EGU2020-3744
https://doi.org/10.5194/egusphere-egu2020-3744
EGU General Assembly 2020

Inference On Streamflow Predictability Using Horizontal Visibility Graph Based Networks

Ganesh Ghimire[1], Navid Jadidoleslam[2], Witold Krajewski[3], and Anastasios Tsonis[4]
[1]The University of Iowa, IIHR Hydroscience and Engineering/Iowa Flood Center, Civil and Environmental Engineering, US (ganesh-ghimire@uiowa.edu)
[2]The University of Iowa, IIHR Hydroscience and Engineering/Iowa Flood Center, Civil and Environmental Engineering, US (navid-jadidoleslam@uiowa.edu)
[3]The University of Iowa, IIHR Hydroscience and Engineering/Iowa Flood Center, Civil and Environmental Engineering, US (witold-krajewski@uiowa.edu)
[4]Department of Mathematical Sciences, University of Wisconsin-Milwauke and Hydrologic Research Center, US (aatsonis@uwm.edu)

Streamflow is a dynamical process that integrates water movement in space and time within basin boundaries. The authors characterize the dynamics associated with streamflow time series data from about seventy-one U.S. Geological Survey (USGS) stream-gauge stations in the state of Iowa. They employ a novel approach called visibility graph (VG). It uses the concept of mapping time series into complex networks to investigate the time evolutionary behavior of dynamical system. The authors focus on a simple variant of VG algorithm called horizontal visibility graph (HVG). The tracking of dynamics and hence, the predictability of streamflow processes, are carried out by extracting two key pieces of information called characteristic exponent, λ of degree distribution and global clustering coefficient, GC pertaining to HVG derived network. The authors use these two measures to identify whether streamflow process has its origin in random or chaotic processes. They show that the characterization of streamflow dynamics is sensitive to data attributes. Through a systematic and comprehensive analysis, the authors illustrate that streamflow dynamics characterization is sensitive to the normalization, and the time-scale of streamflow time-series. At daily scale, streamflow at all stations used in the analysis, reveals randomness with strong spatial scale (basin size) dependence. This has implications for predictability of streamflow and floods. The authors demonstrate that dynamics transition through potentially chaotic to randomly correlated process as the averaging time-scale increases. Finally, the temporal trends of λ and GC are statistically significant at about 40% of the total number of stations analyzed. Attributing this trend to factors such as changing climate or land use requires further research.