Spatial-temporal dynamics of dissolved nitrate and its source identification in the upper Han River basin, China

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Nitrate (NO₃⁻) contamination, as a major form of nitrogen (N) pollution, is a severe environmental problem in river ecosystems with intensive human activities. Source identification of NO₃⁻ contamination in rivers is pivotal for better management of water quality. Here, we investigated the spatial-temporal dynamics of dissolved NO₃⁻ in the upper Han River (including the mainstream and major tributaries) with intensive industrial and agricultural disturbance in central China using data from 32 sample sites at four dates, and identified the NO₃⁻ sources using data of stable nitrogen (δ¹⁵N-NO₃⁻), oxygen and hydrogen (δ¹⁸O-H₂O and δD-H₂O) isotopes. A great deal of spatial-temporal variation in NO₃⁻ concentration was observed with the highest values in summer (22.75±17.75mg/L) compared with other seasons. The δD-H₂O and δ¹⁸O-H₂O data indicated that modern precipitation was the major water source for the river. A large range of δ¹⁵N-NO₃⁻ isotope values (from -20.25‰ to 31.46‰) were discovered, implying that the NO₃⁻ could originate from diverse sources but can be mainly derived from urban or domestic sewage and atmospheric deposition. Moreover, cluster analysis provides a classification of pollution levels in the mainstream and major tributaries of the river during different seasons based on the sample locations and hydrochemical variables. Overall, our results demonstrated the degraded water quality and poor control of N runoff into river. This study provides useful
information for mitigating nitrogen pollution and eutrophication as well as formulating watershed management in river ecosystems.