

Multiscale routes 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 eddy-resolving, and nested high-resolution numerical simulations using Regional Oceanic Modeling System (ROMS) coupled with a N²PZD² ecosystem model, and results from recent in-situ observations. The eddy-resolving simulation can reproduce the elevated nutrient concentrations along the Kuroshio compared to those in ambient waters of the same density, similar to the Gulf Stream. The nested simulations show that nutrients in the upstream Kuroshio can be supplied to euphotic zone by strong diapycnal mixing associated with the Kuroshio over topography. This large nutrient input is consistent with the very strong turbulent mixing observed in the upstream Kuroshio regions, where the Kuroshio flows over the seamounts and on the continental slope. The autonomous microstructure float observations also suggest that the large turbulent nitrate diffusive flux occurs in the Izu Ridge, along the Kuroshio. These diapycnal processes may explain why the basin scale nutrient elevation on the density surface along the Kuroshio path is maintained. During winter-spring, in the model downstream Kuroshio Extension, a large nitrate induction of $O(10 \text{ mmol N m}^{-2}\text{day}^{-1})$, comparable to or greater than wintertime diffusive nitrate flux, occurs through the inclined mixed layer base, which is strongly influenced by the mesoscale structures.

Keywords: Kuroshio, Nutrient stream, Nutrient flux