PICES 2026 Annual Meeting, Oct 28, 2026
POC Contributed Paper Session

Observed intraseasonal variability of the Kuroshio Current in the East China Sea and its different responses to mesoscale eddies on the offshore and onshore sides of the current path

Minsauk Kang[1], Hanna Na[1], SeungYong Lee[2], Hong Sik Min[2], Dong Guk Kim[2], Chanhyung Jeon[3], Jae-Hun Park[4], Hirohiko Nakamura[5], Ayako Nishina[5] and Eisuke Tsutsumi[5]

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[2] Korea Institute of Ocean Science and Technology, Busan, Republic of Korea
[3] Pusan National University, Busan, Republic of Korea
[4] Inha University, Incheon, Republic of Korea
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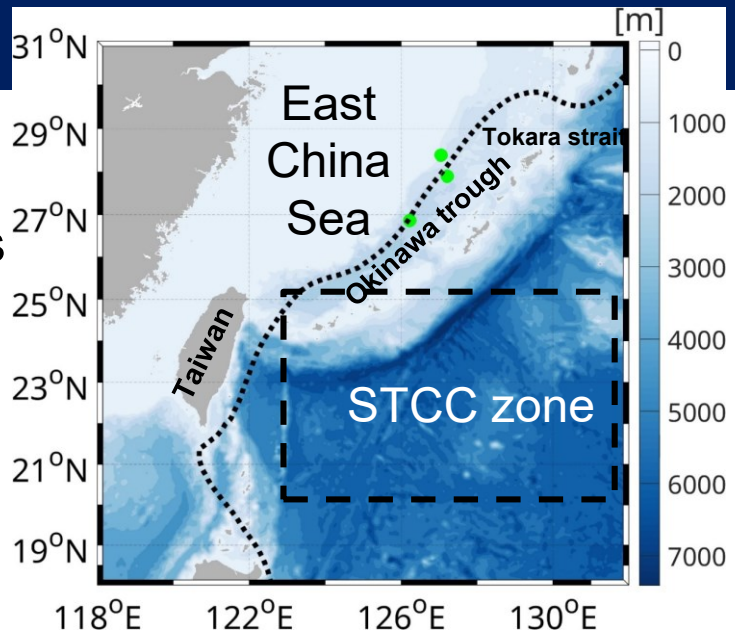
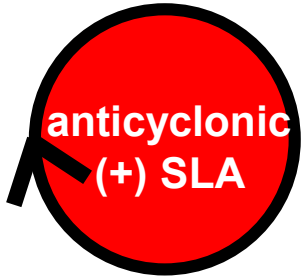
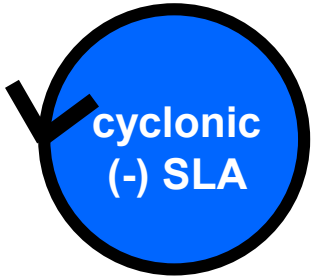
Introduction



- **Kuroshio in the East China Sea (ECS-Kuroshio)**
  - passes east of Taiwan, flows along the Okinawa Trough, and exits through the Tokara Strait
  - transports heat and salt from low to high latitudes, influencing ocean circulation and ecosystems in the surrounding regions

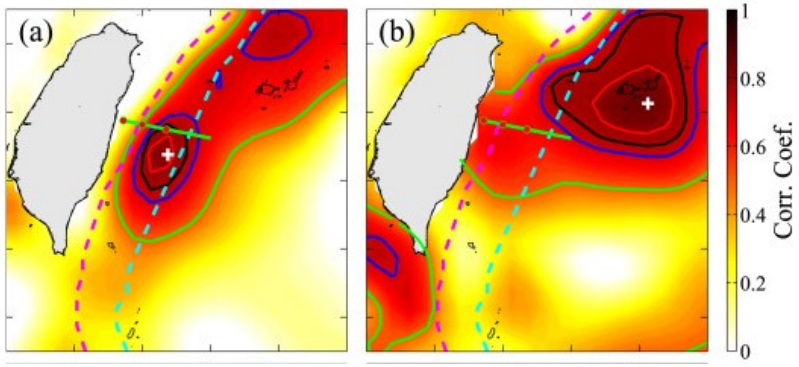




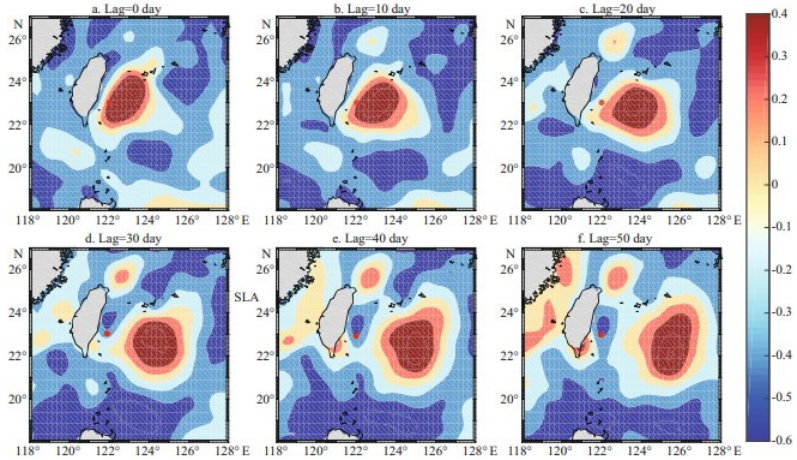
- **Mesoscale eddies affecting the intraseasonal variability of the ECS-Kuroshio**
  - propagate from the subtropical counter current (STCC) zone
  - two representative source regions (**East of Taiwan** and the **Kerama Gap**)

Introduction

➢ Eddies East of Taiwan (ET)

