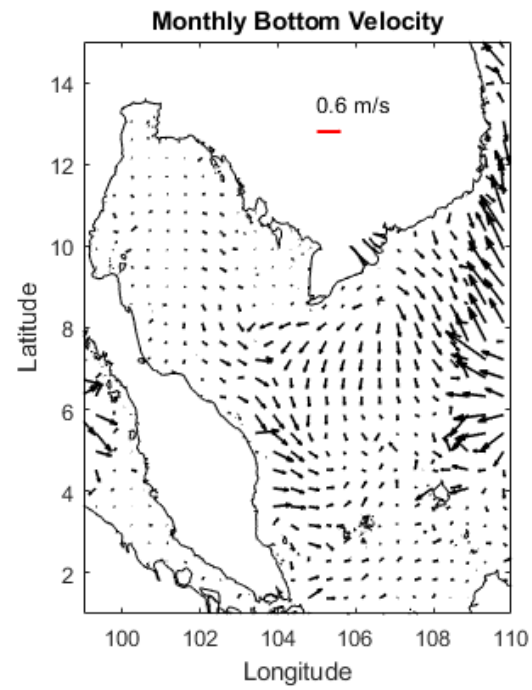
January2018-Bottom



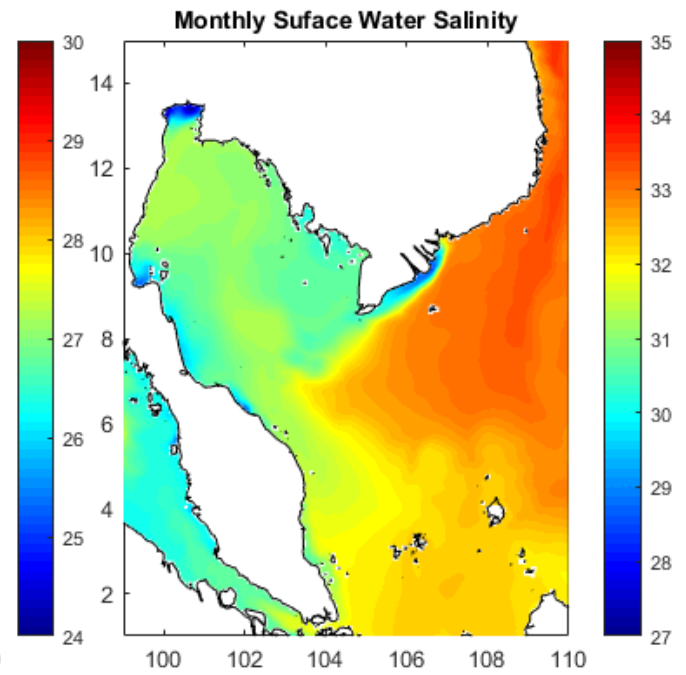
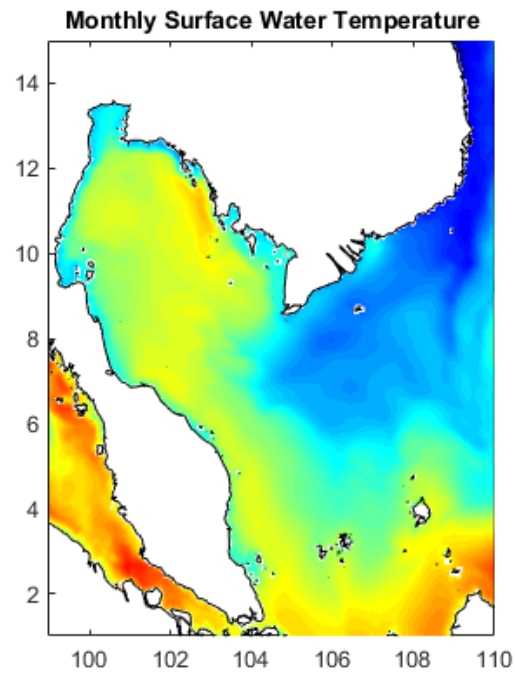
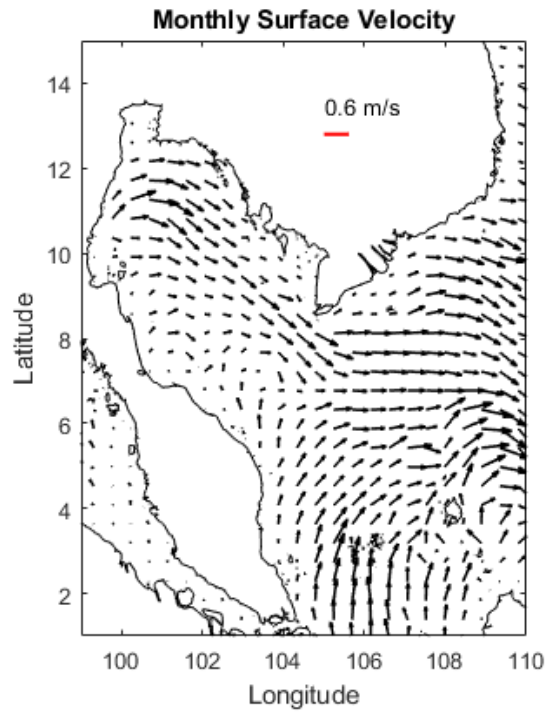
February 2018-Surface



