—GROUP 9 REPORT—

# MODELING INTERMEDIATE WATER AND IRON IN THE SEA OF OKHOTSK AND THE NORTHERN NORTH PACIFIC

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In the beginning, we applied a three-dimensional ecosystem-physical coupled model including iron effect to the Okhotsk Sea (Okunishi et al., 2007). In order to clarify the sources of iron, four dissolved iron compartments, based on the sources of supply, were added to Kawamiya et al.'s [1995, An ecological-physical coupled model applied to Station Papa. Journal of Oceanography, 51, 635-664] model (KKYS) to create our ecosystem model (KKYS-Fe). We hypothesized that four processes supply iron to sea water: atmospheric loadings from Northeastern Asia, input from the Amur River, dissolution from sediments and regeneration by zooplankton and bacteria. We simulated one year, from 1 January 2001 to 31 December 2001, using both KKYS-Fe and KKYS. KKYS could not reproduce the surface nitrate distribution after the spring bloom, whereas KKYS-Fe agreed well with observations in the northwestern Pacific because it includes iron limitation of phytoplankton growth. During the spring bloom, the main source of iron at the sea surface is from the atmosphere. The contribution of riverine iron to the total iron utilized for primary production is small in the Okhotsk Sea. Atmospheric deposition, the iron flux from sediment and regeneration of iron in the water column play important roles in maintaining high primary production in the Okhotsk Sea.

Next, aiming toward modeling intermediate-layer iron transport, we constructed an ice-ocean coupled model that covers the northwestern North Pacific including the Sea of Okhotsk (Uchimoto et al., 2009). The model reproduced circulations and features of the intermediate layer in the Sea of Okhotsk reasonably well. Then, tracer and chlorofluorocarbons (CFCs) simulations were conducted to evaluate performance of the model's transport processes quantitatively. In the tracer experiment, tracer was injected in winter in the northwestern shelf in the Sea of Okhotsk to trace dense shelf water (DSW) formed there. Tracer was transported southward along Sakhalin Island and flew out into the Pacific through the Kuril Straits. In the CFCs simulation, CFC distribution was reproduced well, which is comparable to observations. Two areas are identified where CFCs enter the intermediate layer; one is polynya along the northern coast of the Sea of Okhotsk, and the other is around the Kuril Islands. In the polynya region, CFCs were transported by dense shelf water in winter, which was similar to the transport processes of iron. The CFCs then flow out to the North Pacific Ocean along the Oyashio front and spread to the subarctic gyre. Further, the vertical profile of iron was calculated with a one dimensional iron and phosphate model, and reasonable profile was obtained.

Finally, transport processes of iron was also discussed by a biogeochemical model (called BEC) coupled to an ocean general circulation model (Misumi et al., 2010). The resolution of the model is about 1 degree. Both atmospheric (dust) source and sedimentary source were considered as iron input. The BEC model represented seasonal variation of phytoplankton bloom well. Iron distribution in the Pacific intermediate layer was also well reproduced, in which maximum concentration was found around 600 m. At surface, relatively high concentration was seen in the western North Pacific, which supported high seasonal phytoplankton bloom there. Two additional experiments were conducted; one included dust source only (DST), while the other included sedimentary source only (SED). The SED experiment caused intense intermediate layer maximum in both subtropical and subpolar gyres, while the DST experiment represented weaker maximum in the subtropical gyre. Contribution of DST and SED to primary production was then estimated. In the western North Pacific where a pathway of the outflow from the Sea of Okhotsk was present, SED contribution to primary production was comparable to DST contribution, suggesting significance of the intermediate-layer iron from the SED source.

## REFERENCES


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