Geophysical Research Abstracts
Vol. 21, EGU2019-8513, 2019
EGU General Assembly 2019

Multi-scale modelling of nutrient pollution in the rivers of China

Xi Chen (1), Maryna Strokal (1), Michelle T.H. van Vliet (1), John Stuiver (2), Mengru Wang (1), Zhaohai Bai (3), Carolien Kroeze (1), and Lin Ma (3)

(1) Wageningen, Environmental Sciences Group, Water Systems and Global Change, Wageningen, Netherlands (xi.chen@wur.nl), (2) Wageningen, Environmental Sciences Group, Laboratory of Geo-information Science and Remote Sensing, Wageningen, Netherlands, (3) Key Laboratory of Agricultural Water Resources, Center for Agricultural Resources Research, Institute of Genetics and Developmental Biology, Chinese Academy of Sciences, Shijiazhuang , China

Surface waters account for 77% of the total fresh water resources in China. Rivers are important fresh water resources for human needs, but severely polluted with nutrients in China. This study addresses three challenges in nutrient modelling for rivers in China. First, the understanding of the impacts and the development of associated management strategies are still humbled by the traditional modelling scales. Existing models often quantify nutrient pollution on biophysical scales (e.g. basin, grid), whereas sources and management strategies are from administrative scales (e.g. county, province levels). Second, the representation of locations of point sources in existing water quality models is generally poor. The spatial characteristics of the point source locations (e.g. hydrology) can influence on the water quality. Third, the direct discharges of manure are not well represented in most existing water quality models. However, direct discharges of manure to rivers have a considerable contribution to the nutrient pollution in China. The objective of this study is, therefore, to quantify inputs of nitrogen (N) and phosphorus (P) to Chinese rivers from different sources at multiple scales.

We developed a novel multi-scale modelling approach based on three models: The Model to Assess River Inputs of Nutrients to seAs (MARINA), NUtrient flows in Food chains, Environment and Resources use (NUFER) and the Variable Infiltration Capacity (VIC) hydrological model. Our multi-scale model is novel for (1) modelling on multiple scales for different processes as appropriate, (2) producing the outputs (e.g. inputs of N and P to rivers) on multiple scales and (3) including a detailed, state-of-the art representation of point sources of nutrients in to rivers. Major improvements were made to the model inputs by using the Chinese county database (2238 counties) and by including the location of manure discharges and of 4404 wastewater treatment plants (WWTPs) for the whole China.

The model results show that the river pollution and source attributions differ among spatial scales. Point sources account for 75% of the total dissolved phosphorus (TDP) inputs to rivers in China in 2012, and diffuse sources for 72% of total dissolved nitrogen (TDN) inputs. One-third of the sub-basins account for more than half of the nutrient pollution in the Chinese rivers. Downscaling to the smallest scale (polygons) reveals that 14% and 9% of the area contribute to more than half of the calculated TDN and TDP pollution, respectively. Sources of nutrient pollution vary considerably among and within counties. Clearly, multi-scale modelling may help to develop effective policies to reduce river pollution.