Impact of the Yellow Sea Bottom Cold Water on the Occurrence of the Cold Water Zone in the Southwest Sea of Korea

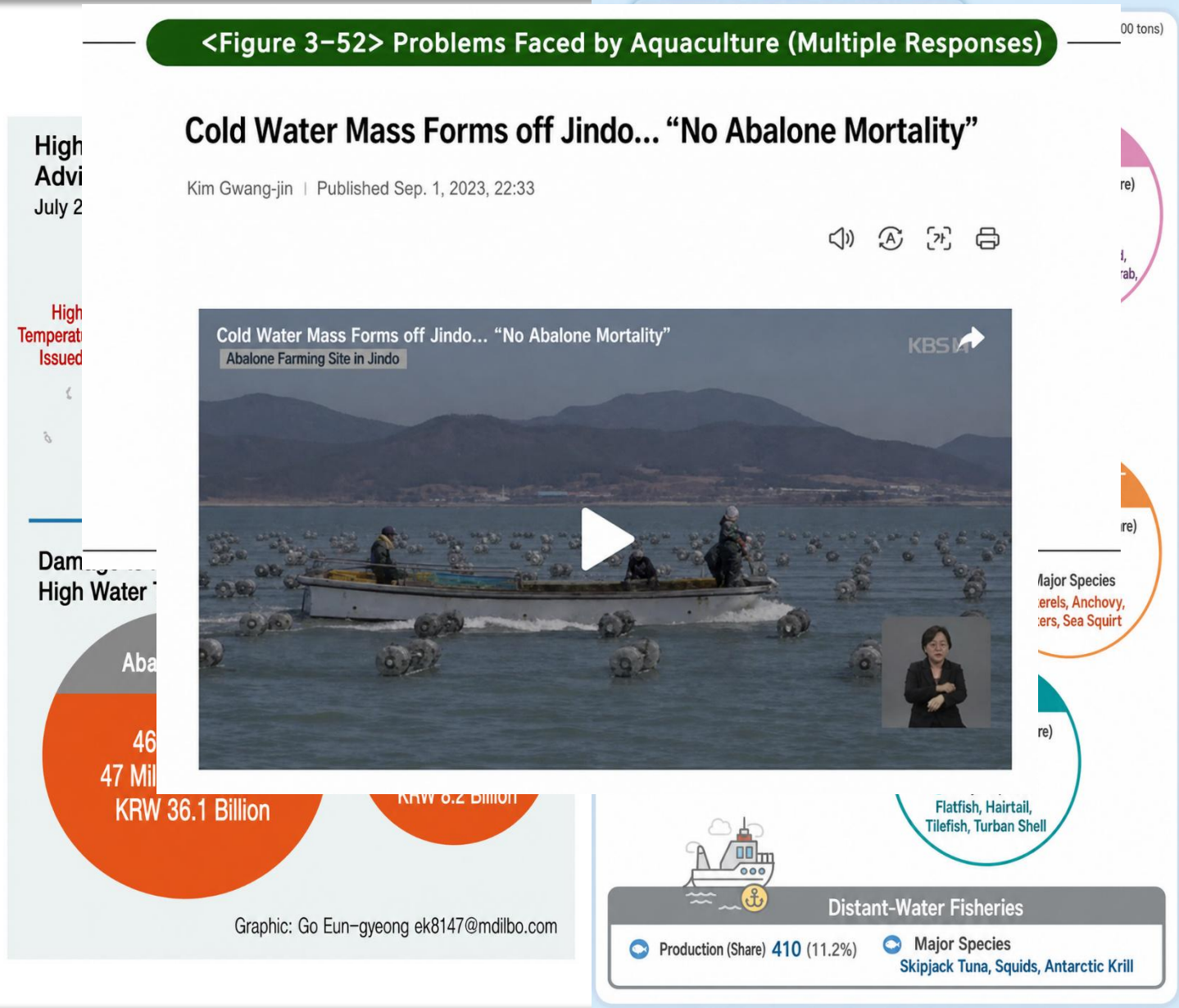
Ji Myeong Seo
Chaewook Lim
YangHo Choi
Seung Buhm Woo

01 Introduciton

1. Necessary of Cold Water Zone

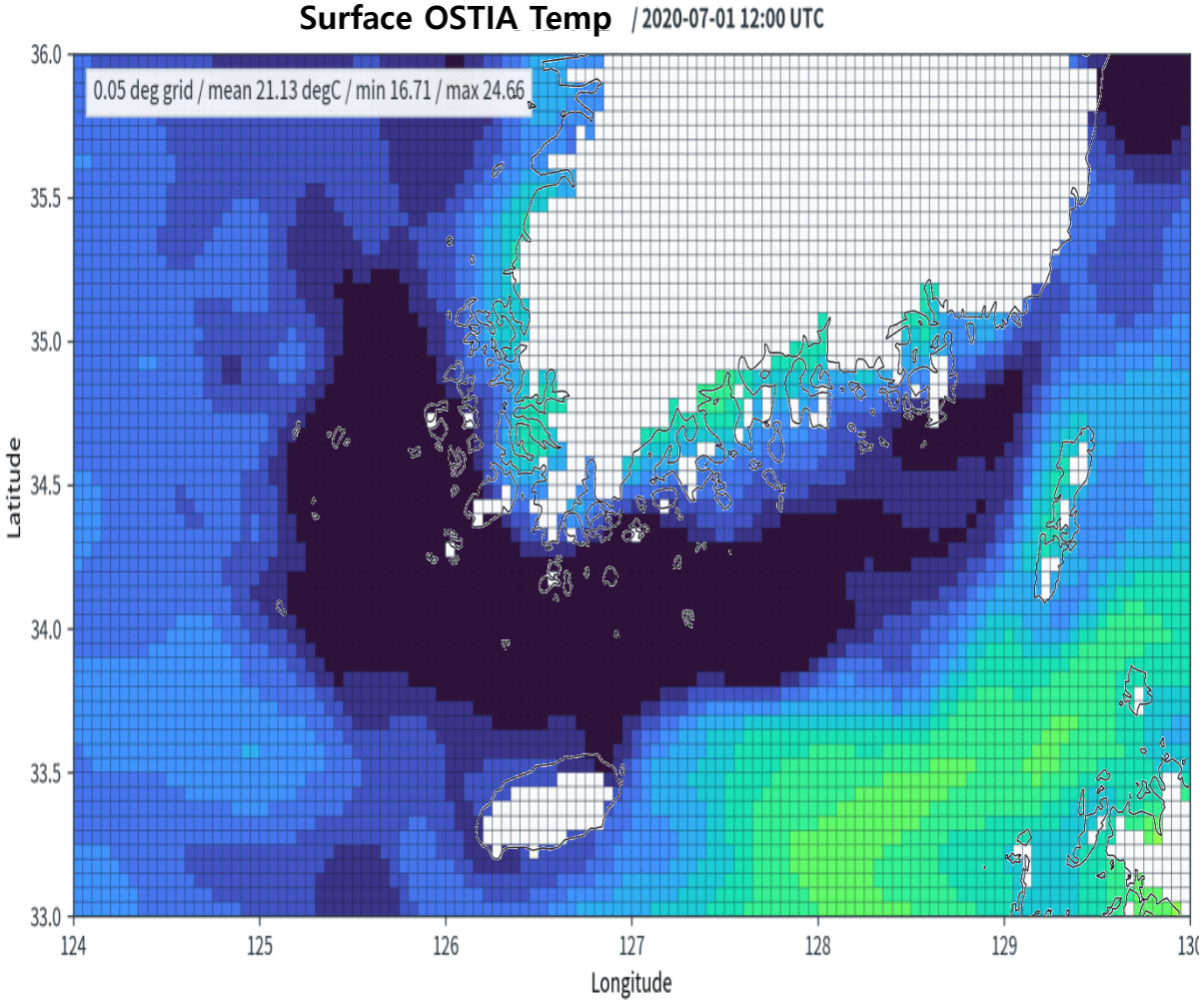
Necessity of Water Temperature Prediction

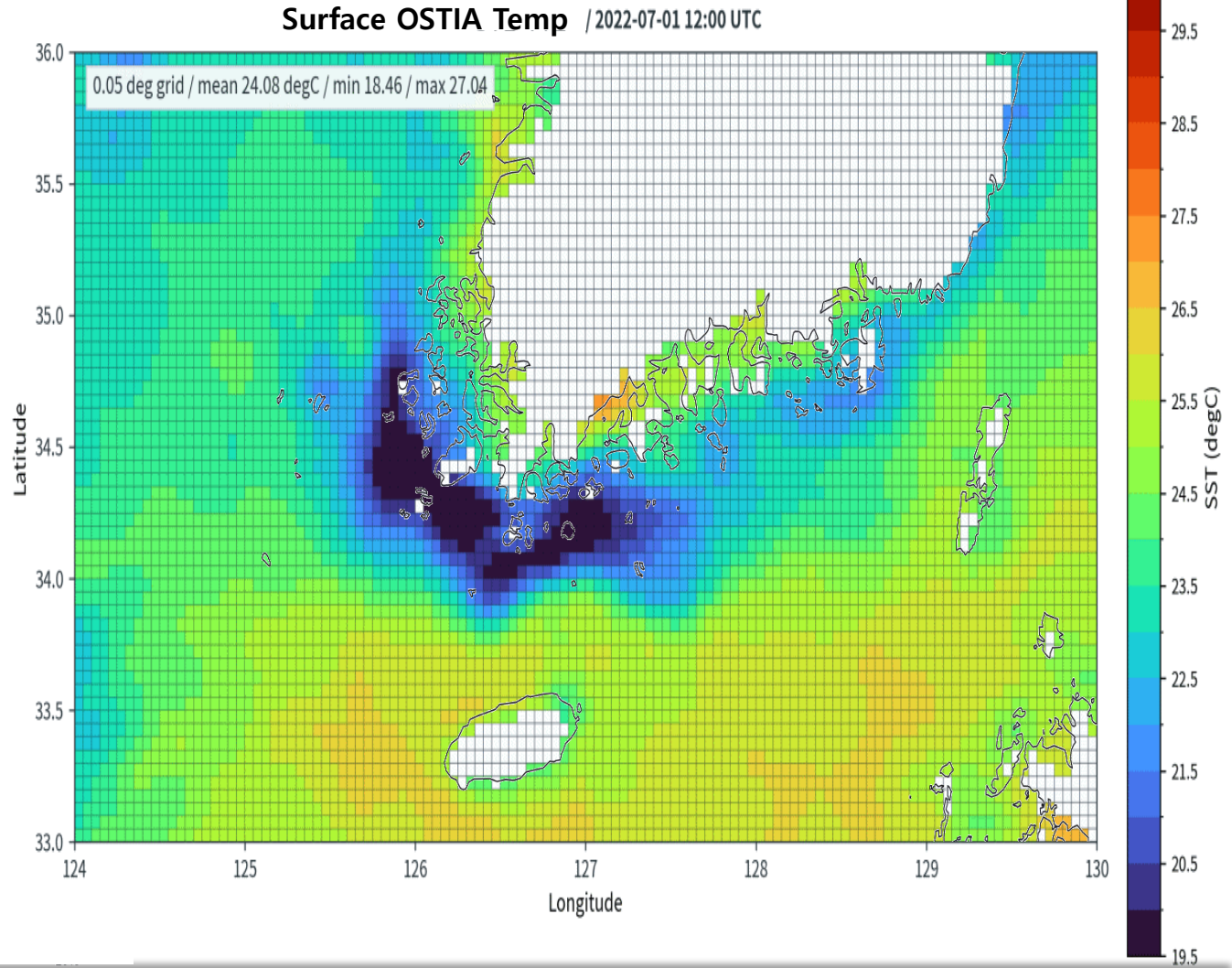
- The southwest sea accounts for 60% of the total domestic fising production
- Rapid fluctuations in water temperature (high and low temperatures) affect the life activities of fish (Han et al., 1995; Chang et al., 1999).
- It is expected to reduce damage by more than 500 million dollor a year in the aquaculture industry through research on predicting the occurrence of cold water zone (NIFS, 2013)
- Prevent mass mortality of farmed fish caused by high water temperatures in summer



