The slope current and the Diel Vertical Migration of zooplankton and micronekton in the northern slope of the South China Sea observed by a moored ADCP

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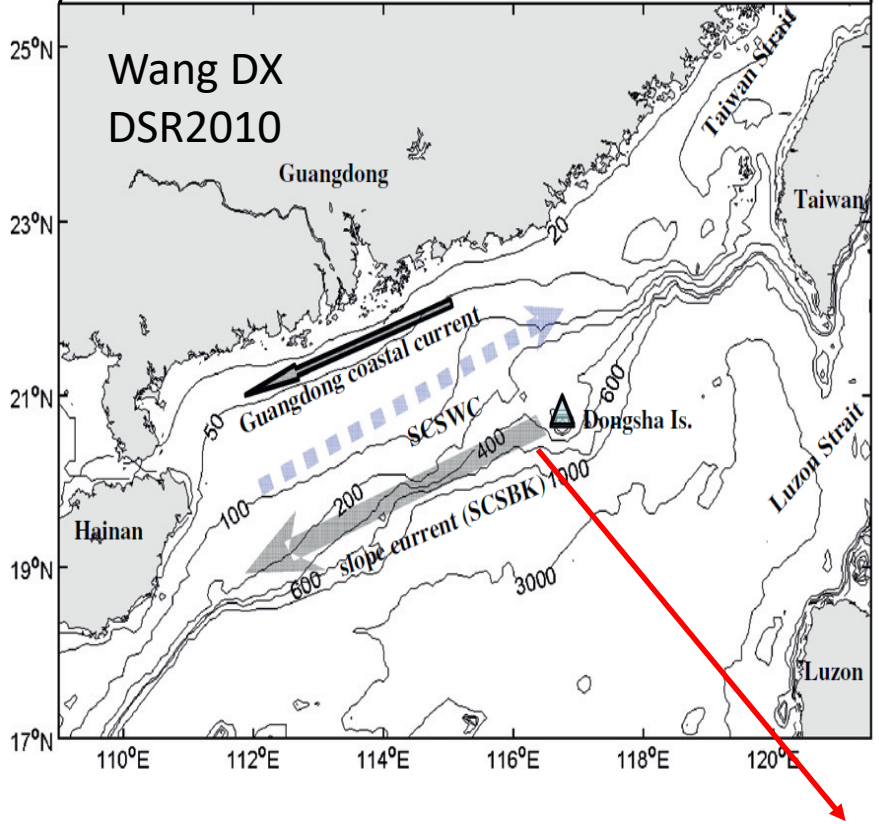
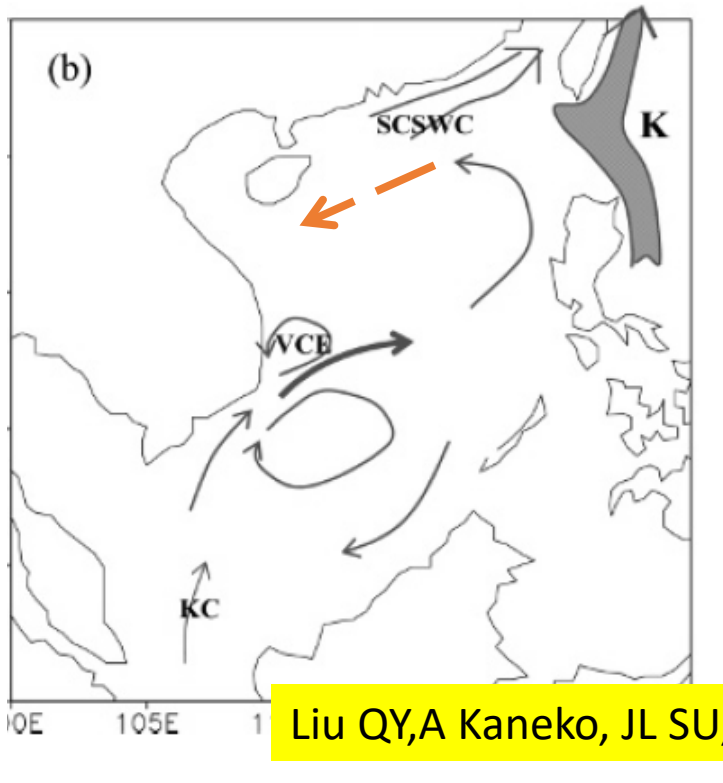
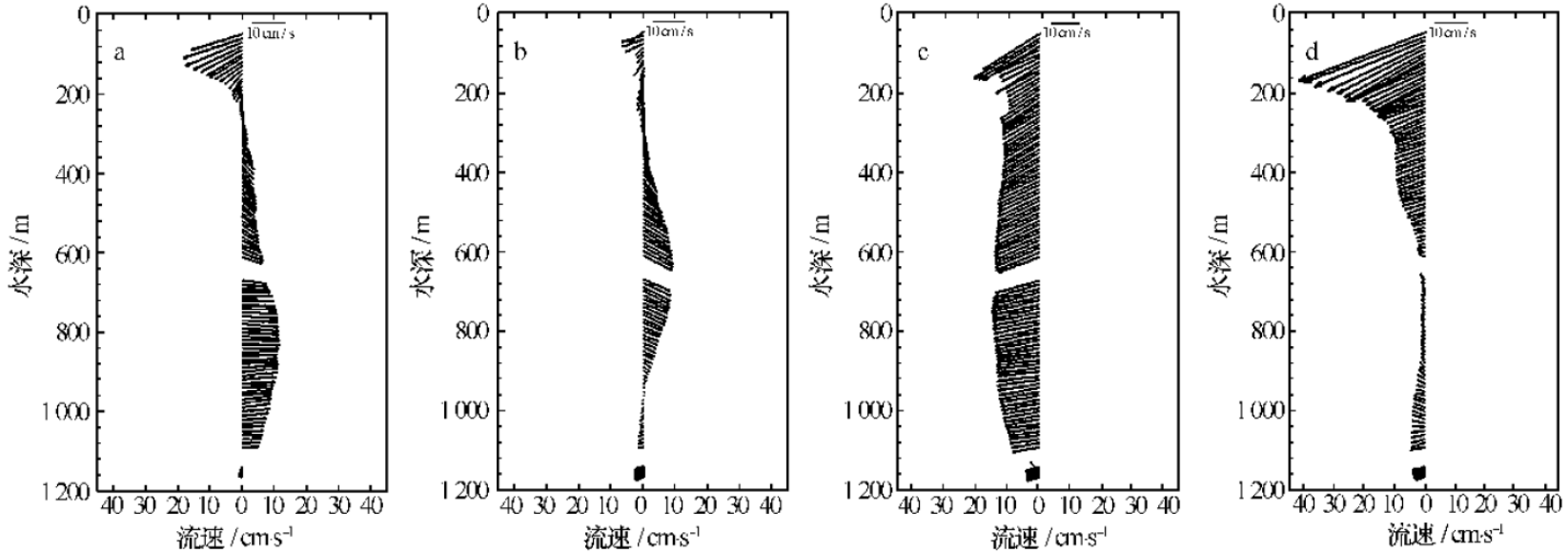
Victoria,BC Oct.,2019





Liu QY,A Kaneko, JL SU,2008



Aug~Nov 2016 monthly mean Mooring near Dongsha (depth 1210m）（a.Aug.b.Sep，c.Oct，d.Nov.）（from：何琦，魏泽勋等，**2012**）

Winter

Summer

Annual mean

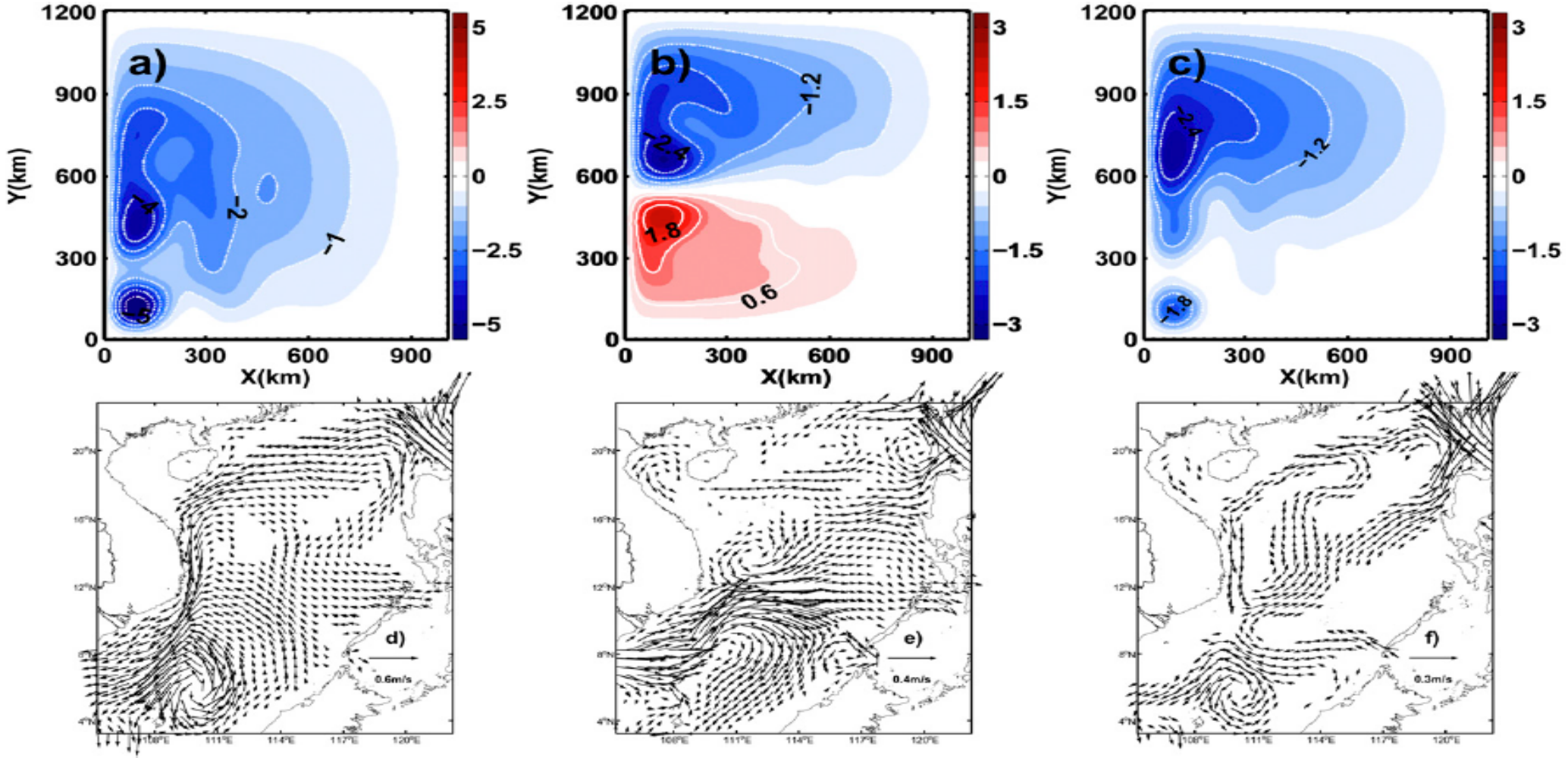


FIG. 2. QG model-simulated SCS (a) winter-mean, (b) summer-mean, and (c) annual-mean upper-layer dynamical streamfunction (Sv). (d) Winter-mean, (e) summer-mean, and (f) annual-mean surface velocity field derived from SODA.

