

豊後水道における乱流混合と鉛直硝酸塩フラックス

Turbulent mixing and vertical nitrate flux in the Bungo Channel, Japan

*堤 英輔¹、吉江 直樹²、眞野 能³、神田 泰成³、藤井 直紀⁴、郭 新宇²

*TSUTSUMI EISUKE¹, Naoki Yoshie², Takashi Mano³, Kanda Taisei³, Naoki Fujii⁴, Xinyu Guo²

1. 九州大学 応用力学研究所、2. 愛媛大学 沿岸環境科学研究センター、3. 愛媛大学大学院 理工学研究科、4. 佐賀大学 農学部

1. Research Institute for Applied Mechanics, Kyushu University, 2. Center for Marine Environmental Studies, Ehime University, 3. Graduate School for Science and Engineering, Ehime University, 4. Faculty of Agriculture, Saga University

Turbulent mixing plays a key role in primary production in coastal seas through supplying nutrients to the euphotic zone from deeper layers and to the ocean from rivers. Understanding of turbulent dynamics in coastal seas is therefore essential for prediction, conservation and management of coastal ecosystems. Here, we studied turbulent mixing and the associated vertical nitrate transport in a tidally-energetic channel between the Kuroshio region and the Seto Inland Sea (Bungo Channel, Japan). Takeoka [1993] hypothesized that strong vertical mixing and the associated secondary circulation in the channel maintains primary production through supplying large amount of nutrients coming from the Kuroshio region. We conducted simultaneous measurements of turbulence and nitrate concentration along a section in the Bungo Channel using a microstructure turbulence profiler (TurboMAP-5, JFE Advantech) and optical nitrate sensor (SUNA-V2, Sea-Bird Scientific) on 27 August, 2017. We found nitrate-rich cold waters in the bottom of the southern part of the section, which coincide with a typical bottom intrusion from the Kuroshio region. Largest vertical eddy diffusivity of $O(10^{-2}) \text{ m}^2 \text{ s}^{-1}$ and the associated upward nitrate flux of $O(10) \text{ mmol m}^{-2} \text{ day}^{-1}$ were obtained at 20-30 m depth south of deep and narrow strait (Hoyo Strait). Also, subsurface maximum in chlorophyll fluorescence is observed just above the strong turbulence layer, possibly suggesting phytoplankton blooms in response to the high turbulent nitrate flux. The strong vertical turbulent diffusion was associated with density overturns and elevated vertical shear, indicating internal wave breaking. We hypothesis that internal tides generated in the Hoyo Strait is one of the key processes in enhancement of turbulent mixing and nutrient transport in the Bungo Channel.

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