Form 3

Annual Report

LaMer, Ehime University

Date (26, 2, 2018)

To Director of LaMer

Principle Investigator:
Affiliation Second Institute of Oceanography, SOA
Position Postgraduate Student
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Include the report on the result of the project/meeting in a separate sheet.

1. Project / Meeting title

Origin and Formation Mechanism of the Ryukyu Current based on HYCOM assimilation data

2. Members of project / meeting

Name	Affiliation	Position	Contribution part
PI Min Wang	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 (please write in separate sheet, A4-size, within 5 pages including figures and tables. Itemize “Title, members’ names and affiliations, aim, procedure, result, publication/conference presentation, perspectives in future”).

This report will be opened to the public through LaMer website and printed matter. Please send additional products, i.e., abstract book, reprint, if available to

LaMer Office of Research Support Division,

Title

Origin and Formation Mechanism of the Ryukyu Current based on HYCOM assimilation data

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 Origin and Formation Mechanism of the Ryukyu Current.

Procedure

The principal investigator (PI) has first made an oral presentation "Origin and Formation Mechanism of the Ryukyu Current based on HYCOM assimilation data" and showed the recent studies of PI including: 1. The horizontal and vertical structure of the Ryukyu Current in HYCOM data. 2. Quantitatively estimated two origins of the Ryukyu Current: Kuroshio eastward branch (KEB) and Northwest Pacific westward flow (NPWF). 3. The KEB forms the subsurface velocity core of the RC and the NPWF strengthens the subsurface velocity core of the RC.

The PI will carry out further research with Prof. Guo Xinyu on the following subjects: 1. The variability of two origins. 2. What happens to the Ryukyu Current when KEB is missing.

Results

Based on HYCOM reanalysis from January 1993 to December 2015, we show the horizontal and vertical structure of the Ryukyu Current, and the volume transports are calculated across sections in four layers. The RC is powerful and stable between 500 m and 1250 m, east of the Ryukyu Islands, from Ishigaki-jima to Amami-Oshima (Fig. 1). The contribution of the KEB (R1) and NPWF (E1-E5) to the RC are 6.20 Sv and 8.75 Sv (R2, 4.96 Sv; E2-E5, 9.85 Sv), respectively (Fig. 2). In addition, the inflow of the NPWF is mainly south of Okinawa (72.7% through the section E2 and E3). Moreover, the two origins also formed the subsurface velocity core of the RC. First, the Kuroshio is blocked

by the Ilan Ridge below about 700 m. The KEB has a maximum value between 700 and 900 m, and flow along the slope into the RC forms the subsurface velocity core (Fig. 3). Second, due to the β-effect and mesoscale eddies, the NPWF is unable to form a stable northeast current in the surface layer. The subsurface current cannot shift into the ECS due to the Ryukyu Ridge, the effect of mesoscale eddies on the subsurface current is much smaller than that at the surface, and the NPWF also forms a subsurface velocity core along the slope. Therefore, the KEB generates the subsurface maximum structure of the RC and the NPWF strengthens it.