Yang ,WU ,JPO,2015

Qi Quan & Huijie Xueet al.
OD 2016

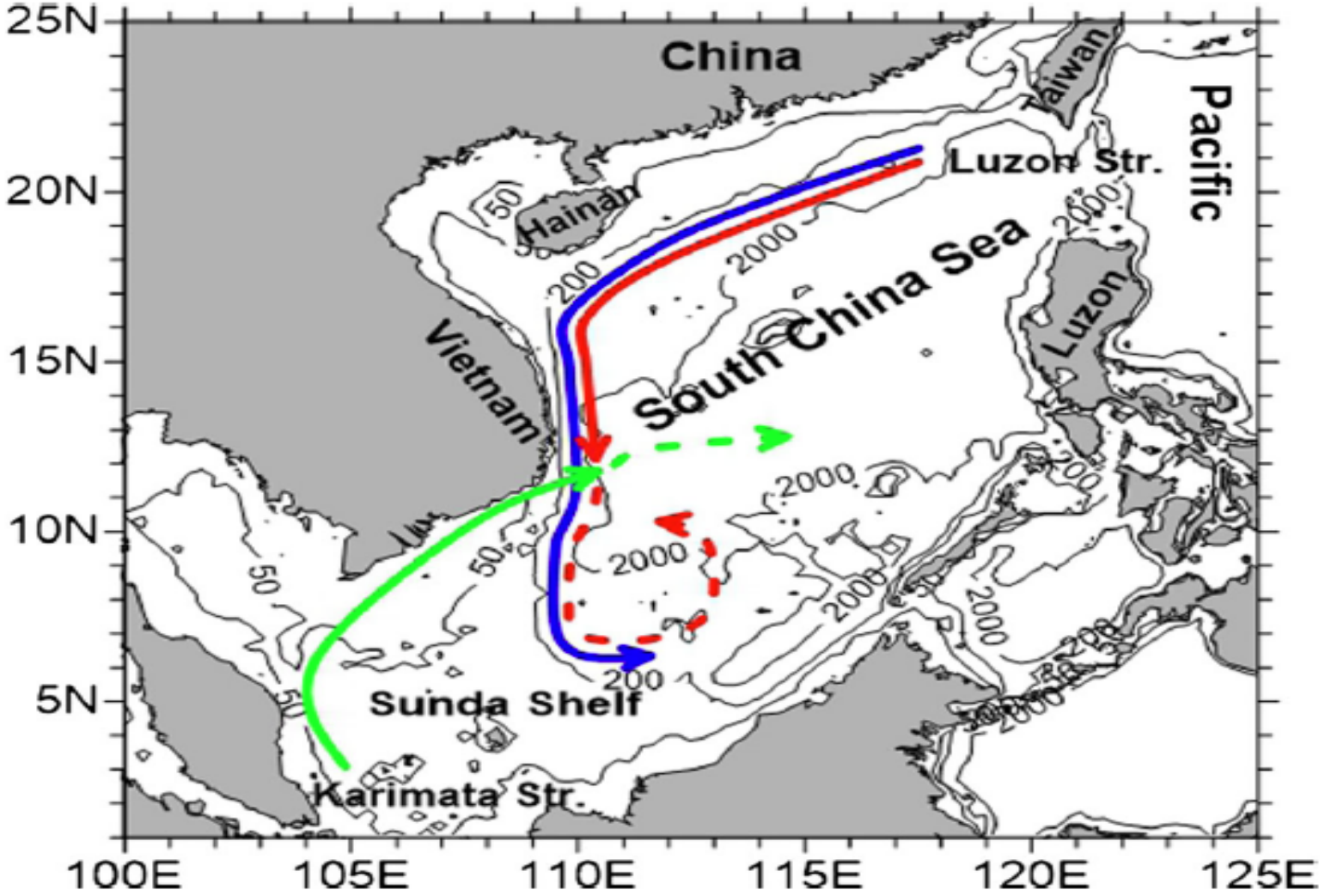
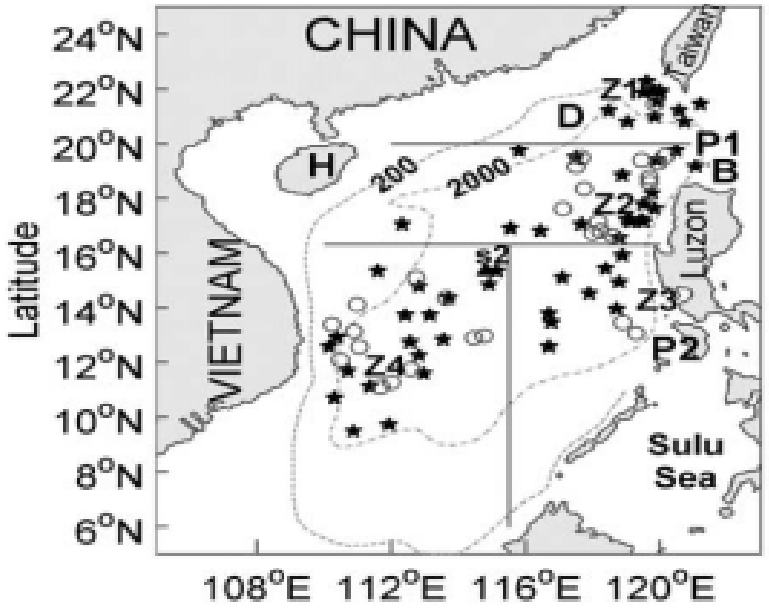
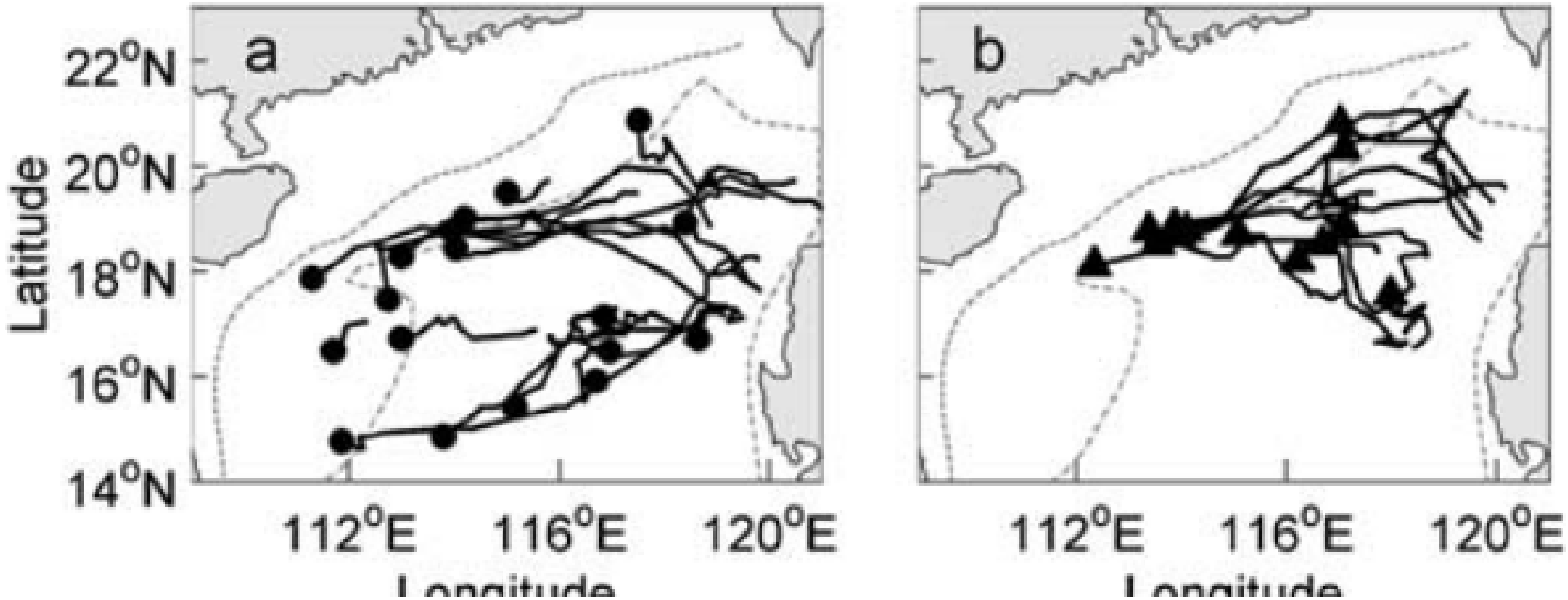


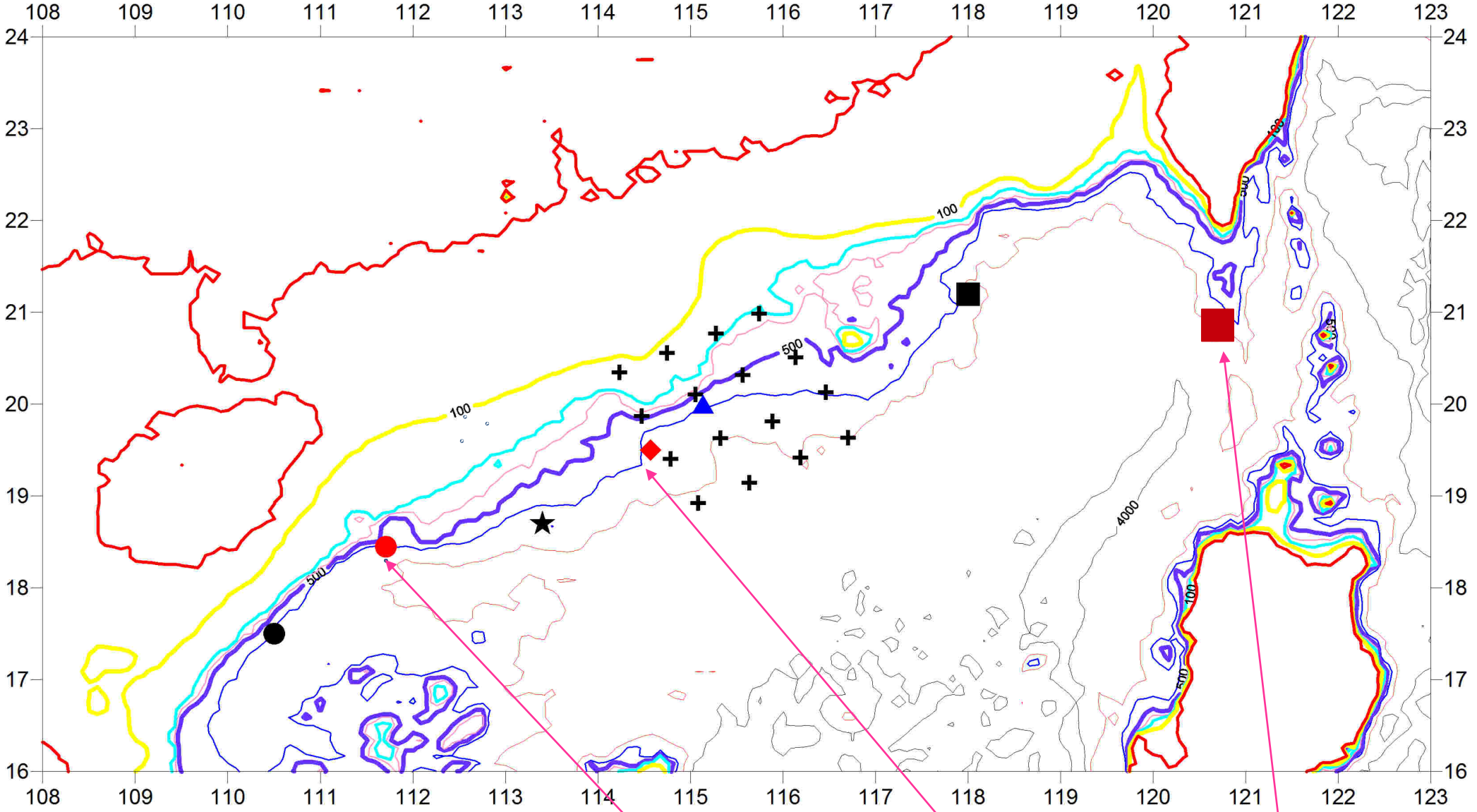
Fig. 4 Schematic of the SCSWBC based on the definition in this paper. The *blue* streamline denotes the SCSWBC in winter. The *red solid* streamline represents the SCSWBC in summer, and the *red dashed* streamline denotes the extension of the WBC which sometimes forms a cyclonic gyre. The *green solid* streamline denotes the current from the southwestern shelf, and the *green dashed* streamline represents the VOC in summer



Wang _GH等2003. Map of the SCS. Isobaths are in meter. (circle: cyclonic eddy; star: anticyclonic eddy;.) Solid lines are boundaries for zones Z1, Z2, Z3 and Z4.

