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14. ABSTRACT

This project focuses on characterizing and understanding the processes responsible for modifying the water masses of the Kuroshio as it transits northward through Luzon Strait, and East of Taiwan. Specific objectives include:
1. Quantify the roles of lateral stirring and diapycnal mixing in the Kuroshio.
2. Understand dynamics of high-wavenumber shear layers in the Kuroshio, in relation to internal waves and mesoscale eddies.
3. Document eddy decay and eddy-island interactions east of Taiwan.

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Eddy and Kuroshio Dynamics near Taiwan

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OBJECTIVES

This project focuses on characterizing and understanding the processes responsible for modifying the water masses of the Kuroshio as it transits northward through Luzon Strait, and East of Taiwan. Specific objectives include:

1. Quantify the roles of lateral stirring and diapycnal mixing in the Kuroshio.
2. Understand dynamics of high-wavenumber shear layers in the Kuroshio, in relation to internal waves and mesoscale eddies.
3. Document eddy decay and eddy-island interactions east of Taiwan.

WORK COMPLETED

Efforts have been directed toward:

- Supporting joint glider deployments with Taiwan National University (NTU).
- Ship-based sampling coordinated with the Taiwanese program SK-II.
- Processing and dissemination of measurements collected from gliders and WHOI-NTU moorings East of Taiwan, in collaboration with Ming-Huei Chang (NTU), Sen Jan (NTU), and Magdalena Andres (WHOI).
- Analysis of surface and sub-surface ship-based measurements to better understand the role of interactions between the Kuroshio and topography, and between the Kuroshio and the barotropic and baroclinic tides in Luzon Strait, for water mass modification.

Our group supported the first Seaglider deployment (SG628) conducted by the National Taiwan University glider group and assisted with piloting across the Kuroshio (Fig. 1, right). We also provided training for NTU (Taiwan) students in general oceanographic field operations.

Ship-based sampling from R/V Roger Revelle (RR1705) focused on mesoscale fronts and eddies in the Luzon Strait, near Heng-Chung Ridge (western ridge, extending south of Taiwan), occasionally extending into the Pacific (Fig. 1). Measurements were collected using ship's underway systems (meteorological data, HDSS, TSG systems), an underway-CTD (UCTD, APL/UW), Marine Radar (CSTARS/U Miami), a Wirewalker drifting profiler (SIO), Revelle's CTD, Seagliders (APL/UW), and SVP surface drifters (SIO). A Marine X-band Radar, operated by Hans Graber's group from U. Miami was also operational during the cruise, measuring currents, fronts, eddies, and convergent flows near the ship.

Coordinated sampling, with R/V Revelle working in conjunction with NTU's OR3 (Ming-Huei Chang, Chief Scientist), quantified Kuroshio variability upstream and downstream of Green Island Ridge to investigate water mass modification along the current's path off southeast coast of Taiwan.

Revelle occupied multiple sections across the Kuroshio, often repeated at timescales of a few hours (Fig. 2). Sampling employed underway and UCTD systems, with over 1050 UCTD profiles collected over the course of the cruise. Measurements focused on the western front of the Kuroshio, between the warm and salty Kuroshio water and the colder and fresher South China Sea Water, with rapidly repeated, short (20nm) sections centered at the sharpest temperature gradient. These intensive measurements were collected in two bursts, between 07:00, 5 March and 06:00, 7 March, and during a joint Wirewalker – ship survey (11-13 March, Figs 3, 4).

Marine Radar data have been reprocessed recently by Bjorn Lund (CSTARS), and during the 2019 NISKINe cruise, Rainville and Lund made plans for coordinated analysis of the data related to the Kuroshio front survey.

The COVID pandemic made travel to Taiwan during the latter part of the project impossible. These trips had been planned to support additional training for NTU students and to facilitate collaborative analyses.

PRODUCTS

A manuscript focused on mixing associated with Kuroshio intrusions is in preparation.

Sanchez-Rios, A., R.K. Shearman, C.M. Lee, H.L. Simmons, L. St. Laurent, A.J. Lucas, T. Ijichi and S. Jan, 2022. Characterization of mixing at the edge of a Kuroshio intrusion into the South China Sea: Implication for Thermal Variance Diffusivity Measurements. In preparation for the Journal of Physical Oceanography.