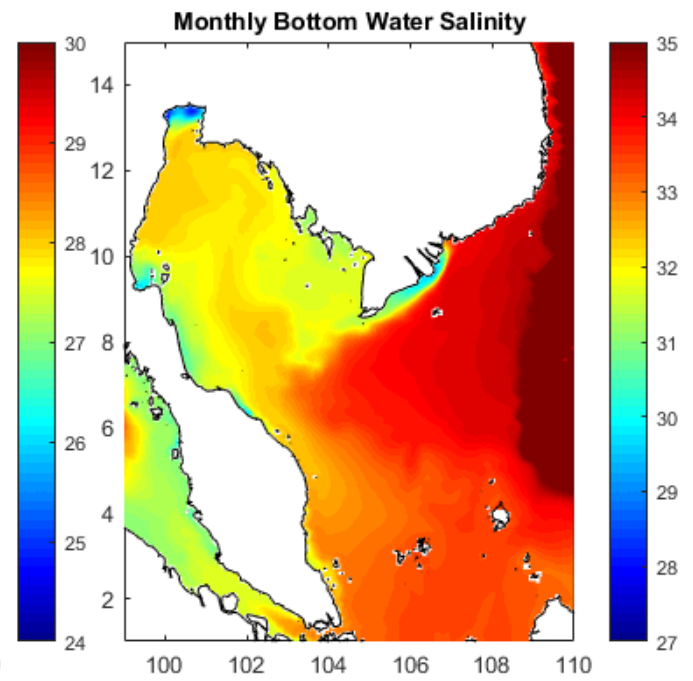
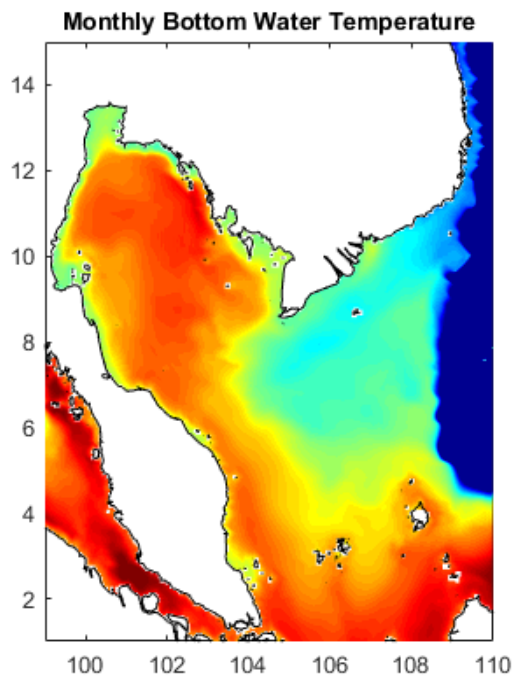
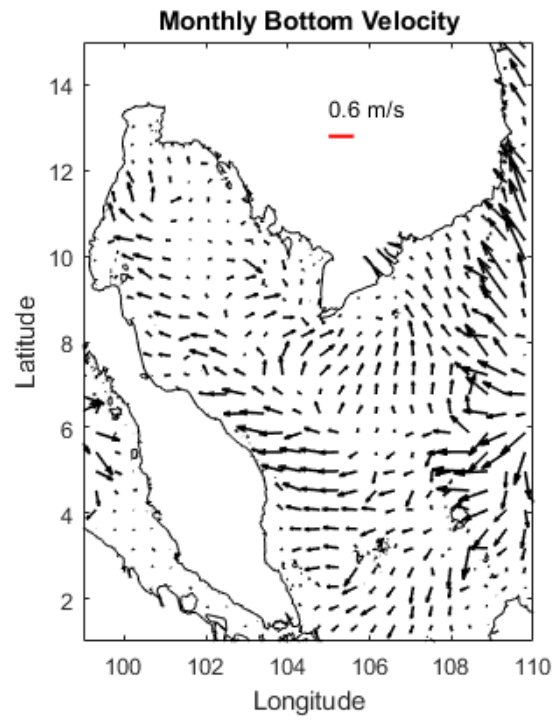
February 2018-Bottom