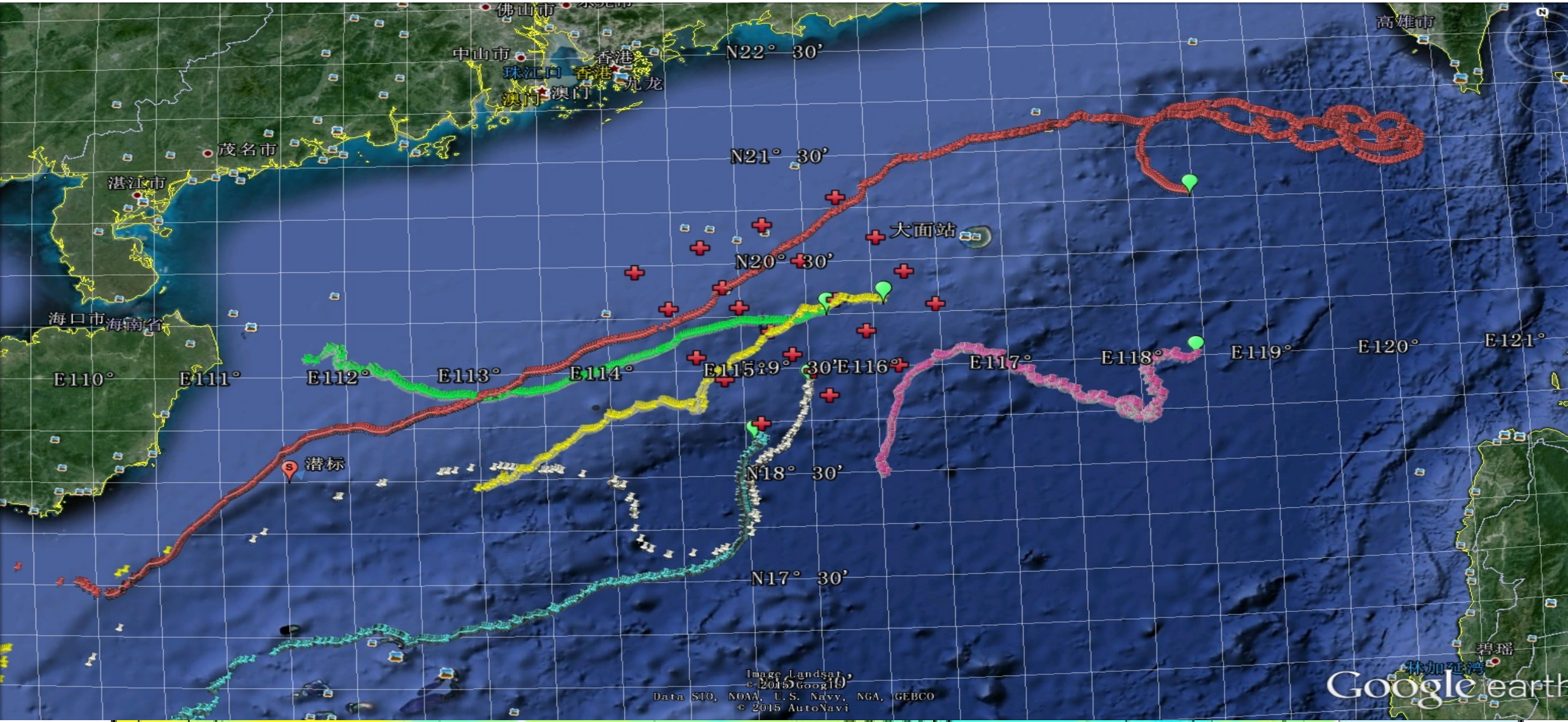
ACE(a), CE(b) for Z2



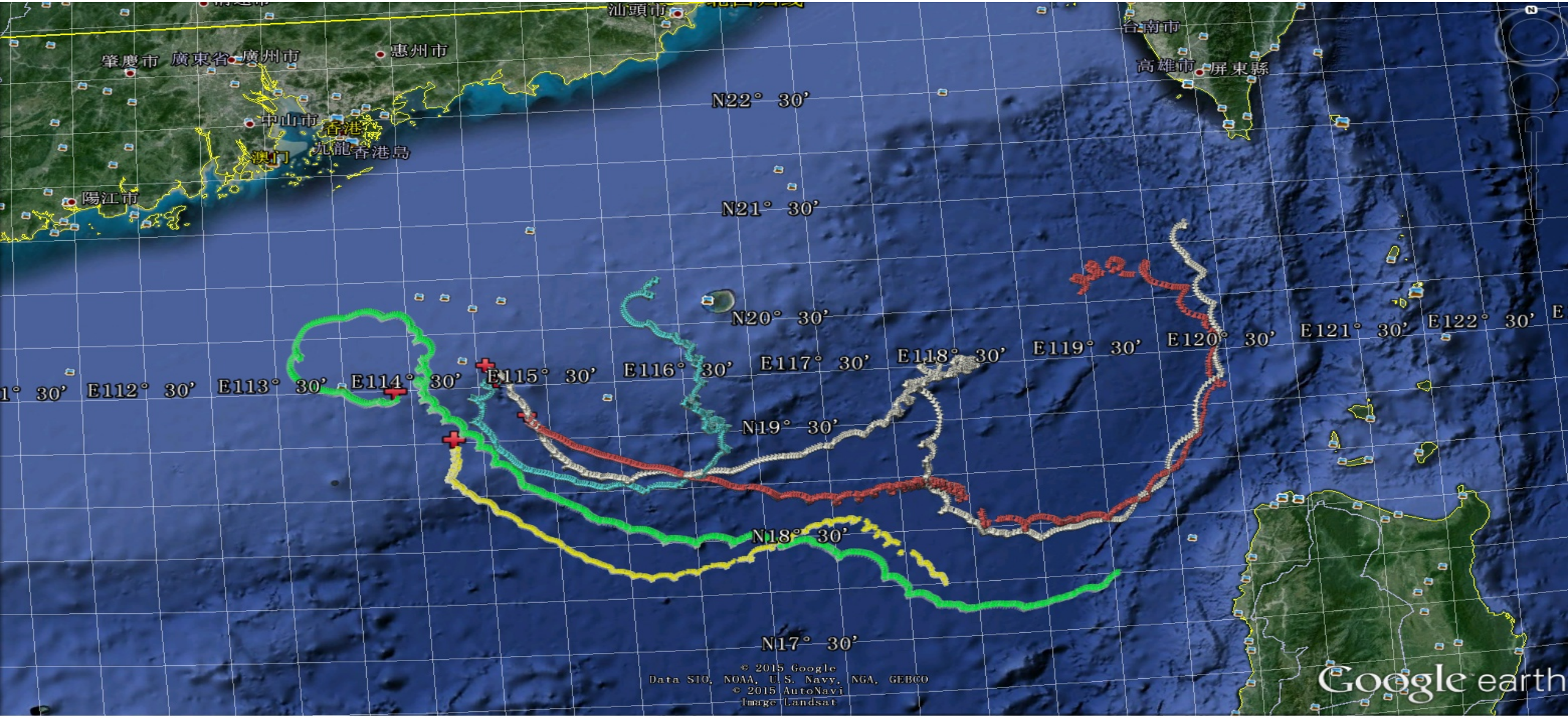


973 CTD站位和2013～2016年锚系站位置，黑色十字是973项目2015～2017年CTD站位；蓝色圆形：2014～2015年捕获器和海流计锚系站；红色圆形：2014～2015年ADCP锚系站；方形为“Luzon Strait”2009～2011年ADCP锚系站；红色菱形为973项目2015～2016～2017～2018～2019年ADCP锚系站。`

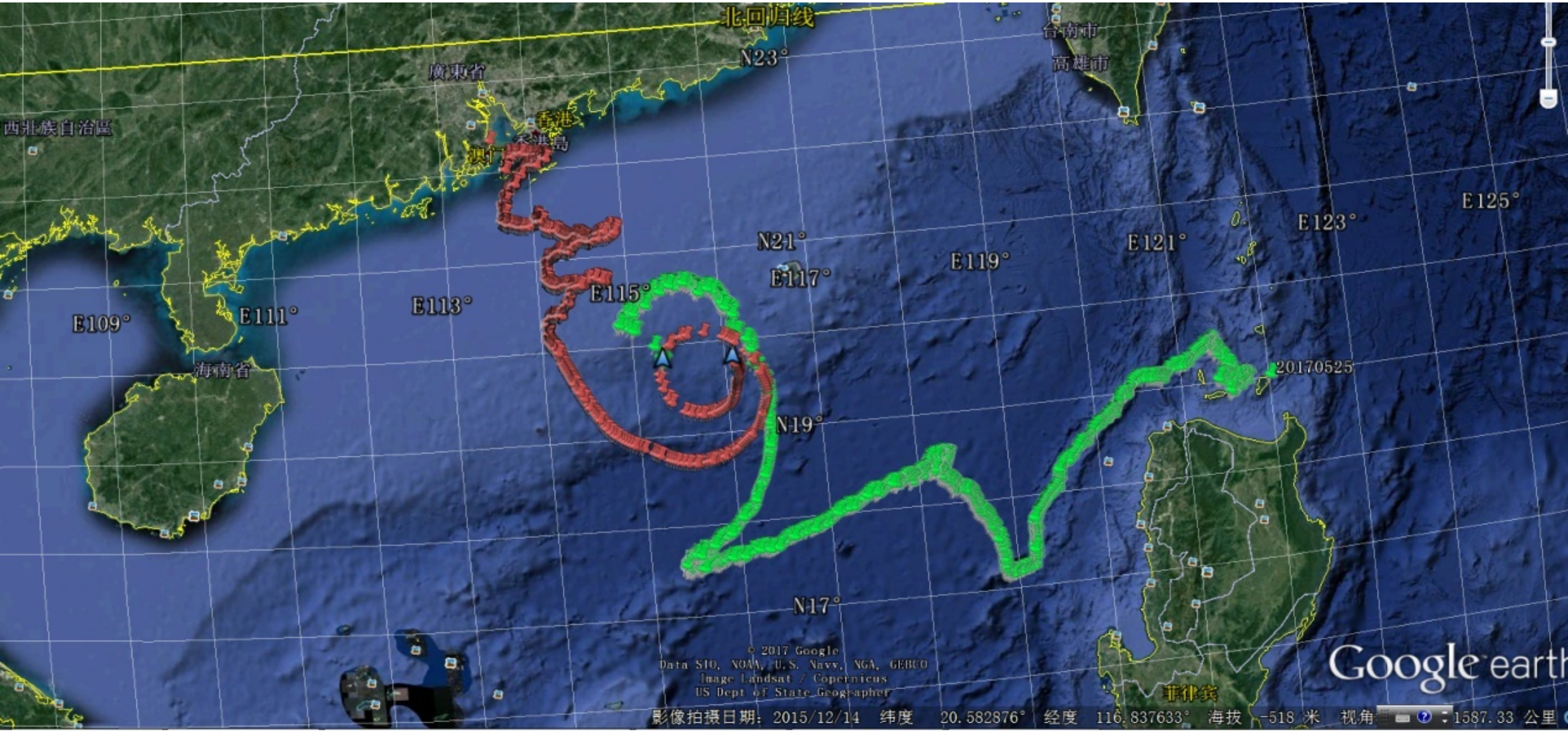
Drifter trajectory of Oct. 2014； Southwesterly current dominated

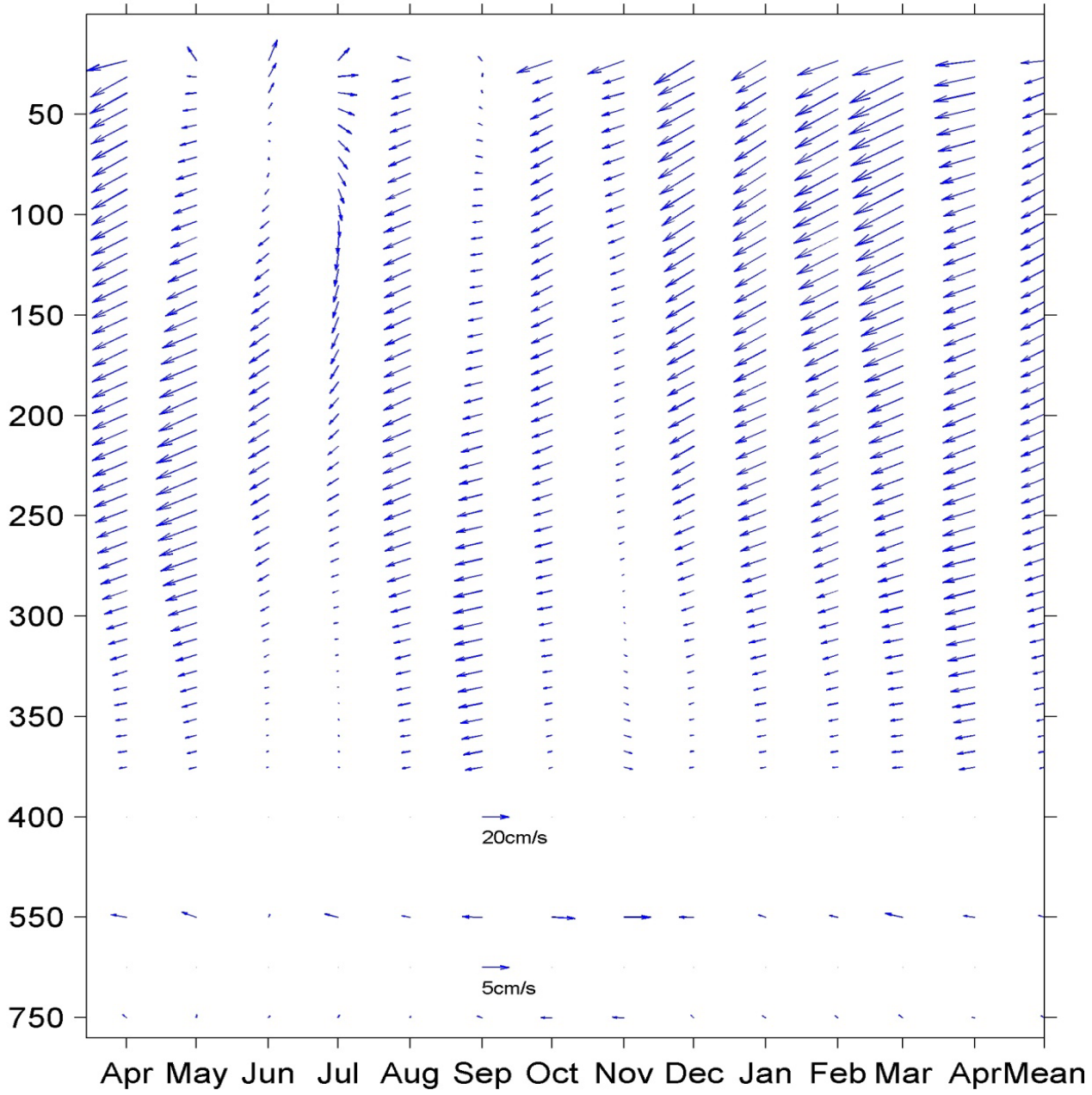


Drifter trajectory of Jun 2015. cross-shelf transport happen for the eddy-pair



Drifter trajectory of Mar –June 2017 Eddy.





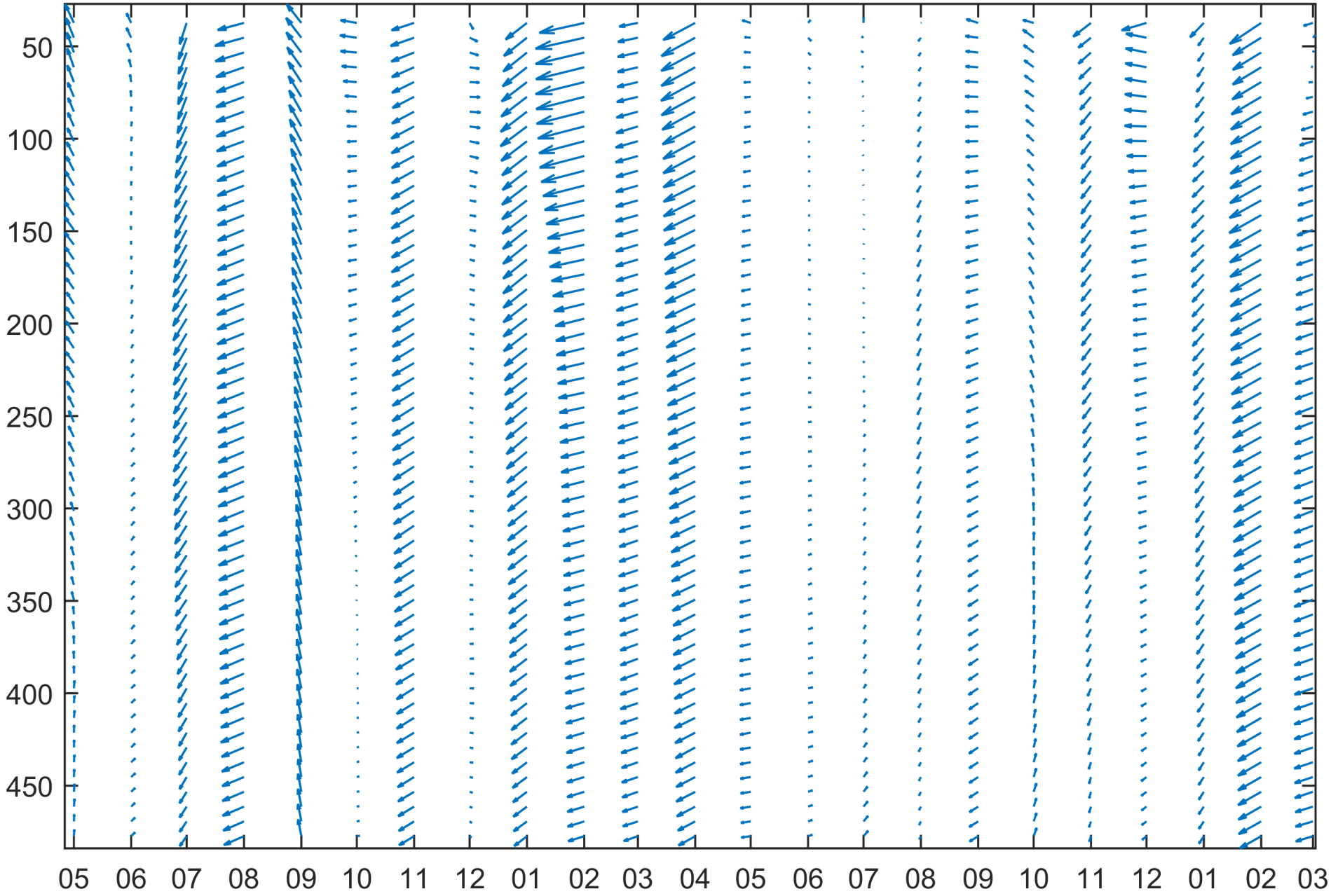
Vertical mean

- Annual mean current is westward in the whole-profile, especially in the upper 400m layer.
- Eastward currents just occur only above 100m layer in June and July.
- Baroclinic effect is obvious.
- Cross-shelf intrusion maybe strong。

