Turbulent mixing and its contribution to oxygen flux in the northwestern boundary current region of the Japan/East Sea, April-October 2015

Dmitry Stepanov[1], Alexander Ostrovskii[2], Dmitry Kaplunenko[1], Jae-Hun Park[3], Young-Gyu Park[4], and Pavel Tishchenko[1]

[1]V.I. Il'ichev Pacific Oceanological Institute, Russia
[2]Shirshov Institute of Oceanology, Russia
[3]Department of Ocean Sciences, Inha University, Korea
[4]Korea Institute of Ocean Science and Technology, Korea

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Abstract

The Japan/East Sea is well ventilated and is the most oxygen-rich region in the Pacific. However, quantitative estimates of the turbulent fluxes are missing due to a lack of observational data. To assess turbulent mixing, we employ data from the moored profiler Aqualog survey of April - October 2015 near the northwestern boundary of this region. The survey allowed observation of collocated depth profiles of conductivity, temperature, ocean current, and dissolved oxygen 8 times per day. Based on the finescale parameterization framework, the dissipation rate, the eddy diffusivity and the diapycnal fluxes of heat, salt and oxygen are estimated in the depth range from 130 to 350 m throughout the profiler deployment period. The survey average diffusivity increased with depth from 0.5x10-5 to 4.0x10-5 m2 s-1. The month-to-month variability in the mixing is presented. It was shown that the turbulent mixing undergoes intraseasonal variability. Early in May 2015, a transition in mixing occurred from the winter regime with upward turbulent fluxes of both heat and salt to the summer regime with the downward mixing of heat. The turbulent mixing was elevated in June when large anticyclonic eddies passed the profiler mooring. The probability distributions of the ratios of the turbulent heat and oxygen fluxes to the observed local changes in heat and oxygen were rather stable, particularly in the warm season. The application of the MX Toolbox to the profiler mooring data yields an estimate of the downward oxygen flux of roughly 8.6x103 μmol m-2 month-1. The data analysis was partly performed in the framework of the assignment of FASO Russia (theme 0149-2019-0011) and supported in part by RFBR grant 19-05-00459. The contribution of Dmitry Stepanov in modifying the Mixing Oceanographic Toolbox was supported by RFBR grant 20-05-00083.

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1. Pacific Oceanological Institute, Russia, 2. Shirshov Institute of Oceanology, Russia, 3. Department of Ocean Sciences, Inha University, Korea, 4. Korea Institute of Ocean Science and Technology, Korea

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Keywords: diapycnal mixing, Japan/East Sea, fine-scale parameterization, diapycnal fluxes of heat and salt, downward oxygen flux

