Origins of the Kuroshio and Mindanao Currents

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LONG-TERM GOALS

The long-term goal of this project is to quantify the processes leading to the bifurcation of the NEC into the northward flowing Kuroshio and the southward Mindanao Current. As these are the dominant currents of the region, the improved dynamical understanding should lead directly to better predictions.

OBJECTIVES

The four objectives are (a) to clarify the dynamic state of the NEC-Kuroshio-Mindanao Current system, (b) to quantify the temporal evolution of the upper ocean temperature and salinity fields, the seasonal mixed layer above the pycnocline, and the deeper mode and intermediate waters, (c) to evaluate the upper ocean heat, salt and potential vorticity budget in the OMKC region, and (d) to improve the predictability of the oceanic circulation variability on various timescales in the OKMC region by incorporating in-situ data, including those from the profiling float measurements.

APPROACH

Profiling floats will be deployed during the duration of the OKMC project. In conjunction, high-quality satellite altimeter sea surface height (SSH) information will be analyzed. By combining the SSH information and profiling float T/S data, we plan to infer the strengths and locations (through dynamic height difference and maximum gradient) of the incoming NEC and the bifurcated Kuroshio and Mindanao Currents. Dynamic height maps from the SSH and float T/S data will be used to put in perspective the temporal and spatial variability of the regional circulation detected by other observational instruments. The broad-scale SSH information will also be used to explore the dynamics for regional variability that is forced remotely in the interior ocean.

WORK COMPLETED

Following the start of the OKMC project in November 2009, we have investigated the temporal changes of the NEC bifurcation with the use of satellite altimeter sea surface height (SSH) data from the past 17 years.

RESULTS

The NEC bifurcation latitude was found to migrate quasi-decadally between 10°N and 15°N with northerly bifurcations observed in late 1992, 1997-98 and 2003-04, and southerly bifurcations in 1999-2000 and 2008-09. The observed NEC bifurcation latitude can be approximated well by the SSH anomalies in the 12°-14°N and 127°-130°E box east of the mean NEC bifurcation point. Using a 1.5-layer reduced-gravity model forced by the ECMWF reanalysis wind stress data, we find that the SSH anomalies in this box can be simulated favorably to serve as a proxy for the observed NEC bifurcation. With the availability of the long-term reanalysis wind stress data, this allows us to lengthen the NEC bifurcation time series back to 1962. Although quasi-decadal variability was prominent in the last two decades, the NEC bifurcation was dominated by changes with a 3~5-yr period during the 1980s and had low variance prior to the 1970s. These inter-decadal modulations in the characteristics of the NEC bifurcation reflect similar inter-decadal modulations in the wind forcing field over the western tropical North Pacific Ocean.

IMPACT/APPLICATIONS

It is the first time that the NEC bifurcation, with amplitude exceeding 5 degrees latitude, is captured. This has implications for the forth-coming in-situ observations of the OKMC project, as well as for the ocean processes over the shelf and slope waters off the Philippines and Taiwan that are inherently multi-scaled and pose a challenge to predictability.

RELATED PROJECTS

NONE

PUBLICATIONS

Qiu, B., and S. Chen, 2010: Interannual-to-decadal variability in the bifurcation of the North Equatorial Current off the Philippines. *J. Phys. Oceanogr.*, in press. (available from http://www.soest.hawaii.edu/oceanography/bo/QC_NEC.pdf)