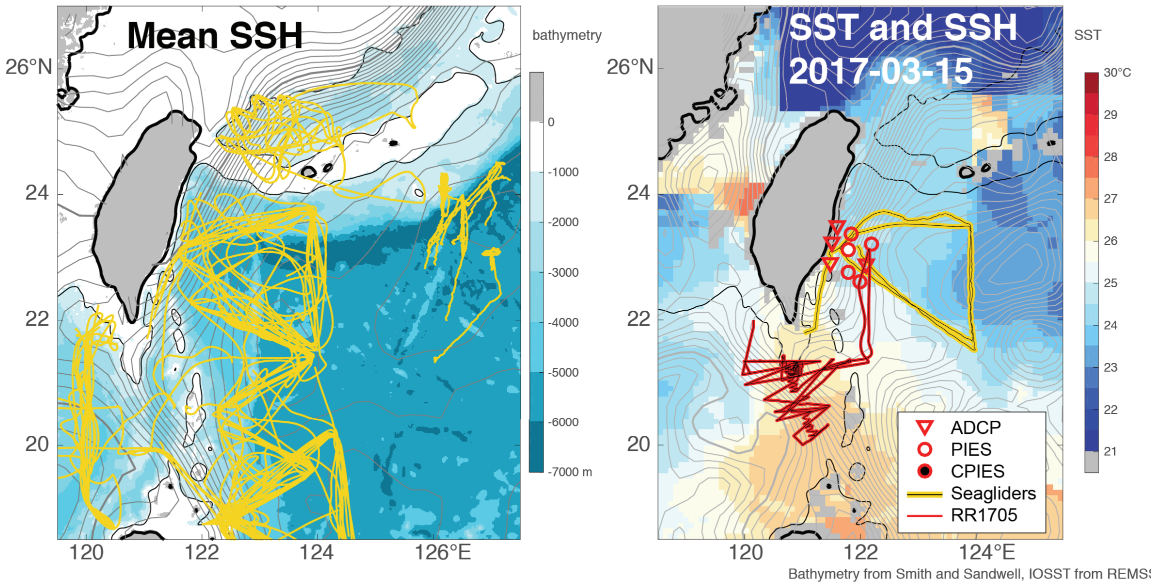

Figure 1. Map of historical glider tracks from the Kuroshio Experiment, OK-MC, QPE, and ITOP. (right) Map of SST from 15 March 2017 with SSH contours from the same day, with the track of sg628, which had been sampling since Dec 2016. Revelle cruise track is shown in red, and the locations of the SK-II moored array elements are depicted by the red circles and triangles.

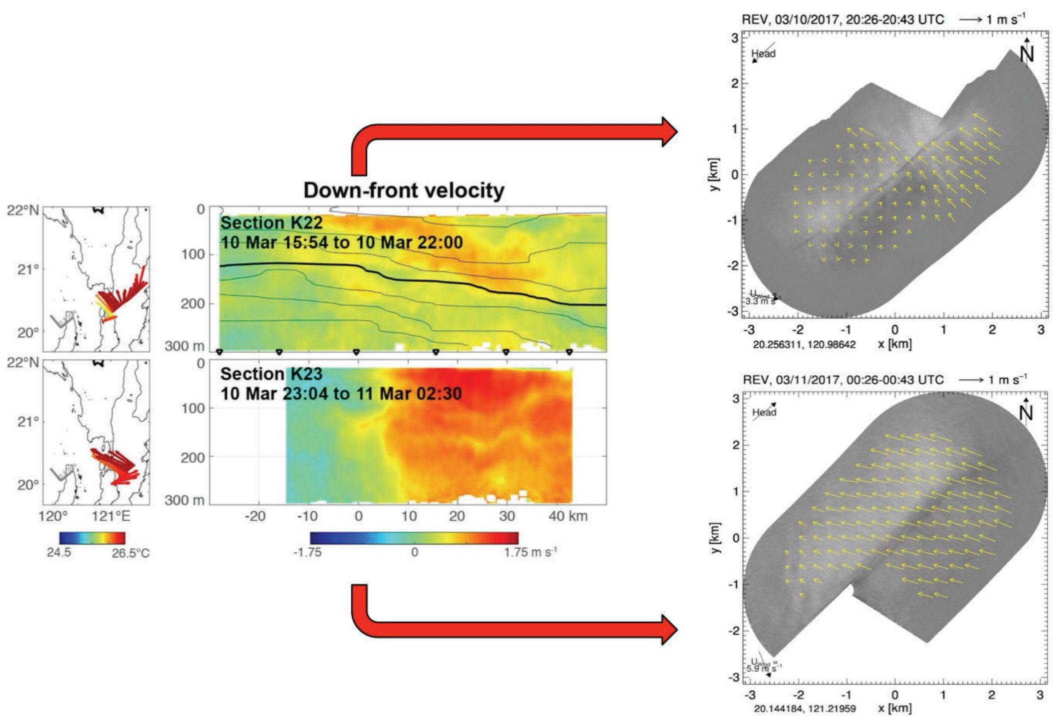

Figure 2. 30-m current vectors (from HDSS 140kHz) colored by SST (from TSG) for two sections across the Kuroshio, along with surface current vectors map from the Marine Radar at the times of the western Kuroshio front crossing.

