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Evaluation of land cover conversion impact on dissolved iron flux of the Amur River

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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.
By using the constructed model, we evaluate the impact of land cover conversion on dissolved iron productivity of the basin. First, two typical land cover conversion scenario were designed. One scenario is conversion of wetlands to agricultural lands. The other is forest fires. In each scenario, conversion ratio was gradually changed from 10% to 100% with the interval of 10%. Under each fixed land cover conversion ratio, multiple simulations were done randomly selecting different grids which experience land cover conversion. While statistical analysis indicate that both wetland conversion and forest fire will decrease dissolved iron productivity, effect of wetland conversion is large compared with forest fire. Based on this result, several preliminary numerical experiments with more realistic wetland conversion scenario were executed.

Keywords: dissolved iron, Amur River, wetland, agriculture, Sea of Okhotsk