Geophysical Research Abstracts
Vol. 20, EGU2018-767, 2018
EGU General Assembly 2018

Nutrient Spiraling and Eutrophication in German Rivers: Data Analysis and Parsimonious Modeling of UWWTP loads as Point Sources

Soohyun Yang (1), Olaf Buettner (2), Christoph Jaeger (2), James Jawitz (3), Suresh Rao (1), and Dietrich Borchardt (2)

(1) Lyles School of Civil Engineering, Purdue University, West Lafayette, IN, USA, (2) Department of Aquatic Ecosystem Analysis and Management, Helmholtz UFZ Centre for Environmental Research, Magdeburg, Germany, (3) Soil and Water Sciences Department, University of Florida, Gainesville, FL, USA

Human activities in intensively managed landscapes (agricultural, urbanized, and industrial regions) in watersheds contribute nutrient loads to receiving water bodies (e.g., rivers, lakes, and oceans) as diffuse or point sources. Although travel-time scales are different between diffuse and point sources, nutrient inputs have significant adverse impacts on lotic and lentic ecosystems. Point sources from urban wastewater treatment plants (UWWTPs) are regulated to protect water-quality and aquatic ecosystem integrity. UWWTP treatment levels are designed to meet the regulations, while their sizes are constrained by economy of scales. However, their locations within a catchment are not always determined to satisfy integrated viewpoints for aquatic habitat protection. Thus, unexpected adverse effects at a catchment scale are often observed in many catchments (e.g., algal blooms due to eutrophication).

We utilize national-scale data available for around 9,000 UWWTPs in Germany to examine: (1) the size and location distribution of UWWTPs, and (2) the magnitude and spatial distribution of nutrient (N and P) loads discharged to streams of different Horton-Strahler orders (Horton, 1945; Strahler, 1957). Based on our analyses, we develop a parsimonious systems model for assessing water-quality and ecological vulnerability of river networks to nutrient (N and P) loads from UWWTPs as point sources in Germany. We estimate nutrient spiraling lengths at river network scale, assuming steady flow within a reach. For a given UWWTP point source, we use statistical moments (mean and variance) of water stage and the first-order nutrient loss rate constant to estimate nutrient spiraling lengths and level of eutrophication. We discuss implications to optimization of spatial patterns of UWWTPs within catchments to minimize water quality impairment and eutrophication levels in river networks.