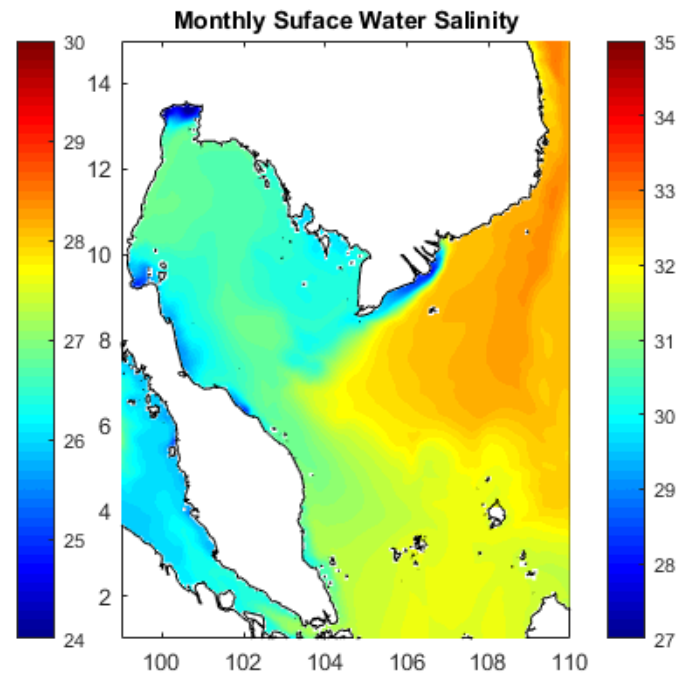
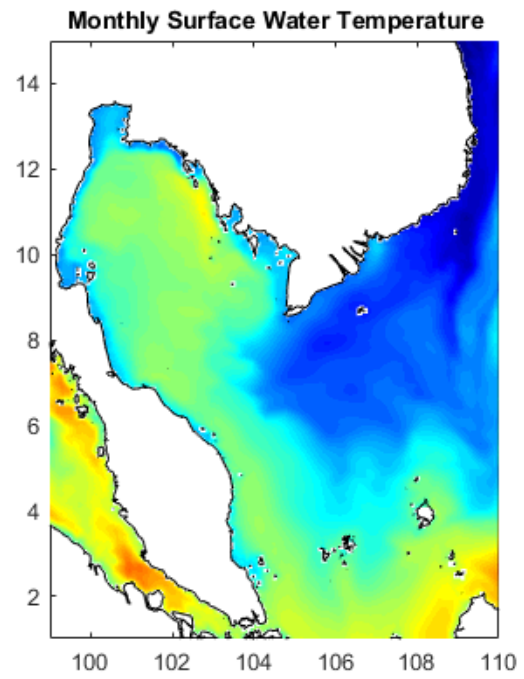
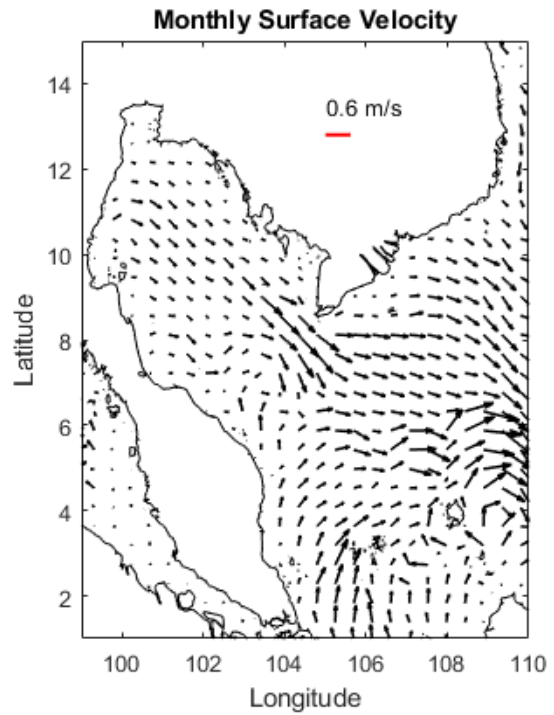
August2018-Surface



