Form 3

Annual Report

LaMer, Ehime University

Date (25, 2, 2017)

To Director of LaMer

Principle Investigator:
Affiliation Second Institute of Oceanography, SOA
Position Postgraduate Student
Name in print Menghong Dong

Include the report on the result of the project/meeting in a separate sheet.

1. Project / Meeting title

Mapping of tidal and residual currents in the Qiongzhou Strait

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
PI Menghong Dong	Second Institute of Oceanography, SOA	Postgraduate Student	Data processing
Members Xiao-Hua Zhu	Second Institute of Oceanography, SOA	Senior Research Scientist	Beneficial discussion
LaMer Faculty member in charge Xinyu Guo	Ehime University	Professor	Beneficial discussion

3 Contents (separate sheets)

Title

Mapping of tidal and residual currents in the Qiongzhou Strait

Members' names and affiliations

Name	Institution and Department	Employment position	E-mail
Zhu Xiao-Hua	Second Institute of Oceanography, SOA	Senior Research Scientist	xhzhu@sio.org.cn
Xinyu Guo	Faculty member of LaMer	Professor	guoxinyu@sci.ehime-u.ac.jp

Aim

This project aims to carry out a cooperative research with Prof. Guo Xinyu of Ehime University on the tidal and residual current structures in the Qiongzhou Strait and the formation mechanism of residual current by synchronous observation data.

Procedure

The principal investigator (PI) has first made an oral presentation "Tidal currents and Kuroshio transport variations in the Tokara Strait estimated from ferryboat ADCP data" and showed the recent studies of PI including: 1. The spatial distribution of major tidal currents in the Tokara Strait. 2. The Kuroshio volume transport time series in the Tokara Strait at a high spatiotemporal resolution.

The PI will carry out further research with Prof. Guo Xinyu on the following subjects: 1. The variability of residual current estimated by shipboard ADCP data in the Qiongzhou Strait. 2. The cause of the change in the residual current between different seasons. 3. Use an ocean model or some numerical experiments to understand the formation mechanism of the residual current.

Results

The Qiongzhou Strait (QS) is a key channel connecting the northern part of the South China Sea and the Beibu Gulf (Gulf of Tonkin). Zhu et al. [2014] reported the spatial structure of the tidal current (including its major tidal constituents and residual current across the whole strait) in winter using synchronous data. To provide these important data in different season, we carried out 59 repeat shipboard Acoustic Doppler Current Profile (ADCP) surveys to measure the tidal current through the QS in summer (from 6 July to 26 July 2014). The vector plots of depth-averaged current velocity obtained by this shipboard ADCP data are shown in Figure 1. The ADCP data show only a small change in current direction in each section among the 59 cruises.

The tidal ellipse of the five major tidal constituents (K1, O1, M2, S2 and MSf) and the residual current (Figure 2) were estimated from the ADCP raw data by tidal harmonic analysis. The diurnal tidal current is dominated in the strait and the vertical distribution of the O1 and K1 tidal constituents show a uniform structure over the across section. The amplitude of the five major tidal constituents in summer is larger than that estimated from the measurement data obtained in winter time. Likewise, the residual current shows a different vertical structure between summer and winter. However the salinity distribution across the strait (Figure 3) shows a similar structure with that of the residual current. We consider that the difference of the tidal current and residual current between different seasons may be caused by the presence of stratification in the strait that is obvious in summer time, but disappears in winter time.

References:

1. Zhu, X.-H., Y.-L. Ma, X. Guo, X. Fan, Y. Long, Y. Yuan, J.-L. Xuan, and D.

Huang (2014), Tidal and residual currents in the Qiongzhou Strait estimated from shipboard ADCP data using a modified tidal harmonic analysis method, J. Geophys. Res.