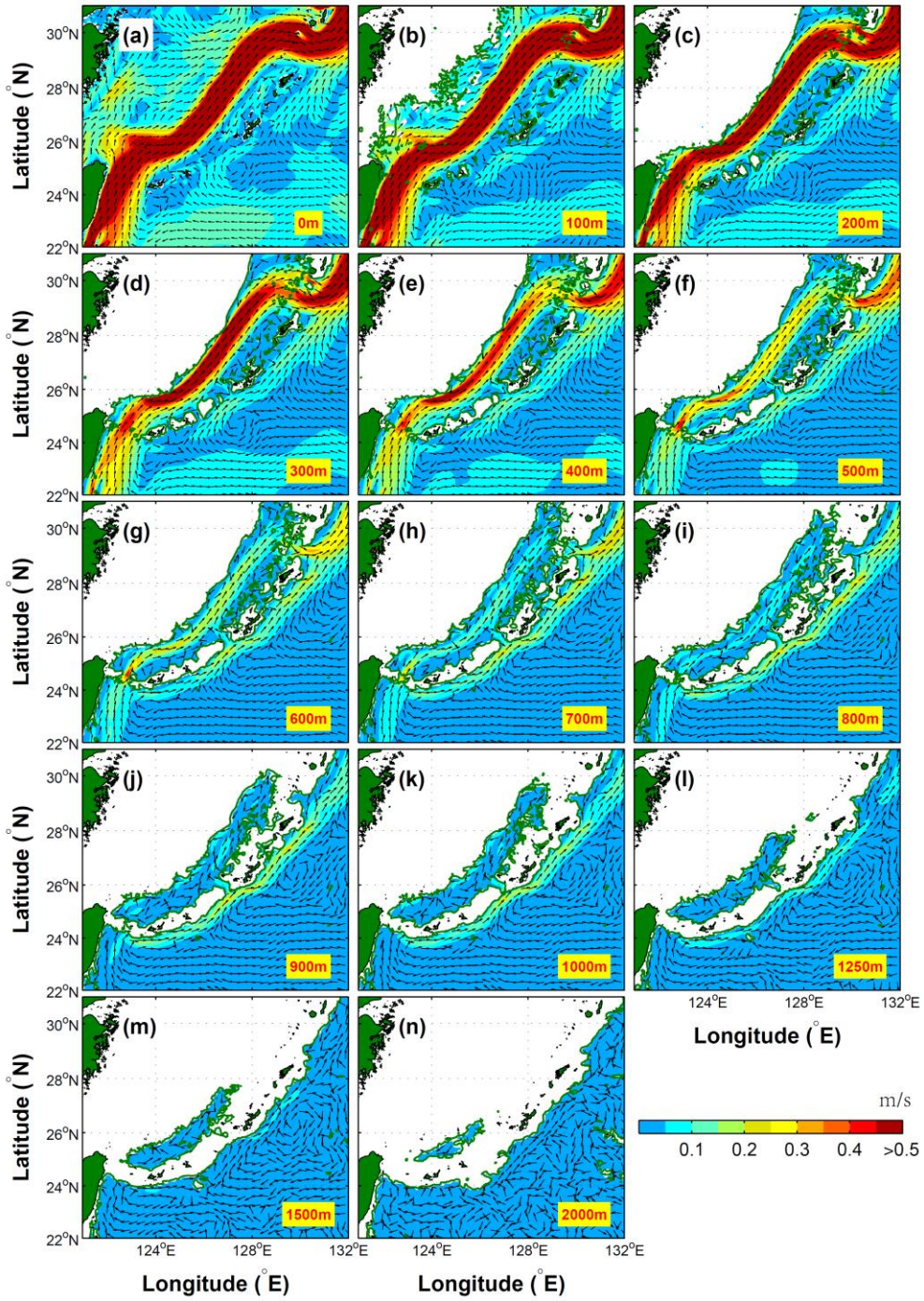

Fig. 1. Annual mean currents at (a-l) 0–2000 m from the HYCOM reanalysis data during 1993–2015 with current speed (m/s) shaded.

