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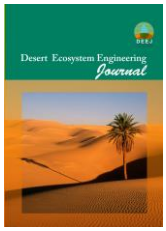

Investigating the relationship between the spatial and temporal distribution of meteorological and hydrological drought indicators (Case study: Jiroft Plain)

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Extended Abstract

Introduction: Drought is an unavoidable natural disaster with far-reaching detrimental effects on various sectors, including water resources, agriculture, and the environment. Effective drought management necessitates identifying the dominant climatic factors that contribute to these events. Consequently, employing weather indicators and models, alongside analyzing the distribution of variables to accurately understand the underlying processes, is essential. Given that over two-thirds of Iran's regions are classified as arid and semi-arid – a condition partly attributed to the Alborz and Zagros mountain ranges hindering rain clouds from reaching the central and eastern parts – and experiencing greater precipitation variability, the central and southern regions of the country face more significant environmental damage. This research was conducted to investigate the spatial and temporal distribution of meteorological (SPI) and hydrological (SDI) drought indices.

Materials and Methods: In this research, precipitation data from 10 synoptic and climatology stations (covering the common statistical period of 1996-2020) and 7 hydrometric stations (covering the statistical period of 1993-2016) were utilized. Geostatistical methods were employed to analyze the spatial distribution of drought indicators, while the Mann-Kendall test was used to assess the temporal distribution and identify trends in changes. Pearson's correlation coefficient was calculated to examine the relationship between the SPI and SDI indices. The Mann-Kendall test, a non-parametric method, requires no specific distributional assumptions, making it suitable for time series that do not follow a particular distribution. The null hypothesis of this test posits randomness and the absence of a trend in the data series. Rejection of the null hypothesis indicates the presence of a statistically significant trend. Trend detection, as well as the identification of abrupt changes in the data, can be achieved through the Mann-Kendall test using both the test statistic (T) and the Mann-Kendall diagram. By inputting discharge and precipitation data into the software, the trend (or lack thereof) and any sudden shifts within the desired statistical period can be visualized using the corresponding graphs for each parameter.

Results: The results of the SPI index revealed that very severe droughts occurred in some years over both short-term and long-term periods (spanning 8 consecutive years). According to the SPI classification, precipitation amounts during these years were significantly below normal. Conversely, the SDI index results for the hydrometric stations indicated below-normal flow and prevalent dry conditions in the 2000s (specifically the Iranian calendar decade of the 1380s), particularly in August, December, and March. The Kahnag-Shibani,

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Kenaroieh, Zarin, Dehroud, and Qhala-Rigi stations showed consistency between the meteorological and hydrological indicators, suggesting that in most years with below-normal rainfall, river flow was negatively impacted, leading to reduced flow and a downward trend. Pearson's correlation coefficient results demonstrated the strongest correlation between the SPI and SDI indices at 12, 24, and 48-month time scales.

Discussion and Conclusion: Across all stations, no statistically significant relationship was found between the meteorological and hydrological drought indices. In other words, instances of hydrological drought did not consistently coincide with meteorological drought conditions. One potential reason for this discrepancy could be the influence of upstream flows contributing to baseflow at the hydrometric stations. Within the studied area, the most significant fluctuations in flow rate occurred during March, December, and August, while April, May, July, September, and November exhibited relatively stable and good flow conditions. A primary factor contributing to short-term flow variations is the utilization of moving averages and changes in precipitation across different months in the calculation of the SDI index. The analysis of SPI and SDI index variations revealed significant differences between the existing stations at the 95% and 99% confidence levels. Overall, it can be concluded that changes in river flow are influenced by the rainfall conditions in the region, albeit with a time lag.

Keywords: Zoning, IDW, drought, Maan-Kendall.