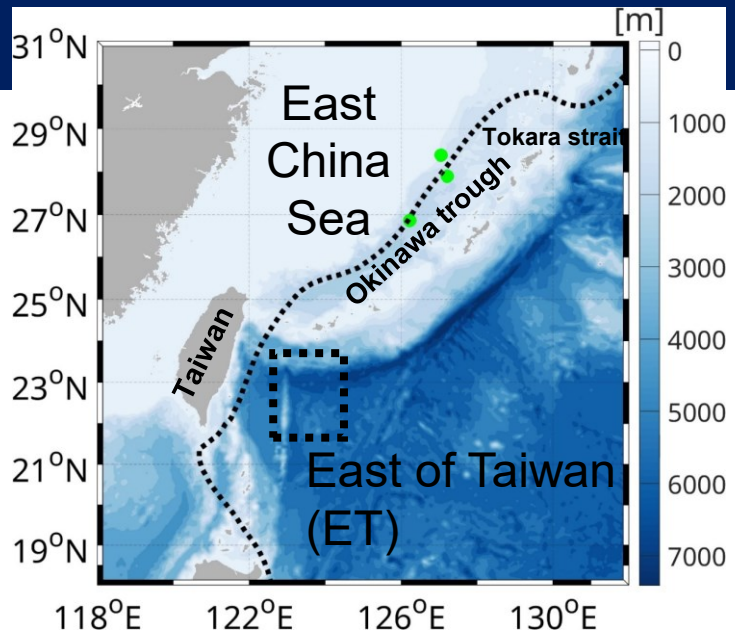


Chang et al., 2018



Qiang et al., 2020

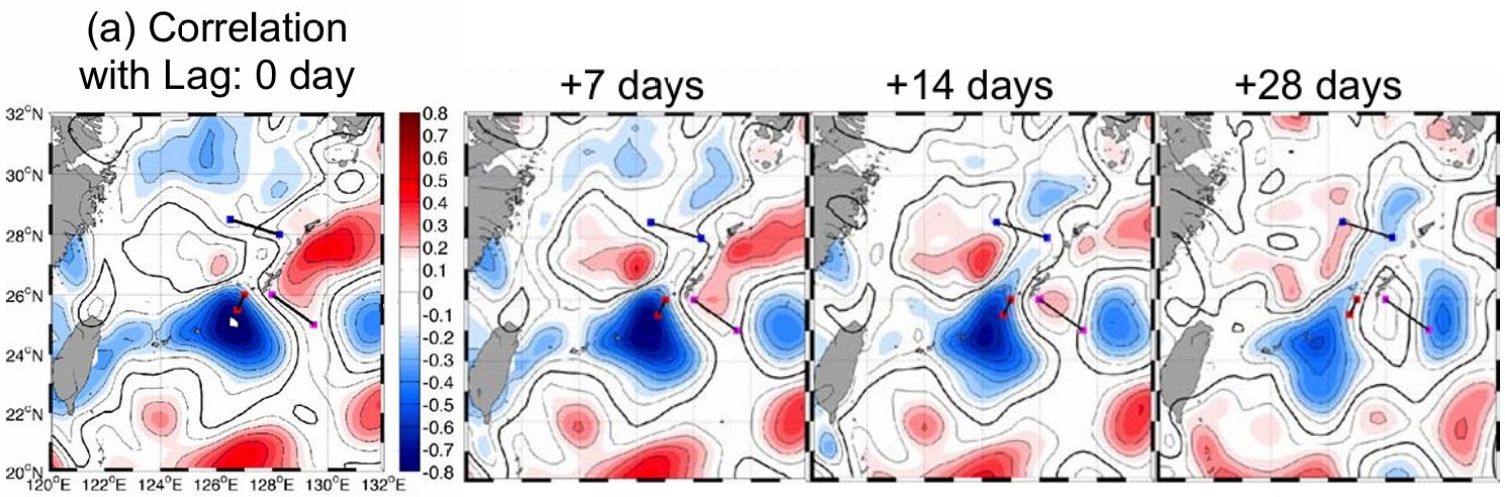
- **Anticyclonic** eddy
  → **enhanced** Kuroshio transport
- **Cyclonic** eddy
  → **reduced** Kuroshio transport



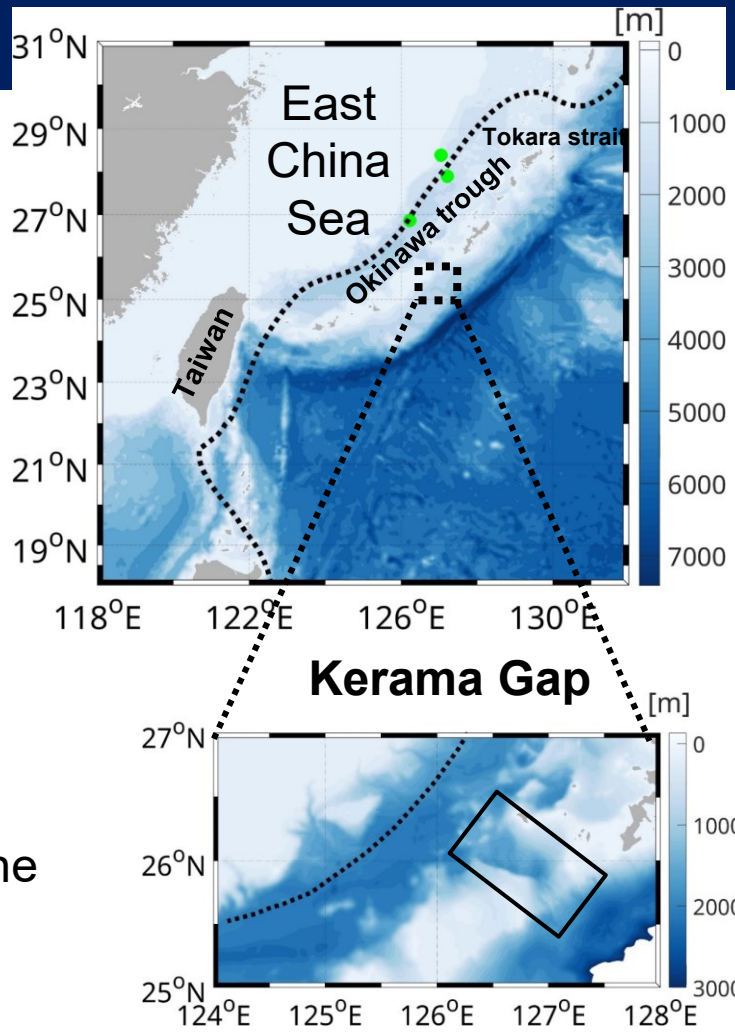
- **Anticyclonic** eddy
  → **stronger** Kuroshio velocity, axial **offshore** shift
- **Cyclonic** eddy
  → **weaker** Kuroshio velocity, axial **onshore** shift

Introduction

➢ **Eddies south of the Kerama Gap (KG)**



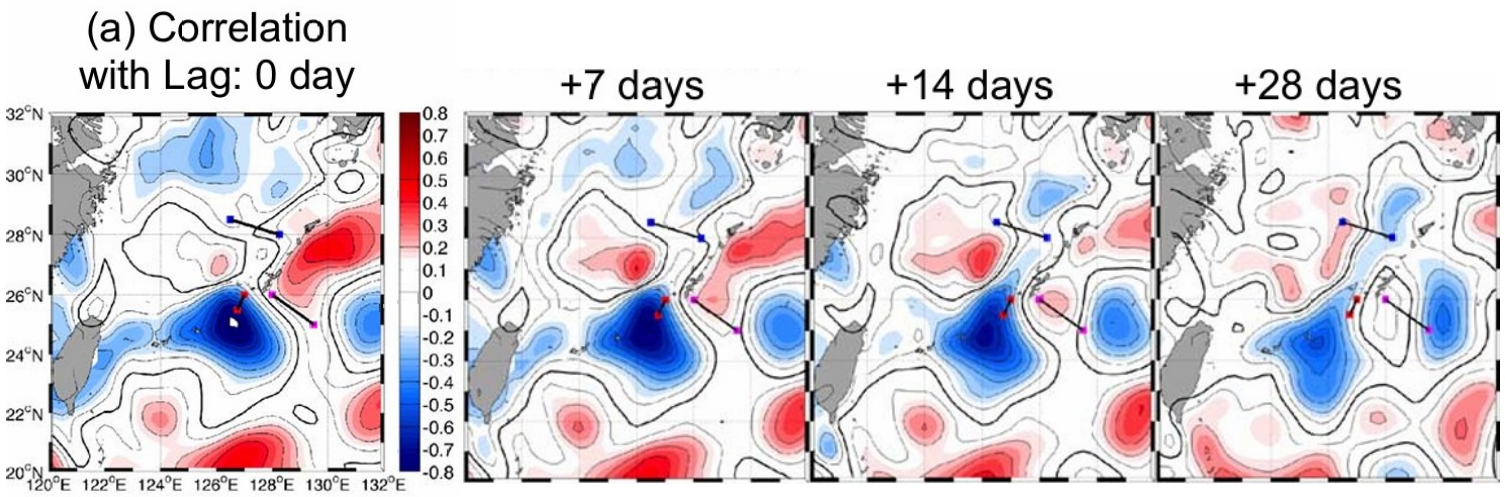
Na et al., 2014



- **Cyclonic** eddy
  → **(-) sea level anomalies** elongated in the northeast-southwest direction to the east of the Kuroshio main axis in the ECS
  → ECS-Kuroshio transport **decrease**
- **Anticyclonic** eddy
  → **(+) sea level anomalies** elongated in the northeast-southwest direction to the east of the Kuroshio main axis in the ECS
  → ECS-Kuroshio transport **increase**

