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Salinity anomaly traveling across the basin navigates North Pacific ventilation

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Dense shelf water (DSW) is formed in association with the brine rejection due to sea ice production over the northwestern shelf region of the Sea of Okhotsk. DSW plays an important role in the climate and the biogeochemical cycles because it ventilates the North Pacific Intermediate Water (NPIW) located at the depths of 200 m - 800 m and transports atmospheric gases and sedimentary materials such as carbon dioxide and iron to these depths. Variability of DSW salinity (a key factor determining the strength and vertical extent of ventilation and consequently controlling the overturning circulation in the North Pacific) and its cause, however, have been unknown because of the limited availability of observed data. A new data set of the Sea of Okhotsk and the Bering Sea was compiled using the data collected by Russian institutes. The data set shows that the DSW salinity has a decreasing trend and significant decadal-scale variations during the recent 50 years and that this DSW variability is controlled by salinity anomalies traveling from the Bering Sea along the pathway of the surface circulation (its travel time to the formation site of DSW is 3 years), while the focus in previous studies has been on the local atmospheric forcing affecting the sea ice production in the Sea of Okhotsk. These salinity anomalies can be traced back further upstream region in the North Pacific subpolar gyre (the Alaskan Stream and the western subpolar gyre). The pathway of these anomalies shows the surface branch of the North Pacific overturn. It is crucial to elucidate three-dimensional characteristics of the overturn that should be controlled by forcing over the whole North Pacific in order to evaluate changes of local as well as global environment in the context of the projected enhanced hydrological cycles because the circulations of materials such as carbon and nutrients are coupled tightly with variations of the North Pacific overturn.