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Feasibility Assessment for Use of Wind Energy in Ardebil and Zanjan Provinces

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Extended Abstract

Introduction

In comparison with fossil fuels which pollute the lower layer of the atmosphere, use of wind energy has many environmental and economic advantages. Wind is a clean and renewable energy resource and use of the energy in the recent decades has been welcomed so much in the world. Energy plays an important role in the development of each society. All different activities including housing, transport, industry and agriculture may be dependent on this source of energy. The use of clean and renewable energy such as wind has environmental advantages compared with fossil fuels. The increase of population and demand for energy has caused that wind energy potential is considered as an alternative source of energy. Wind speed is the most important parameter of the wind energy. This is used in the analyses relating to this energy because wind power has a cubic relation with wind speed.

Methodology

The parameters of Weibull distribution is used to estimate the parameters related to wind energy

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and determine the sites which have wind energy potential. Thus, it is important to use proper methods in the estimation. In this paper, 6 distinct methods for estimating parameters of Weibull distribution have been considered. For this purpose, 5 synoptic station which have adequate 3 hours wind speed data from 1987 to 2009 (23 years) have been selected. These stations are: Ardebil, Parsabad, Khalkhal, Zanjan and Khoramadare. The method of moments, empirical, graphical, energy pattern factor and maximum likelihood methods and probably weighted moments have been employed to estimate scale (m/s) and shape parameters (dimensionless) of Weibull distribution. For determining the best parameters estimating method using cumulative distribution function of the Weibull distribution (F(v)), expected values have been generated. The Chi square test has been used to select the appropriate method. Cumulative distribution function has also been used in order to calculate the probability that wind speed is smaller than or equal to 5 m/s. In addition to 10 m height, Weibull distribution parameters and parameters related to wind energy potential namely, wind power density (Wm^{-2}), wind energy density ($Kwh^{-1}m^{-2}$), the most probable wind speed (ms^{-1}) and the maximum energy carrying wind speed (ms^{-1}) have been computed in 20 and 40 m.

Results and Discussion

Among considered methods, method of moment because of having higher significance level and lower chi square compared with other methods has been selected as the best one to estimate Weibull distribution parameters. Using this method, scale and shape parameters of Weibull distribution at 20 and 40 m height has also been estimated. Then, wind energy characteristics, namely, wind power density (Wm^{-2}), wind energy density ($Kwh^{-1}m^{-2}$), the most probable wind speed (ms^{-1}) and the maximum energy carrying wind speed (ms^{-1}) have been computed. The results have showed that at monthly time scale and in 10 m height, the maximum value of k was observed in Zanjan and Khalkhal stations on June and the lowest value of k in Khalkhal station in January. The maximum value of c was observed at Ardebil in Februrary and the lowest value of c at Parsabad in November. Using the wind power density all the stations are ordered as following: Ardebil, Khoramdareh, Khalkhal, Parsabad and Zanjan. This order shows that Ardebil has high potential of wind energy and Zanjan has the minimum potential.

Conclusion

We can summarize main conclusions drawn from this investigation as following:

- In this study, among the considered methods, the method of moment is specified as the proper one and using parameters obtained from this method, features relating to wind energy in studied stations were estimated.
- Among the studied stations, the maximum of wind power density is observed at Ardebil. In this station, in 40 meter height the largest value of wind power density which was equal to $491w/m^2$ is also observed. The minimum value of wind power density is observed in Zanjan which is equal to $107.2\ w/m^2$.
- The probability that wind speed is smaller than or equal to 5 m/s was calculated using

cumulative distribution function for the studied stations in 3 heights namely 10, 20 and 40 meter. The results showed that in 10 m height, among studied stations the highest probability belongs to Ardebil. After Ardebil station, the highest probability was observed in Khoramdare.

- In 10 meter height, at Parsabad, Khalkhal and Zanjan in all the year the probability is lower than Ardebil and Khoramdareh. So, in these stations the operating possibility of wind turbines will be low.

Keywords: ***Ardebil and Zanjan Provinces, Shape and Scale Parameter, Weibull Distribution, Wind Energy.***

Identification of Synoptic Patterns Causing Heavy Rainfall in Northern Coast of Persian Gulf

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Extended Abstract

Introduction

Sometimes, the showers of the northern coast of Persian Gulf are very heavy and disastrous and hazardous. They cause heavy damages to the people and the infrastructures of the region. Therefore the economic development of the area is highly dependent upon the identification of the cause and management of these hazardous phenomena. The main factor controlling the surface climate is the pressure patterns of the atmosphere. Therefore, the main objective of this study is to identify the synoptic patterns of these showers. Thus, we can predict their occurrence and mitigate their damages. The successful achievement is dependent on two major factors: (a) the methodology of pattern recognition and (b) identification of actual patterns. Most of the models of pattern analysis are linear while the atmospheric processes are non-linear in nature. Any methodology that neglects the nonlinear nature of atmospheric phenomena would result in inadequate classification of atmospheric circulation. For this reason, this research has used the nonlinear models of classification algorithms to identify the pressure patterns of the heavy rains of the area.