01 Introduciton

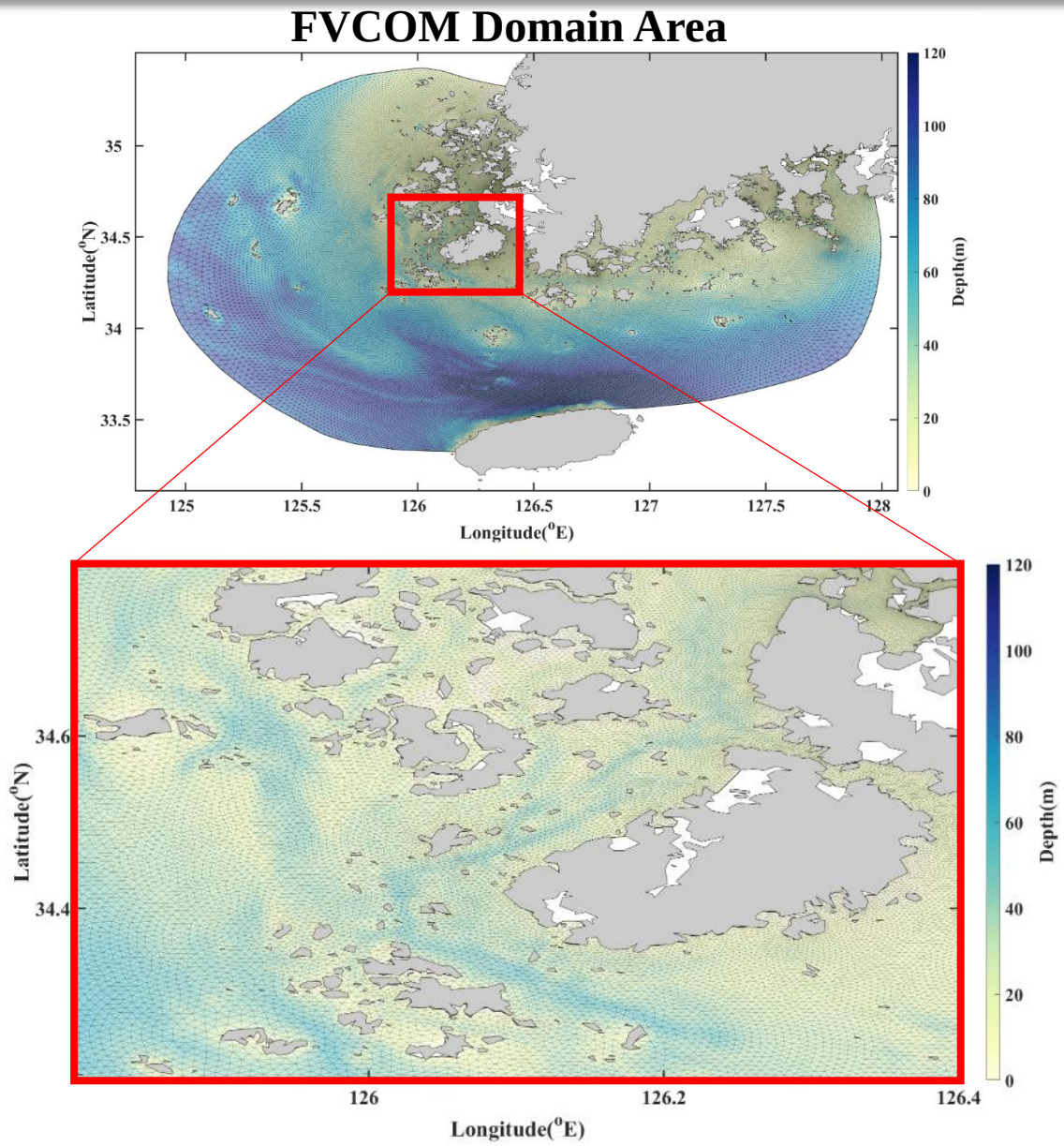
1. Cold Water Zone Analysis



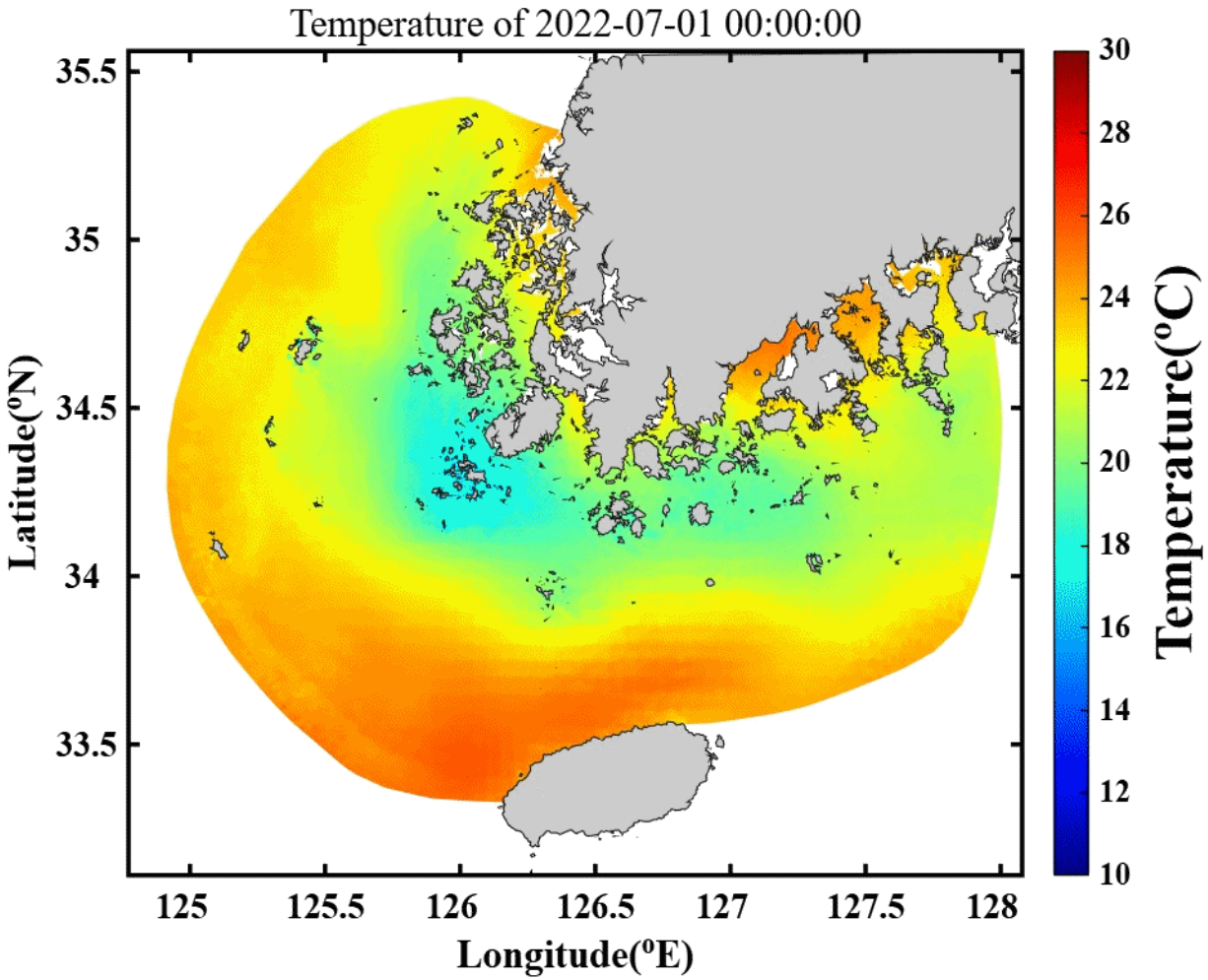


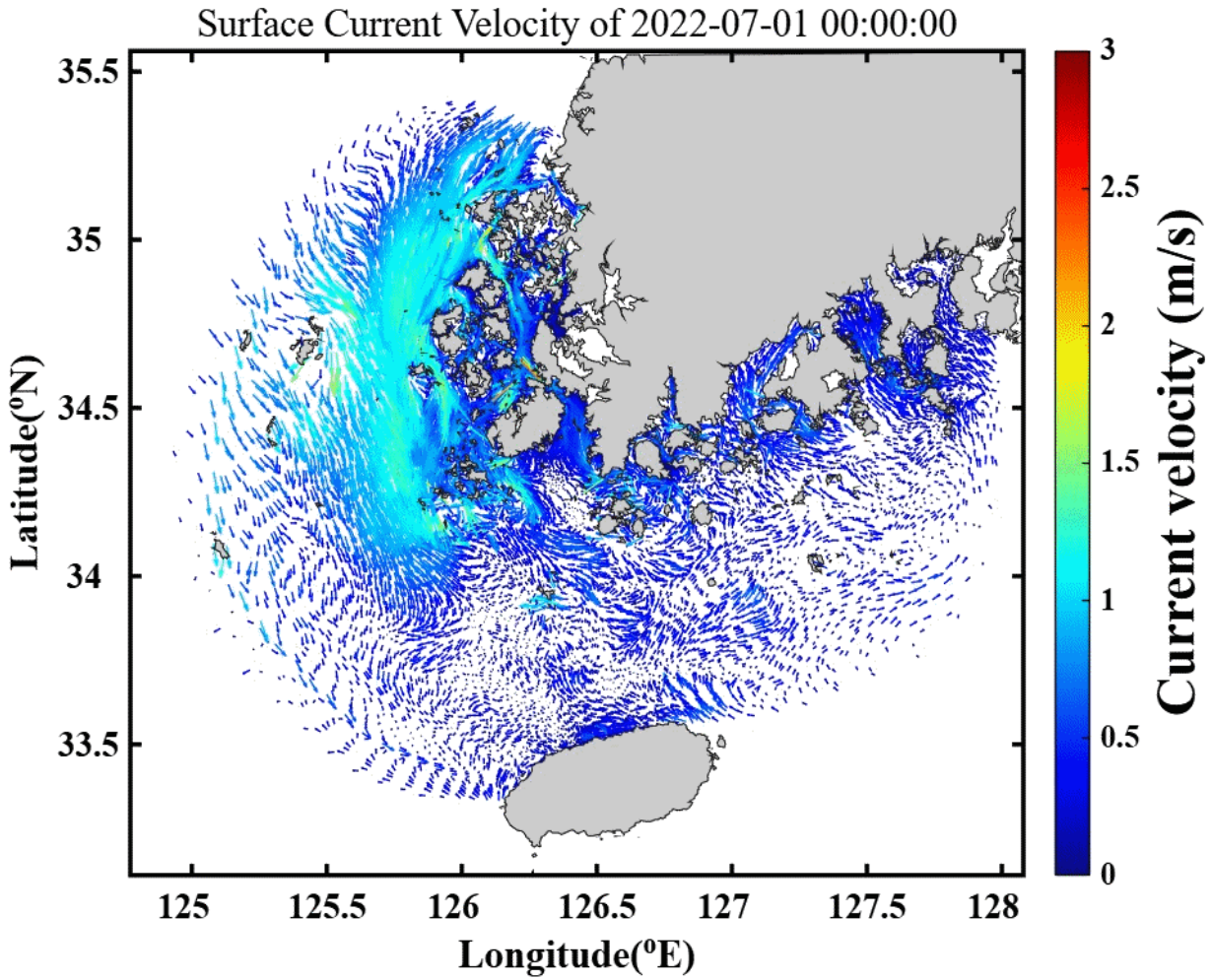
02 Model Construction
FVCOM Setting Information

Node & Element number	81,851 (Node) 155,162 (Element)
Grid Resolution	10 km ~ 50m
Depth	BADA v1
Surface Condition	ERA5 (U10, V10, Heat Flux, Air pressure)
Initial Condition	HYCOM (Temp & Salinity)
Boundary Condition	HYCOM/TMD (TPXO8) (5 Major, Temp & Salinity)
Modeling period	2020 & 2022
Data Assimilation	OSTIA(SST) & Bouy merged SST Field



02 Model Construction