2014 - 2015

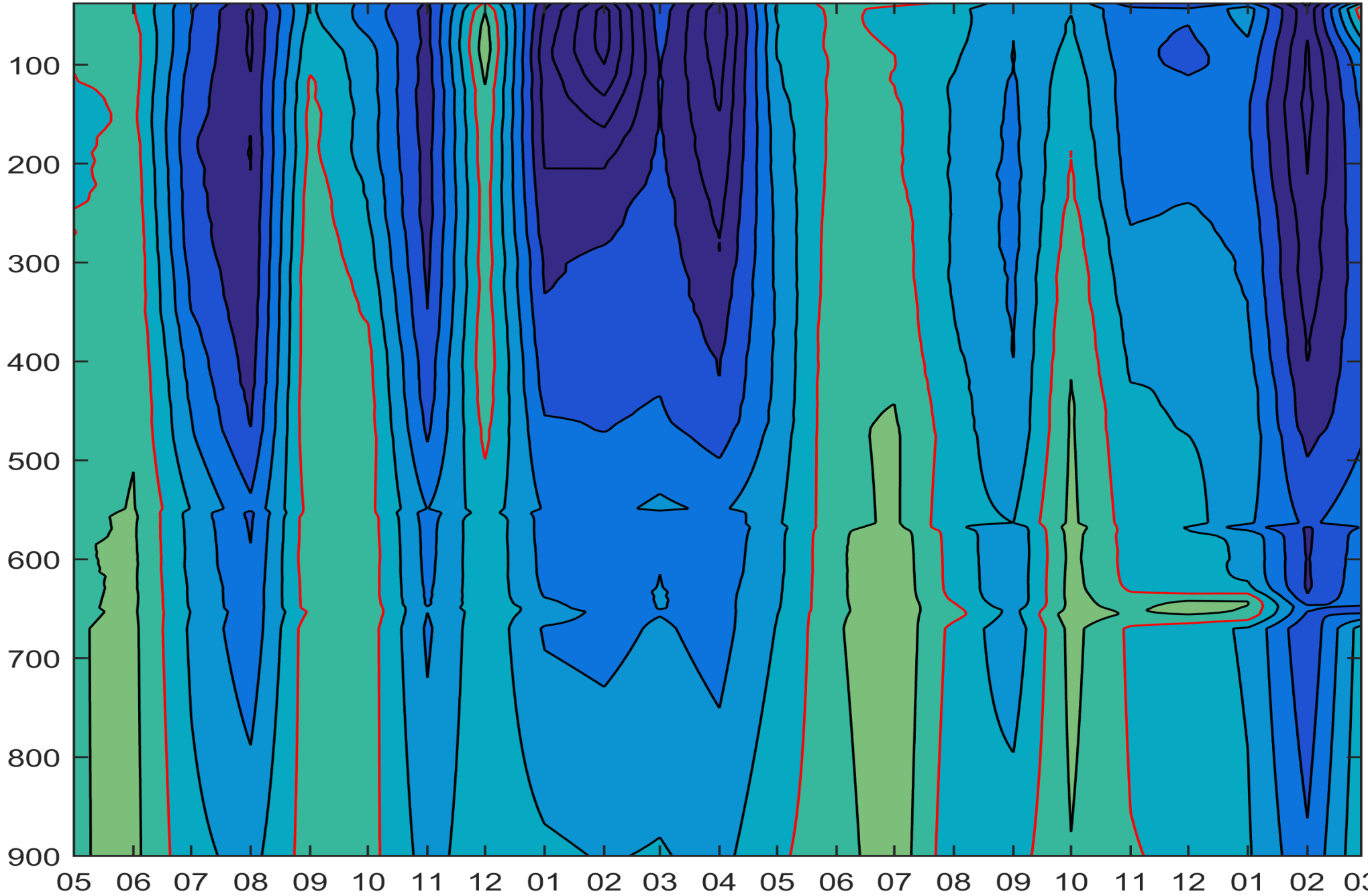
2015-2017

current vector

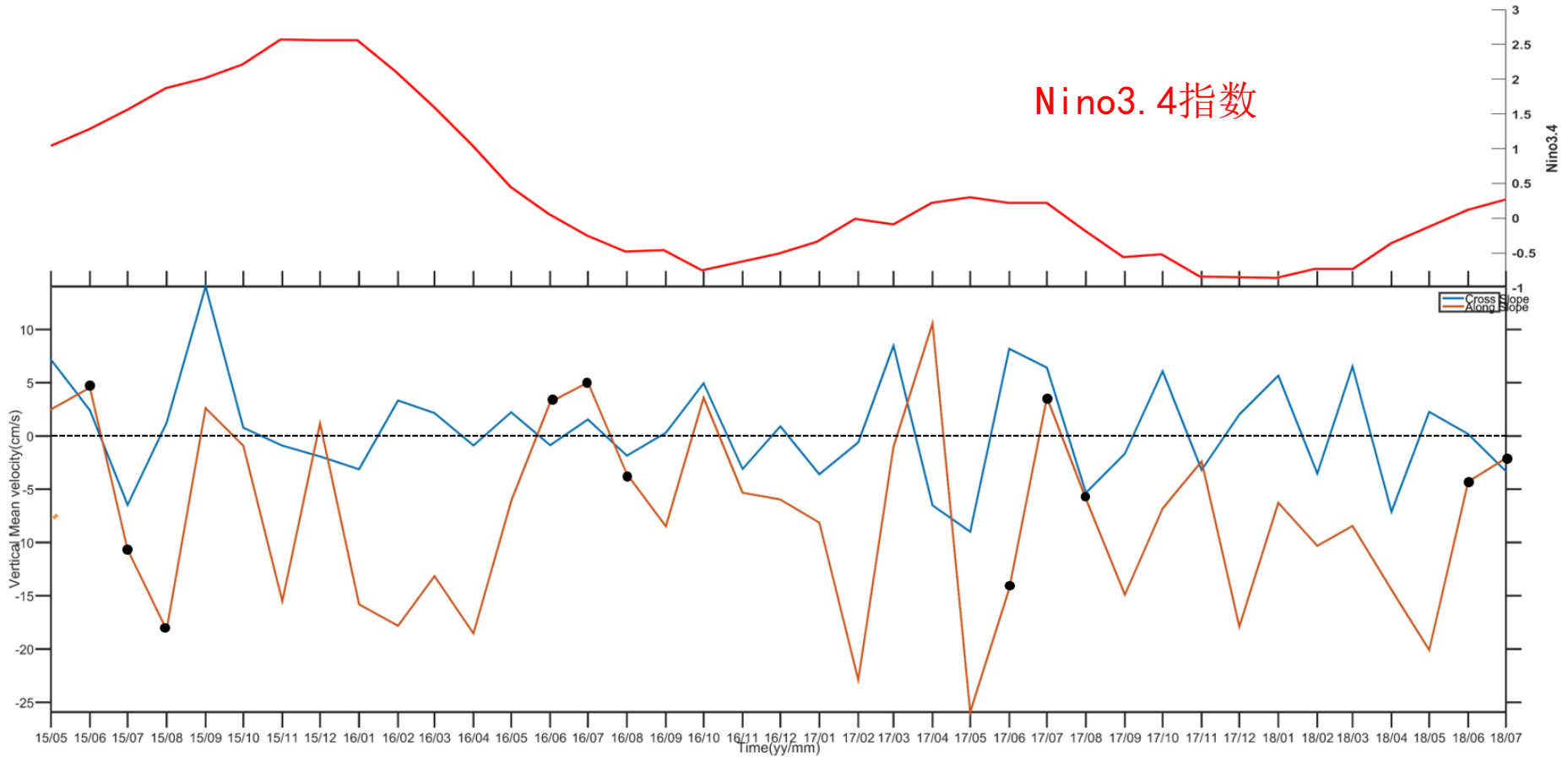


2015-2017

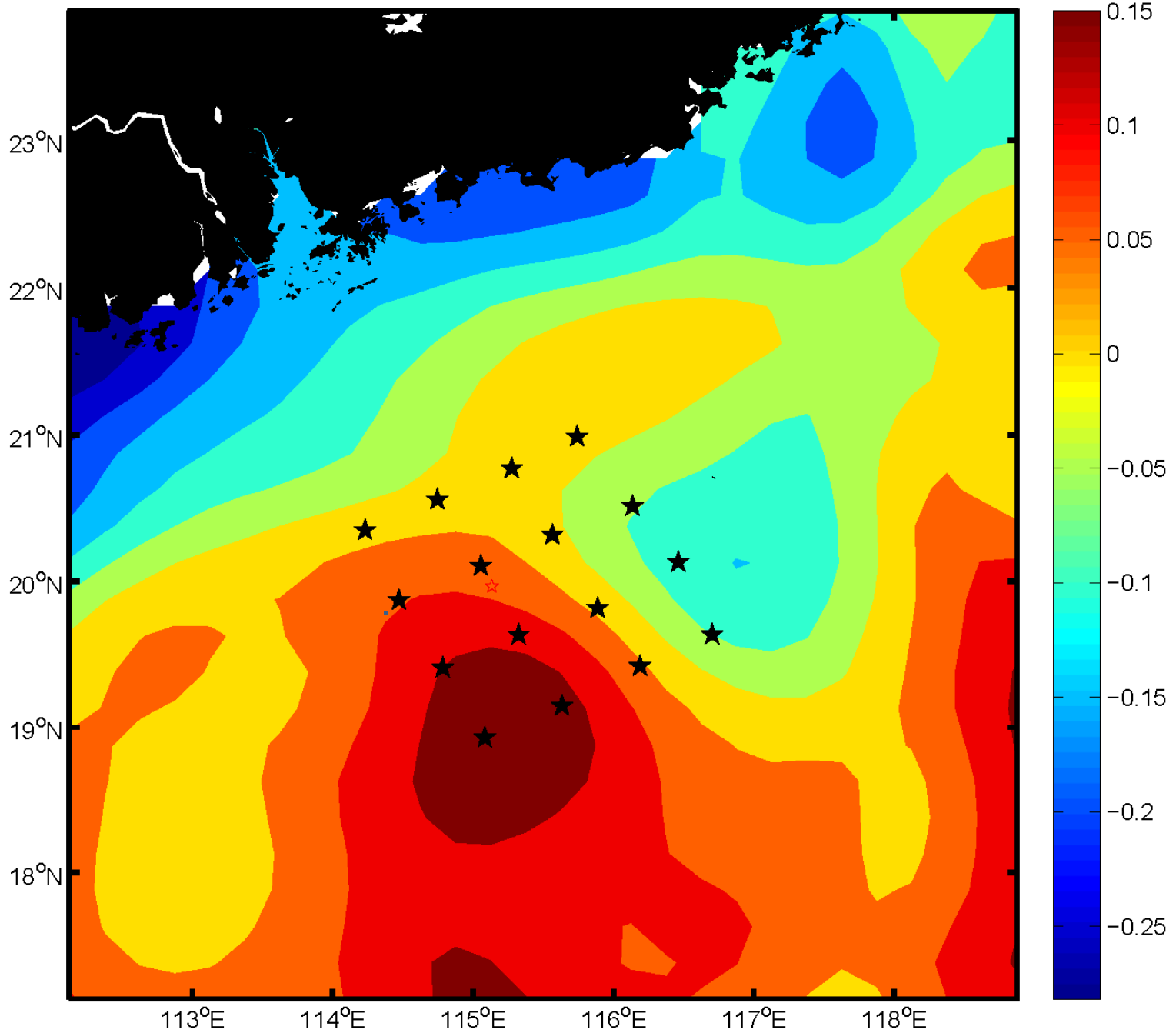
along-slope current



Nino3.4 Index & 2015~2018 monthly mean Velocity



Along-slope -7.4±8.8 cm/s，年平均为西南向海流，冬季强于夏季，夏季为负。
Cross-slope 0.6±4.9 cm/s，More variable than that of along-slope component （Xu Dongfeng， 2019）

