Elucidating Dynamical Processes Relevant to Flow Encountering Abrupt Topography (FLEAT)

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LONG-TERM GOALS

The long-term goals of this project are to identify new 3-dimensional circulation features from in-situ and eddy-resolving OGCM model simulations around the Palau-Guam ridge system and to clarify the dynamics controlling the mean and time-varying circulation in the region.

OBJECTIVES

The three objectives are (a) to detect multi-scale circulation features around the Palau-Guam ridge system, (b) to quantify the temporal evolution of the regional ocean temperature and salinity fields, the seasonal mixed layer above the pycnocline, and the deeper mode and intermediate waters, and (c) to explore relevant dynamics by using both simplified models and OGCM output with realistic topography and surface boundary conditions.

APPROACH

We plan to collect all deep hydrographic casts in the regions surrounding the Palau-Guam ridge and construct a high-resolution (1/8°x1/8°), full water-column, temperature-salinity dataset. The northwestern Pacific is one of the world oceans with tremendous amount of in-situ observations. A careful and in-depth examination will help not only identify deep ocean circulation features of different spatial scales, but also guide the dynamical explorations using numerical models.

To put the in-situ measurements in context, we plan to analyze the output from the submesoscale eddy-permitting OFES simulation. With a 1/30° horizontal grid resolution and 100 vertical levels, this OFES simulation will provide us a tool to diagnose balances of heat, momentum, and potential vorticity in the abyssal northwestern Pacific Ocean.

To address the dynamical questions, such as the interaction between mesosacle eddies and seamounts, the validity of the island rule, and how topographically-enhanced turbulent mixing affects the broad-scale abyssal circulation, we propose to use the Hallberg Isopycnal Model (HIM). The HIM allows sloping isopycnals to interact with bottom topography and is a computationally-affordable, primitive-equation model suitable for process-oriented numerical experiments.

WORK COMPLETED

During this first year of the project, we have collected all available historical CTD, XCTD, and profiling float temperature/salinity data from the ONR OKMC (Origins of the Kuroshio and Mindanao Currents) DRI and international Argo program. A regional high-resolution (1/8°x1/8°) T/S climatology is being ensembled and high-resolution 3-dimensional circulation maps are being generated. Detailed descriptions about the data collection and analyses may be found in Qiu et al. (2015).

In addition to the T/S data analyses, we have conducted preliminary analyses of the 1/30° resolution OFES model output in the region surrounding the Palau-Guam ridge system. Detailed 3-dimensional circulation patterns are examined. Some of the model results were presented at the June FLEAT PI meeting at the Scripps Institution of Oceanography.

RELATED PROJECTS

NONE

PUBLICATIONS

Qiu, B., S. Chen, D.L. Rudnick, and Y. Kashino 2015: A new paradigm for the North Pacific subthermocline low-latitude western boundary current system. *J. Phys. Oceanogr.*, 45, 2407-2423.