

## Multiscale transport, stirring, and mixing processes to supply nutrients through the Kuroshio nutrient stream

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In this study, the role of the Kuroshio as a nutrient conduit is discussed using results from recent in-situ observations and numerical simulations. Our results show that nutrient concentrations below the Kuroshio are elevated compared to that in ambient waters of the same density, similar to the Gulf Stream. The source of the Kuroshio nutrient stream appears to be tropical western North Pacific on the south side of the North Equatorial Current. Along its path, widespread vigorous subsurface turbulence with an average eddy diffusivity of  $O(10^{-4} \text{ m}^2\text{s}^{-1})$  associated with near-inertial waves is observed in the Tokara Strait, where the upstream Kuroshio flows over shallow topography and seamounts. Within the Kuroshio Extension, subinertial shear forms thermohaline interleaving structures, which induce double-diffusive convection with an average subsurface thermal diffusivity of  $O(10^{-3} \text{ m}^2\text{s}^{-1})$ . These very strong diapycnal mixing processes appear to be important for the upward nutrient supply. An eddy-induced nitrate flux is directed mostly downward and offshore, removing nutrients in the region between the Kuroshio and the Japanese coast off Honshu Island. In contrast, on the north side of the Kuroshio Extension, where warm streamers and warm core eddies emanate from the Kuroshio Extension, the eddy-induced nitrate flux is upward and northward.

Keywords: Kuroshio, Nutrient stream, multiscale