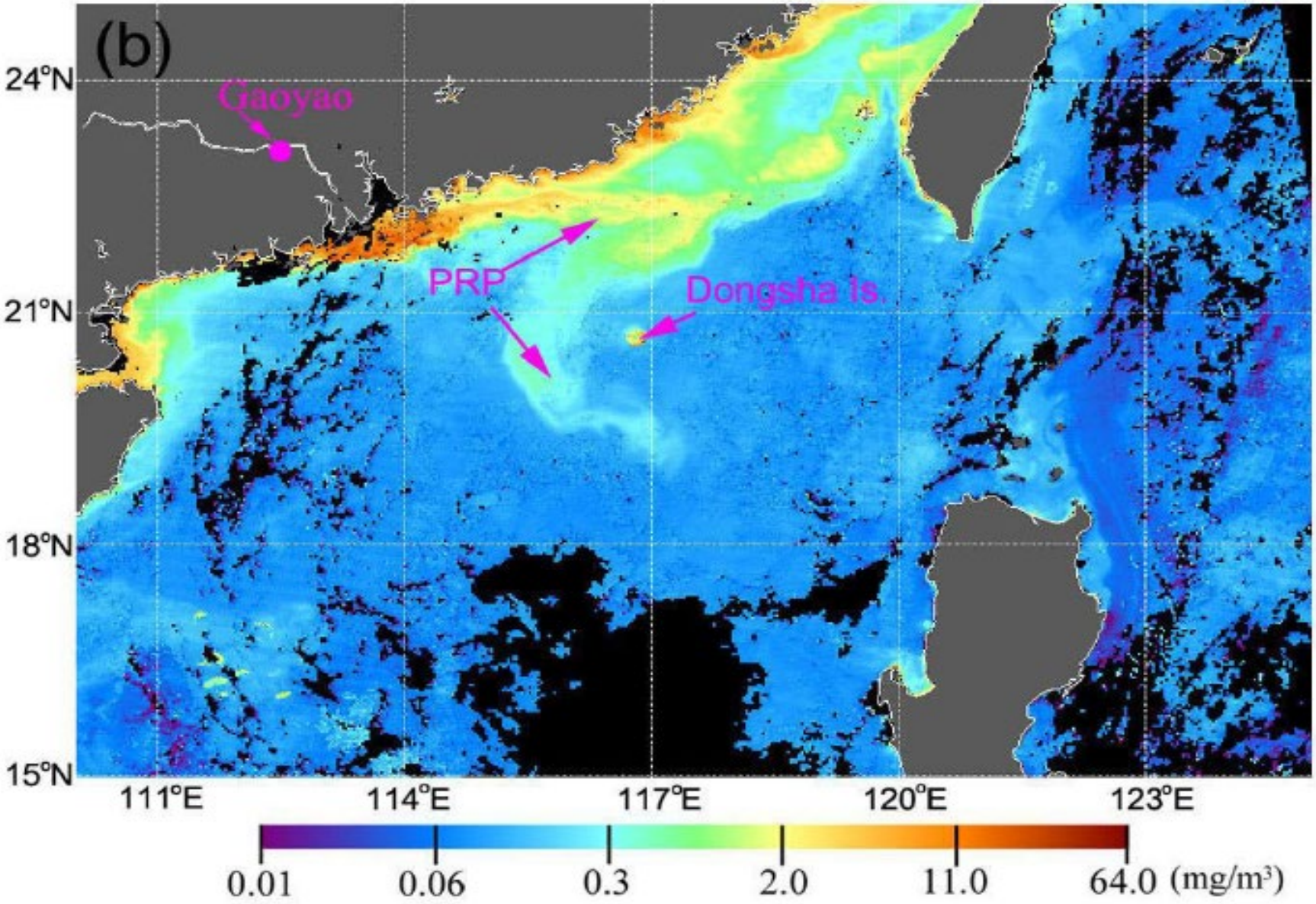


2015 June
SSHA
Eddy pair

1 year
Mooring Stn

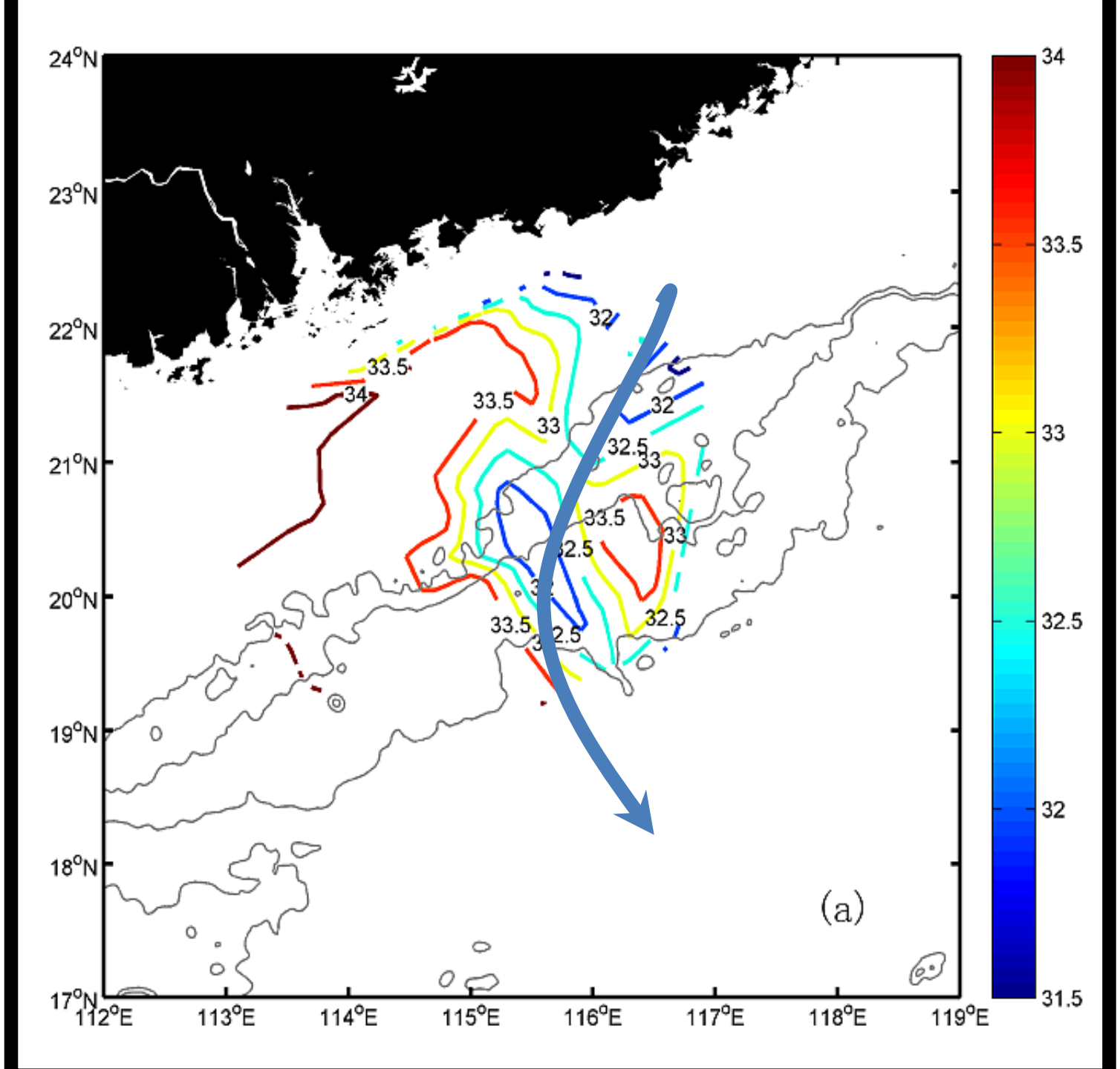
15 day
Mooring Stn

a rare large phytoplankton bloom, which is ~500 km long, 100 km wide and lasting more than 19 day. SSS



Satellite Chla images from MODIS Ocean color of June 17 2015

He X.Q., **D.F.Xu**, Y. Bai et al., Eddy-entrained Pearl River plume into the oligotrophic basin of the South China Sea, Continental Shelf Research, 2016.



Salinity at 5m depth
32 psu line reaches 19.5N

Diel Vertical Migration of zooplankton and micronekton by Moored ADCP

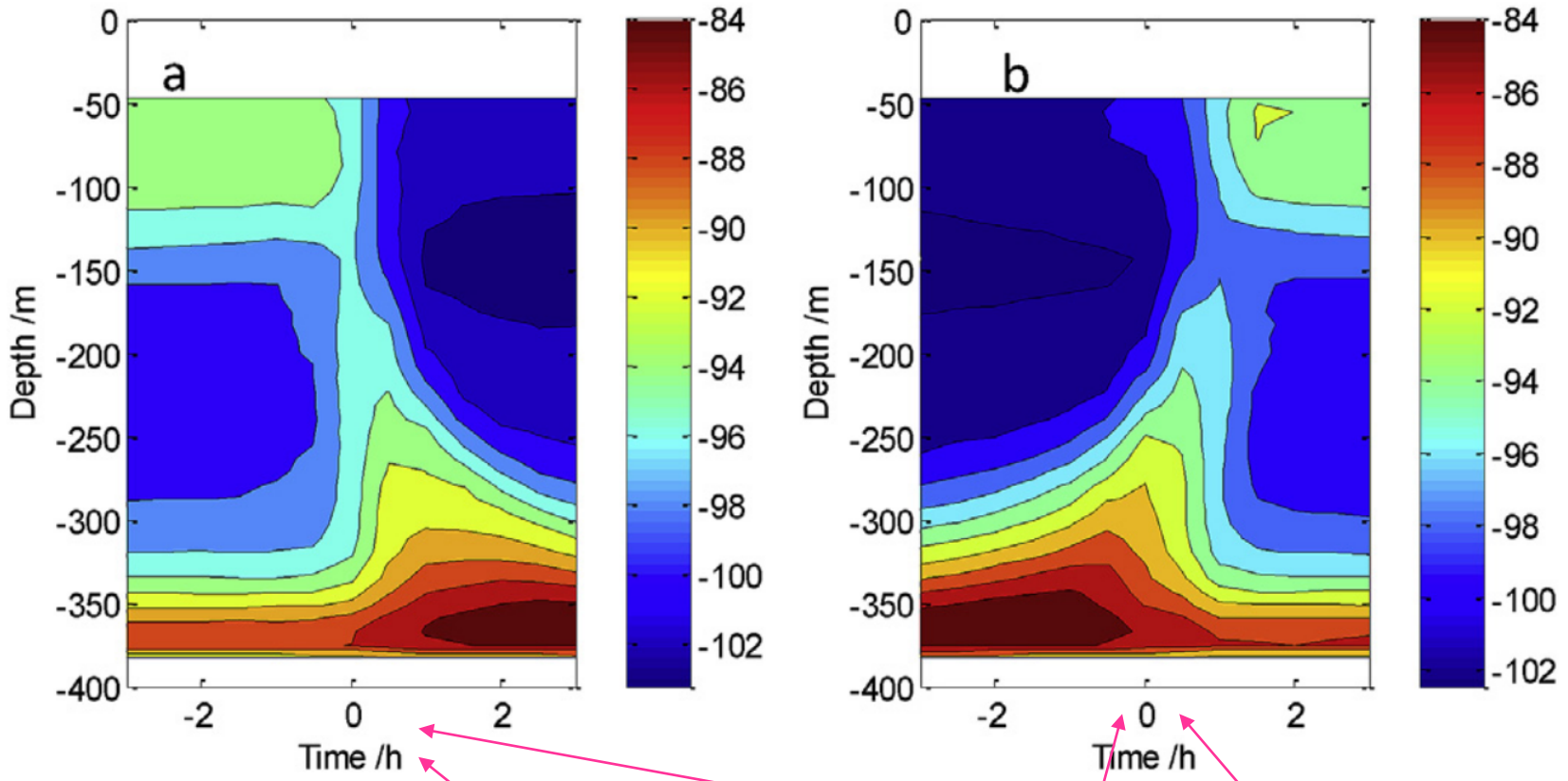
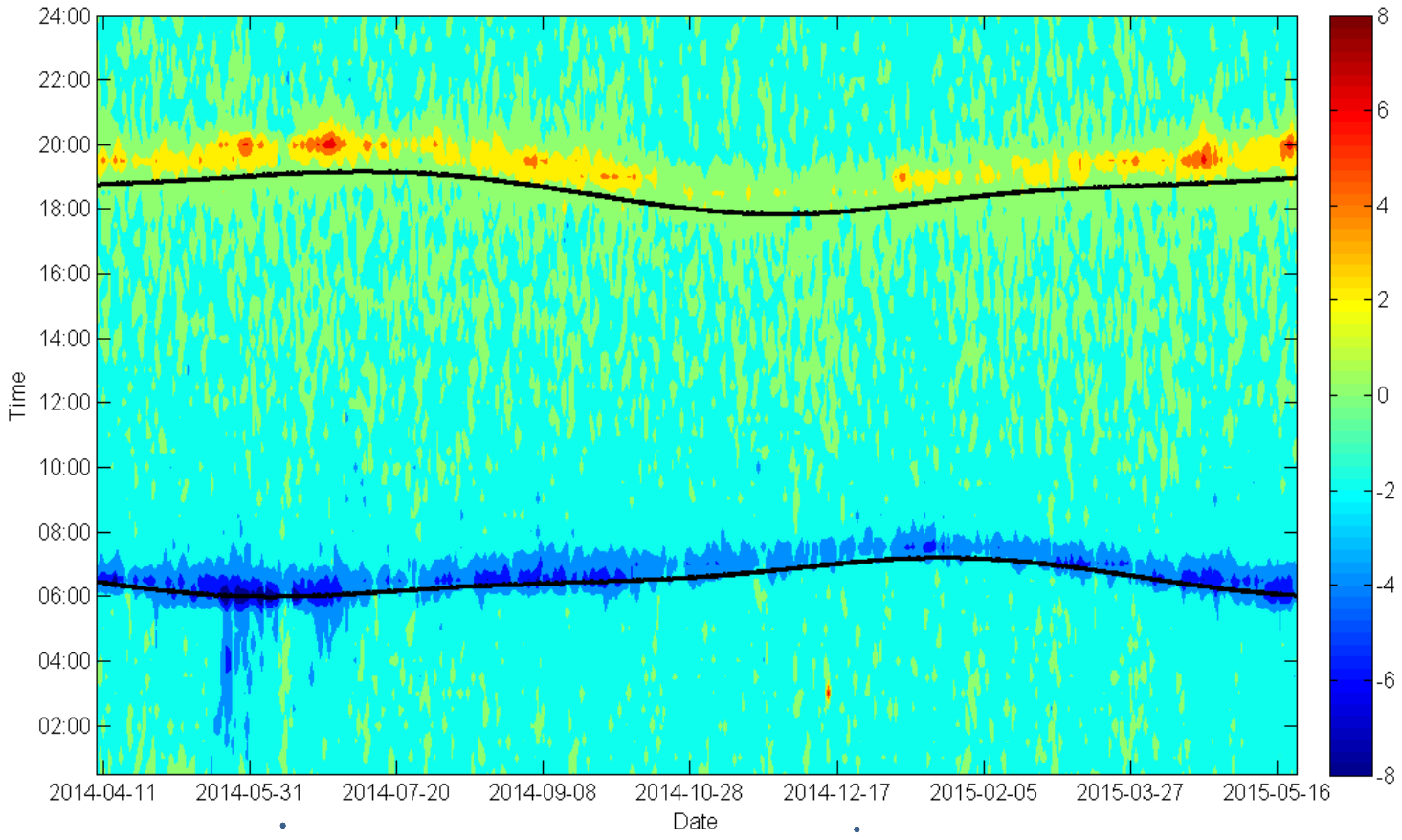