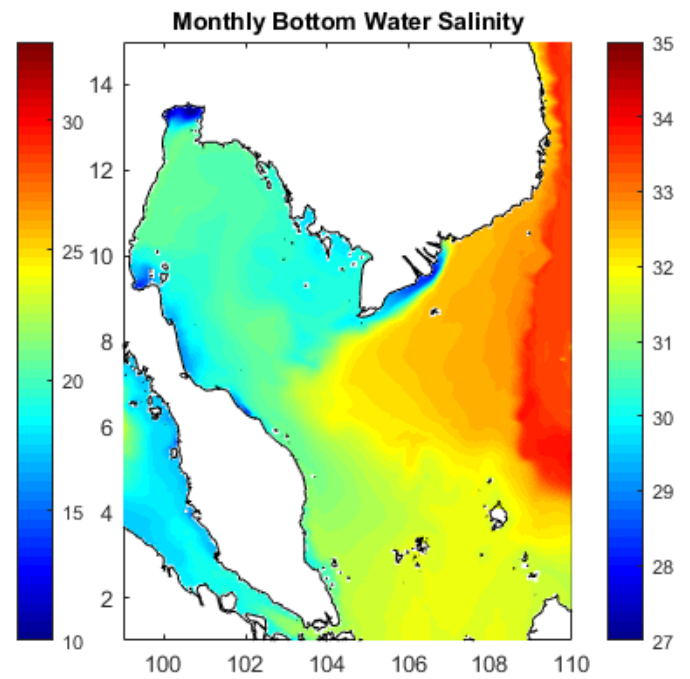
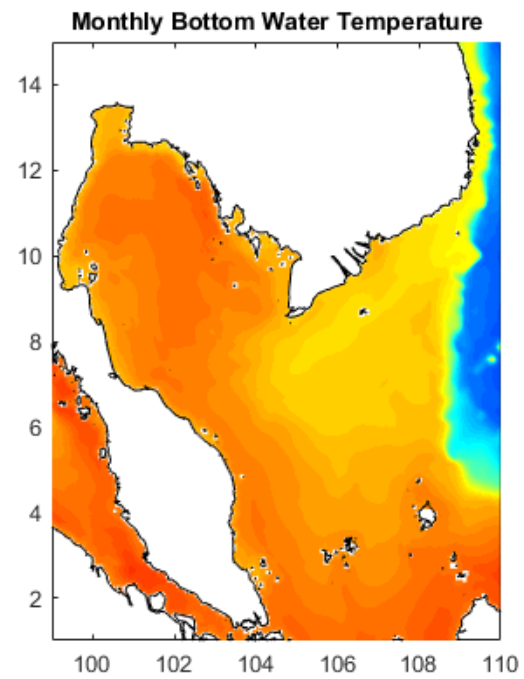
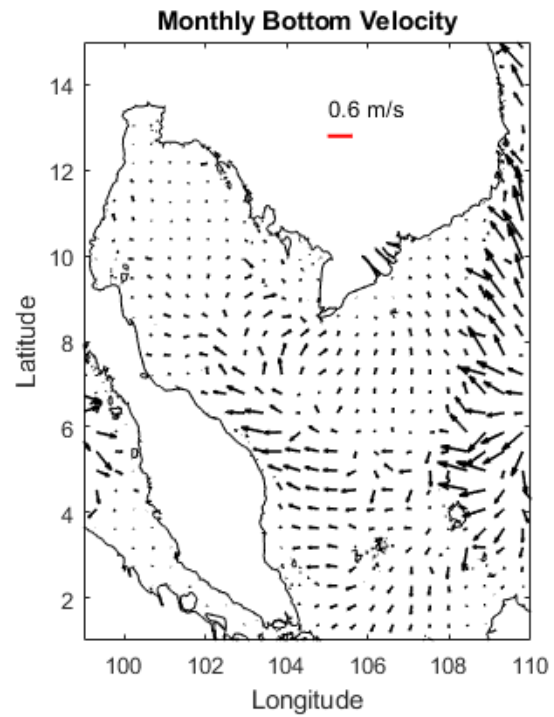
August2018- Bottom



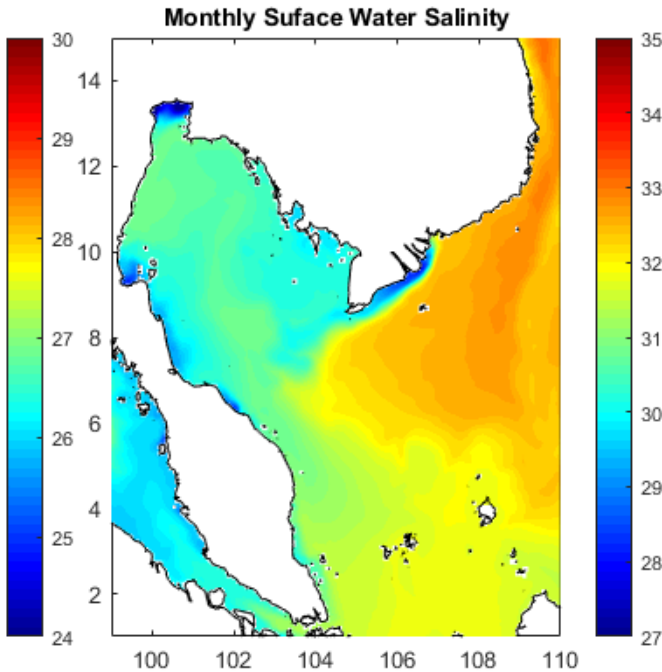
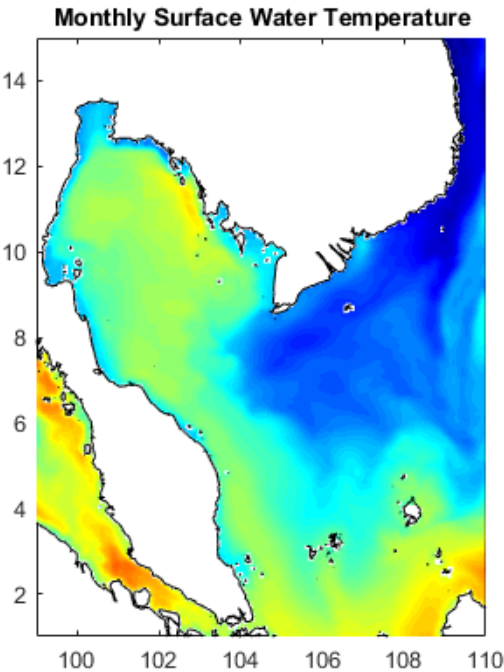
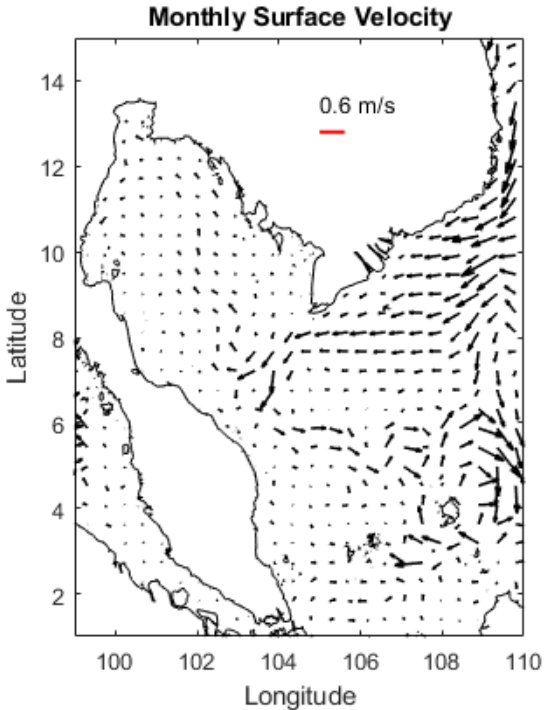
September2018-Surface



