Biogeochemical linkage between Amur River basin and western subarctic Pacific by iron transport through Okhotsk Sea Intermediate Water: A new paradigm to explain changes in ocean primary productivity

Takeshi Nakatsuka[1], Jun Nishioka[1], Takayuki Shiraiwa[2] and all members of the "Amur-Okhotsk" Project

[1] Institute of Low Temperature Science, Hokkaido University, Sapporo, Japan
E-mail: nakatuka@lowtem.hokudai.ac.jp
[2] Research Institute for Humanity and Nature, Kyoto, Japan

Most oceanographers believe that the indispensable element for phytoplankton growth, iron, is supplied to the open ocean as an atmospheric aerosol from arid regions. Here, we present a new hypothesis that the open ocean ecosystem is supported not only by atmospheric iron but also by intermediate water iron flowing from the coastal zone. The Amur River is the largest river in Russian Far East flowing into the Okhotsk Sea. Because of the broad wetlands in the watershed, dissolved iron concentrations in the Amur River water are about 1 mg/l, a million times higher than that in the open ocean surface. Most of the dissolved iron, in fact, precipitates by flocculation around the river mouth. However, part of the precipitated iron does not deposit on the shelf, but is re-suspended by strong tidal currents there and penetrates into the offshore intermediate layer (Okhotsk Sea Intermediate Water; OSIW) due to water ventilation induced by brine water rejection from sea ice formation. Part of the iron discharged into the OSIW is transported far into the western subarctic Pacific by strong ocean currents, without being scavenged owing to the scarce number of organisms in the intermediate layer, and finally re-entrained into the surface layer by tidal mixing near the Kuril archipelago, and winter convective mixing, supporting the huge phytoplankton bloom in western subarctic Pacific. Because this iron transport system can be easily damaged by global warming or land surface conversion through the reduction of sea ice formation or wetland areas, human activities may change the biological productivity in the western subarctic Pacific completely in the near future.