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Spatial-temporal analysis of seasonal meteorological drought

M. Faghani[1], Kh. Ghorbani[*2], M. Salarijazi[3]

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Abstract
Meteorological drought is one of the most important natural hazards which frequently occur in any climate. In this study, for regionalization of similar regions from drought situation point of view, a clustering approach was used. For this purpose, 25 years rainfall data of 120 synoptic meteorological stations across Iran were retrieved from IRIMO and examined by routine quality control tests. The drought severity was evaluated using standardized precipitation index (SPI) in a three months window during different seasons of the year. The calculated SPI values were interpolated in Arc GIS environment using Kriging method. The interpolated values formed a matrix consisting 16203 grid points during the 25 years study period. The obtained values were clustered by means of K-means method in different seasons of each year based on SPI values in different seasons. Results indicated that the optimum number of clusters are 8, 10, 9 and 6 for spring, summer, autumn and winter respectively. Besides it was concluded that the type of precipitation systems arriving in Iran during different seasons can affect the clusters direction and shape.

Keywords: Drought, Clustering, Kriging, Standardized Precipitation Index, K-means

[1] M. Sc. Graduate, Water Resource Engineering, Gorgan University of Agricultural Sciences and Natural Resources, Golestan, Iran
[2] Associated Professor of Water Engineering Department, Gorgan University of Agricultural Sciences and Natural Resources, Golestan, Iran
(*Corresponding author email address: ghorbani.khalil@yahoo.com)
[3] Assistant Professor of Water Engineering Department, Gorgan University of Agricultural Sciences and Natural Resources, Golestan, Iran

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Agroclimatic zoning of citrus cultivation in Khuzestan province using AHP method

R. Borna[*1], A. Alizadeh[2]

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Abstract
The aim of this study is classification of suitable climatic regions of Khuzestan province, southwest of Iran, for Citrus cultivation using a four level Analytic Hierarchy Process (AHP) approach using climatic and environmental information of the region during a 20 years period of (1981-2010).After determination reference options and their ranking, the weighing coefficient of criteria and sub-criteria were calculated using Expert Choice software based on pairwise comparison matrices method. Then, using AHP model, the corresponding values of layers were allocated and generated maps were combined in GIS environment. According to final weight of each climatic and environmental sub-criteria affecting citrus cultivation, the suitable regions maps were obtained. The results of this study revealed that AHP method is capable of classification by incorporating qualitative and quantitative criteria. The generated agro-climatic suitability map of citrus cultivation regions of province consists of four classes, i.e. poor, medium, good and excellent. The northern and eastern regions are the most favorable areas. The less suitable regions are located in southern, western and central parts of province.

Keywords: Citrus, Climate, GIS, AHP Model, Khuzestan

[1] Assistant Professor of Climatology, Department of Geography, Islamic Azad University, Ahvaz Branch, Ahvaz, Iran (*Corresponding author email address: bornareza@yahoo.com)
[2] M. Sc. Student of Climatology, Islamic Azad University, Ahvaz Branch, Ahvaz, Iran

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Projection of the early fall and late spring frosts under climate change condition with SDSM model in several selected stations in the mid-western Iran

Z. Agha Shariatmadari[*1], J. Baszrafshan[2], S. E. Safaei[3]

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Abstract

In recent years, many researchers have studied change in extreme climatic events (such as the early fall and late spring frosts) due to climate change. This research is aimed to evaluate the future changes in the beginning and ending dates of frost events on the basis of the HadCM3 data under two scenarios A2 and B2, which were downscaled through the SDSM software at four selected stations in western half of Iran including Arak, Zanjan, Qazvin and Saghez. To this end, the downscaling model was calibrated based on the 40-year (1961-2001) minimum daily temperature data of four selected stations in the western half of Iran. The calibrated model, then, was employed to downscale the projected minimum daily temperature data at the stations of interest for the period 2011-2051. The first and late frost dates were extracted in three temperature thresholds of slight, moderate and severe. Results showed that the future fall frost date of Qazvin station will be later and Saghez station will be sooner in comparison to the other stations. The future spring frost date of Qazvin station will be sooner and Saghez station will be later in comparison to the other stations. In general, the findings revealed that SDSM outputs under both scenarios had no significant difference in projection of the first and late frost dates.

Keywords: Downscaling, Frost, SDSM, HadCM3, Iran

[1] Assistant Professor, University of Tehran, Iran
(*Corresponding author email address: zagha@ut.ac.ir)
[2] Associate Professor, University of Tehran, Iran
[3] M. Sc. Student of Agricultural Meteorology, University of Tehran, Iran

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Remotely sensed measurements of apple orchard actual evapotranspiration and plant coefficient using MODIS images and SEBAL algorithm (Case study: Ahar plain, Iran)

A. Rostami[1], **M. Raeini-Sarjaz**[*2]

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Abstract

Global warming and its consequence, climate change impede crop production in some regions. As Iran mainly consists of arid and semiarid regions and water scarcity is the main feature of such climates, decrease of the water shortage impacts is essential. Therefore, improvement of water resources management and increase of water use efficiency may be one of the main strategies to overcome these shortcomings. Precise evapotranspiration and crop water requirement estimation could beneficially improve cultivation management and water allocation. To precisely estimate actual evapotranspiration (ET_a) of apple orchard trees at Ahar plain, East Azerbaijan province, MODIS images and SEBAL algorithm were employed. The energy balance equation was used to make calculations. SEBAL model calculates the energy balance equation parameters by using of surface temperature, surface reflectance and normalized difference vegetation index. Based on achieved data the actual evapotranspiration has an increasing trend toward middle of summer and the highest actual evapotranspiration value (10.1 mm d^{-1}) occurred on 18th July, 2014. The spatial distribution of crop indices and energy balance components revealed that southern part of the plain beside of having the highest crop density it has also the highest amount of evapotranspiration. Highly significant correlation (r = 0.92) was found between SEBAL and Penman-Montieth-FAO estimated ET_a values. Meanwhile, t-test showed no significant difference between the two set of data with a RMSE value 0.96 mm d^{-1}. It could be concluded that regional estimation of ET based on remote sensing approach, may be used as an acceptable alternative to point methods for estimation of crop water requirement.

