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Dissolved iron transport modeling of the Amur River - toward complete understanding of late 1990s' increase

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Recent oceanographic studies revealed that primary production of the Sea of Okhotsk and the Oyashio region are limited by iron and important part of it has its origin in the Amur River basin. Iron transported by the Amur River is in the form of dissolved iron, most of which consists of the complex of organic compounds such as fulvic acid and iron. Terrestrial biogeochemical observation verified that wetlands play an important role in producing this dissolved iron. Since wetlands soil is rich in undegraded organic matter and tends to be reductive condition, abundant dissolved iron is produced from wetlands. However, the Amur River basin has been affected by increasing human activity such as conversion of wetland to agricultural land through out the last century. Thus, human activity in the basin might have a great impact on primary productivity of the Sea of Okhotsk by changing dissolved iron productivity of the basin. The aim of this study is to evaluate how human activity will affect dissolved iron productivity of the basin. To achieve this aim, hydrological model which incorporate dissolved iron production mechanism is constructed. The model consists of two modules, one for dealing with the physical processes involved with runoff (TOP-RUNOFF), and the other for processes involved with the production of dissolved iron (TOP-FE). While spatial resolution of river routing is 0.5 degree, runoff calculation is done with 1 km spatial resolution. Time resolution is 1day. Number of tuning parameters is designed to be minimum as possible as we can. Calibration period and validation period is from 1981 to 1983, and 1984 to 1990 respectively. As a result, both monthly discharge and monthly averaged dissolved iron concentration can be calculated with acceptable accuracy. On the other hand, drastic increase of dissolved iron flux was observed during the period from 1996 to 1998. And mechanism which can fully explain this increase is not clarified. Thus, we tried to explain this increase by incorporating three possible mechanisms into the constructed model: 1) effect of groundwater irrigation which contains highly concentrated dissolved iron; 2) effect of inundation by extreme flooding; and 3) effect of thawing and snow melt on reductive condition of soil during the period of spring time. We are going to report how these mechanisms will affect dissolved iron productivity of the basin.

Keywords: dissolved iron, Sea of Okhotsk, wetland, flooding, groundwater irrigation