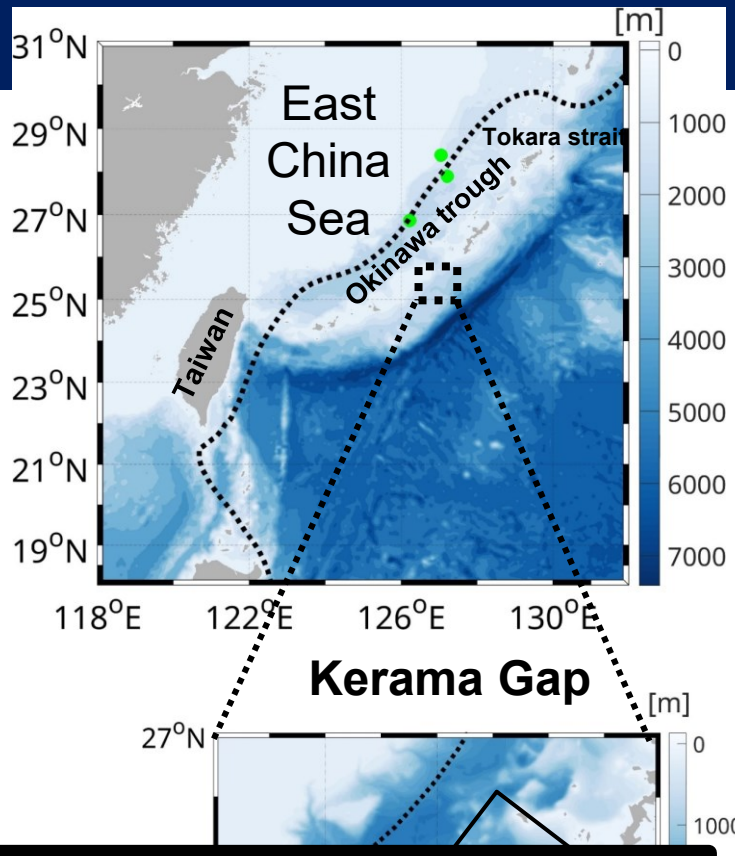
Introduction

➢ **Eddies south of the Kerama Gap (KG)**



Na et al., 2014

- **Cyclonic** eddy



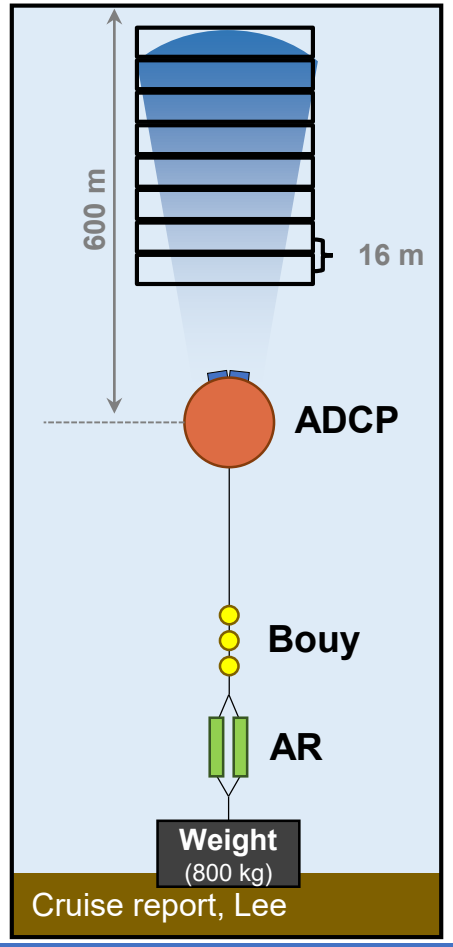
➢ **Objective**

- **To investigate the Influence of mesoscale eddies from east of Taiwan and the Kerama Gap on the ECS-Kuroshio variability using the ADCP observation for 5 years (2020/06–2025/06)**

Data

➢ Acoustic Doppler Current Profiler (ADCP)

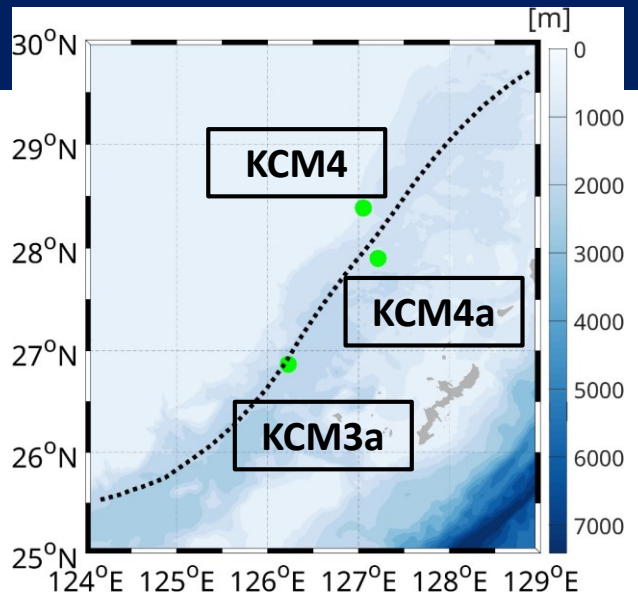
- measures vertical profiles of currents using acoustic waves based on the Doppler shift effect
- 16 m vertical interval; 30 mins;



QC process

- Observed depth < ADCP depth - 30 m
- Magnetic → True North
- Speed < 0
- Percent good < 90
- Depth < 3.5*BinSize (16m)
- dU/dz <-10 $cm*s^{-1}*bin^{-1}$ (57–72m)
- 1 m pchip vertical interpolation (1–600m)
- Obs/(Obs + Nan) >0.95
- pchip temporal interpolation
- 72 hours low pass filter
- Daily mean (>45)