Keywords: Ahar, Evapotranspiration, Remote Sensing, SEBAL Model

[1] Ph. D. Candidate of Irrigation and Drainage, Water Engineering Department, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
[2] Associate Professor, Water Engineering Department, Sari Agricultural Sciences and Natural Resources University, Sari, Iran
(*Corresponding author email address: raeini@yahoo.com)

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Disaggregation of air temperature by using fractal and periodic regression in two arid and semi-arid climate

Sh. Tajabadi[1], B. Ghahraman[*2], A. N. Ziaei[3]

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Abstract
Air temperature is one the most important variables required for environmental and agricultural studies which are not generally available with sufficient spatial and temporal resolution. Thus, the spatial and temporal disaggregation of properties of the catchment is essential for optimal management of the catchment. The common interpolation functions, including fractal, and regression can produce reasonable results. In this research the interpolation functions based on fractal and periodic regression models were used for modeling and disaggregating temperature datasets for the period of 2007- 2009 at Mashhad and 1980-1982 at Kerman Synoptic stations, respectively. At first, two produced daily temperature from daily datasets. Then data with 5-day and 10-day intervals were used to produce daily temperature. Second, we considered data to be missing at random, and then periodic regression and fractal interpolation were adopted to model daily temperature and then to generate 3-hours temperature. On general results showed similar trends in both climates, and 5-day intervals performed more acceptable, such that determination coefficient for Mashhad and Kerman was 0.98 - 0.77 and 0.98 - 0.82, respectively, while RMSE was between 1.52 - 5.81 and 1.19 - 5.48 °C, respectively. The intercepts and slopes of regression lines between measured and predicted temperatures were not statistically (5% level of significant) different from 0 and 1, respectively. On the overall, fractal interpolation was better than periodic regression.

Keywords: Fourier series, Interpolation, Missing data, Modeling

[1] M. Sc. Student of Water Engineering Deptartment, College of Agriculture, Ferdowsi University, Mashhad, Iran
[2] Professor of Water Engineering Deptartment, College of Agriculture, Ferdowsi University, Mashhad, Iran
(* Corresponding author email address: bijangh@um.ac.ir)
[3]Assistant Professor of Water Engineering Deptartment, College of Agriculture, Ferdowsi University, Mashhad, Iran

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Application of Artificial Neural Network and Fuzzy regression in remotely sensed monitoring of drought

L. Parviz[1]*

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Abstract
Drought monitoring is a major issue for agricultural water management and environmental protection .In this study, artificial neural network and fuzzy regression models have been used to evaluate the performance of several remotely sensed indices retrieved from MODIS images including NDVI, VTCI, VHI, NVSWI, TCI and TVX for monitoring drought in 7 meteorological station across Iran namely Kermanshah, Tabriz, Kerman,Mashhad, Urumia,Yazd and Zanjan. The VHI, NVSWI, TCI and TVX had the highest number of significant coefficient of correlation with amount of rainfall in study stations. Based on error measures, the Fuzzy regression approach had the least error in modeling correlation of VHI, TCI and NVSWI with rainfall amount. Using the ANN model, the TVX found to be the best index in monitoring drought with highest accuracy. The results revealed that in the case of symmetric membership functions, changing the value of confidence level parameter would affect the value of fuzzy spread coefficient. For example increasing the confidence level parameter in case of VHI from 0.7 to 0.8 led to 50% increase of spread. In case of non-symmetric fuzzy coefficient, the peak point is sensitive to skewness factors; such that its value was increased for 22.2% moving from minimum to maximum skewness factor in case of TVX index. The decrease in confidence level parameter of TVX, which represents the degree of fuzziness, confirmed the better performance of artificial neural network in correlating TVX index and rainfall.

Keywords: Drought, ANN, Fuzzy, Rainfall

[1] Assistant Professor, Collage of Agriculture, Azarbaijan Shahid Madani University
(*Corresponding author email address: laleh_parviz@yahoo.com)

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Technical Note

Statistical downscaling of HadCM3 model for projection of temperature (Case study: Saghez station)

S. A. Hosseini[*15], H. Ahmadi[16]

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Abstract
Climate change and global warming are major challenges in 21 century which affects agriculture, water resource and environment significantly. In this study, the outputs of HadCM3 general circulation model were statistically downscaled using LARS-WG model under A1B, A2 and B1 scenarios for projection of T_{max} and T_{min} variables. The outputs for future period of 2046 to 2065 were compared with baseline period of 1961-1990.The Weather generator performance in simulation of temperature data were evaluated using statistical indices of MSE, RMSE and MAE. The projected data showed that both minimum and maximum temperature would rise during all month of future period. This increase is 3.2 and 3 $^{\circ}$C for T_{min} and T_{max} comparing to baseline period, respectively. Highest and lowest increase for both variables was projected by A1B and B1 scenarios. The results may be used in water resource management and crop water requirement calculation.

Keywords: Saghez, Temperature, Projection, General Circulation Model, LARS-WG

[15] Lecturer of Physical Geography (Climatology), Payam e Noor University ,Saghez branch, Iran
(*Corresponding author email address: Hosseini.asad8@gmail.com)
[16] Ph. D. Student in Physical Geography (Agroclimatology), University of Hakim Sabzavari