Fig. 4. Vertical distributions of mean MVBS at dawn and dusk, respectively. Zero time indicates the sunrise time (a) and the sunset time (b). High value of MVBS (warm color) is proportional to high level of biomass, while low value is related to low level of biomass. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

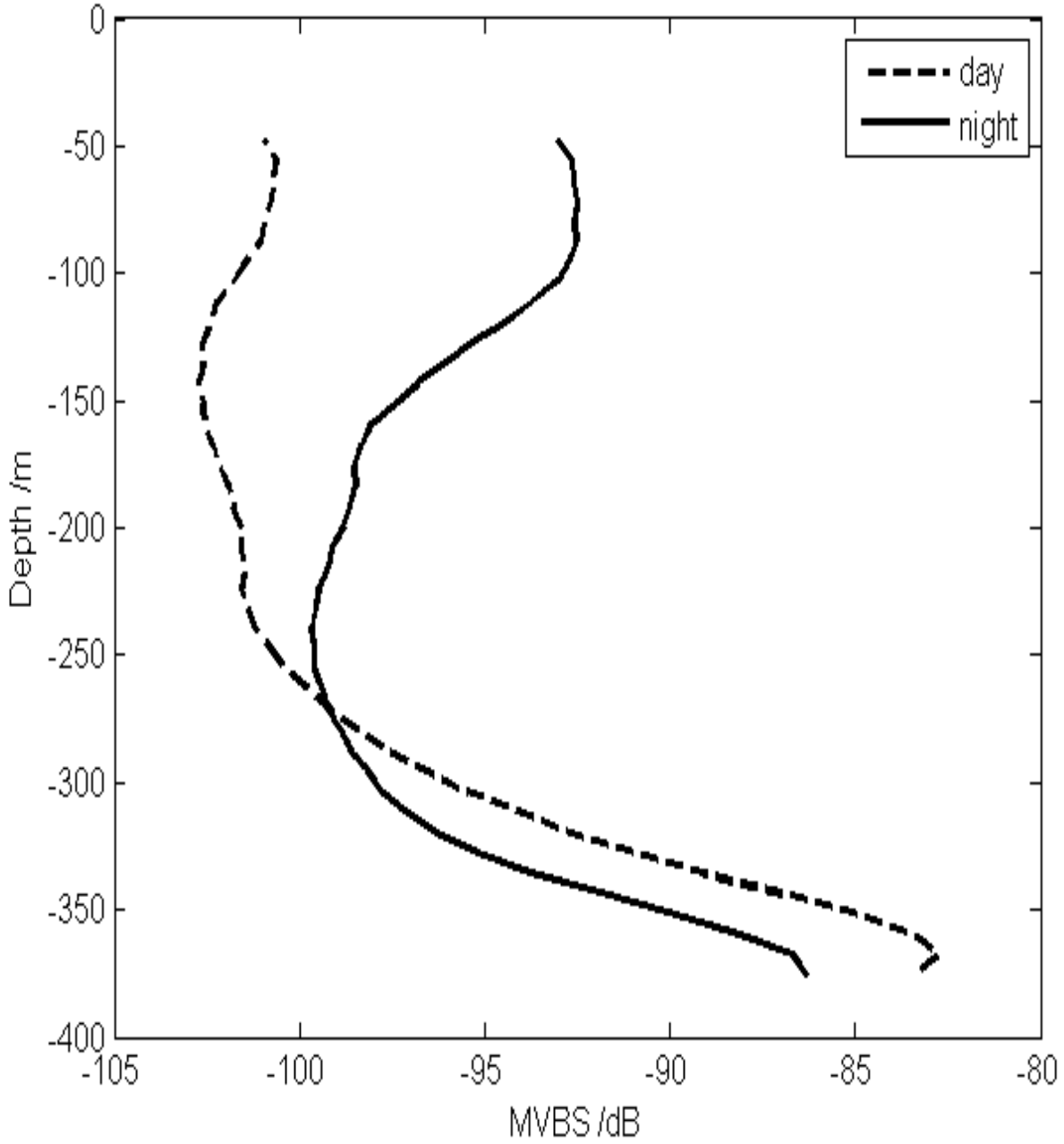


DVM of zooplankton and micronekton below the 200 m layer observed by the upward-looking ADCP.

Descent speed (cool color) occurs around the sunrise time (black line on the bottom half), and upward migration (warm color) occurs after the sunset time (black line on the top half), peaks one hour later.

Mean descend speed (-3.7cm/s)

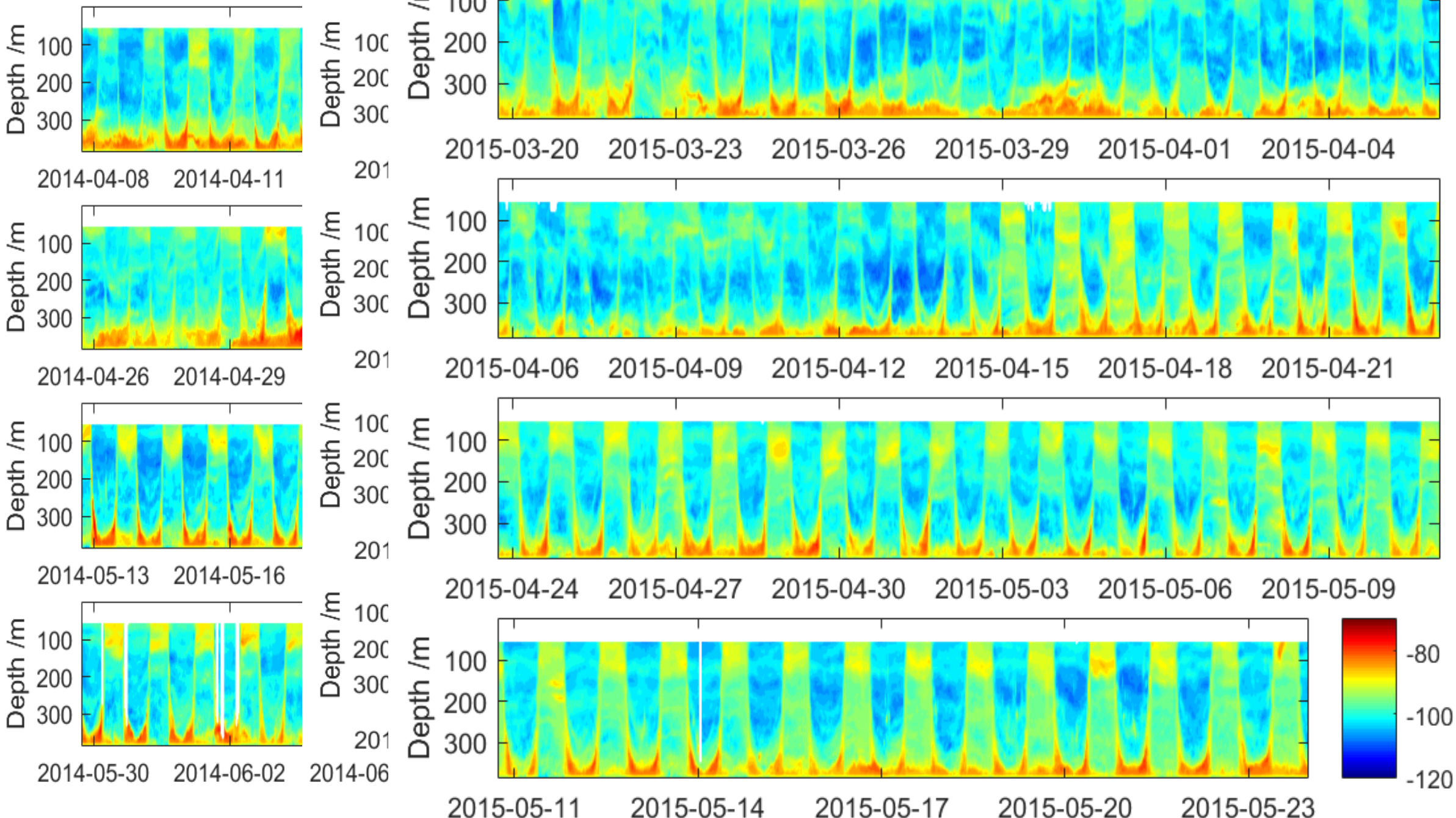
Mean ascend speed (2.6cm/s)

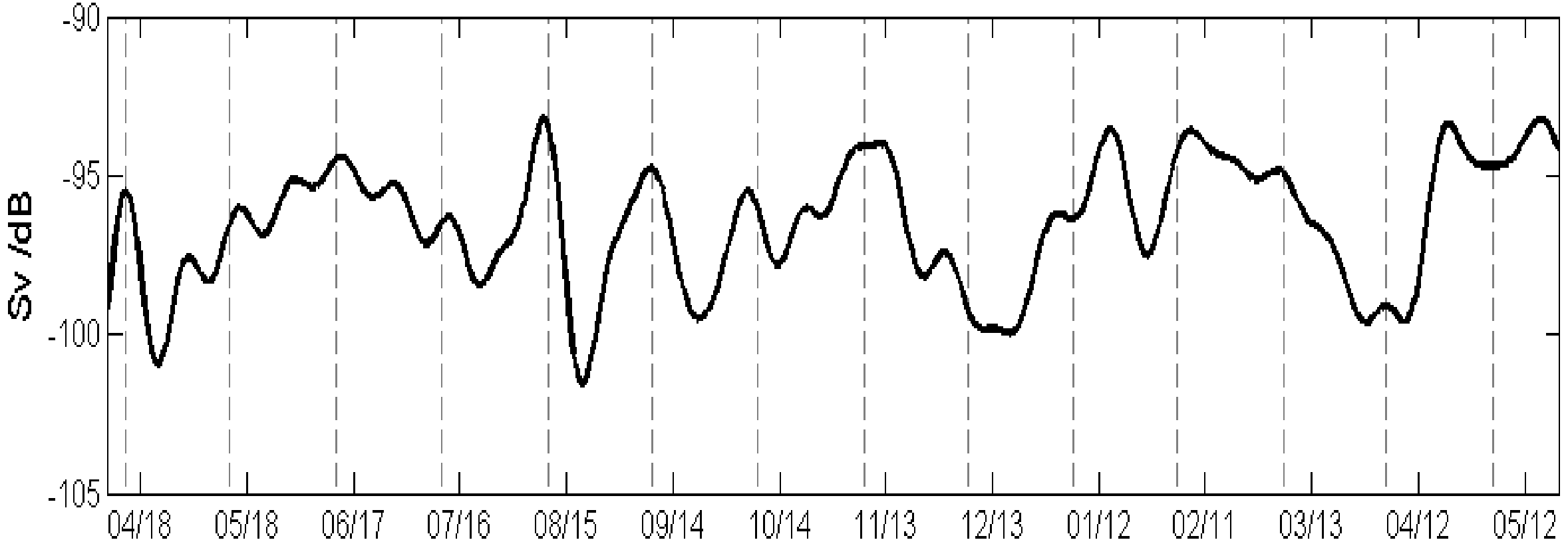


Profile-mean MVBS during daytime (dashed line, between 2 hours after sunrise and 2 hours before sunset) and nighttime (solid time, between 3 hours after sunset and 2 hours before sunrise)

