Studying the Origin of the Kuroshio with an Array of ADCP-CTD Moorings

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LONG-TERM GOALS

Our long-term scientific goals are to understand the dynamics and identify mechanisms of small-scale processes—i.e., internal tides, inertial waves, nonlinear internal waves (NLIWs), and turbulence mixing—in the ocean and their interaction with mesoscale processes such as western boundary currents. We aim to develop improved parameterizations of mixing for ocean models. For this study, our focus is on the origin of the Kuroshio, the interaction among internal tides, internal waves, mesoscale eddies, and the Kuroshio, and the interaction of oceanic processes with the complex topography in Luzon Strait.

OBJECTIVES

The primary objectives of this observational program are to identify the origin of the Kuroshio and to quantify its properties there and as it evolves downstream.

APPROACH

An array of three or four surface moorings will be maintained for about 1 year northeast of the Philippines, where the strong Kuroshio enters Luzon Strait. Each mooring will have an ADCP and a chain of CTD sensors to measure the velocity field, temperature and salinity in the upper 600 m. We propose to service the moorings and conduct a shipboard survey every 6 months. Our long-term velocity, temperature and salinity observations will help identify the origin and properties of the Kuroshio before it enters Luzon Strait. We will compare our observations with glider observations and with downstream mooring observations east of Taiwan to quantify the evolution of the Kuroshio.

WORK COMPLETED

In FY11 we attended one ONR workshop in Taipei, Taiwan, and one video conference workshop among U.S. and Taiwanese principal investigators in April 2011. An integrated observational program has been established. The proposed mooring array is represented in Fig. 1 and the mooring design in Fig. 2. In this plan, arrays of two and three surface moorings and an array of five H-PIES will be deployed in Luzon Strait. These moorings will be maintained for 1 year and serviced every 6 months.

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The mooring observations are scheduled to begin in June 2012.

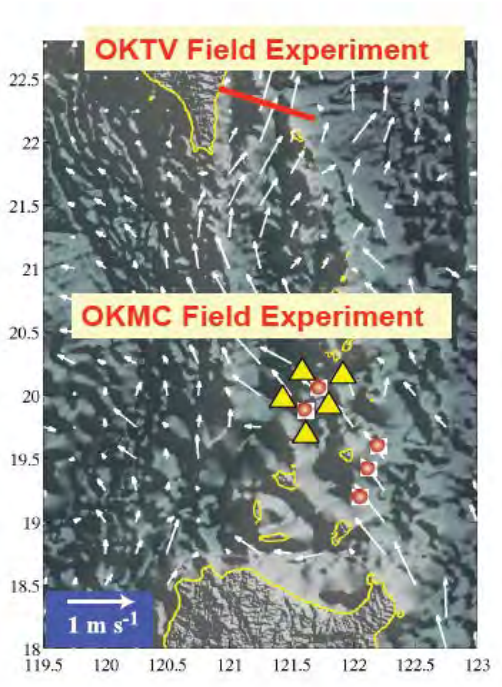

Figure 1. The proposed plan for ADCP-CTD moorings (red bullets) and H-PIES (yellow triangles) deployments for the OKMC experiment. The vectors are the composite shipboard ADCP velocity at 100-m depth. The red line is the proposed Taiwanese mooring line.

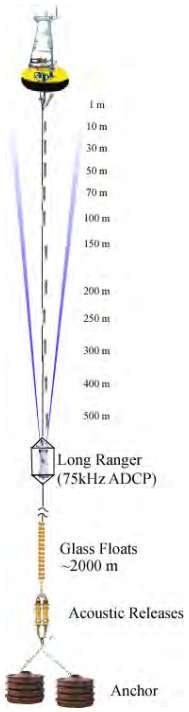

Figure 2. Schematic drawing of surface mooring.

IMPACT/APPLICATION

The Kuroshio is well defined north of the Luzon Strait as a strong western boundary current. Nonetheless, its origin and the dynamics of its initiation are not well understood. The potential origin of the Kuroshio is complicated by a rich spectrum of oceanic processes, e.g., remotely and locally generated eddies. The Kuroshio carries significant mass, heat and energy from the tropics to subtropics and interacts with marginal seas. Therefore it is crucial to understand its origin and dynamics.

RELATED PROJECTS

Study of Kuroshio Intrusion and Transport Using Moorings and EM-APEX Floats (N00014-08-1-0558) as a part of QPE DRI: The primary objectives of this observational program are 1) to quantify and to understand the dynamics of the Kuroshio intrusion and its migration into the southern East China Sea (SECS), 2) to identify the generation mechanisms of the Cold Dome often found on the SECS, 3) to quantify the internal tidal energy flux and budgets on the SECS and study the effects of the Kuroshio front on the internal tidal energy flux, 4) to quantify NLIWs and provide statistical properties of NLIWs in the SECS , and 5) to provide our results to acoustic investigators to assess the uncertainty in acoustic predictions. Results of the NLIWI DRI will provide a better understanding of the dynamics of NLIWs that have strong effects on acoustic propagation and sonar performance.

Process Study of Oceanic Responses to Typhoons Using Arrays of EM-APEX Floats and Moorings (N00014-08-1-0560) as a part of ITOP DRI: We study the dynamics of the oceanic response to and recovery from tropical cyclones in the western Pacific using long-term mooring observations and an array of EM-APEX floats. Pacific typhoons may cause cold pools on the continental shelf of the East China Sea. The cold pool dynamics are likely related to the Kuroshio and its intrusion as well as the shelf/slope oceanic processes.