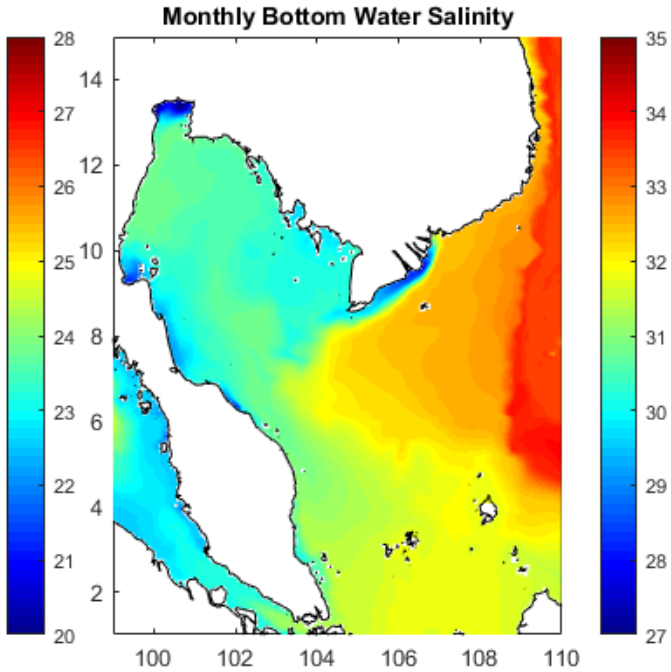
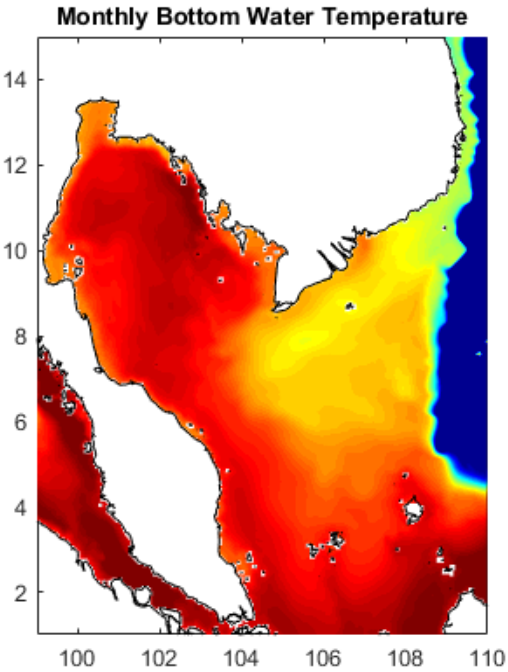
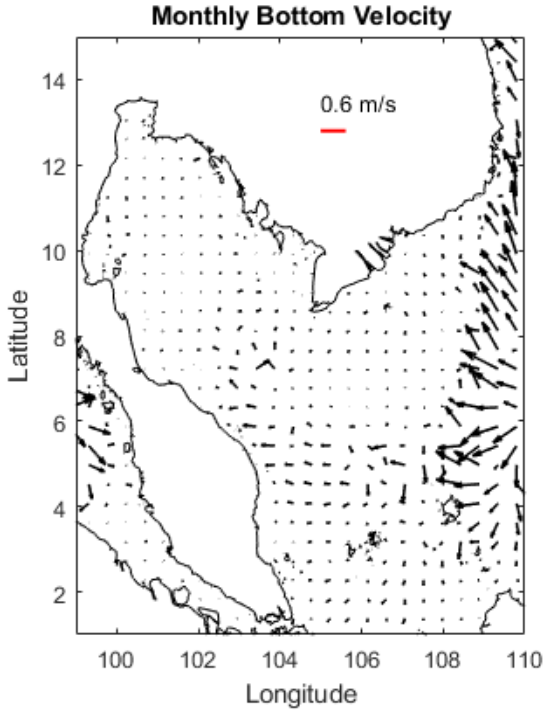
September2018-Bottom