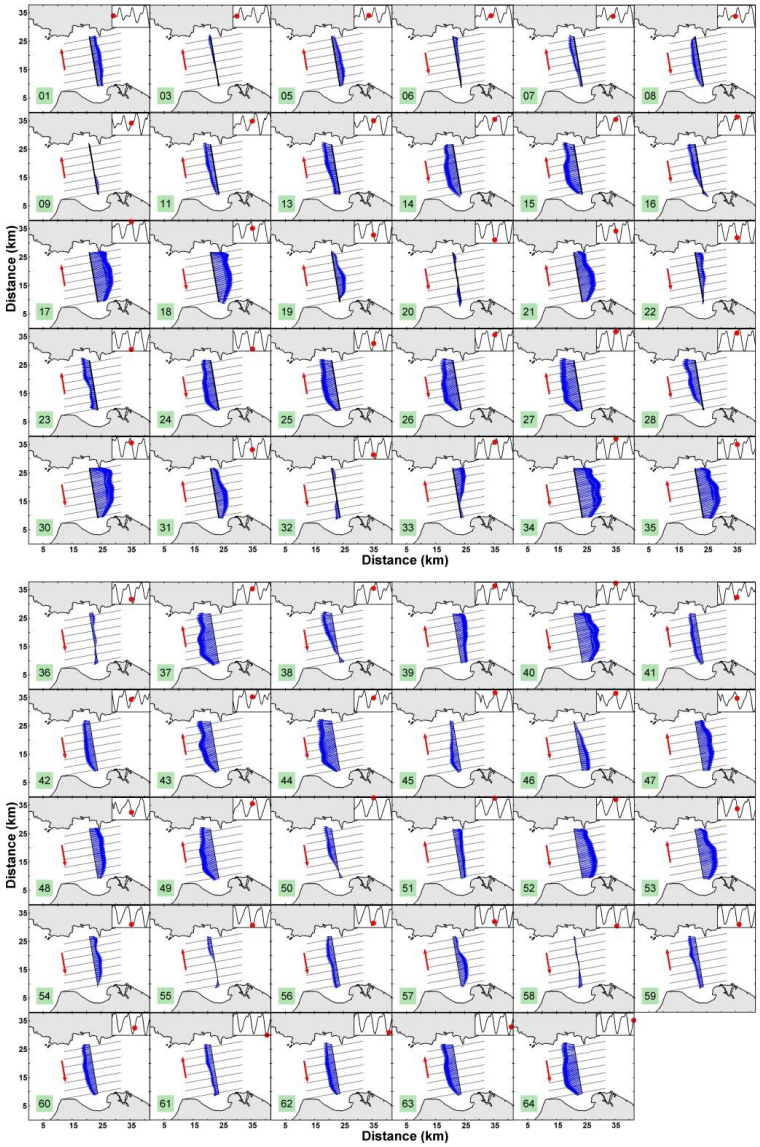

Figure 1. Vector plots of the depth-averaged current measured by the shipboard ADCP. The red arrow indicates the direction of the ship movement. The tidal phase is shown with a red dot on the sea level anomaly plot in the top right corner of each plot.

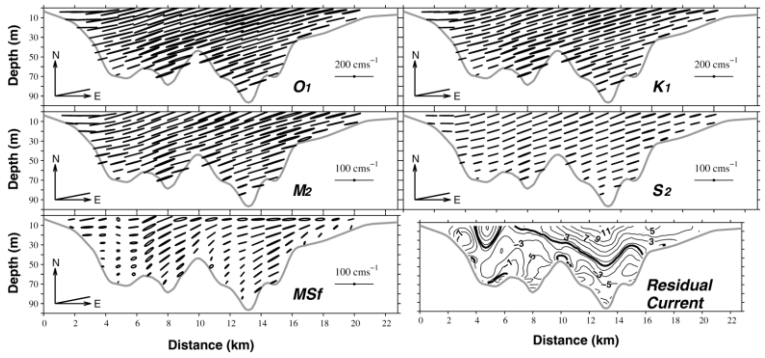

Figure 2. Vertical structures of tidal current ellipses of the five major tidal constituents and residual current normal to the section estimated by the observational data in summer. The thick lines in the N-E coordinate indicate the strait direction. The upward direction is north.

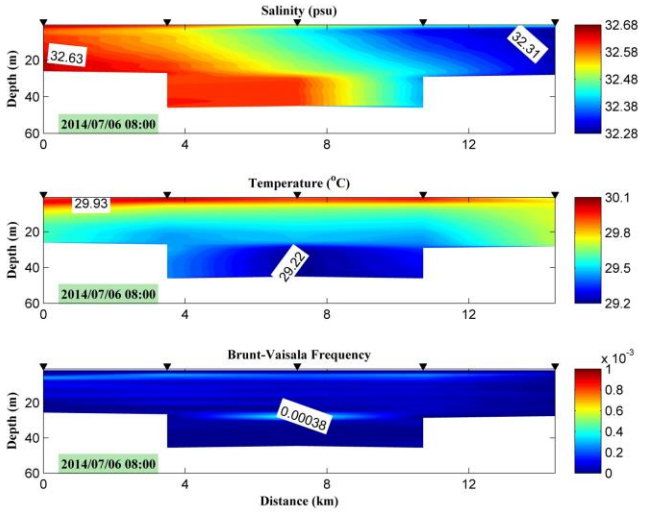

Figure 3. The upper, middle and middle plots respectively represent vertical sections of salinity, temperature and brunt-vaisala frequency for the across section.

Publication/conference presentation

Oral presentation:

Title: Tidal currents and Kuroshio transport variations in the Tokara Strait estimated from ferryboat ADCP data

Lecturer: Menghong Dong

Time: February 7, 2017

Location: Ehime University.

Perspectives in future

We expect a great progress on the tidal & residual current structures in the Qiongzhou Strait and our understanding on the circulation in the northern South China Sea. We wish to publish our joint research on an international journal.