Numerical Model Animation: Surface

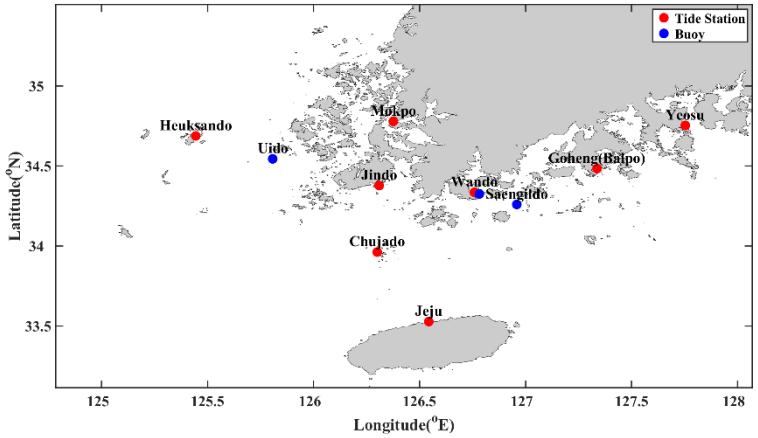


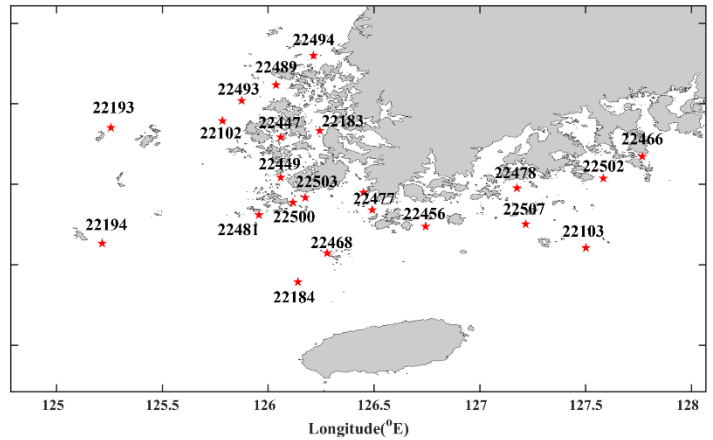


02 Model Construction
Numerical Model Validation

- Tide: Tidal Station & Current: Current Buoy
- Temperature: KMA Surface Buoy

Model Validation





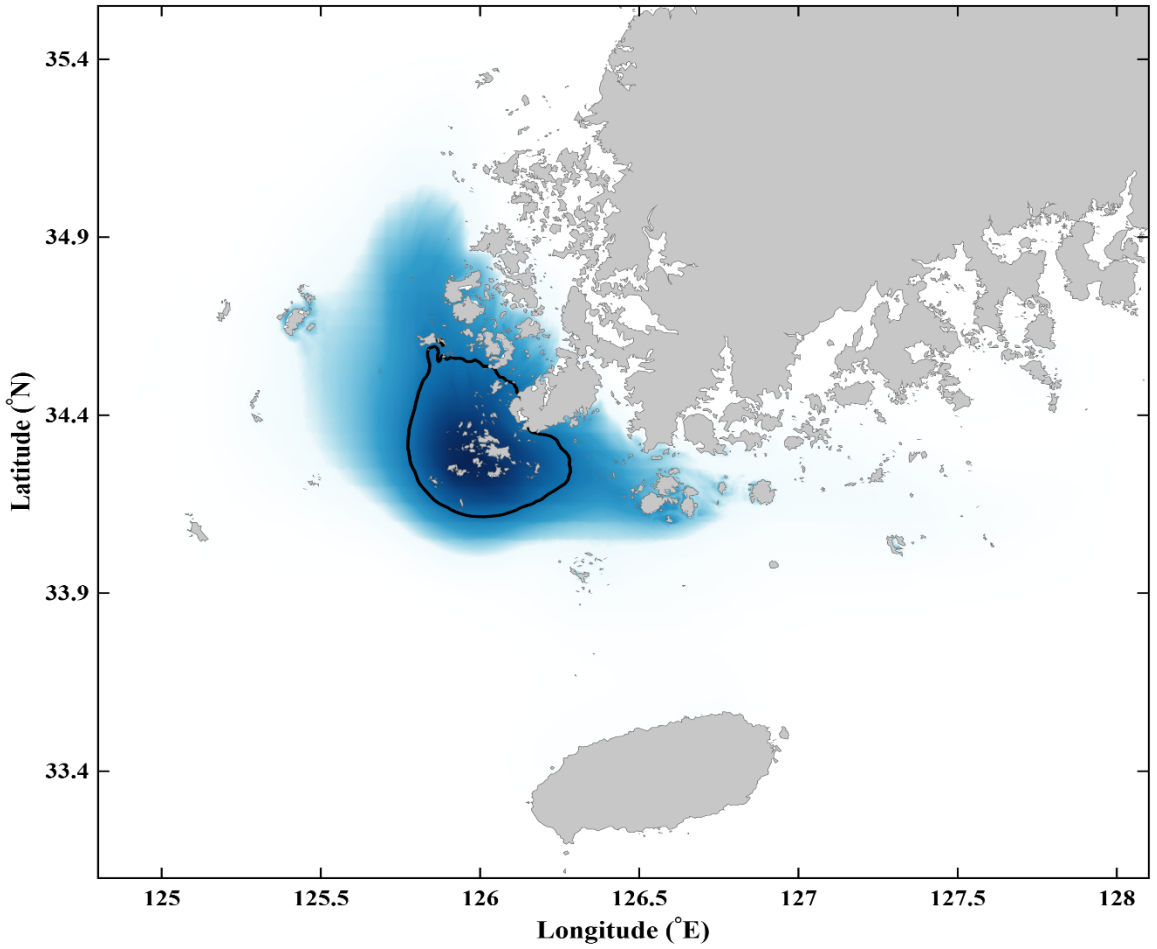
	Location	CCR	IOA	MAE	MB	MSE	RMSE
Tide	**8**	0.9829	**0.9922**	0.1279	0.0004	0.9829	0.1585
U	**3**	0.8303	**0.8680**	0.1207	0.2912	0.5544	0.2444
V	**3**	0.7960	**0.8483**	0.1678	-0.0405	0.7959	0.1997
Temp	**25**	0.9664	**0.9736**	0.4445	0.1298	0.4969	0.6429