October2018-Surface



October2018-Bottom

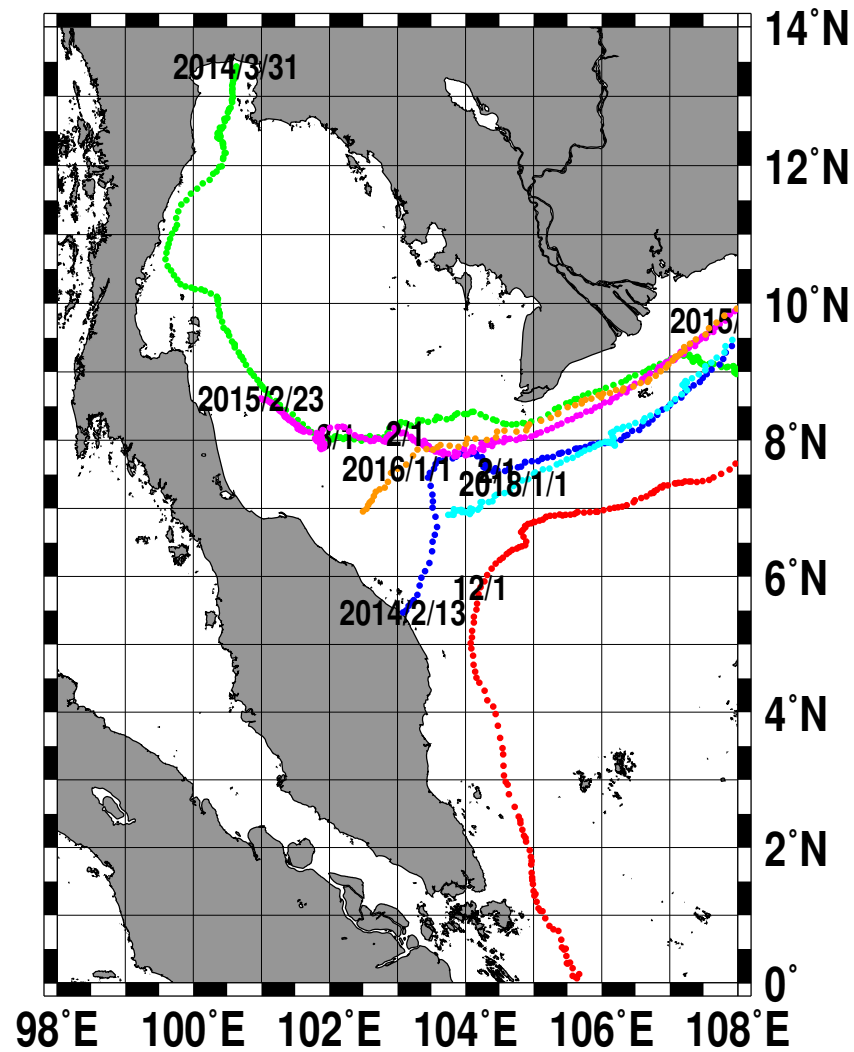
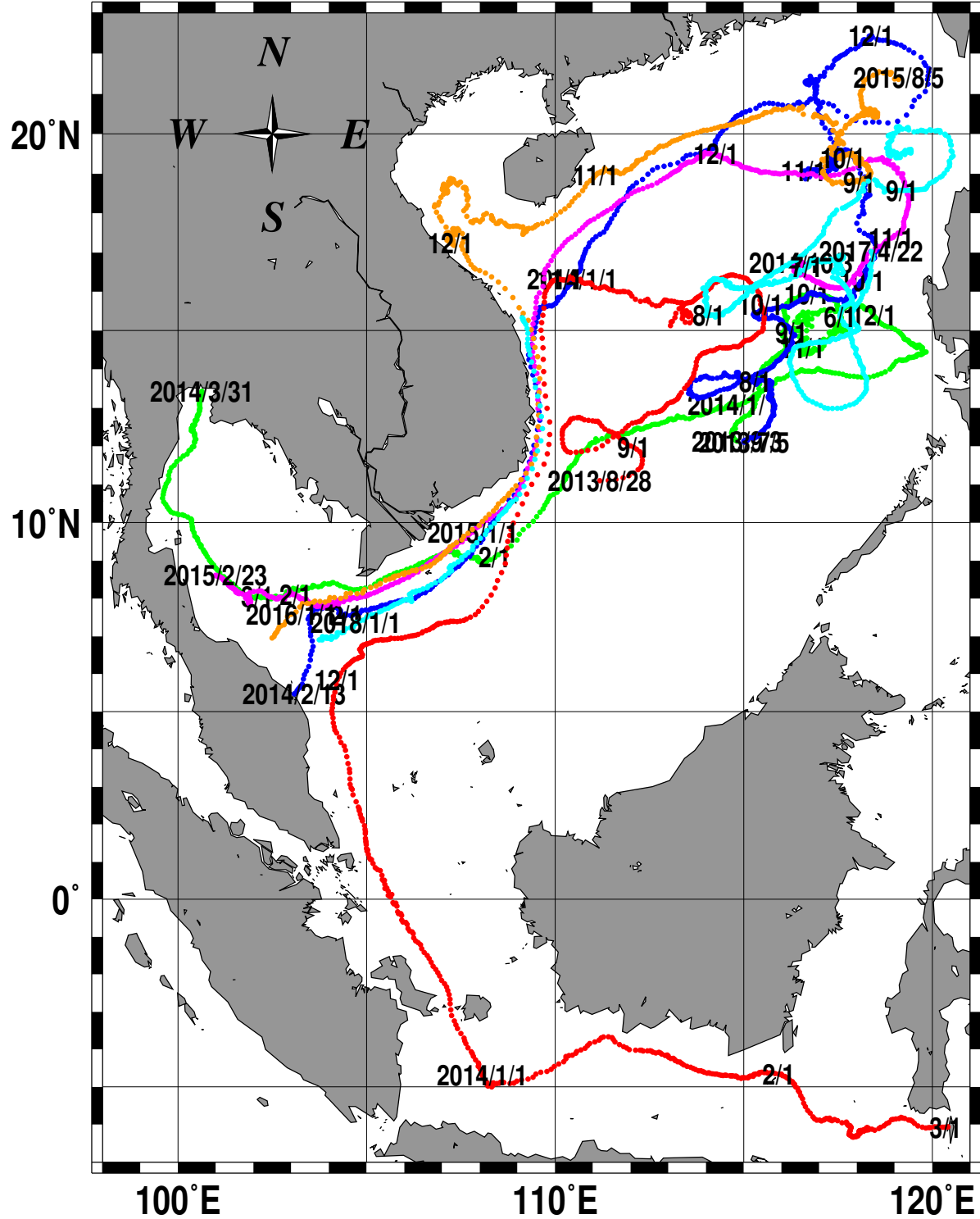


