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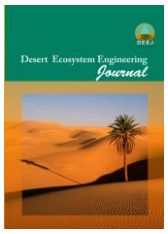

Evaluation of Meteorological Indices and Interpolation Methods to Drought Monitoring and Zoning in Arid and Semi-Arid Regions (A Case Study: Qoum-Kahak Basin)

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Extended Abstract

Introduction: Drought is recognized as a slow, creeping phenomenon that can accelerates the expansion of desertification in different regions especially in arid and semi-arid area with its effect on the agricultural sectors, water resources and vegetation cover. Positioning of Iran in the world arid and semi-arid belt is exposed to drought and water crisis and desertification. Drought monitoring and zoning with the goal of planning and water resources management are very important in different area especially in arid and semi-arid regions. One of the methods for drought study is monitoring and mapping of drought using meteorological indices and Geographic Information System techniques.

Materials and Methods: In order to investigate and drought monitoring in present research during the period of 29 years (1989 to 2017) in Qoum-Kahak study region we used annual rainfall data from four stations (i.e. Qoume, Kahak, Koohsefid and Janatabad) which are located inside and around the Qoume-Kahak catchment. Then we applied meteorological indices such as Standard of Precipitation Index (SPI), Percent of Normal Index (PNi), Deciles Index (DI), Chinese Z Index (CZI) and Z-Score Index (ZSI) for drought monitoring during the study period. Afterward for drought mapping, four interpolation methods included Simple Kriging (SK), Ordinary Kriging (OK), Inverse Distance Weighting (IDW) and Radial Basis Functions (RBF) were used and compared. After determination of best method in each year, yearly drought map was produced based on the best interpolation methods in ArcGIS software environment.

Results: According to the result of meteorological indices the near-normal class occurred more than other classes in study stations. SPI results indicated that Jannatabad and Kahak stations have the highest and lowest frequency of extremely dry class during the study period, respectively. The most extremely dry class with the SPI of -2.35 was occurred in Janatabad station in the year of 1997-98. Based on the results of PNI and ZSI indexes there was no occurred extremely dry class in all stations. The result of PNI index indicated that Koohsefid station has the highest frequency of very dry class between all stations. According to the result of CZI index the extremely dry class was occurred only for Kahak and Janatabad stations in the water years of 2016-2017 and 1997-98 respectively. Extremely wet class was occurred also for Kahak and Janatabad stations during the water years of 2009-2010 and 1992-1993 respectively. The results of DI index illustrated that the

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class of very much below normal was occurred in Qoume and Koohsefid stations 4 times and in Kahak and Janatabad stations 3 times during the study period. We applied geostatistical analyst tools in ArcGIS software to produce zoning maps for rainfall and drought. Its result showed that ordinary kriging with RMSE of 28 mm is the best method to create rainfall map. Accordingly mean annual rainfall was 136 mm/year during the study period. We selected SPI index for drought monitoring and zoning because of according to the results of all meteorological indices, only for this index the extremely and severely drought classes for all stations have occurred Simultaneous with the minimal rainfall during the study period. Afterward we compared different interpolation methods to produce drought zoning maps for each year during the study period. Based on the results of RMSE ordinary kriging and simple kriging were the best methods for most years.

Discussion and Conclusion: The results of all meteorological indices suggested that in all stations the near-normal class has the most frequency during the study period. According to the results of SPI and CZI indices, the highest (7 years) and lowest (3 years) number of droughts were occurred in Kahak and Jannatabad stations, respectively. While according to PN index the highest (9 years) and lowest (3 years) number of droughts were observed in Qoum and Jannatabad stations, respectively. Also, the results of PN index illustrated that there was no wet period during the study period. According to the ZSI Index, the extremely dry class did not occur in the region and the ZSI results about the frequency of extremely wet class was similar to the SPI results. The results of drought zoning indicated that in the years of 1990, 1995 and 1997, most of the region has been in a state of extremely to slightly drought. In the years 2010 and 2017, slight to sever drought classes were occurred in most parts of the study area and the slight wet class was observed in the eastern part of region. While during the years of 1992, 1996 and 2009 whole of the study area has experienced moderate and severe wet conditions. In the year of 2011, half of the study area which is located in the eastern part of the region has been in a state of moderate wet condition.

Keywords: Drought Monitoring, Interpolation Methods, Zoning, Meteorological Indices, Arid and Semi-Arid, Qoum-Kahak.