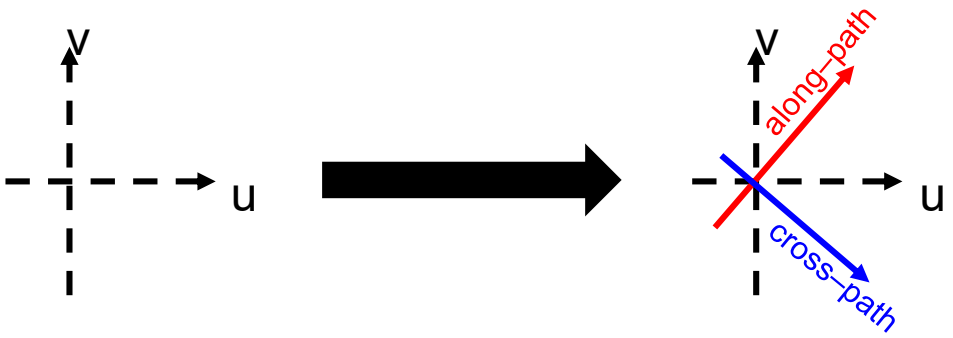
→ NaN



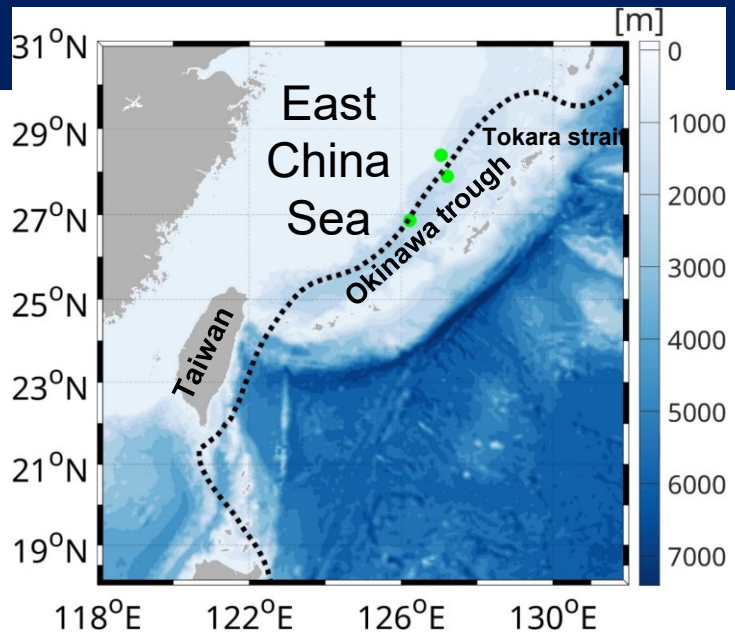
- Collaboration between Japanese and Korean scientists
- Annual recovery and deployment of the mooring arrays aboard the T/V Kagoshimamaru



Data



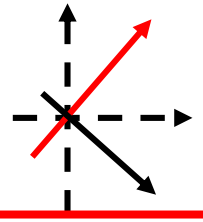
Rotate the u, v component
by 30˚ for 3a and 35˚ for 4 & 4a



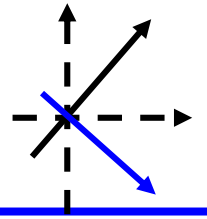
Data	Spatial domain	Period	Resolution	Depth	Variables
75 kHz ADCP	KCM4 [28.389˚N, 127.051˚E] KCM4a [27.901˚N, 127.214 ˚E] KCM3a [26.868˚N, 126.225˚E]	2020/06/14– 2025/06/10	Daily	84–523 m (1 m interval)	along-path & cross-path velocity
DUACS (Satellite altimetry)	18.0°–31.0°N, 118.0°–132.0°E	2020/04/01– 2025/06/30	Daily 1/4°	–	Sea Level Anomaly (SLA)

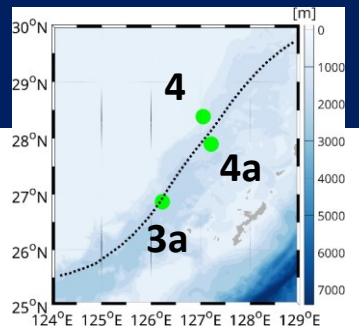
Results: Time series of the velocity vertical profile

