Numerical simulation of dissolved iron productivity in the Amur River basin under different land-cover change scenarios

Takeo Onishi[1]; Muneoki Yoh[2]; Hideaki Shibata[3]; Seiya Nagao[4]

[1] RIHN; [2] Tokyo Univ. Agri. Tech.; [3] FSCNB, Hokkaido Univ.; [4] Inst. Nature and Environ. Technol., Kanazawa Univ.

http://www.chikyu.ac.jp/AMORE

Recent research showed that iron limits phytoplankton growth in the western subarctic Pacific and that significant part of it comes from the Amur River, which forms the boundary of China and Russia and finally flows into the Sea of Okhotsk. Our research group also revealed that the crucial processes of producing dissolved iron are reductive release of ferrous iron and formation of iron complex with organic compound in wetland. However, drastic conversion of wetland into cultivated land in China part during the last half of 20th century may have great impact on iron production. To assess the land conversion impact on dissolved iron production, we constructed a semi-distributed hydrological model incorporating dissolved iron production mechanism.

The model consists of two modules; one for dealing with the physical process that calculates runoff (TOP-RUNOFF), and the other for dissolved iron production process (TOP-FE). Performance level of TOP-RUNOFF without any calibration assessed by Nash and Sutcliff criteria against observed discharge at several points are fairly well except for catchments affected by anthropogenic impact such as dam. On the basis of TOP-RUNOFF, TOP-FE was formulated as a function of water content, organic compound, air temperature, and a parameter representing the degree of redox condition. Calculated values were compared with observed value at the several tens of points. The result shows that the model reached the level which can predict annual dissolved iron flux though some discrepancy remained in the monthly flux level.

By using the developed model, we tried to simulate the land cover change impact on dissolved iron productivity of the Amur River basin under different land cover scenarios. Two typical land cover change scenarios were set up as possible future land cover change in the basin. One is conversion of wetland to agricultural land (paddy fields and dry lands). The other is forest fire. In each scenario, conversion ratio was assumed to be within the range of 10% to 100% with the interval of 10%. The numerical experiments indicated that both agricultural activities and forest fire had a potential to decrease the amount of dissolved iron flux significantly in some cases. On the other hand, scenarios used in this study were not realistic. Thus, our next important subject is to execute numerical experiments along with more realistic scenario, which should be constructed through cross disciplinary work with researchers of economics and politics in agriculture and forest.