03 Analysis of Cold Water Zone

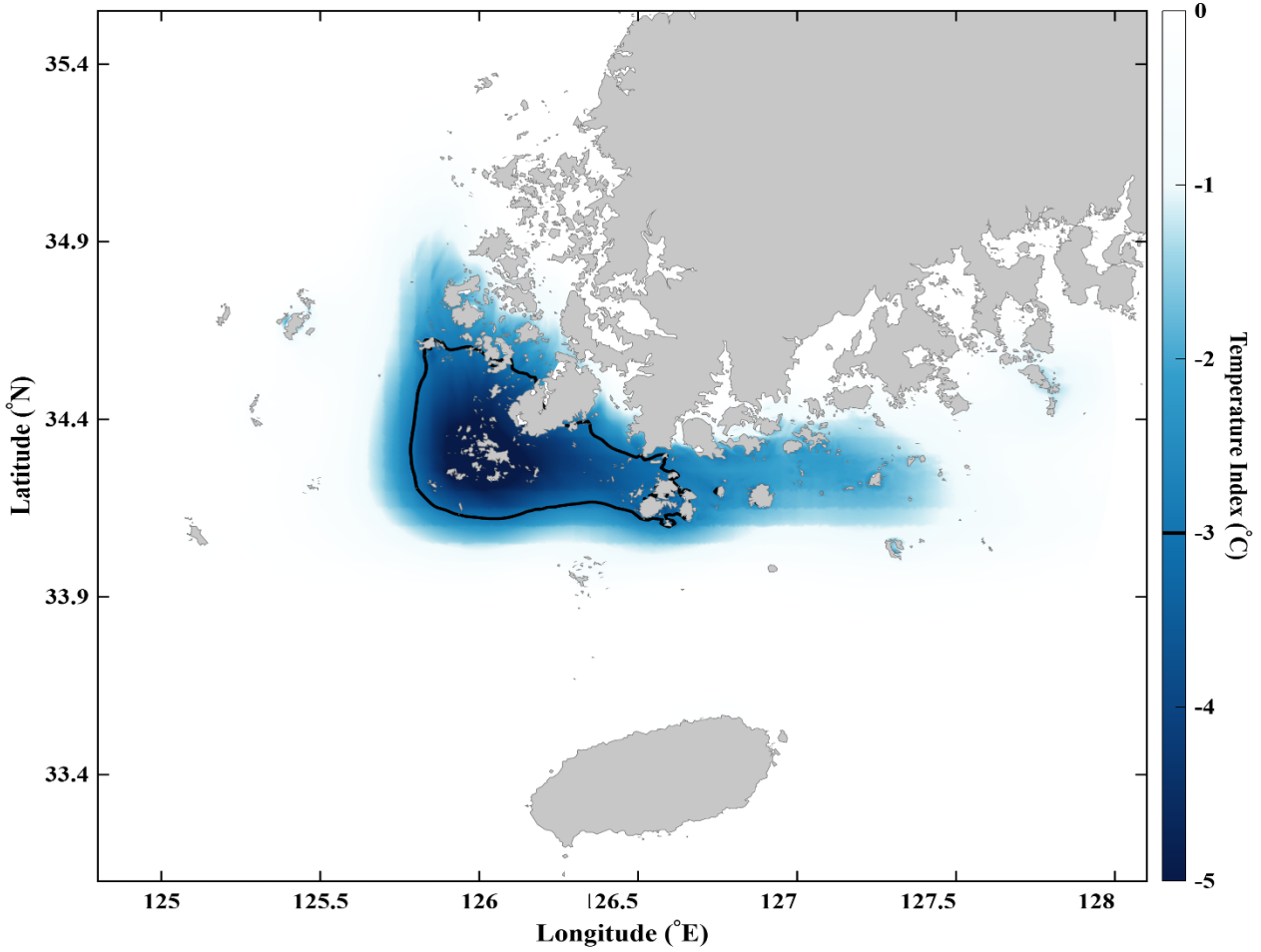
Calculate Cold Water Zone Area

$$\mathrm{CPI}_i(t) = T_i(t) - \overline{T}(t) \qquad (\mathrm{CPI}_i \leq -3\,^{\circ}\mathrm{C})$$

(a) Spatial Mean Area 2020



(b) Spatial Mean Area 2022



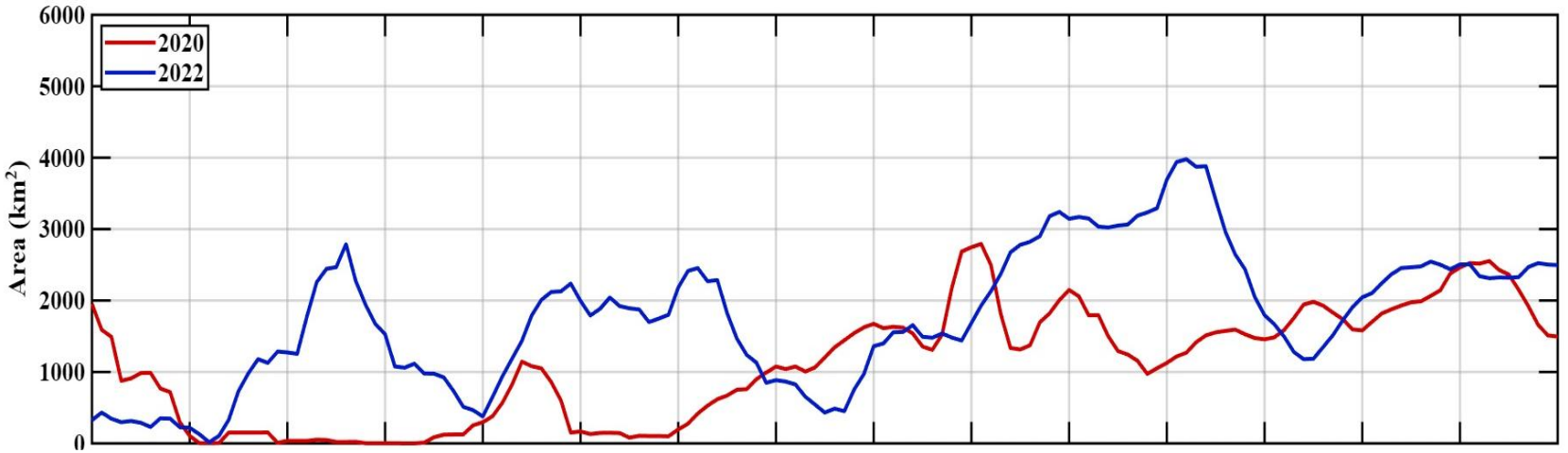
03 Analysis of Cold Water Zone
Calculate Cold Water Zone Area

Calculate Result of Cold Water Zone

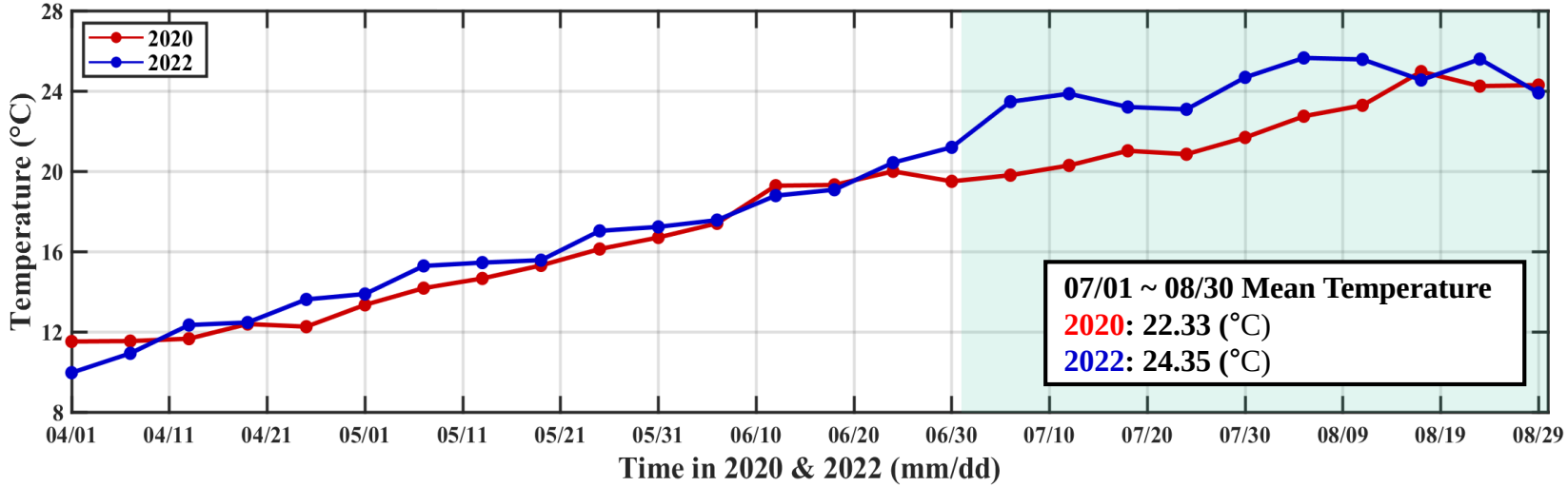
- Mean Area of Cold Water Zone in 2020: 1652.4 km^2
- The average cold water mass area in 2022 was 2,166.3 km^2 , showing a 30% increase compared to 2020.