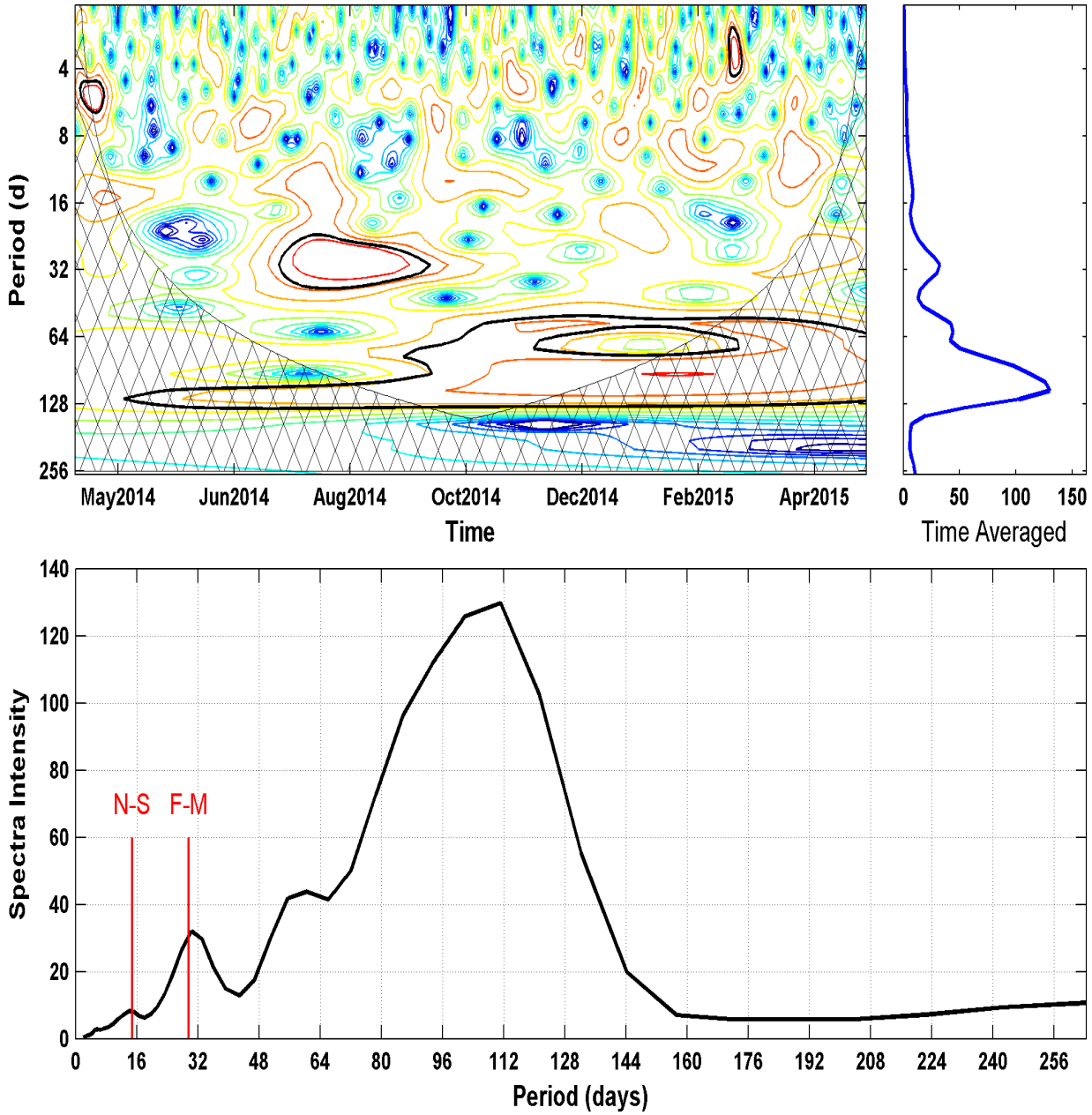
MVBS:mean volume backscattering strength

Zooplankton， micronekton （75





Time series of mean MVBS above 270m at night, and dashed vertical lines indicate dates of full moon

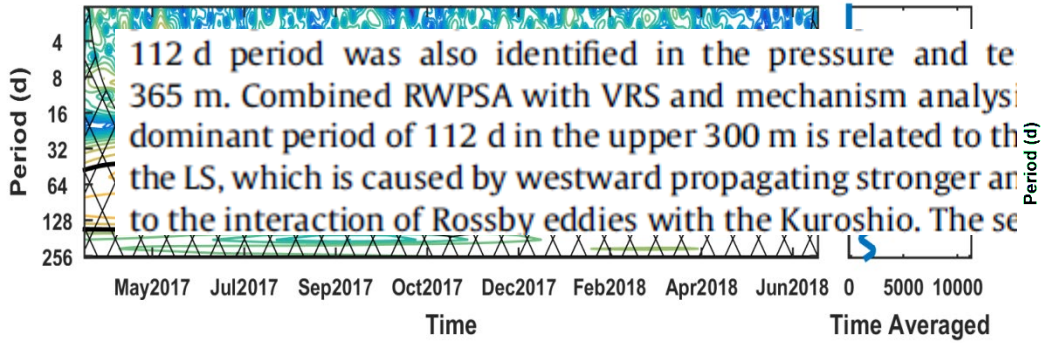


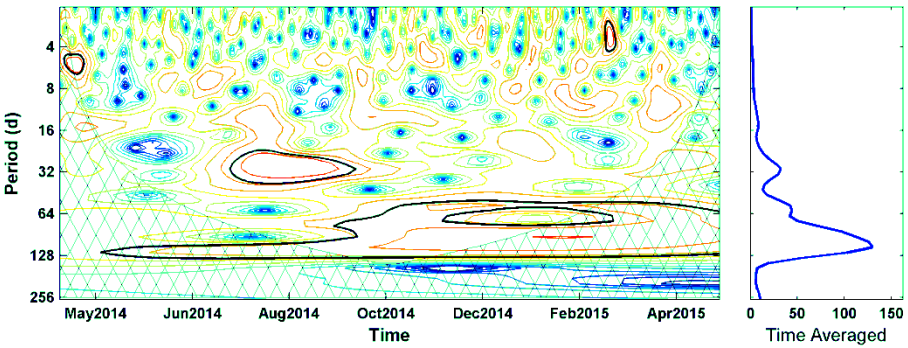
Top row: rectified wavelet power spectra (left column) and time-averaged rectified wavelet power spectra in base 2 logarithm (right column) for profile-mean MVBS time series above 270m at night from the echo intensity of ADCP at the mooring station. Red and blue contours indicate high and low wavelet power spectrum values, respectively. The regions of greater than 95% confidence are shown with thick black contours. Cross-hatched regions indicate the 'cone of influence', where edge effects become important.

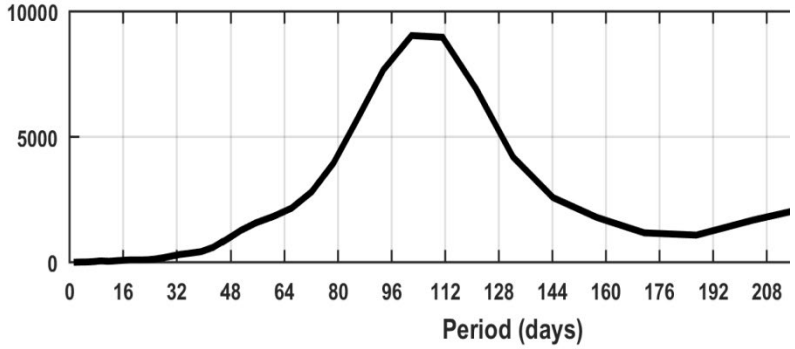
Bottom: time-averaged rectified wavelet power spectra (not log-transformed) for profile-mean MVBS time series above 270m at night .

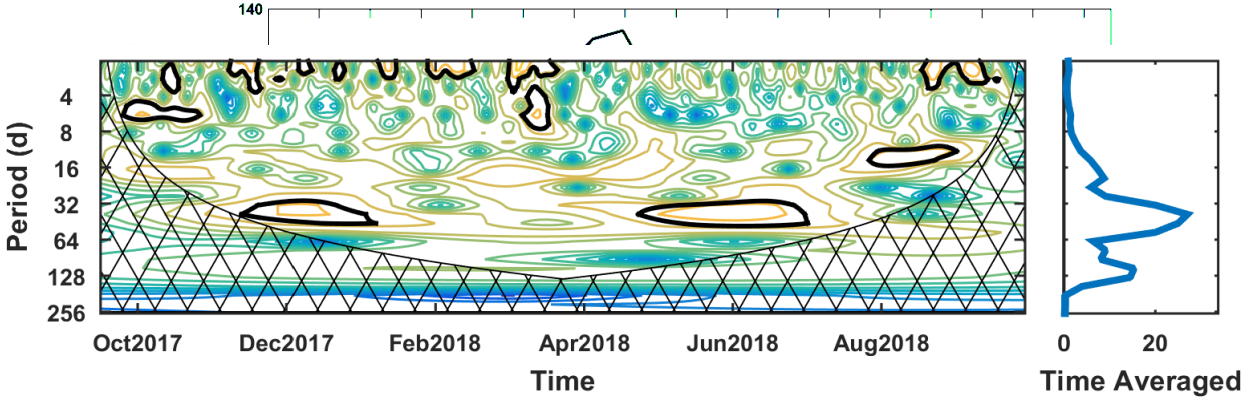
海流变化以及对生物影响 Variation in current & DVM

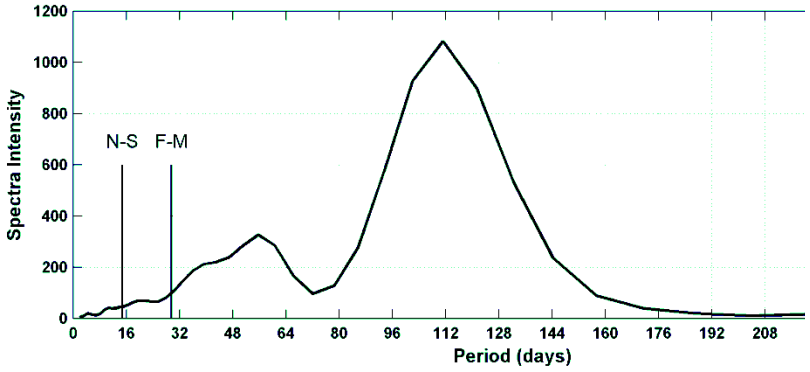
MVBS ,current spectral (973 、LZ strait，NE HaiNan、NW Pacific SM 海山+DVM)

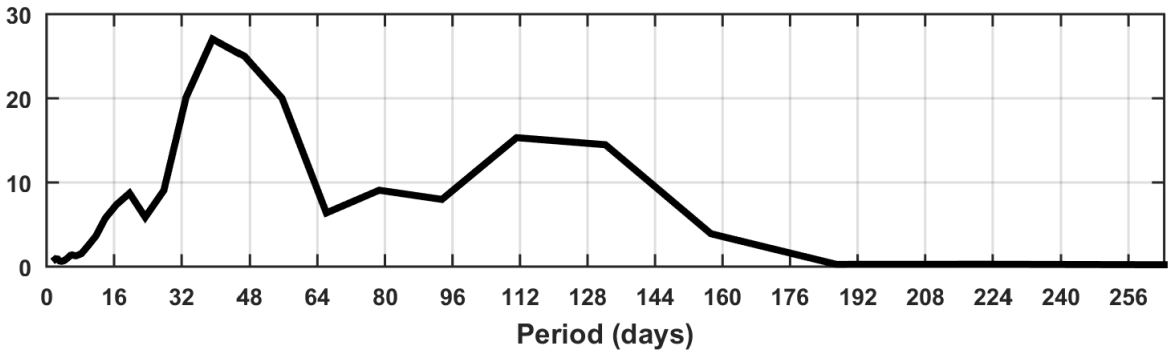




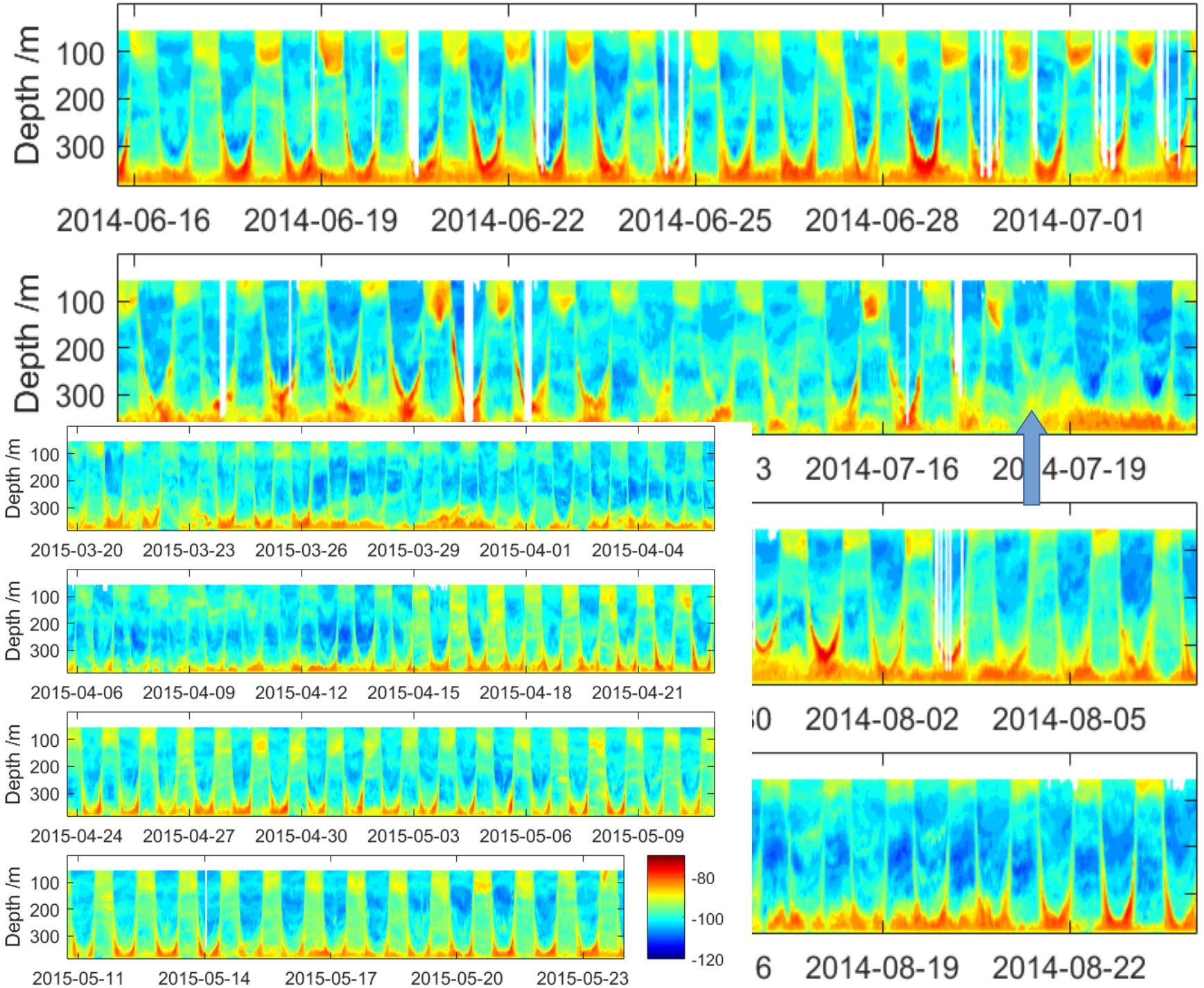








Yuan ,Yang CH et al. Prog. in Oceangr. 2017 ， Yang CH DF XU et al DSR II 2019 .



