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学位論文要旨
Dissertation Summary

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論文名: Nutrient transport in the Kuroshio area: an analysis of model results
(Dissertation Title)

The Kuroshio carries a large amount of nutrients from the area east of Luzon Island to the area south of Japan. However, only nutrients transported into the euphotic zone can be utilized by phytoplankton. Firstly, this paper uses results of an eddy-resolving coupled physical-biological ocean model to investigate (1) horizontal and vertical transport of nutrients (integration of the product of velocity and nitrate concentration over one section) into the euphotic layer (0-100 m) in the Kuroshio and Kuroshio Extension and (2) the contribution of different sources of nutrients (coastal, deep layer and open ocean) to the variation of downstream nutrient transport within the euphotic layer along the Kuroshio and Kuroshio Extension.

As a mean state, the horizontal transport of nutrients in the euphotic layer varies along the Kuroshio path: 2.8 kmol s⁻¹ east of Luzon Island, 7.9 kmol s⁻¹ east of Taiwan, 8.9 kmol s⁻¹ near the Tokara Strait, 21.5 kmol s⁻¹ near the Izu-Ogasawara Ridge and 19.6 kmol s⁻¹ around 160°E. Vertical nutrient transport from the bottom of euphotic layer around the Luzon Strait due to uplifting of the potential density layer is an important contribution to the increase in horizontal transport by 3.8 kmol s⁻¹. Horizontal transport from Japan coast area contributes 14.3 kmol s⁻¹ of nitrate to the Kuroshio main stream. An interesting staggered upward and downward distribution of vertical velocity, which can be explained by conservation of the potential vorticity, was found in the Kuroshio Extension and contributed a total transport of 5.2 kmol s⁻¹ nitrate to the euphotic layer.

Secondly, the variation of nitrate concentration at the upstream area of Kuroshio would influence nitrate transport along the Kuroshio and phytoplankton growth in the downstream area of the Kuroshio. With this idea, seasonal and interannual variations of nitrate concentration along a transect across the Kuroshio east of Taiwan is analyzed. The summer increase of nitrate on the shoreward side is confirmed both in in-situ data and model results. In addition, the anticyclonic eddy pushes the Kuroshio shoreward and induces a shoreward increase and seaward decrease of nitrate concentration. Corresponding increase of phytoplankton can be observed at this transect as well as its downstream. However, seasonal variation influences a smaller area of phytoplankton growth than interannual variation does.

Thirdly, a brief review of an estimation of nutrient transport along the Kuroshio from the area east of Taiwan to the area south of Japan is given. Previous estimations were essentially

based on observations that were limited in a specified area and time. To understand downstream transport by the Kuroshio more broadly, this study presents a new estimation of nutrient transport using the results of an eddy-resolving nitrogen-based four-component nitrate-phytoplankton-zooplankton-detritus (NPZD) type model. Based on these calculations, the downstream nutrient transport along the Kuroshio path is shown. In addition, particular attention is paid to the contribution of recirculation to nutrient transport increasing along the Kuroshio south of Japan as described in Guo et al. (2013, <https://doi.org/10.5194/bg-10-6403-2013>) based on observation data along several sections of the Kuroshio. From the viewpoint of the entire Kuroshio south of Japan, recirculation of the Kuroshio contributes to nitrate transport increasing with an order of 45 kmol s^{-1} , which is smaller than the previously reported value by one order. The previous estimation considered only the joining of recirculation into the Kuroshio but neglected the departure of recirculation from the Kuroshio.