Freshwater flux from the Kamchatka Peninsula controls overturning circulation in the Sea of Okhotsk and the North Pacific

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Dense Shelf Water (DSW) in the Sea of Okhotsk forms over the northern continental shelf. DSW entrains a lot of materials, such as dissolved oxygen, CO_2 and iron, from the continental shelf region and carries them to the North Pacific through the intermediate layer. The overturning circulation associated with the DSW is controlled by salinity. One of controlling factors is salinity anomaly of the surface inflow from the North Pacific Ocean to the continental shelf region via the Kuril Straits. In a previous study (Uehara et al., 2014, Progress in Oceanography), we found that the precipitation over the Kamchatka Peninsula is significantly correlated with the DSW salinity variations, and suggested that the former could explain one-third of the latter. However, quantitative evaluation of the riverine discharge to the DSW salinity has not been done.

In this talk, we overview results of a project that concerns the effects of riverine discharge from the Kamchatka Peninsula on the DSW salinity. We aimed to quantify hydrological cycles and the effects of freshwater processes throughout atmosphere, land and ocean around the Kamchatka. We obtained discharge data of 13 rivers from the Russian HYDROMET. The observed annual riverine discharge from the Kamchatka Peninsula exhibits a significant correspondence with a discharge derived from the precipitation and evaporation of high-resolution atmospheric modeling using the WRF. The estimation by WRF suggests that the freshwater discharge from the whole Kamchatka Peninsula contributes approximately 50 % of the total freshwater input to the coastal ocean around the Peninsula. Further, total river discharge from the western coast of the Kamchatka Peninsula, estimated by a hydrological and land surface model SWAT, showed a significant negative correlation with interannual variations of DSW salinity. Maps of the sea surface salinity estimated by ocean color images (MODIS) exhibited very narrow, river plumes formed along the coast of the Kamchatka Peninsula, implying a river-ocean linkage. Coastal ocean modeling of the northern Okhotsk Sea using FVCOM simulated the narrow coastal plumes and currents realistically. The comparison with and without the riverine water inflows shows that the freshwater inflows lower the salinity more than 1 salinity unit as a maximum value. Freshening (warming on the same density) reaches deeper levels through the DSW formation.

Keywords: the Sea of Okhotsk, Kamchatka, dense shelf water, riverine freshwater discharge, salinity, meridional overturning circulation

