

Changes of Oyashio water properties due to multi-decadal and 18.6-year period variabilities

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Time series and bi-monthly climatologies of hydrographic properties (temperature, salinity, dissolved oxygen) in the Okhotsk Sea and the North Pacific are used to study the impact of long-term climate change and 18.6-year tidal cycle on the Oyashio water (OYW). Changes in the Okhotsk Sea Intermediate Water (OSIW) properties have the largest influence on the Oyashio water at densities greater than $26.8 \sigma_{\theta}$, whereas variability of the Western Subarctic Water (WSAW) transported by the East Kamchakta Current mainly affects OYW characteristics for densities less than $26.7 \sigma_{\theta}$.

The long-term trend is characterized by an increase of the OYW temperature (salinity) at all seasons and all sigma layers, which is due to the combined effect of the warming of OSIW and WSAW, and a reduced outflow of OSIW into the North Pacific Ocean (smaller mixing ratio). The long-term decrease of mixing ratio of OSIW is prominent in winter. During the high tidal period of the 18.6-year cycle, the properties have opposite tendency to those of the long-term change, i.e. a significant decrease in temperature and salinity, and increase in dissolved oxygen. These changes are likely caused by the increase of the outflow of OSIW into the North Pacific Ocean, rather than due to changes in the OSIW properties, and are also prominent in winter. We further discuss the causes for the changes in properties and mixing ratio of the WSAW and OSIW for these two time scales.

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