Mean (Jul ~ Aug)	2020 (km^2)	2022 (km^2)	2022/2020
Lower 3°C	1652.4	2166.3	1.31
Lower 5°C	168.4481	319.5108	1.8968

(a) Cold Water Patch Area



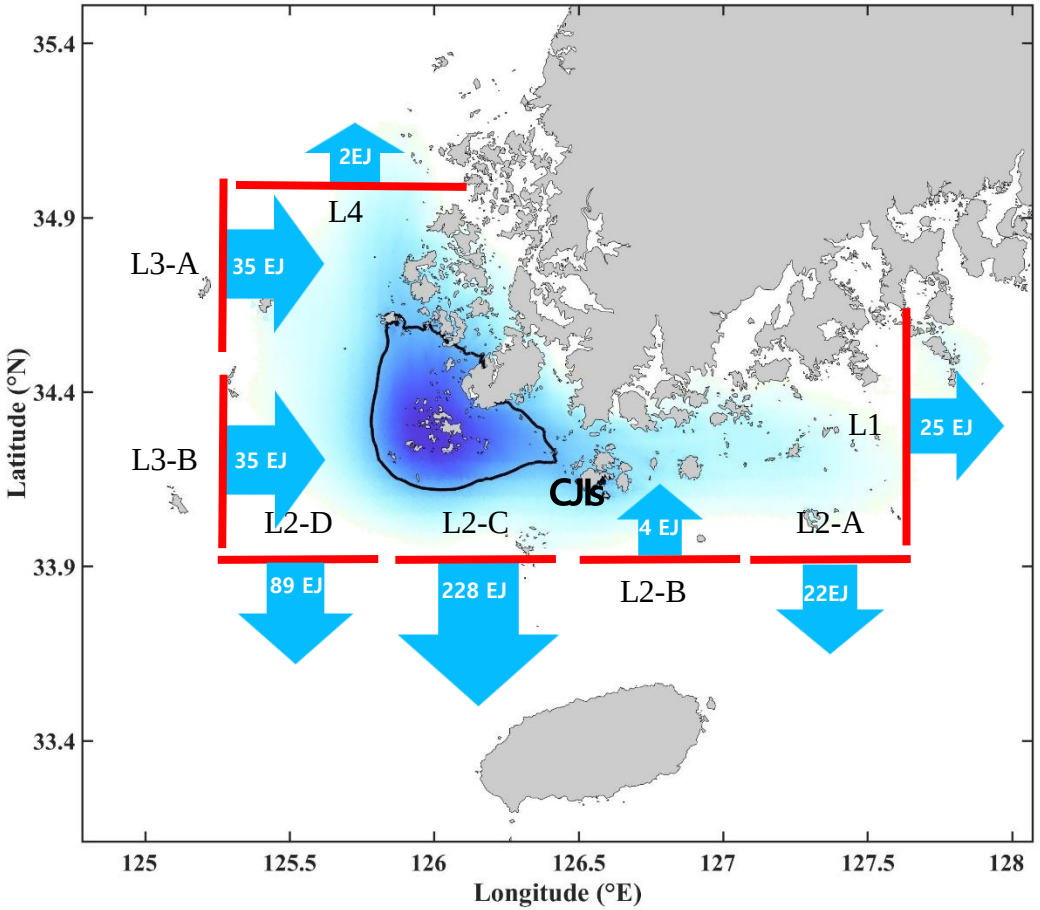
(b) Mean Sea Surface Temperature in All Model Domain



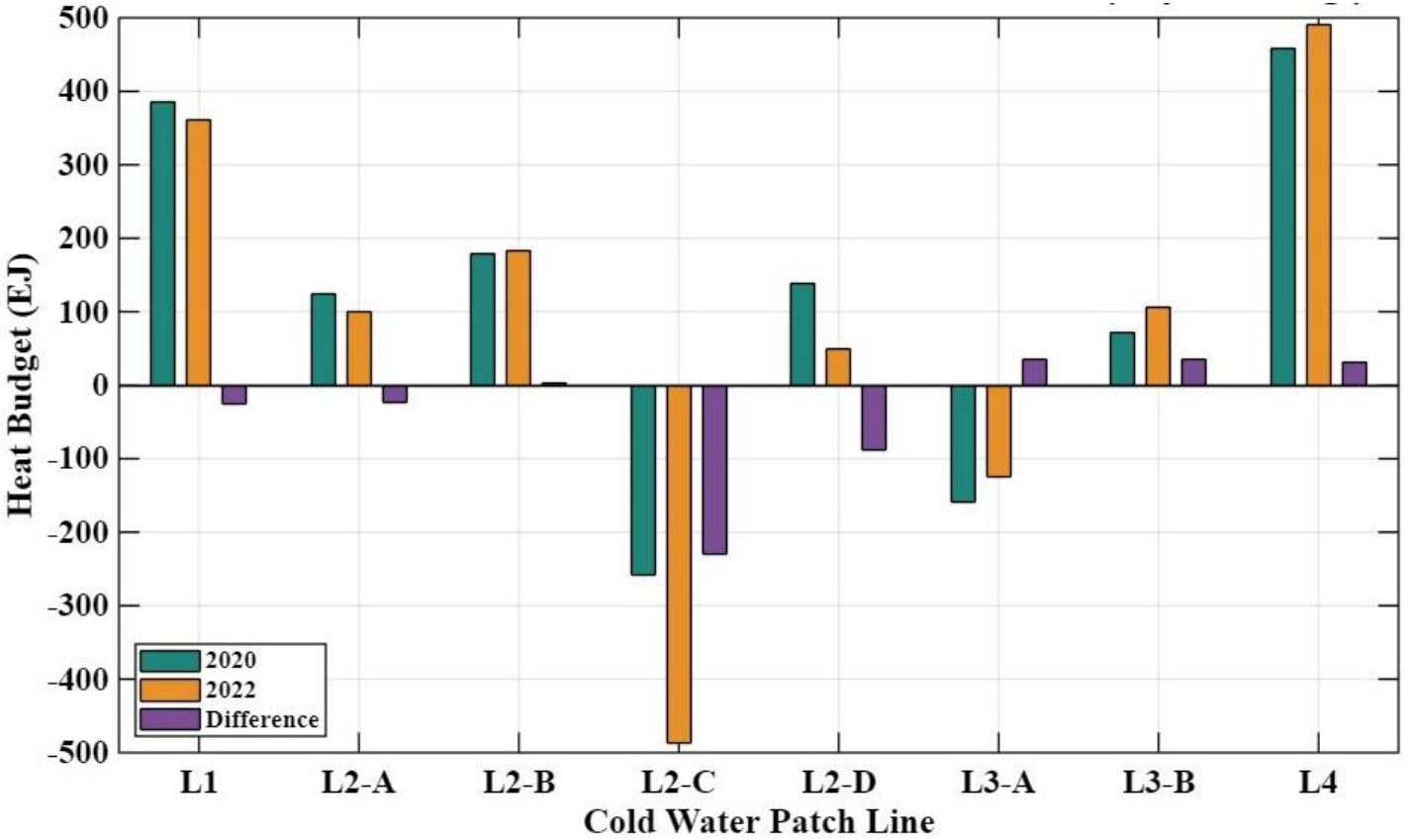
03 Analysis of Cold Water Zone
Calculate Cold Water Zone Area

$$Q_{\text{heat}} = \int_{t_0}^{t_1} \int_A \rho_0 c_p T u_n \, dA \, dt$$

(a) SCPs Line and Difference of Heat Budget



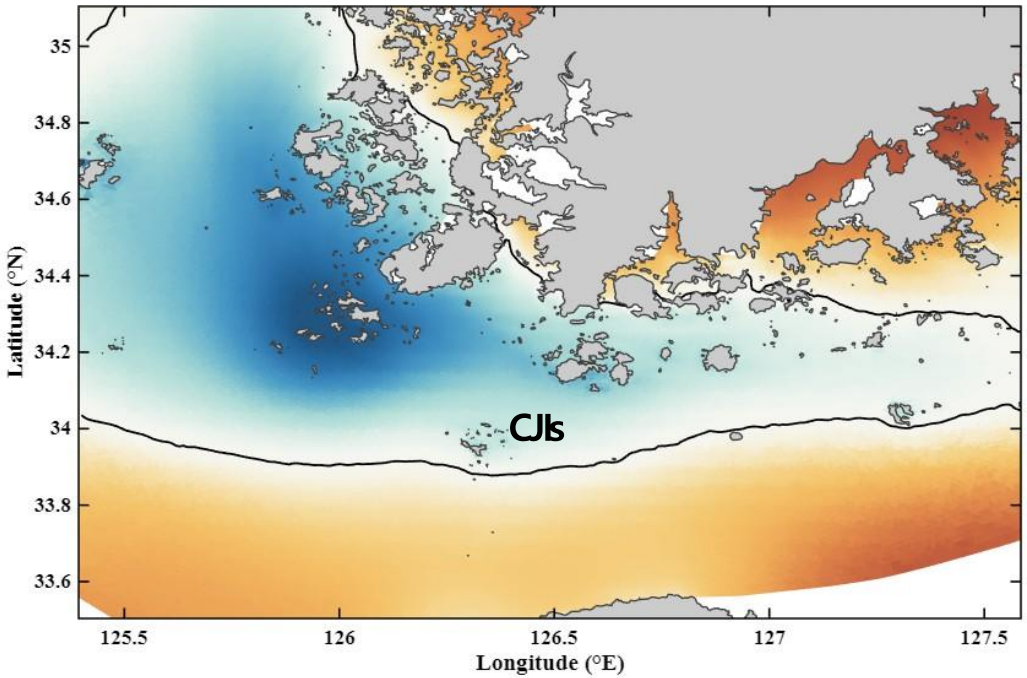
(b) Total Heat Budget in Each Line (Apr-Aug)

