



Spatial Variations of Hydrological Drought in Different Time Scales in Rivers of Ardabil Province

Nahideh Parchami ¹, Raouf Mostafazadeh ^{*2}, Abazar Esmali- Ouri ³, Rasoul Imani ⁴

1- Ph.D Student of Watershed Management Engineering, Faculty of Agriculture and Natural Resources, University of Tehran, Karaj, Iran

2- Associate Professor, Department of Watershed Management and Member of Water Management Research Institute, University of Mohaghegh Ardabili, Ardabil, Iran

2- Professor, Department of Watershed Management and Member of Water Management Research Institute, University of Mohaghegh Ardabili, Ardabil, Iran

4- Ph.D. of Watershed Management Sciences and Engineering, Kashan University, Iran

1-Introduction

During the occurrence of hydrological drought, the river flow will be reduced and the quality of the river ecosystem will be degraded, while there is no need for water for the users. Determining the temporal and spatial variations of the hydrological drought index makes it possible to plan for the optimal use of river water. The variety of spatial and temporal scales has made drought a unique phenomenon. However, by analyzing the available indices and information, its occurrence can be estimated for different return periods, and by adopting management measures and implementing plans to cope with the drought, the effects and consequences can be reduced. Hydrological droughts usually do not coincide with meteorological and agricultural droughts and has a delayed due to longer effects of rainfall deficit on components of the hydrological system, such as river water flow, soil moisture, or lake water levels. Therefore, assessing the impact of hydrological drought in different economic and social sectors is quite different from each other. In this study, spatial variations in river flow in the watersheds of Ardabil province were investigated.

2-Methodology

For this purpose, daily flow time series were assessed in 28 river gauge stations. Streamflow drought index was calculated using DrinC software and then hydrological drought characteristics were analyzed and spatial variations of SDI indices were determined in GIS software environment. Spatial variations of SDI in different time scales (1-month, 3-month, 3-month, 6-month and annual) have been mapped in GIS

* Corresponding Author: **E-mail:**raoofmostafazadeh@uma.ac.ir

software. The severity of drought events has been classified using the standard hydrological drought classification.

3-Results and Discussion

According to the results, the presence of mild drought in hydrometric stations was obtained in the study of river flow drought index (SDI) on 1-month, 3-month, 6-month and annual time scales. The 1-month drought index indicates the existence of short-term drought in the watershed and the annual drought index indicates the occurrence of long-term drought in the basin. The results indicate that the values of the 1-month streamflow drought index calculated in the range of -1 to -1.5, which indicates the occurrence of moderate drought in the region. According to the spatial map of SDI changes, the 1-month hydrological drought index (which indicates short-term droughts), mild droughts had occurred more in the central part of the Ardabil province. The 3-months SDI in the range of -1 to 0 indicates mild drought occurrence and most study stations experience mild drought intensity. The 6-month hydrological drought, had the values in the range of -1 to 0, and had similar behavior to 3-months drought intensity. According to the analysis of the annual hydrological drought (long-term), most of the stations are in the range of -1 to -1.5 and have a mild drought, which indicates the occurrence of mild hydrological drought at annual time scale.

4-Conclusions

Spatial changes of SDI indices showed that the spatial variations of drought index on a 1-month scale are completely different from the annual scale. The lowest occurrence of hydrological drought was in upstream stations and flowing rivers on the slopes of Sabalan. Severe and very severe droughts occur in rivers with low discharge values. The higher the river discharge, the lower the incidence of severe droughts, and the greater its flow stability than low-discharge rivers.

Keywords: Hydrological drought, Spatial variation, River drought index, DrinC, Ardabil Province

5- References

- Amini, H., Esmali-Ouri, A., Mostafazadeh, R., Sharari, M., & Zabihi, M. (2019b). Hydrological Drought Assessment and Analysis of its Characteristic Using the Stream flow Drought Index (SDI) at Hydrometry Stations in the Province of Ardabil. *Watershed Management Research*, 32(3): 21-36. (In Persian).
- Heim, R.R. (2002). *A review of twentieth-century drought indices used in the United States*: Bulletin of the American Meteorological Society, 83: 1149-1165.

- Mehri, S., Mostafazadeh, R., Esmali-Ouri, A., & Ghorbani, A. (2017). Temporal and spatial changes of basal flow in rivers of Ardabil province: *Earth and Space Physics*. 43 (3): 623-634. (In Persian).
- Nalbantis, I. and Tsakiris, G. (2009). Assessment of hydrological drought revisited: *Water Resources Management*, 23(5): 881-897.
- Tigkas, D., Vangelis, H., & Tsakiris, G. (2015). DrinC: A software for drought analysis based on drought indices. *Earth Science Informatics*, 8(3):697-709.