Understanding long-term persistence and multifractal behaviors in river runoff: A detailed study over China

Naiming Yuan¹, Wenlu Wu², Fenghua Xie³, and Yanjun Qi⁴

¹Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, 100029, China (yuannm@tea.ac.cn)
²Department of Physics, Beijing Normal University, Beijing, 100875, China
³School of Environmental studies, China University of Geosciences, Wuhan, 430074, China
⁴Chinese Academy of Meteorological Science, Beijing, 100081, China

Long-term persistence (LTP) and multifractality in river runoff fluctuations have been well recognized over the recent decades, but the origins of these characteristics are still under debate. In this study, runoff and precipitation data from China are analyzed using detrended fluctuation analysis (DFA) and its generalized version, multifractal detrended fluctuation analysis (MF-DFA). By comparing the results between runoff and the nearby precipitation data, we find the multifractal behaviors in river runoff may be propagated from the nearby precipitation data, but the LTP is not inherited from precipitation. The LTP in river runoff may arise from the spatial aggregation effect, as it is closely related with the catchment area, especially for stations with large catchment areas. These findings are based on data from China, which was not analyzed systematically due to the poor data availability. Since the existence of LTP and multifractality makes the runoff change not completely random, one should further introduce these characteristics into hydrological models, for improved water managements and better estimations of hazard risks.