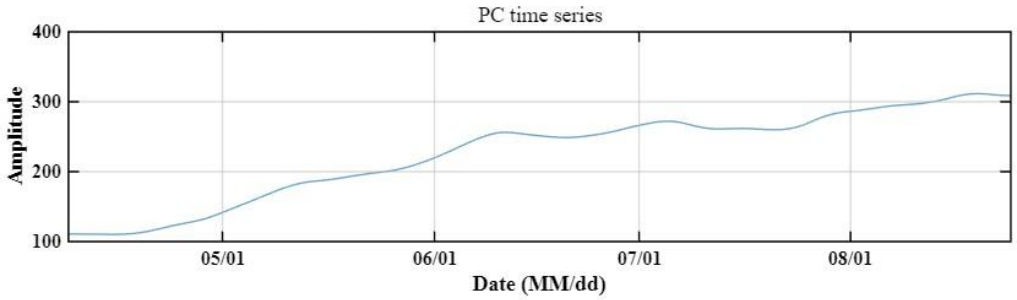


03 Analysis of Cold Water Zone

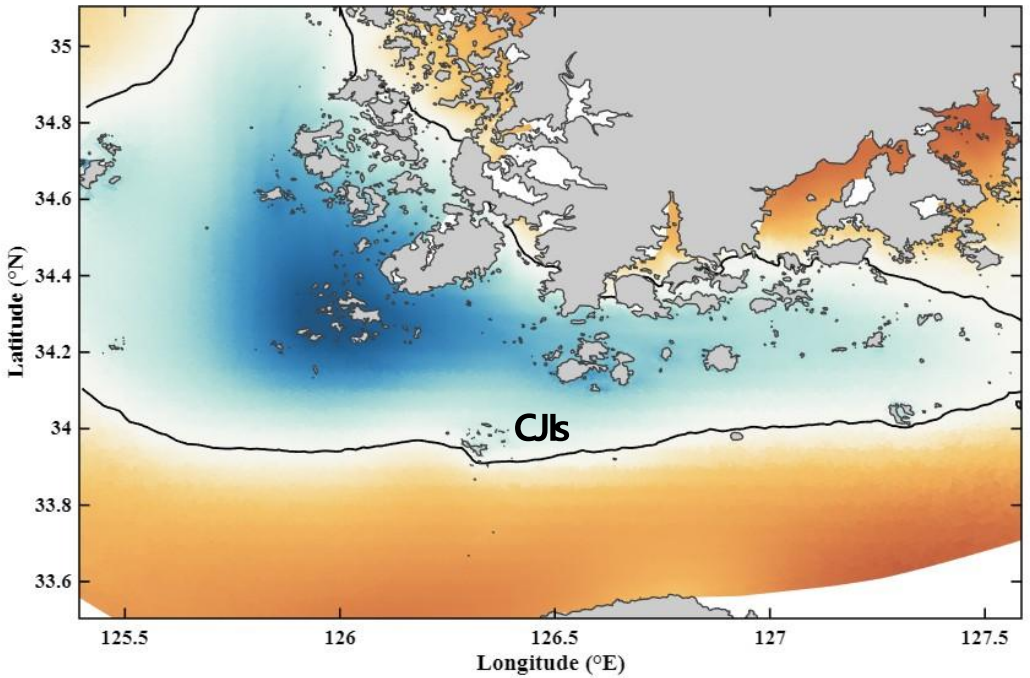
EOF Analysis

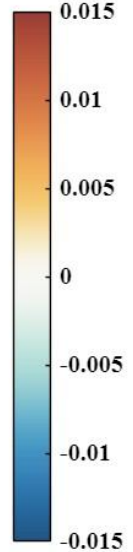
(a) 1st EOF Mode in 2020 (81.5%)

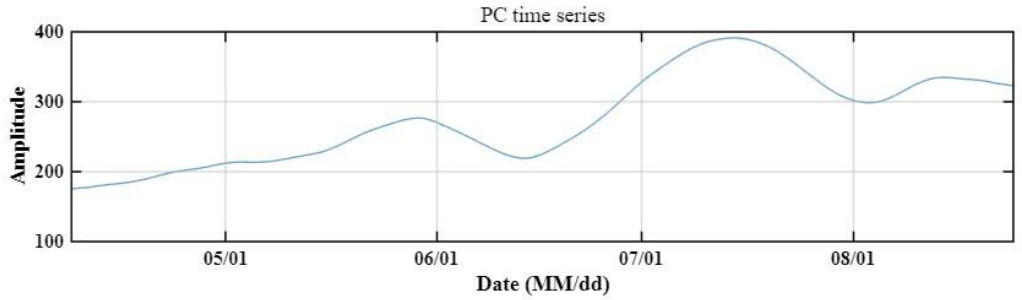




(b) 1st EOF Mode in 2022 (85.6%)