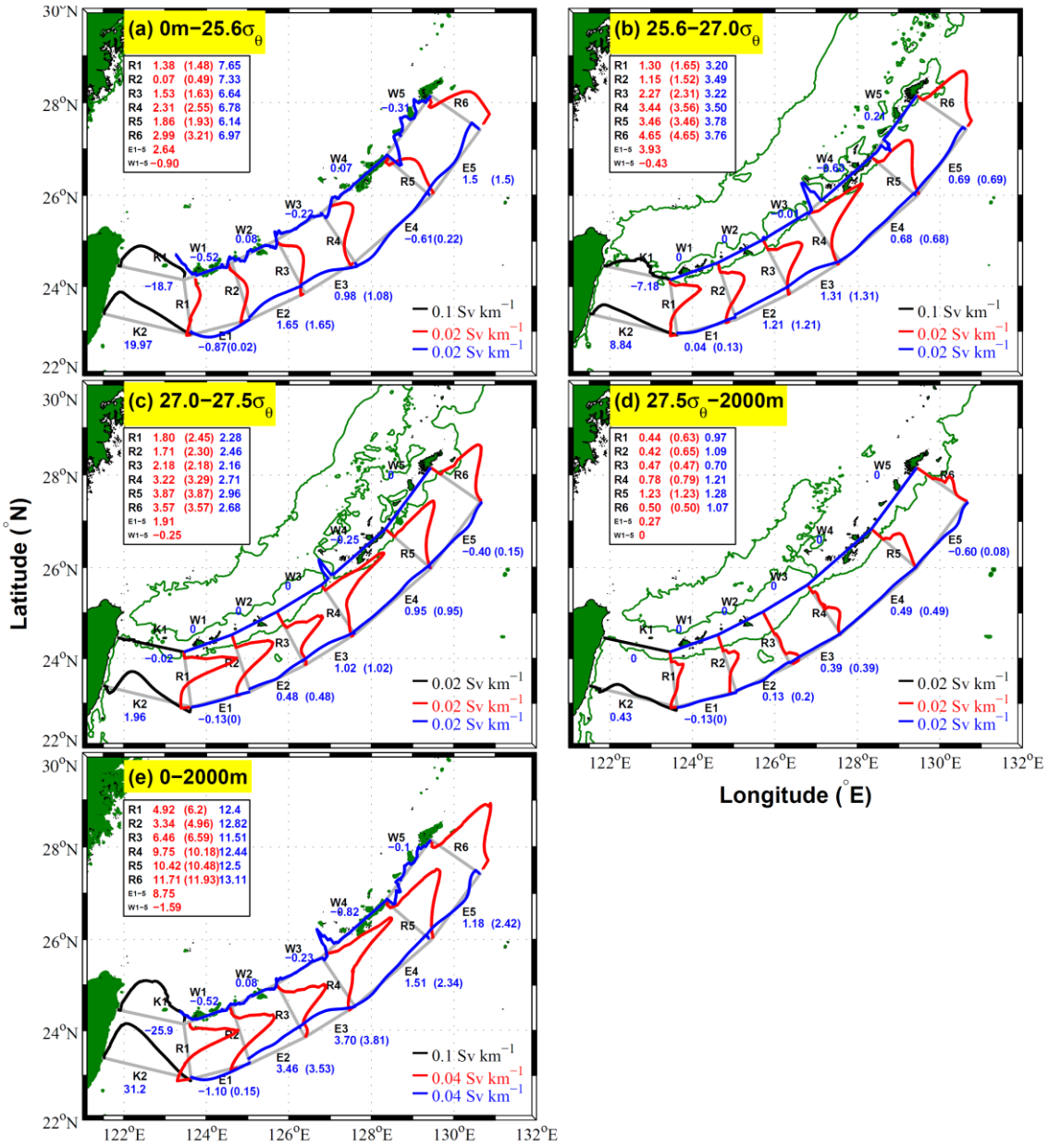

Fig. 2. Mean volume transport from HYCOM reanalysis (1993-2015) integrated from (a) sea surface-25.6 σ_θ; (b) 25.6-27.0 σ_θ; (c) 27.0-27.5 σ_θ, (d) 27.5 σ_θ-2000 m, (e) sea surface-2000m (bottom depth set to 2000 m) with 1 km width. Gray lines represent the positions of the sections used for transport calculations. Mean volume transport across sections K1-K2 and R1-R6 are shown by black and red lines, respectively. Mean volume transport across sections W1-W5 and E1-E5 are shown in blue lines. The net volume transports through sections R1-R6 are shown in the top left of each panel (the values in brackets indicate the northeast volume transport; the values in blue indicate the standard deviation of the volume transport). In addition, the sums of the net volume transports from E2 to E5 and W1 to W5 are shown in the top left of each panel (the values in brackets indicate the volume transport into the box).

