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AS KUROSHIO TURNS: (II) THE OCEANIC FRONT NORTH OF TAIWAN[1]

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ABSTRACT

As the Kuroshio turns northeastward towards Japan from Taiwan, part of it spins off to the north of Taiwan and up to the continental shelf of East China Sea. Since the Kuroshio is a current with high salinity and high temperature whereas the shelf water is relatively cold and fresh, an oceanic front is formed at the East China Sea. Satellite thermal images were used to visualize the pattern, the scales, and the locations of oceanic thermal fonts, and to assist cruise planning. In situ observations were collected to verify the existence of the front and to find the vertical structure of the cross-front distributsn of both chemical and physical properties. In the spring of 1987, the observed oceanic front north of Taiwan appears to be the result of topographically forced upwelling of Kuroshio water from about 100 m depth.

INTRODUCTION

The Kuroshio, originating east of the Philippines, flows past the east coast of Taiwan, then follows the East China Sea continental slope and the Pacific coast of Japan, and terminates in the sub-polar region of the North Pacific ocean. While turning from Taiwan to Japan, part of the Kuroshio water will cross the shelf break into the East China Sea (Liu, 1984). Since the Kuroshio is a warm and salty current with the surface layer nearly nutrient-depleted, a conspicuous band of property gradient will be formed at the confluence of Kuroshio and shelf waters which differ from the open ocean water in every aspect. This band may be named as a front if the change of water property across the band is much larger than the local variations. The surface thermal gradient of this front is easily detectable in the winter time, but not necessarily in the summer time when the cold coastal water is held to the north by the warm current passing the Taiwan Strait, and the surface layer is almost uniformly heated by the solar radiation. Surface fronts of the salinity, nutrients, and dissolved oxygen have much less seasonal variability because they do not have strong seasonal dependent surface sources/sinks, and because their intensities are mostly determined by the local water properties (like surface nutrient concentration) which has a lot smaller intra-annual variability than the temperature has.

If there are oceanic fronts close to Taiwan, then why we could not study these fronts using historical data? The reason is that the spatial scale across this front is much smaller than that along the front, either the wide station spacing (e. g. 50 km) adopted by earlier hydrographic surveys, or the large spatial scale averaging, or the long-term averaging used in processing hydrographic data, prohibits one from finding, or even noticing the existence of fronts. Some examples can be found in the earlier publications of Institute of Oceanography. Lien and Chen (1977) showed the analyzed historical (1960–1977) hydrographic data around Taiwan. From the winter time distributions of temperature (T) and salinity (S), one may conclude that most of the property changes occurred in

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