DVM 2014-2015

Name or ID	Time (in UTC)	Distance (n mile)	MSW* (ms^{-1})	Pressure (hPa)
Rammasun	2014071800	51.5	**65**	**900**
TC-0017	2014090712	48.0	**15**	**1000**
Kalmaegi	2014091600	69.3	**42**	**960**

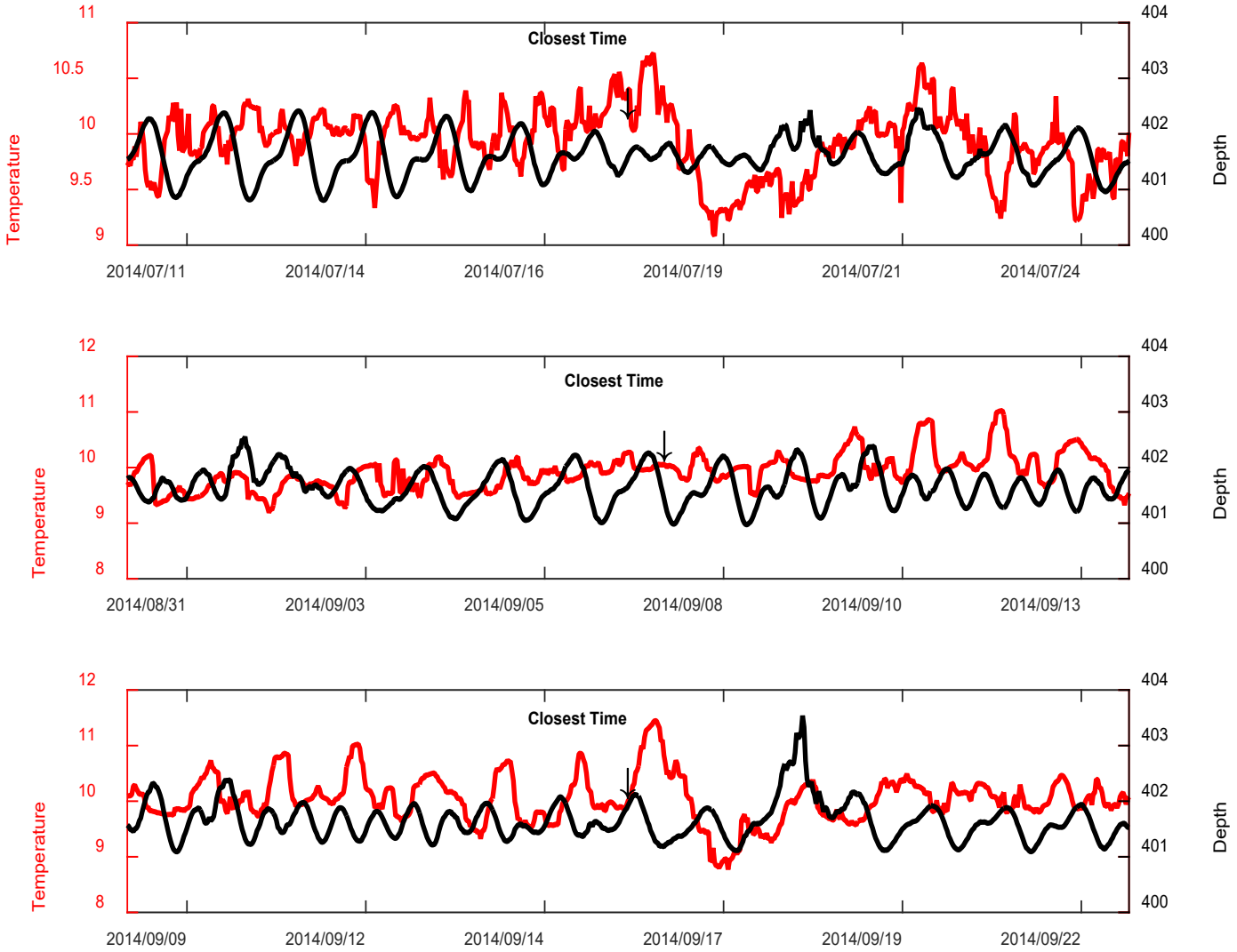


Fig. 11. Temperature time series (red lines) and depth time series (black lines) recorded by a CTD, which was fixed to the appropriate floating ball of the ADCP, when the tropical cyclones, Rammasun (a), tropical depression (b), and Kalmaegi (c) passed by the mooring site. The down-arrows are the times the three cyclones were closest to the mooring station.

(Warming ---Cooling 2 degree at 402m inertial oscillation)

Yang C H， **D.F.Xu*** et al.， Diel Vertical Migration of live zooplankton and micronekton in the slope of northern South China Sea using a mooring ADCP. **Deep Sea Research II** ,2019

Conclusion

1. From the 3 years ADCP observation, the velocity of along slope component is -7.4±8.8 cm/s. while the across slope component is 0.6±4.9 cm/s, which is more variable than the former.
2. DVM occurs throughout the year, with the maximum migrating speed reaching 9.0 cm s^{-1}.
3. Neap-spring tidal cycle and full moon phase influences are prominent, and the peak at 112d may be driven by current variations.
4. Super and severe typhoons reduced the vertical migration, had less influence in the deep scattering layer.

Paper

1. Yang C, **Xu D F***, Chen Z, et al. Diel vertical migration of zooplankton and micronekton on the northern slope of the South China Sea observed by a moored ADCP[J]. Deep Sea Research Part II: Topical Studies in Oceanography, 2019.
2. Liu J, Dai J, **D.F Xu**, et al. Seasonal and Interannual Variability in Coastal Circulations in the Northern South China Sea[J]. **Water**, 2018, 10(4): 520.
3. He X, **Xu D.F.**, Bai Y, et al. Eddy-entrained Pearl River plume into the oligotrophic basin of the South China Sea[J]. **Continental Shelf Research**, 2016, 124: 117-124.

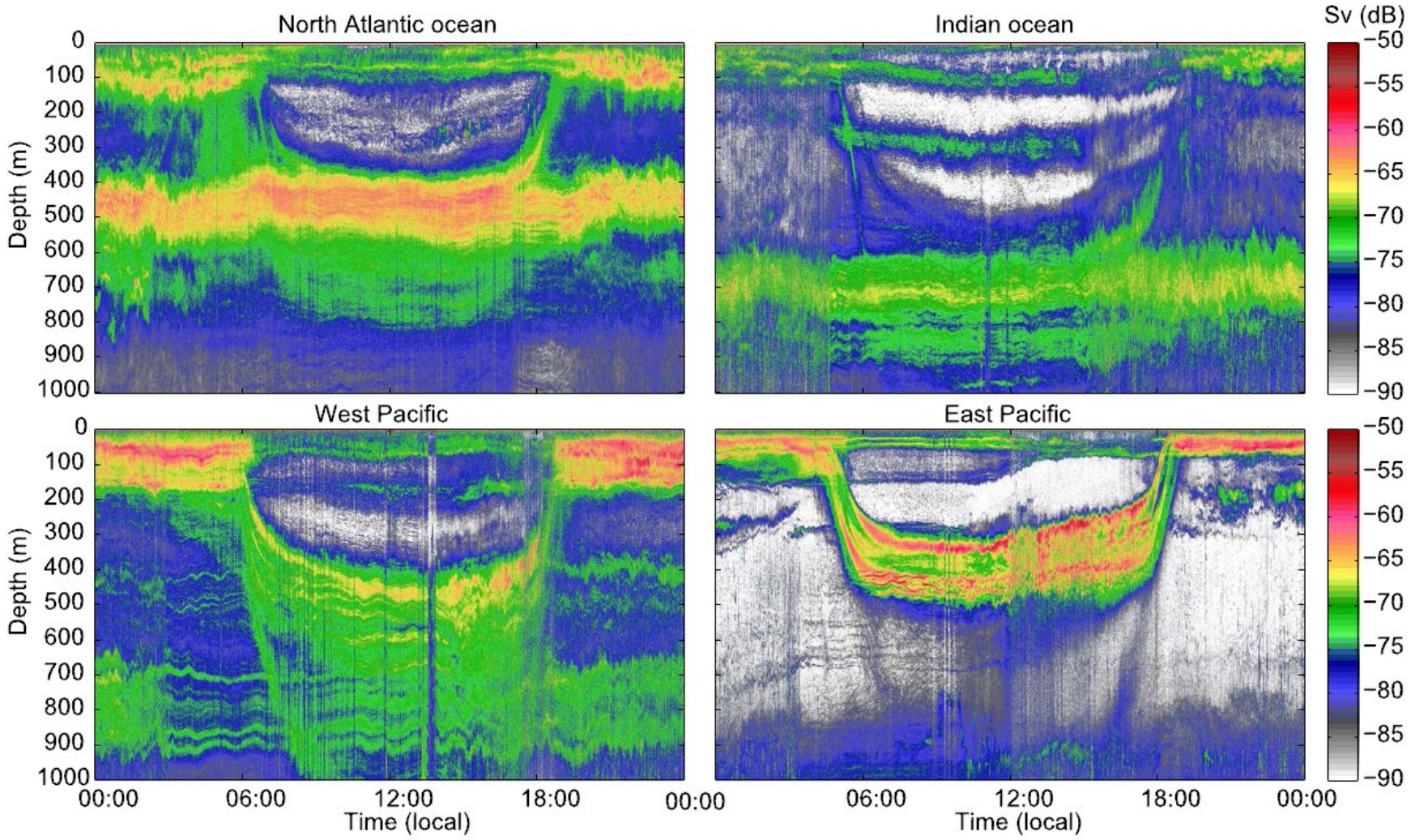
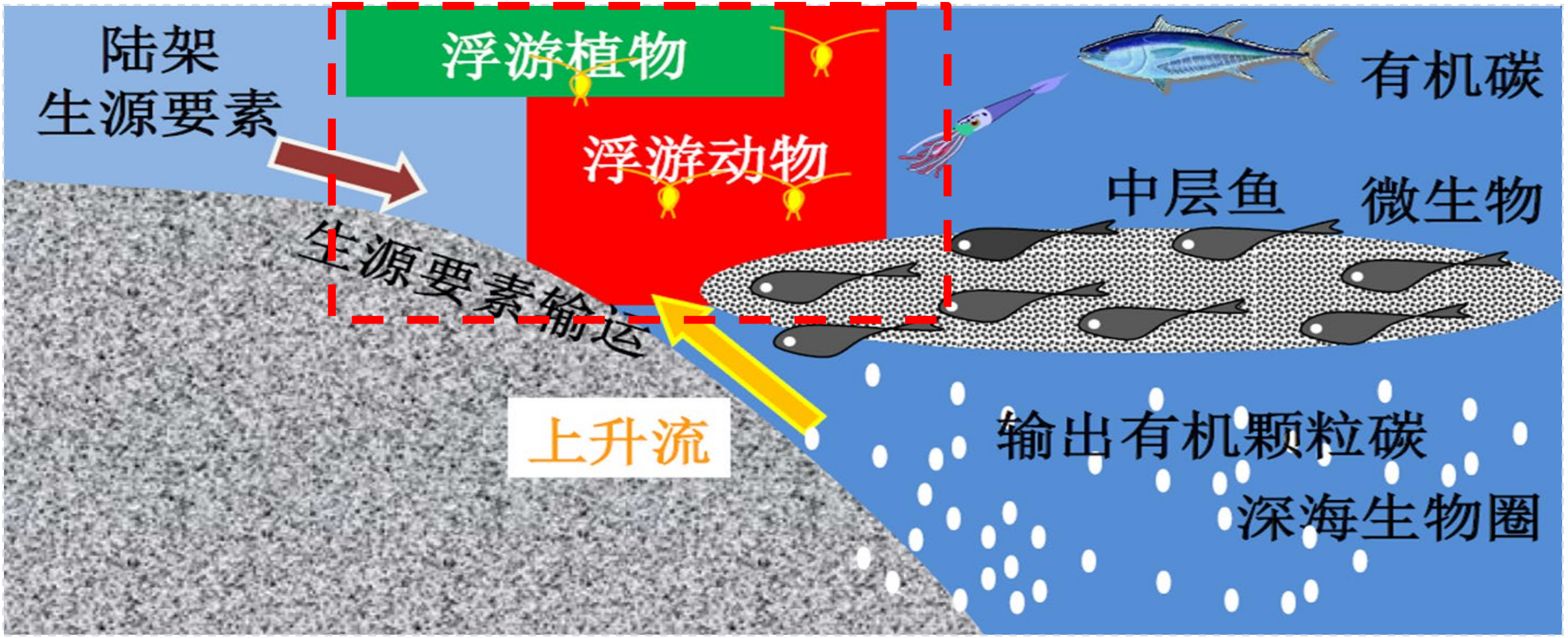


Figure 1. Echograms. Examples of echograms at 38 kHz, spanning 24 hour periods, from different geographic regions, clockwise from upper left: North Atlantic ocean, Indian ocean, East Pacific, West Pacific. Lower threshold is −90 dB.

Klevjer et al Scientific **Reports**， 2016

西太： 深，东太：浅、强； 北大西洋：强； 东印：弱、深

课题背景和总体思路



Group 1: Physical Process in slope

2014CB441501

SIO/MNR,IOCAS,HKUST

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