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Decline and bidecadal oscillations of dissolved oxygen in the Oyashio region and their propagation to the western North Pacific

The western North Pacific is one of the oceans where oxygen (O_2) concentration has been declining significantly over the past several decades. Among the studies in the western North Pacific, we have identified trends of declining O_2 along the meridional sections at 137E (P09) (Takatani et al., 2012) and at 165E (P13) (Sasano et al., 2015), respectively, where Japan Meteorological Agency (JMA) has been making high-frequency measurements of physical and biogeochemical Essential Ocean Variables including O_2 . In this study, we extended the analyses of long-term O_2 changes in the Oyashio region, i.e., the southwestern region of the western boundary current in the western subarctic, by Ono et al (2001) back to the year 1954 over the past 61 years using quality-controlled data acquired by the JMA.

Concentrations of O_2 in the Oyashio region have been declining significantly and oscillating over bidecadal timescales on the isopycnal layers spanning = 26.6-27.5 kg m⁻³. The mean rate of the long-term O_2 decrease is the highest (-0.70 ± 0.06 mol kg⁻¹ yr⁻¹) on = 26.7 kg m⁻³ in the temperature minimum layer. The O_2 decline here is predominantly attributed to the reduction of ventilation in winter due to warming and freshening. At = 27.4 kg m⁻³ in the Oxygen Minimum Layer (OML) at around the depth of 950 m, O_2 concentration is 43 mol kg⁻¹ on average and has been declining at a mean rate of -0.14 ± 0.03 mol kg⁻¹ yr⁻¹ for the past six decades. The trends in the OML are attributable to a reduction in ventilation in the Sea of Okhotsk associated with a reduction in sea ice formation and the propagation of its impact to the Oyashio through diapycnal mixing adjacent to the Bussol' Strait in the Kuril Islands. These trends of O_2 decline is accompanying bidecadal oscillations and have also been found in the downstream to the east in the 165E section at latitudes 30N-42.5N on = 26.8 kg m⁻³ with attenuated amplitudes at latitudes of 40N-45N in the OML on = 27.4 kg m⁻³. These results indicate that the signal of secular declines of O_2 , together with bidecadal oscillations, is being propagated broadly from the Oyashio source region into the interior of the North Pacific Ocean.

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