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Configuration entropy analysis of river water quality dynamics under fine time resolution and network topology

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The water environment is an important carrier of material processes, in which a large number of biochemical reactions and energy transmission processes occur. High-frequency water quality observation can help us understand the dynamics of solute transport in the water environment. The information-theoretic approaches to system dynamics are receiving more and more attention that it reveals the new laws and support board applications. Configuration entropy (H^*) is one of the derivative indexes that originated from information entropy, which was first introduced in 1994 to describe the disorder in random morphologies. It can reflect the complexity of the system under different space or time resolutions. Researchers have analyzed the characteristics of configuration entropy in some of the environment scenarios, such as spatial arrangement of rainfall. In this paper, we analyzed the space structure of river basin water quality dynamic system under the network topology of rivers, together with the time structure of water quality dynamic system. We calculated the configuration entropy of six water quality parameter data from four monitoring stations at Potomac River in two dimensions of time and space with topological treatment of river water system map. We arranged the high-frequency water quality time series according to different time slices to form a two-dimensional pixel image for calculating configuration entropy and the variation under different time resolutions. Results show that with the increasing length of time slice (from 1 day to 9 days), except pH and turbidity, the configuration entropy curve of other parameters has only one peak (1 day, 1.5 days, 2 days) to the valley (2.5 days and later), which confirms a hypothesis that the configuration entropy will not have a valley when the length of time grid is significantly greater than the width. When the length of the time slice is more than 2.5 days, even if the length of the time slice is increased, the overall shape of configuration entropy curve does not change significantly, suggesting that the configuration entropy of specific water quality parameters did not show temporal heterogeneity in a long-time period observation. We also assumed that temporal fractal phenomena exist in some water quality parameters consistent with previous studies. More analysis is in progress.