along–path



cross–path

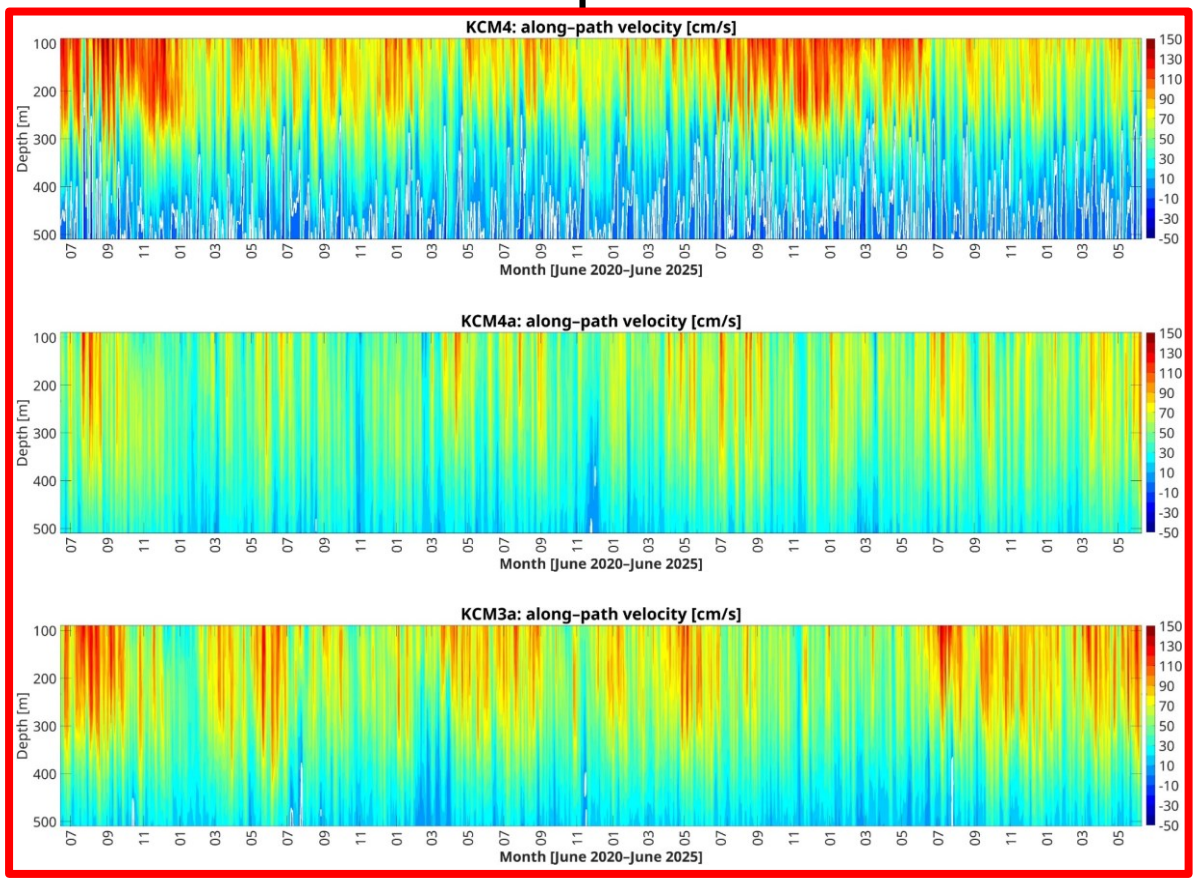


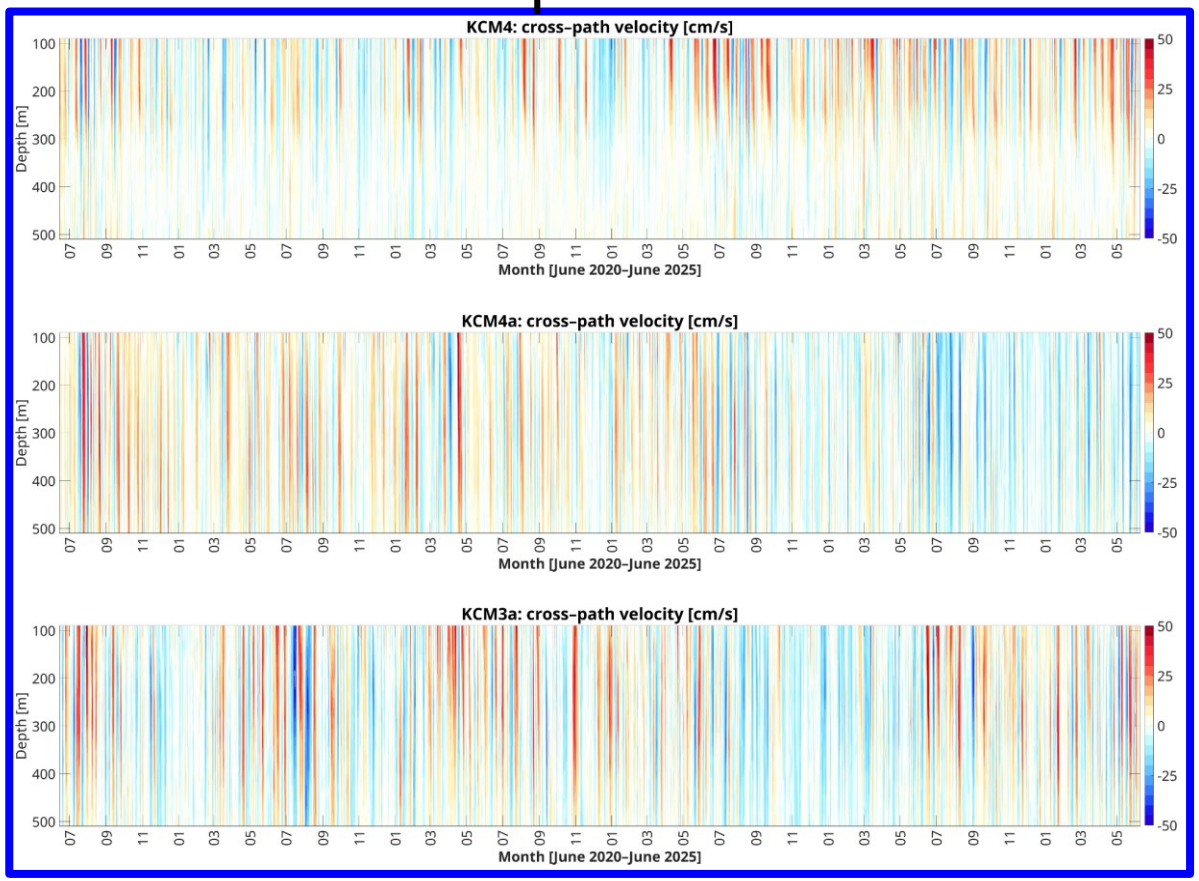


4

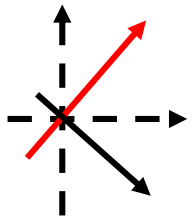
4a

3a

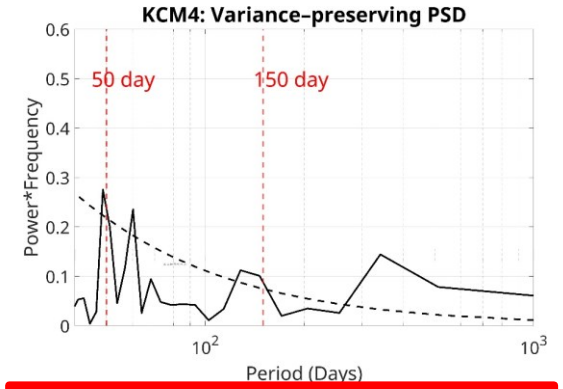




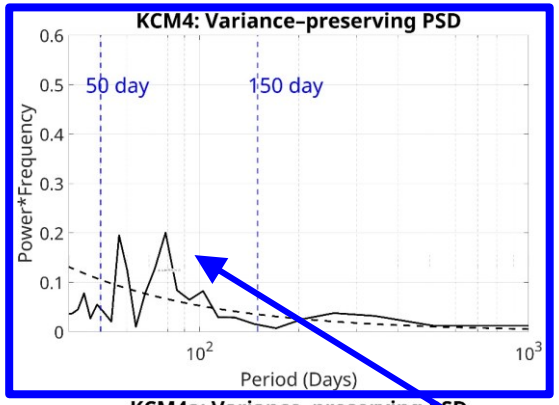
Results: Spectral analysis of depth–integrated velocity