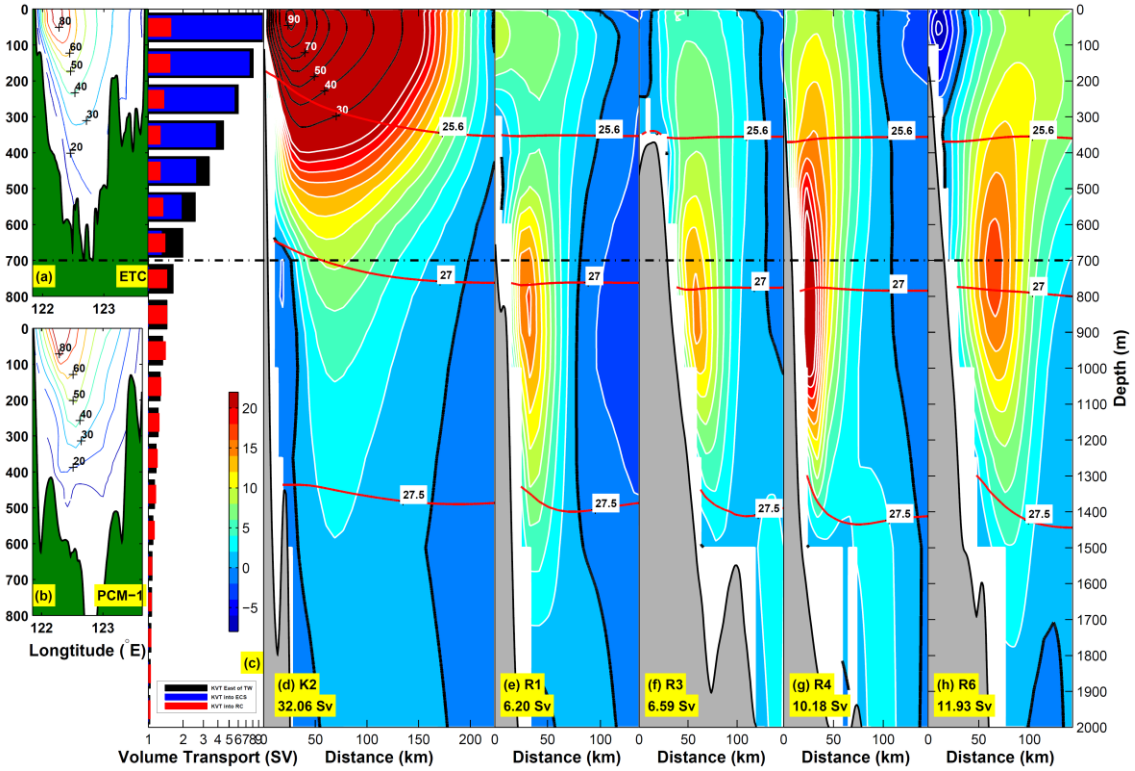

Fig. 3. Mean Kuroshio velocity (unit: cm/s) structure in the ETC obtained from (a) HYCOM reanalysis and (b) PCM-1 measurements, respectively. (c) The vertical distribution of the Kuroshio volume transport east of Taiwan (black), flow into the ECS (blue), and the Ryukyu Current (RC). The volume transport integrated per 100m. (d-h) The mean velocity (unit: cm/s) structure in sections K2, R1, R3, R4 and R6 obtained from the HYCOM output. Colored areas and white contours show velocity with an interval of 2 cm/s and the thin black lines in (d) indicate an interval of 10 cm/s. Positive values are defined as the direction of the Kuroshio (d) or Ryukyu Current (e-f). Red contours indicate the isopycnal layers. Thick black lines indicate a speed of zero. The numbers in the lower left corner represent the volume transport of the positive value.

Publication/conference presentation

Oral presentation:

Title: Origin and Formation Mechanism of the Ryukyu Current based on HYCOM assimilation data

Lecturer: Min Wang
Time: October 10, 2018
Location: Ehime University.

Perspectives in future

We expect a great progress on the origin and formation mechanism of the Ryukyu Current and our understanding on interaction between the Ryukyu Current and the mesoscale eddies.