Beyond Traditional Drought Perspectives: Quantifying Environmental Droughts Using Heuristic Method amidst Climate Change

Aman Srivastava[1] and Rajib Maity[1]

[1]Department of Civil Engineering, Indian Institute of Technology Kharagpur, Kharagpur 721302, West Bengal, India

November 27, 2023

Abstract

An attempt has been made to quantitatively analyze different degrees of environmental drought events, given the limited scientific understanding of environmental droughts, which hinders practical assessment efforts. This study thus aims to rigorously develop and assess the applicability of a novel heuristic method in conjunction with creating an (Srivastava & Maity, 2023). The heuristic method evaluates the combined influences of drought duration and water shortage levels, providing crucial insights into the environmental flow requirements amidst climate change. The Minimum in-stream Flow Requirements (MFR) is first defined as the threshold value essential for sustaining the river basin's ecological functions, aligning with Tennant's environmental flow concept. Establishing MFR enables a balance between water resource utilization and ecological preservation, fostering sustainable water management. To comprehensively assess the eco-status, the study defined the High Flow Season (HFS) and the Low Flow Season (LFS). Drought status is then determined by comparing MFR with observed streamflow rate, quantifying negative differences as environmental droughts. Drought Duration Length (DDL) and Water Shortage Level (WSL) are introduced as functions of environmental drought. DDL categorizes consecutive months into four classes: DDL 1 (1-3 months), DDL 2 (4-6 months), DDL 3 (7-12 months), and DDL 4 (>12 months). WSL is determined by the most significant water deficit observed during DDL, classified into four categories: WSL 1 (<40%), WSL 2 (40-60%), WSL 3 (60-80%), and WSL 4 (>80%). Integrating DDL and WSL yields an index classifying environmental drought events into slight, moderate, severe, and extreme levels. The index value is obtained by comparing DDL and WSL values and selecting the maximum. The study enhances the scientific rigor of environmental drought identification and analysis, contributing to understanding drought impacts and effective mitigation strategies.

References

Unveiling an Environmental Drought Index and its applicability in the perspective of drought recognition amidst climate change. (2023). *Journal of Hydrology*, *627*. https://doi.org/10.1016/j.jhydrol.2023.130462