15. A Novel Fuzzy-Based Integrated Drought Index (Fidi) For Holistic Basin-Scale Drought Risk Evaluation

İsmail Buğra Bölükbaşı Yalova Üniversitesi
Tolga Barış Terzi Karadeniz Teknik Üniversitesi

Drought is a complex and multidimensional natural hazard that affects various components of the hydrological cycle, with far-reaching socio-economic and environmental consequences. While numerous standardized drought indices such as the Standardized Precipitation Index (SPI), the Standardized Precipitation Evapotranspiration Index (SPEI), and the Standardized Streamflow Index (SSFI) are commonly used to quantify specific types of drought (e.g., meteorological or hydrological), they often fall short in providing a comprehensive representation of drought conditions. In this study, a novel Fuzzy-based Integrated Drought Index (FIDI) is proposed to facilitate a more holistic assessment of drought by combining the complementary strengths of SPI, SPEI, and SSFI within a unified framework. The aim is to transform these well-established indices into fuzzy membership functions representing various levels of drought severity, and to integrate them using fuzzy logic rules that reflect the compound nature of drought processes. This approach is expected to improve the interpretation of drought severity through linguistically defined classes, which may be more accessible for decision-makers and stakeholders. In contrast to single-variable indices that provide partial insights, the proposed FIDI framework is designed to capture the full spectrum of drought dynamics at the basin scale, including meteorological and hydrological dimensions. Furthermore, the performance of FIDI will be comparatively evaluated against its constituent indices as well as a multivariate standardized drought index derived from copula-based joint modeling of precipitation and streamflow. The anticipated outcome is a robust, scalable, and policy-relevant tool for integrated drought risk assessment, supporting more informed drought preparedness and management decisions.