Study on the vertical mixing and nutrient supply off the east coast of the Kamchatka

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The western subarctic North Pacific and the marginal seas of the Bering Sea and the Okhotsk Sea are known as the areas of world-highest biological CO_2absorption, where the nutrients and carbon significantly decrease from spring to autumn by biological production. This nutrient loss must be compensated by vertical turbulent nutrient transport across the clines of nutrients and density, however diapycnal nutrient supply has not been observed because no turbulence observation has been performed in this area. In the present study, by using the simultaneous observations of turbulence and nutrients performed in the joint Russia and Japan expedition from July 23 to September 14 in 2018, turbulence structure and turbulent nutrient transportwere examined for the first time in the area off the Kamchatka Peninsula. Near at the pycnocline between 150m to 200m depth (potential density 26.5-26.6) corresponding to the maximum density stratification and buoyancy frequency N,′not only turbulent energy dissipation rate ε but also turbulent diffusivity)took the maxima, even though could be decreased for large N. Since the verticalnutrient gradients were also the maxima at pycnocline, vertical turbulent nutrient transporttended to take the maxima, indicating the enhanced turbulence processes of efficient upward nutrient transport. Since these maxima were located just below the dichothermal (temperature minimum) layer representing the base of the previous winter surface mixed layer,it is suggested that the enhanced turbulence plays a role in upward transport of salt and nutrients and in supplying nutrients to the surface mixed layer exposed to surface in winter.Time-series observations of moored multilayer current measurements in the Kamchatka Strait revealed the continuous maxima of vertical shear of horizontal velocity from broad frequency bands from semi-diurnal, near-inertial, diurnal and low-frequency waves at the maxima of turbulent mixing and vertical gradients of density and nutrients. Since the amplitude of downward energy propagating near-inertial wave was attenuated below the pycnocline,breaking of the wind-generated near-inertial waves could contribute to strengthening turbulence and mixing. The observed turbulent vertical nutrient transport across the pycnocline in the offshore of the Kamchatka Peninsula accounts for 20-30% (20% nitrate, 30% silicate, 26% phosphate) of the biological drawdown of nutrients from March to August with the data of Yasunaka et al. (2014).

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