

Variabilities of currents and turbulence in the Tokara Strait

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Tokara strait is a site through which the Kuroshio Current enters the deep western north Pacific from the shallow East China Sea, and considered to be an important region for the water mass modification of the Kuroshio water due to strong mixing. Although numerical studies have indicated the Tokara Strait is a hot spot of internal tide generation and mixing, observational works of internal tide and turbulence in the strait are only a few. In this study, results of turbulence measurements around the Tokara Strait are presented from a 7-day cruise in November 2015. We performed a survey of current velocity and microstructure along two sections across the Kuroshio Current using shipboard Acoustic Doppler Current Profiler (ADCP) and a free-falling microstructure profiler, TurboMAP-L. In addition, a mooring array with an upward-looking 75-kHz ADCP was deployed beneath the pathway of the Kuroshio for about 6 days to capture temporal variabilities of the Kuroshio Current as well as tidal currents. Elevated vertical shear ($S^2 > 10^{-4} \text{ s}^{-2}$) and dissipation rate of turbulent kinetic energy ($\epsilon > 10^{-7} \text{ Wkg}^{-1}$) were obtained near abrupt topographies and in the downstream side of the strait. The depth-averaged shear and dissipation rate were well correlated ($R^2 \sim 0.8$). Current data from the moored ADCP showed that the vertical shear is dominated by baroclinic tidal currents while mean flow at the site is dominated by the eastward Kuroshio Current ($\sim 1 \text{ ms}^{-1}$), indicating turbulent mixing in the strait was mainly induced by internal tide processes. We discuss the relation between enhancement of internal tide shear and the Kuroshio.

Keywords: turbulence, vertical shear, internal tide, Kuroshio, Tokara Strait