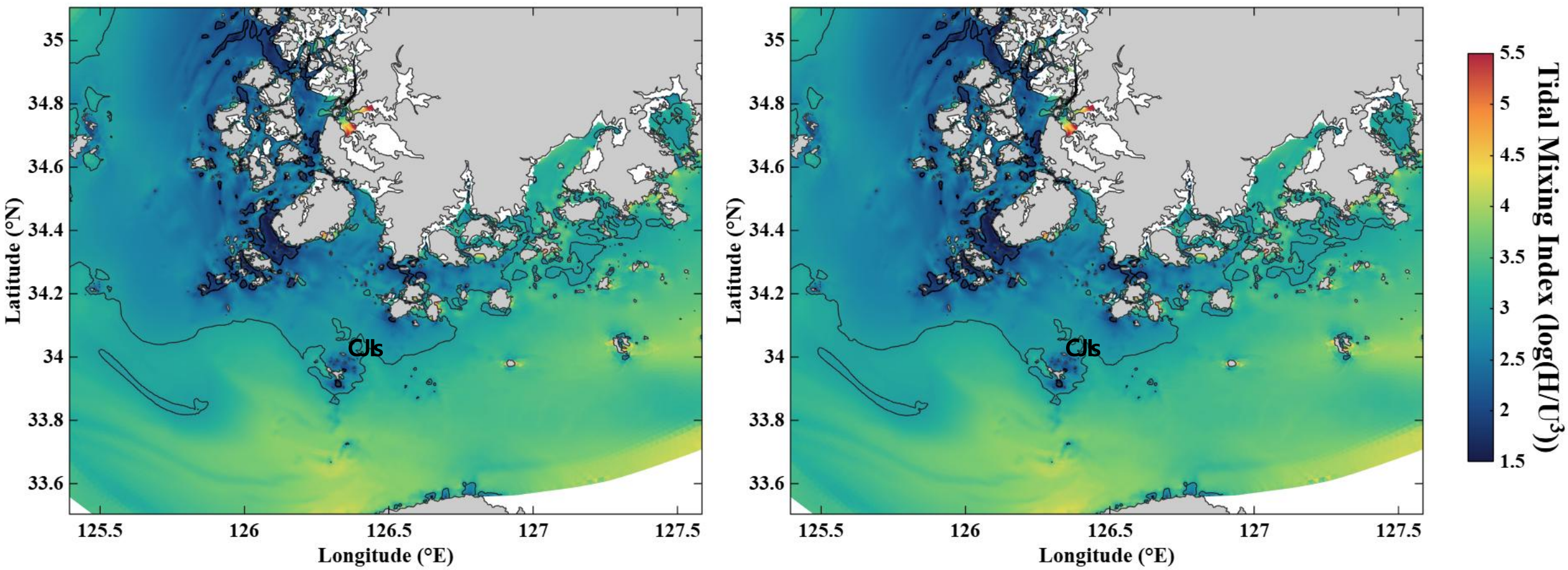


03 Analysis of Cold Water Zone
EOF Analysis

$$\mathrm{TMI} = \log_{10}\left|\frac{H}{U^3}\right|$$

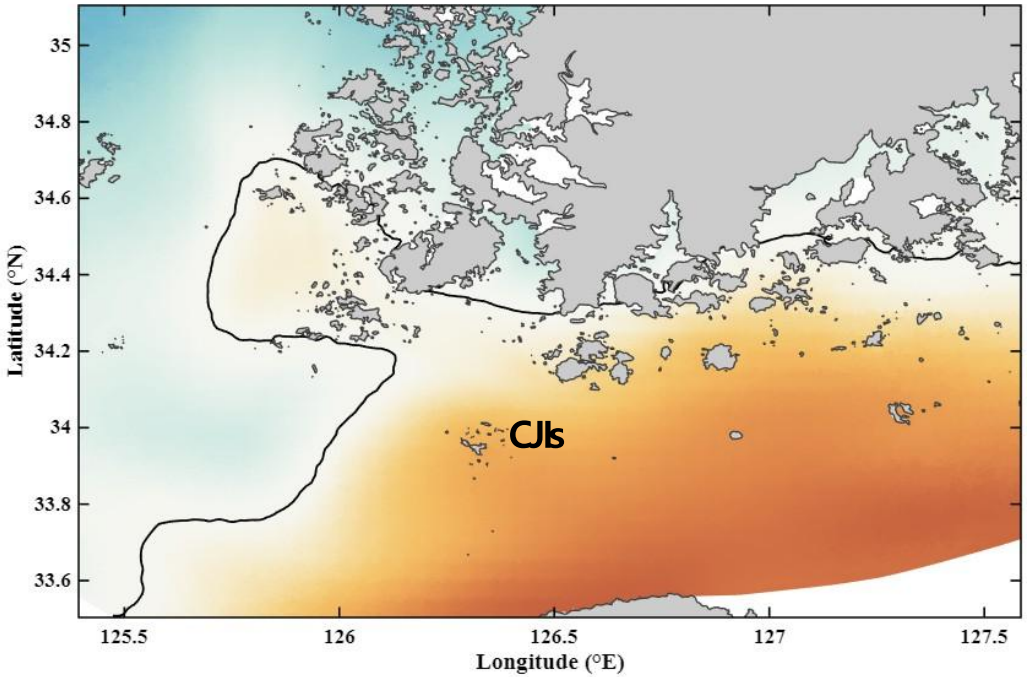
(a) Mean TMI in 2020

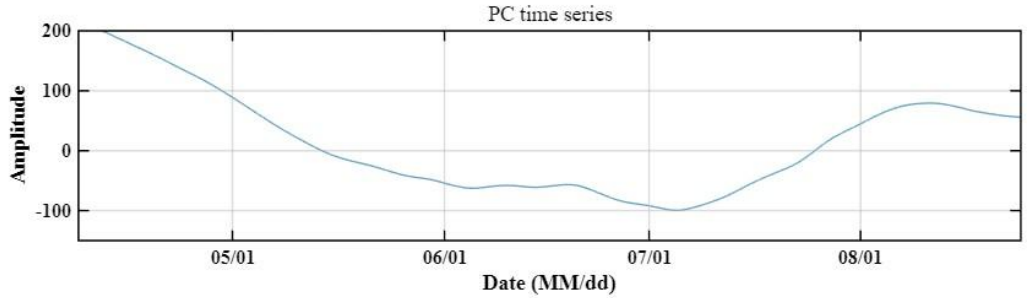
(b) Mean TMI in 2022



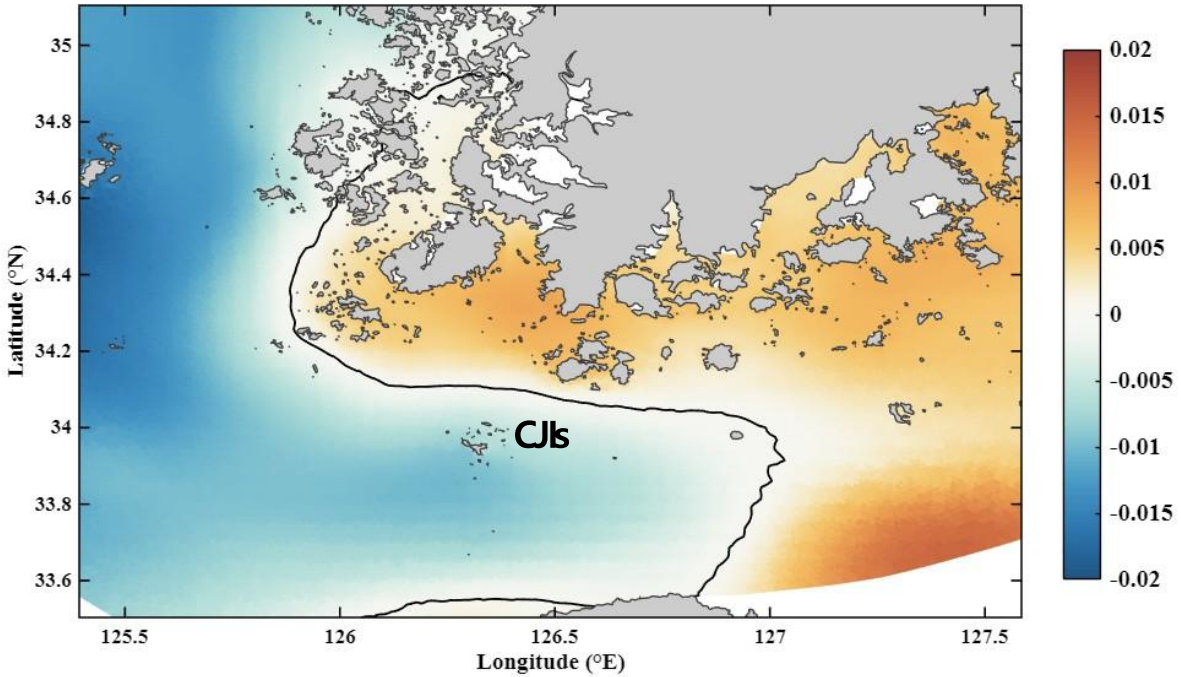
03 Analysis of Cold Water Zone
EOF Analysis

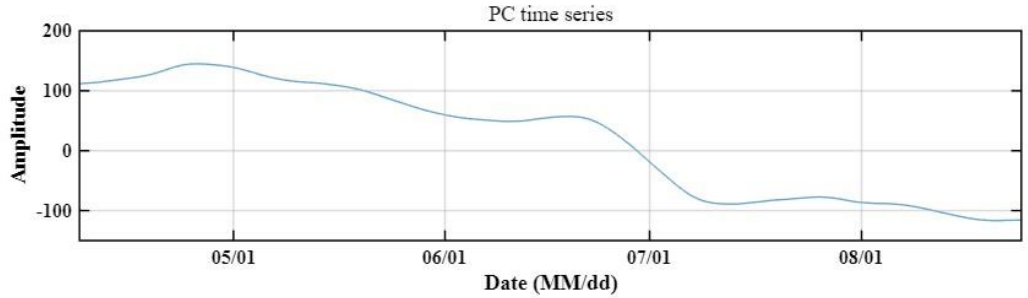
(a) 2nd EOF Mode in 2020 (10.8%)



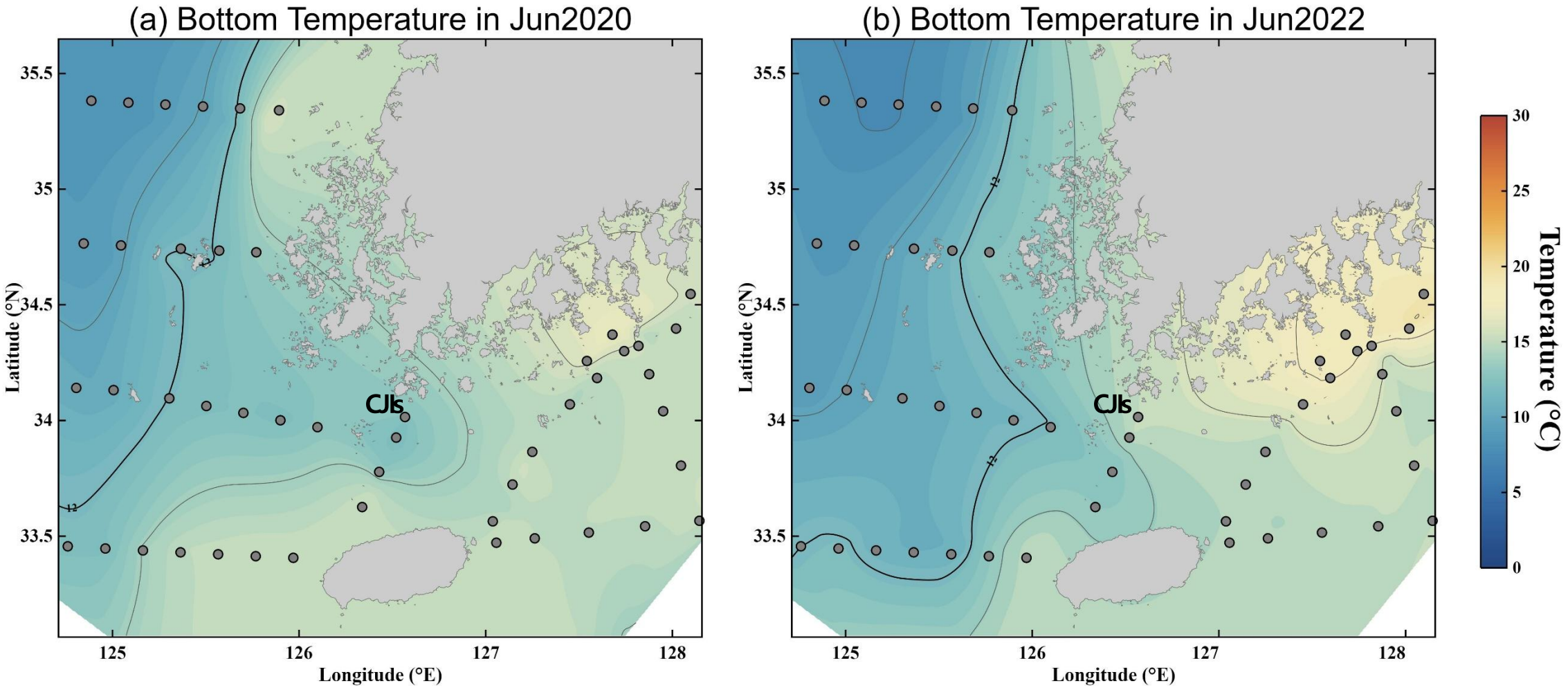


(b) 2nd EOF Mode in 2022 (9.6%)