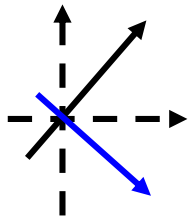


along–path

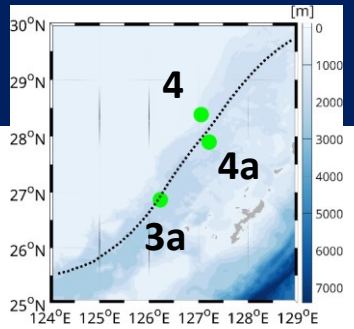


4

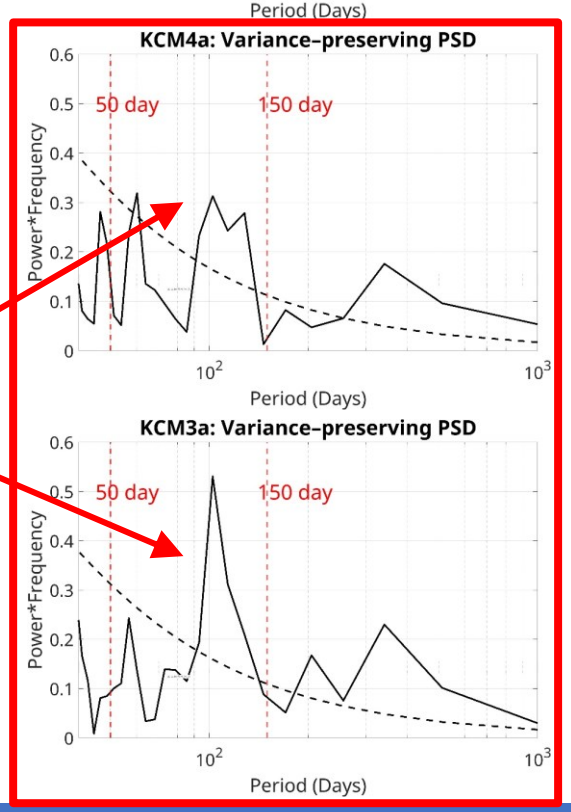




cross–path

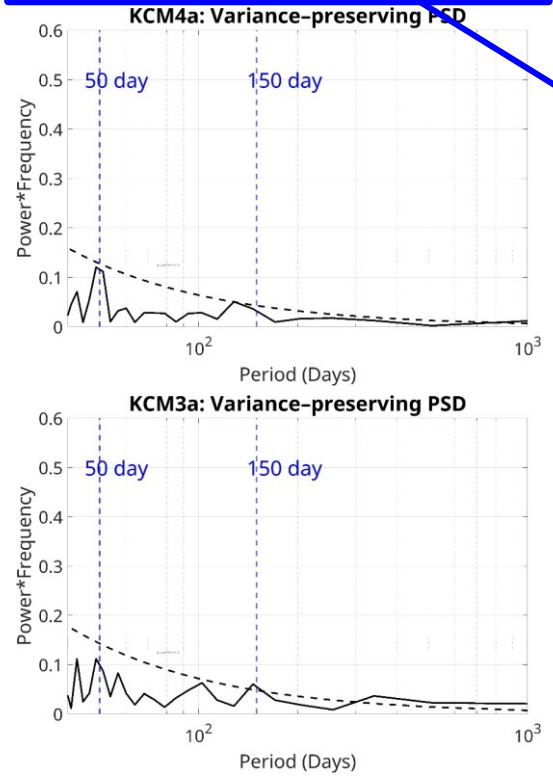


50–150 day



4a

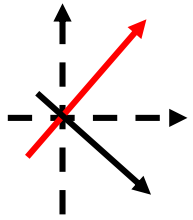
3a



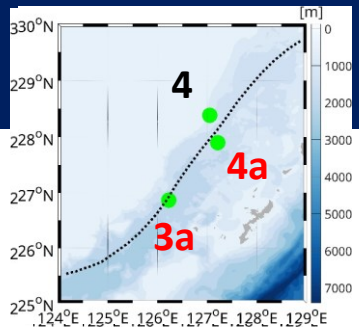
50–150 day

Results: 50–150 day band pass filtered time series at the offshore sites

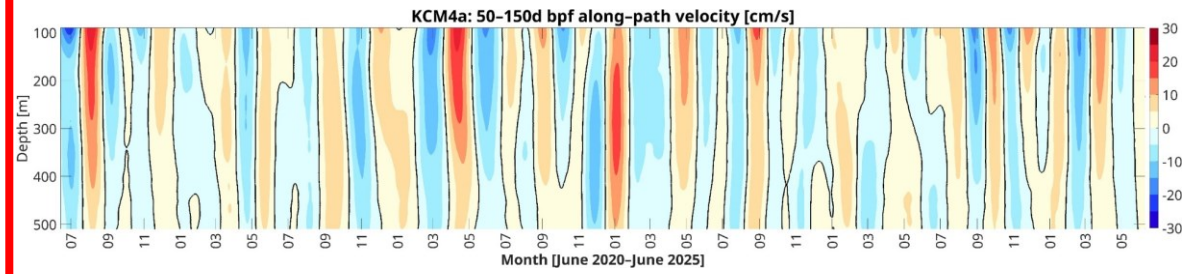
along–path

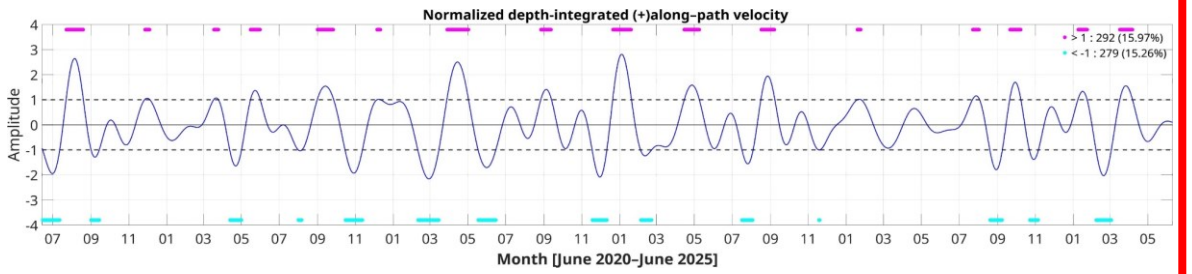


Amplitude > 1: Kuroshio strengthening
Amplitude < -1: Kuroshio weakening



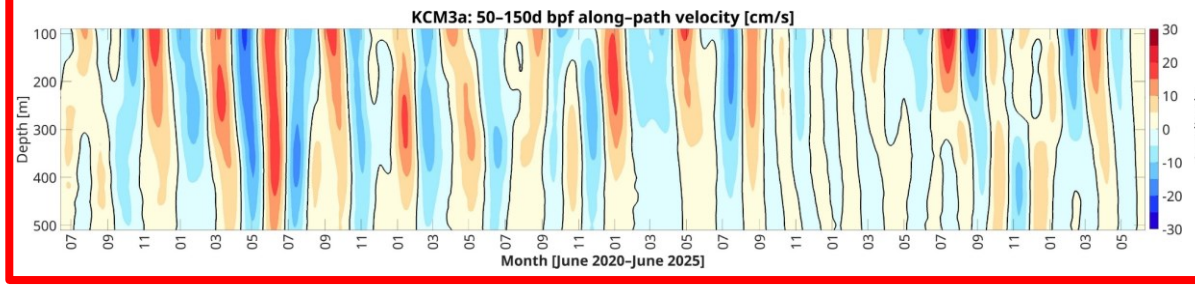
4a

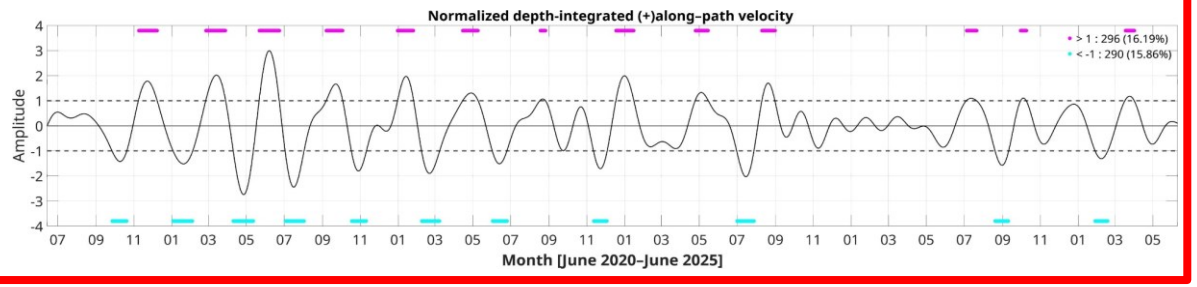




r = 0.63 (+ 2 days)

3a





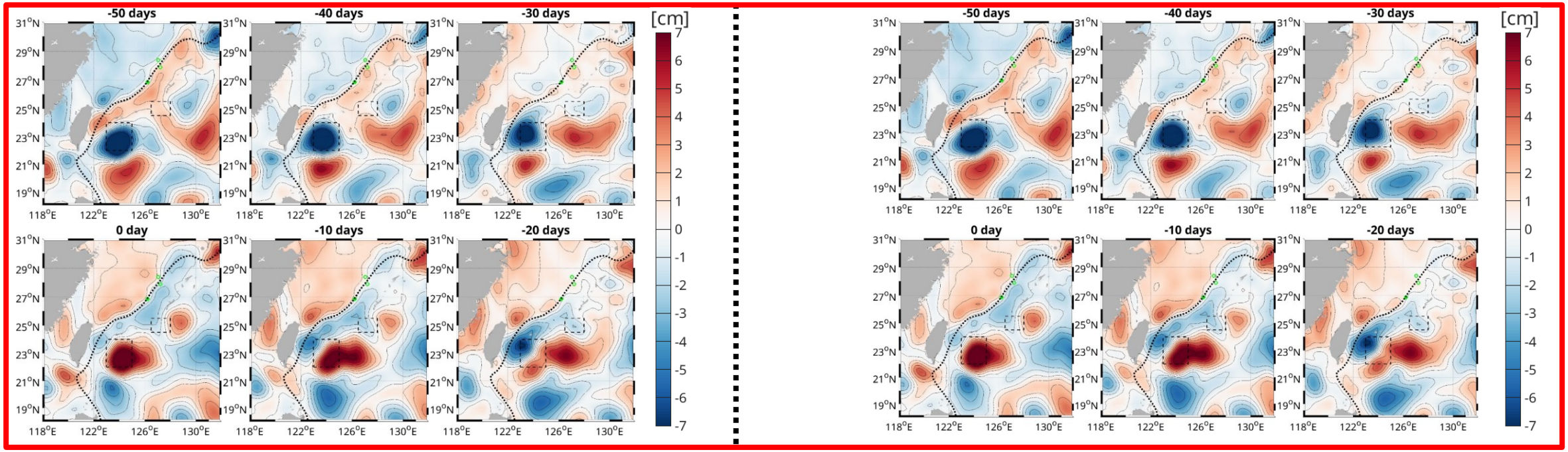
depth integrated velocity → band pass filter → normalize