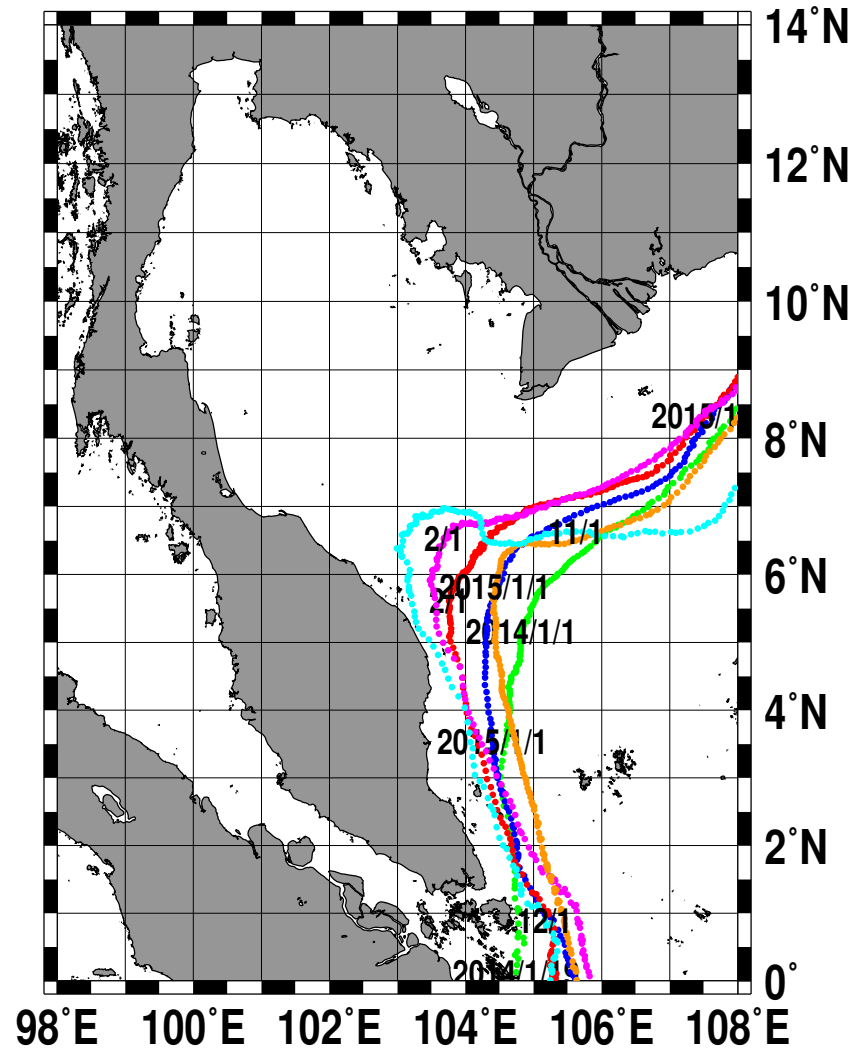
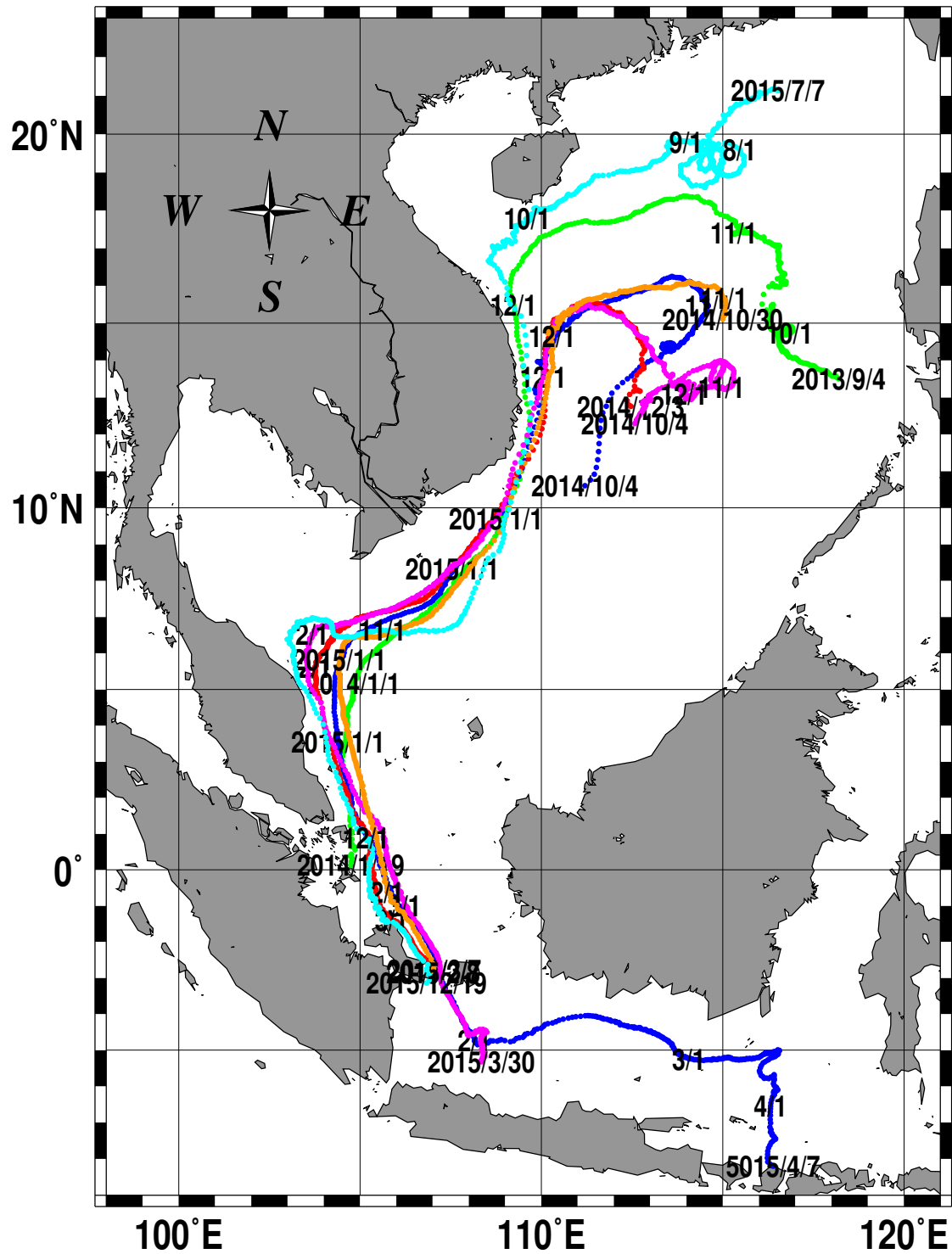
During NE monsoon

