EGU22-12588, updated on 19 Aug 2022
https://doi.org/10.5194/egusphere-egu22-12588
EGU General Assembly 2022

A complex network perspective on catchment water quality dynamics: characteristics, pattern, and drivers

Qingzhi Wen[1], Jiping Jiang[1], and Bellie Sivakumar[2]
[1]School of Environmental Science and Engineering, Southern University of Science and Technology, Shenzhen 518055, China
[2]Department of Civil Engineering, Indian Institute of Technology Bombay, Powai, Mumbai 400076, India

Understanding the connections in the dynamics of water quality at different locations in a catchment is important for catchment studies and watershed management. Complex network science provides effective ways to uncover connections and patterns in catchment water quality dynamics. This study investigates the spatial connections in each of five water quality indexes (Chloride, Dissolved oxygen, pH, Total nitrogen, and Total organic carbon) and flow rate in the Chesapeake Bay basin, USA.High-resolution data (five minutes) from 120 water quality monitoring stations are analyzed. 1) The clustering coefficient (CC) and degree distribution methods are employed to examine the connections and identify the type of the water quality networks. The results indicate that the networks of water quality parameters are scale-free. The power-law (γ) values of for the networks of Chl, DO, flow rate, pH, TN, TOC are 0.74, 0.67, 0.37, 2.0, 0.57 and 1.2, respectively. 2) Monte Carlo simulation of degree distributions and clustering coefficients (CC) shown that all water quality parameters present a decrease in the CC along with the turn down of the threshold of correlation coefficient (R), but the R threshold for DO and flow rate was 0.9. Other water quality parameters showed a sharp decline in the range of correlation coefficient (R) of 0.3-0.6, show a gentle decrease, and then decrease sharply, with an inverse s-curve. 3) All the WQ parameters show stable patterns of CC versus R, for different sizes of networks, arrived by randomly reducing the number of nodes (i.e. stations) of the networks. This seems to indicate that the pattern is an internal systemically feature of the networks, regardless of the node selected for analysis. The variations of CC values for the different stations in the networks with different R values also help identify the “heat area” of the whole catchment, which has some nodes with stable large CC. For the different water quality parameters, the heat area is basically the same, except for pH and TN for which the area is much smaller. The present findings on the characteristics, patterns, and drivers of water quality dynamics in catchments have important implications for water quality studies, especially in large networks of monitoring stations.