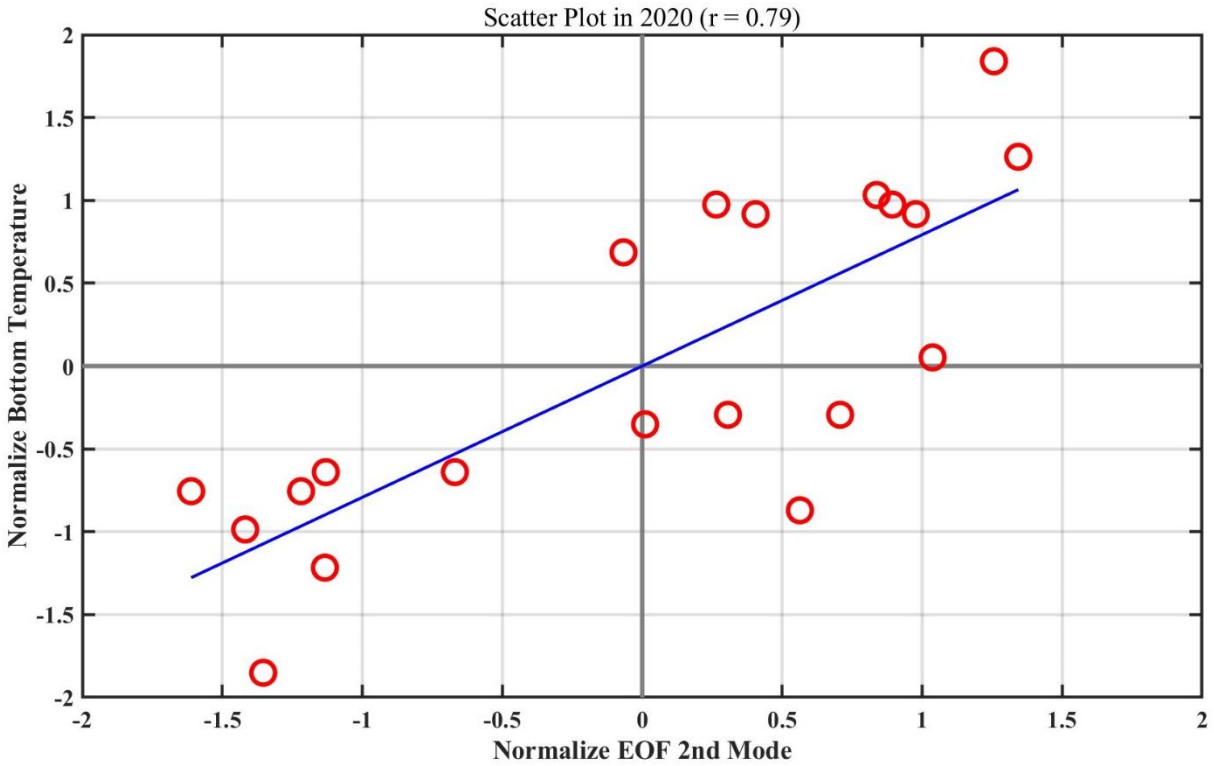


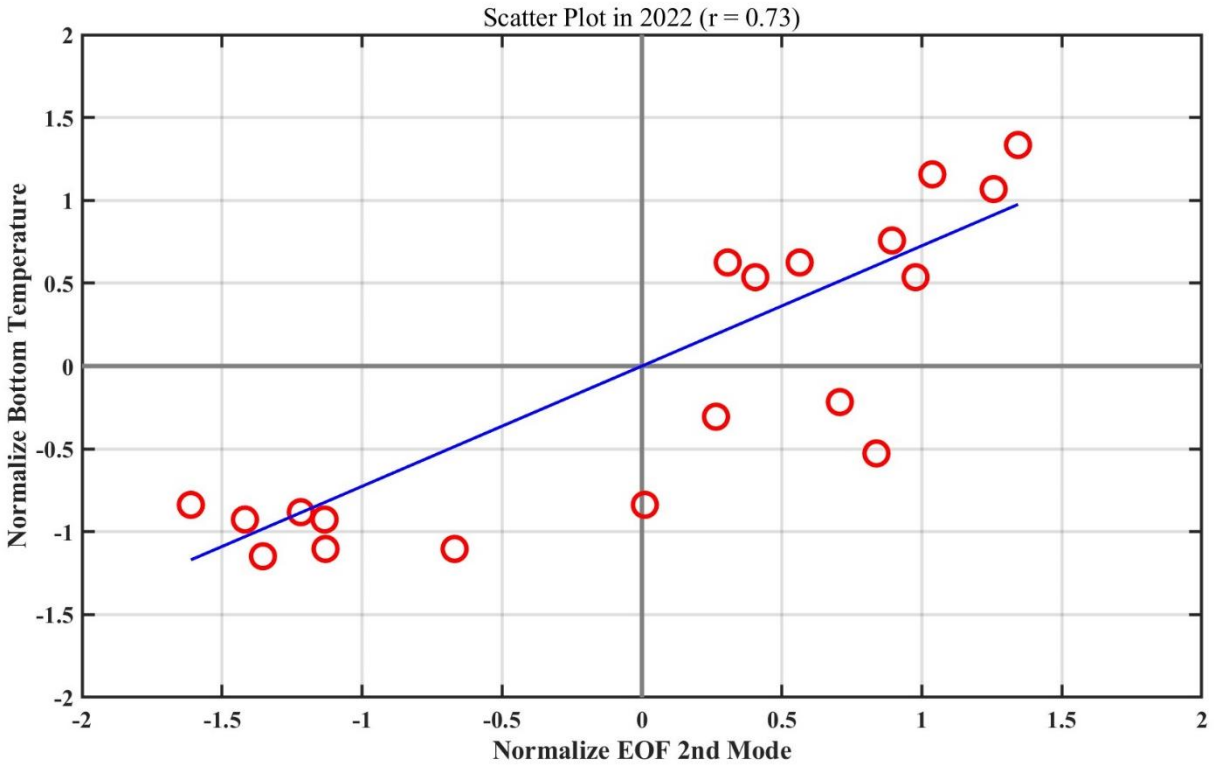


03 Analysis of Cold Water Zone
EOF Analysis



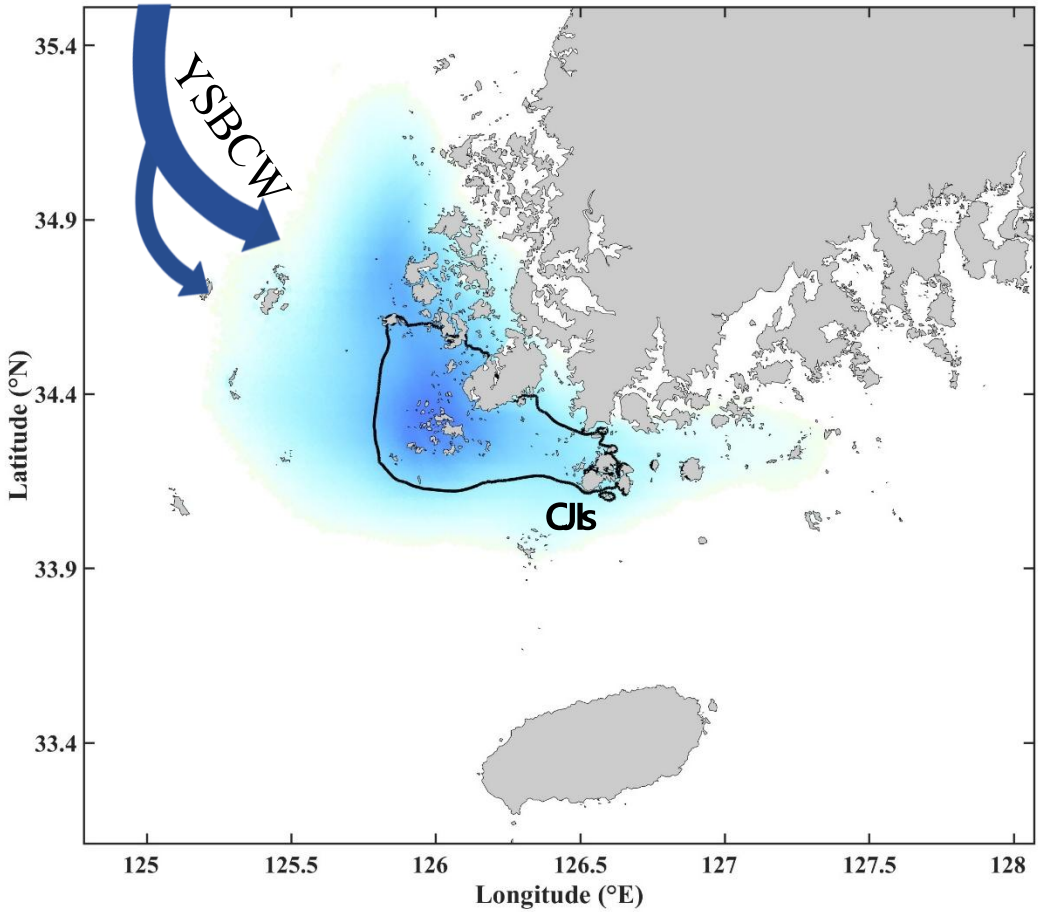
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EOF Analysis



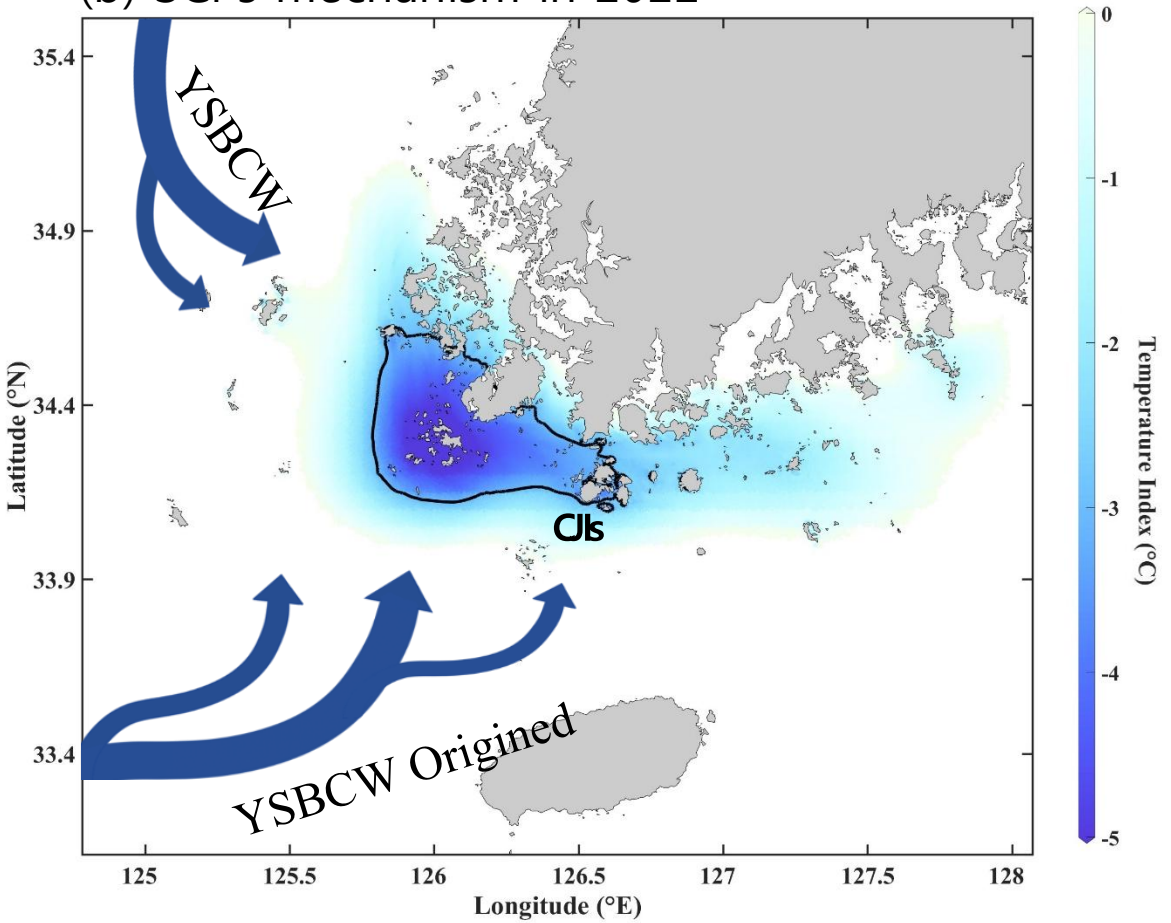


03 Analysis of Cold Water Zone
EOF Analysis

(a) SCPs mechanism in 2020



(b) SCPs mechanism in 2022



Thank You

02 Model Construction
Numerical Model Validation