- At central area of mouth of GoT just inside of GoT, there is strong density front between cold saline water from SCS and warm less-saline water in GoT. Ekman-transport drives SCS water to flow into GoT, but less density water in GoT blocks SCS water to enter at surface.
- However, SCS water can enter into GoT as density flow, sinking deeper and enter along NE coast(Vietnam and Cambodia coast) by Coriolis force, it makes weak anti-clockwise circulation in deep layer.
- On the other hand, at surface, mostly part of blocked SCS water flow out southward along Malay Pen. and very small part of it blancheted at Malay coast flow into GoT along Malay Pen.

GPS Floats

- To clarify the flow pattern of GoT, but most numbers of buoys flow out to southward after stacking at mid-mouth of GoT.
- All position of buoy is plotted every 6-hours.
- If there is no density flow intrusion to GoT, outward flow are dominant at both surface and bottom, SSH in GoT must decrease during NE monsoon.





Conclusions

During SW monsoon,

- Cold dense water in deepest central area and western coastal area along Malaysia Peninsula (from cruise and COPERNICUS data)
- Ekman-transport moves GoT surface water into SCS, while cold dense SCS water in deep layer move northward into the GoT from Malaysia Peninsular as entrainment flow

During NE monsoon

- Strong density front between cold saline water from SCS and warm less-saline water in GoT (around central area of mouth of GoT)
- Ekman-transport drives SCS water to flow into GoT
- While less density water in GoT blocks SCS water to enter at surface. Main part of SCS water flow out southward and others flow into GoT along Malaysia Peninsular
- However, blocked SCS water can enter into GoT as density flow, sinking deeper and enter along NE coast (Vietnam and Cambodia coast)



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