Kuroshio strengthening

Offshore sites

Kuroshio weakening

3a



3a

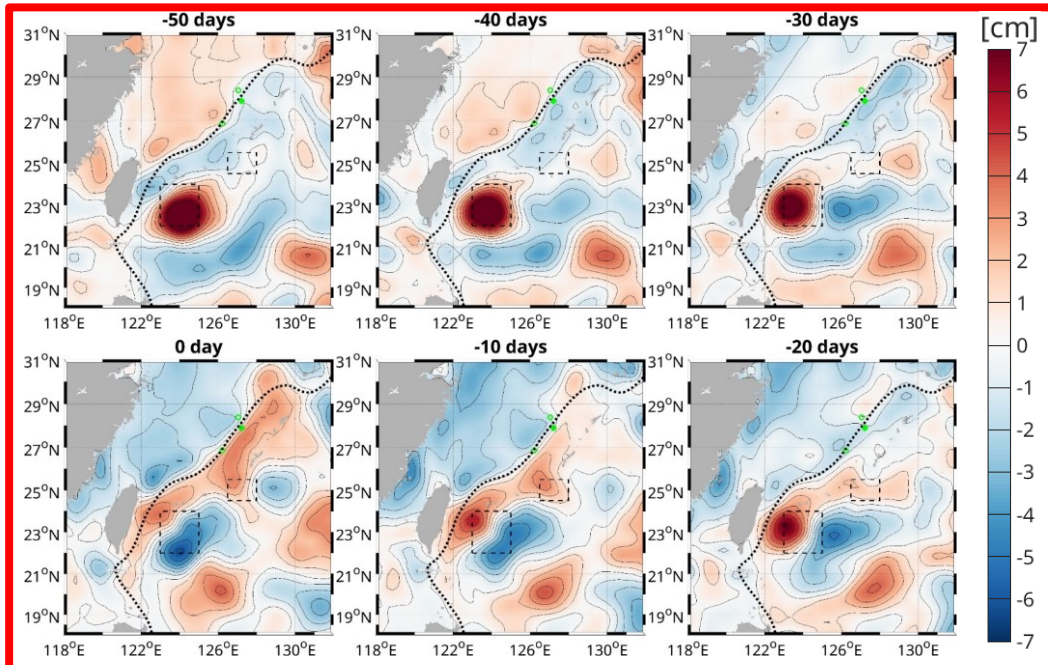
Eddies east of Taiwan: ~40 days before the peak
Eddies south of the Kerama Gap: ~20 days before the peak

- **ACE** is observed before ECS-Kuroshio strengthening
- **(+) SLA** propagate along the ECS–Kuroshio
- **Higher** sea level anomaly to the east of the downstream Kuroshio axis

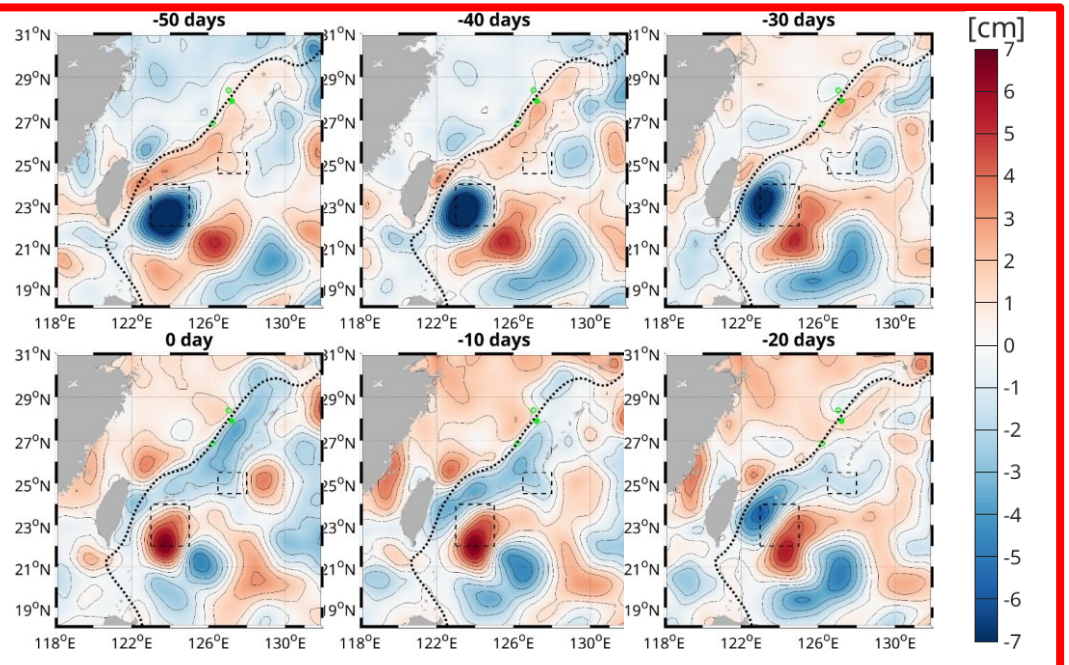
- **CE** is observed before ECS-Kuroshio weakening
- **(-) SLA** propagate along the ECS–Kuroshio
- **Lower** sea level anomaly to the east of the downstream Kuroshio axis

Kuroshio strengthening | Offshore sites | Kuroshio weakening

4a



4a



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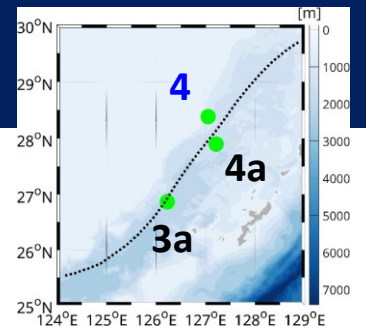
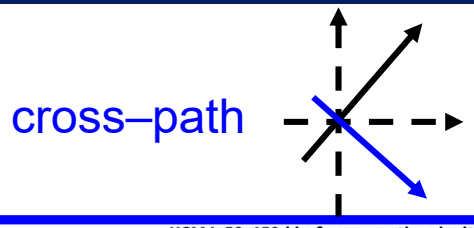
- **(-) SLA** propagate along the ECS–Kuroshio
- **Lower** sea level anomaly to the east of the downstream Kuroshio axis