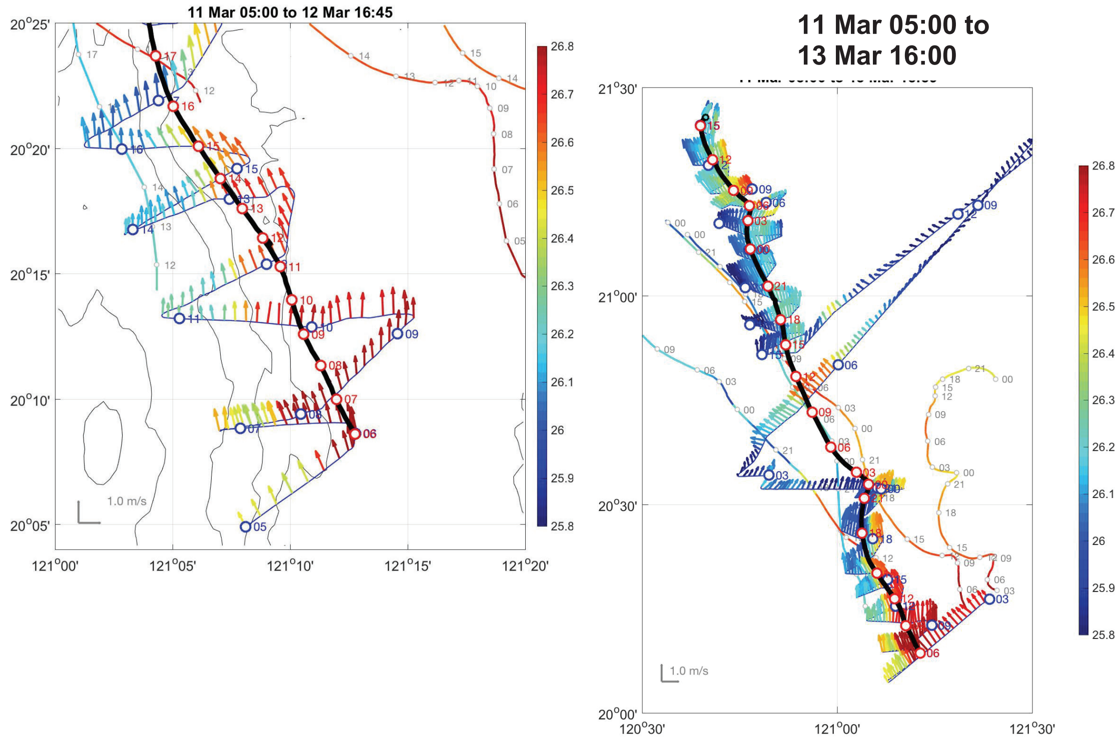

Figure 3. Wirewalker track (black, with hourly markers in red), and ship's 30-m current colored by SST during drift. Left side is a zoom in version of the first 10 hours. Surface drifters track (also colored by SST) are shown as well.

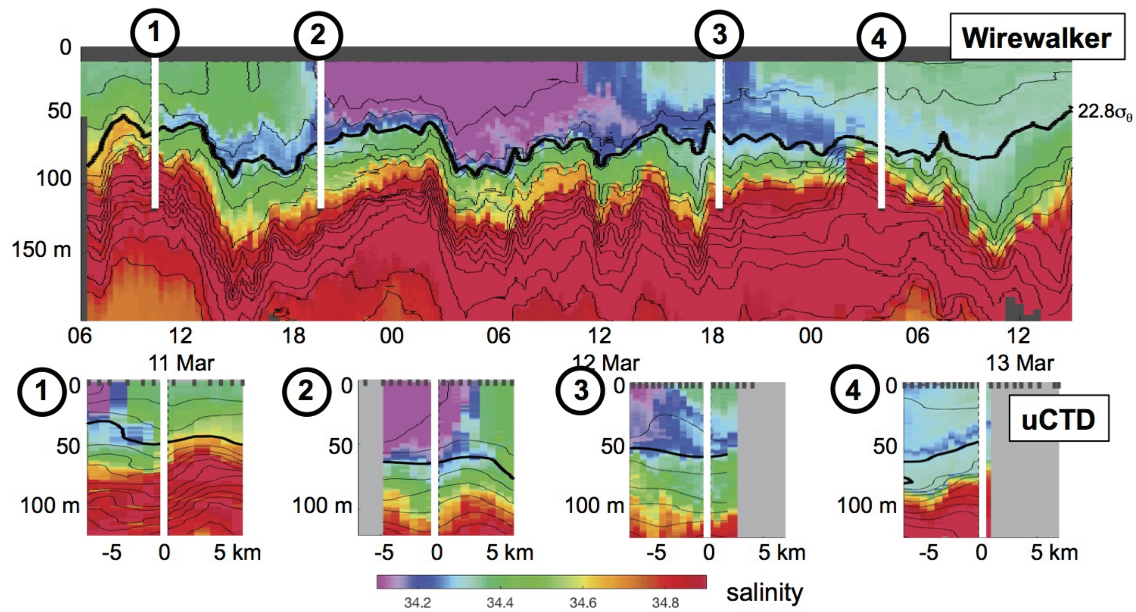

Figure 4. Salinity time series from the Wirewalker (top), and from the uCTD (bottom) across four of the crossings. Isopycnals are shown in black (0.2 intervals, 22.8σ_θ in bold).