Results: 50–150 day band pass filtered time series at the onshore site

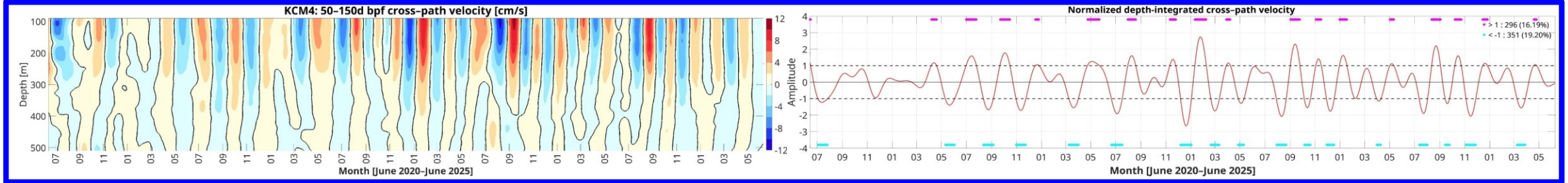


cross–path

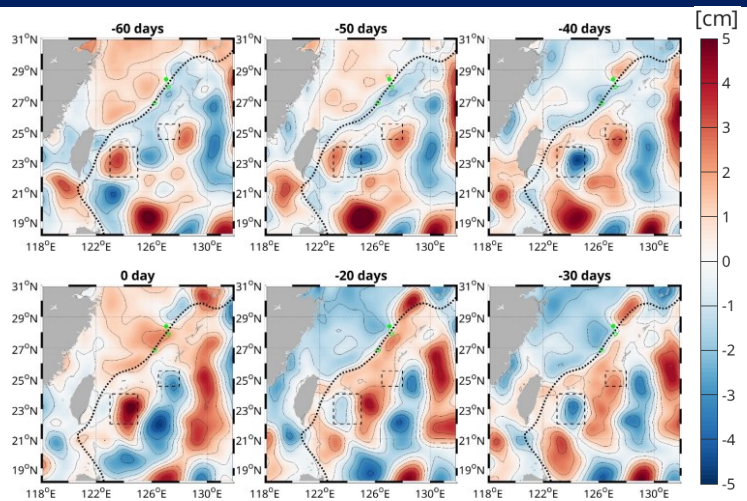


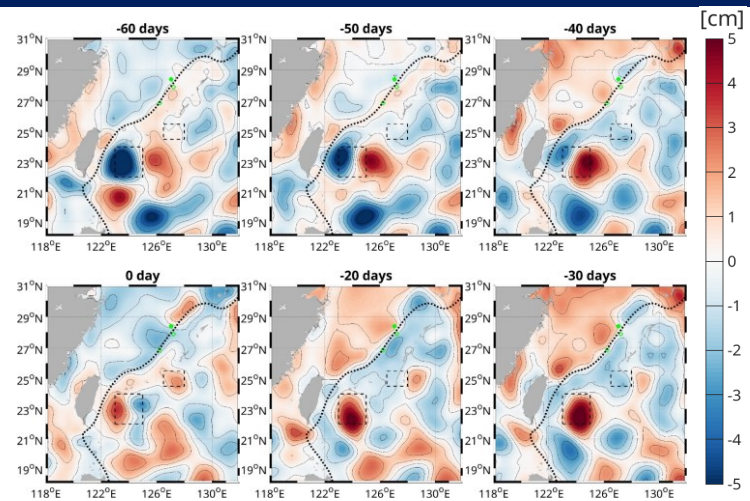
Amplitude > 1: offshoreward
Amplitude < -1: onshoreward

4



Offshoreward | **Onshore site** | **Onshoreward**

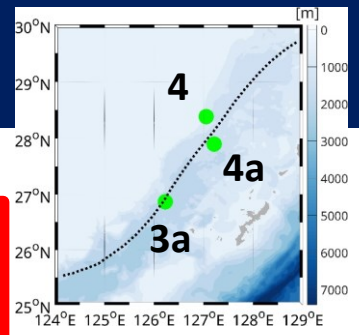




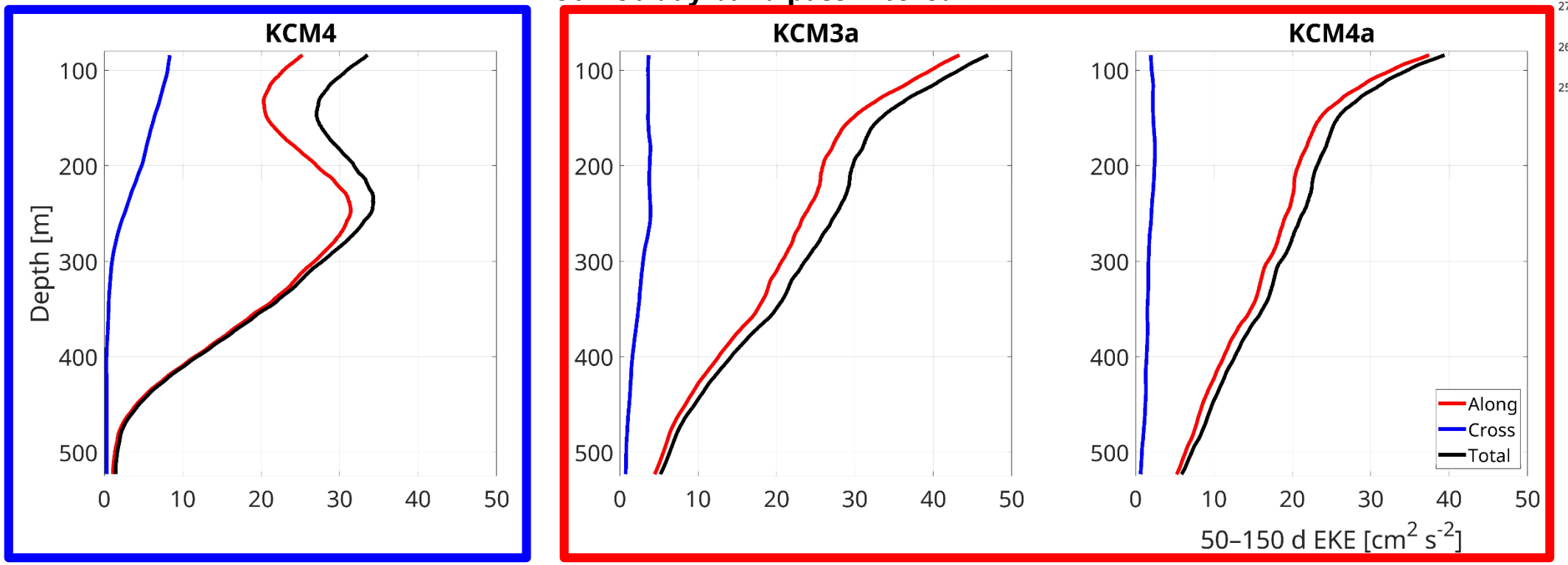
No distinct propagation of eddy signal at the onshore site (KCM4)

depth integrated velocity → band pass filter → normalize

Results & Discussion



50–150 day band pass filtered EKE



- ➢ Onshore site (KCM4)
- Along-path dominant
- Subsurface intensified
- relatively larger cross-path contribution

- ➢ Offshore sites (KCM3a & 4a)
- Along-path dominant
- Surface intensified

➔ **Different vertical distributions** of EKE between offshore and onshore sites

Summary

➢ Summary

- **50–150-day variability** identified in 5 years of ECS-Kuroshio velocity observations
- ✓ **Offshore sites** (KCM3a & 4a)
  - **Along-path velocity variability** associated with **mesoscale eddies** east of Taiwan and south of the Kerama Gap
  - **Surface intensified EKE**
- ✓ **Onshore site** (KCM4)
  - **unclear eddy influence**
  - **Subsurface intensified EKE,** with a relatively larger cross-path contribution
  - **Bathymetric interactions** at the shallower **onshore site** (KCM4) may have contributed to this variability.

➢ Further Study

- Investigate the physical mechanisms driving 50–150-day variability at the onshore site.
- Compare the effects of mesoscale eddies from east of Taiwan and the south of Kerama Gap.

Thank you!