Methodology

The study was based on the hypothesis that the daily atmospheric circulation can be explained by the geo-potential height of 500 hPa level, precipitable water, and the velocity of vertical

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patterns and heavy rainfall, the data have been collected through 15340 days (1966-2007) for these three variables of 289 grid-points, with a resolution of 2.5 degrees, from NCEP database. Daily rainfall data for the same period have also been gathered for Bandar-e-Abbas, Bandar-e-Lengeh, Boushehr, and Abadan stations from Meteorological Organization of Iran. First, the daily circulations as micro-patterns have been classified using self-organizing map (SOM) algorithm, a type of unsupervised neural network. This algorithm begins to calculate the Euclidian Distance between an input vector and all of the weight vectors to find the 'winner' unit (BMU) with the weight vector closest to the input vector. The calculation continues to update all the weight vectors, especially those within neighbouring radius .The iterative calculation proceeds towards the projection of similar data samples in the high dimensional, complex input data space to an identical unit area in the map. As a result, the neighbouring units in the map are similar to each other while distant units are dissimilar. Then, the U*-matrix, as a suitable method for two-dimensional visualization of the trained SOM that enabled us to recognize the degree of the similarity among adjacent units in the two-dimensional map, was employed to identify boundaries among clusters and to extract the actual number of meso-patterns. Finally, K-means method was utilized to cluster these meso- patterns into distinguished macro patterns.

Results and Discussion

The results revealed that SOM, by classifying the micro-patterns into 289 meso-patterns, could discriminate the days of warm and cold periods with an accuracy of more than 99 percent. These patterns were classified into 11 macro patterns through the U*-matrix and K-means models. Through displaying the number of heavy rainfall events in each station on each unit of SOM, it was specified that four macro-patterns explained up to 83 % of heavy rainfall events of the region. These patterns are named as follows: Pattern No. 4 as Syria trough becomes deeper, Siberian high pressure moves towards west, and the moisture of Arabian and Oman Seas move to PG. Similarly, the identification of pattern 6 is possible by Sudan low, subtropical jet stream velocity increase, and its base decreases. Pattern 7 is identified by cut-off low system, very low pressure, and closed low up to upper troposphere. Pattern 9 is specified by two characteristics: (a): the simultaneous presence of warm and cold season components of atmosphere during the seasonal change, and (b) dense isobars over PG.

Conclusion

On the basis of the results, we concluded that the combination of SOM classification method, U*- matrix and K-means clustering methods can be employed as an appropriate instrument to classify nonlinear atmospheric variables, in one hand, and to resolve the problem of extracting the actual synoptic patterns, on the other. Of the four synoptic patterns of heavy rainfall, cut-off low and seasonal transition patterns should be taken into account more seriously because of the persistence and startling nature of their heavy rainfall as well as the vulnerability of society for the probable damage.

Keywords: ***Heavy Rainfall, K-means, Persian Gulf, Self-organizing Map, Synoptic Pattern, U*-matrix.***

The Relationship between Circulation Pattern Types in Sea Level Pressure and Precipitation in Iran

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Extended Abstract

Introduction

The recent developments in computer sciences have considerably affected the application of new methods in climatology. Especially these new technologies have increased the usage of the new methods in climatic classification. The previous classifications were calculated only based on insufficient number of climatic factors. For example, the well-known classification of Koppen was based on precipitation and temperature. In contrary to such threshold-based classifications, the implementation of multivariate statistical techniques has allowed to classify climate without predefined thresholds by grouping individual objects by Jacobeit (2010) methodology. Application of multivariate analysis in climatology is conducted by Yarnal et al (2001). The aim of this paper is to use the classification technique and recognize the circulation patterns at the sea level and their connection to variability of precipitation in Iran. To obtain a comprehensive view of the precipitation in Iran and its effective factors a number of the researches are conducted. Many papers have investigated the main circulation and air masses as effective factors on Iran precipitation. However, there is not an agreement among them and the main disagreement seems to be about the methodology. Khoshhal (1997) using synoptic analysis studied the greater than 100 mm precipitation in coastal area of Caspian Sea. He showed that in contrast to the previous studies, the cold advection of the Siberian anticyclone over Caspian Sea is not the main reason for forming the heavy precipitations and these events are connected to the entrance and settlement of anticyclone and cyclonic systems. Applying the

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vorticity calculation, Alijani (2003) identified the rainy air masses in Tehran.He concluded that the effect of 500 hPa level is stronger than other levels and the cyclonic circulation type create the heavier precipitations.

Methodology

There are two main approaches in synoptic climatology: the environment to circulation and circulation to environment approaches. Because of the high variability of precipitation, researchers used the environment to circulation in their studies (Yarnal, 1993). As a result, the environment to circulation approach is used in this paper as well. The mean daily precipitations of synoptic stations of Iran were collected for time period of 1980 - 2009. The distributions of these stations are shown in Fig 1. Then the point data were interpolated with cell size of 0.057° grid point (5.9×5.9 Km). Totally a number of 46939 cells were calculated and an n × p matrix was created. Where n refers to the days (10958 days) and p refers to the spaces (46939). Using this matrix in daily basis, the Percent area, Mean and maximum precipitation for all area of Iran were calculated. To eliminate the local precipitation and considering only the extensive precipitations, two conditions were defined: the average precipitation of Iran must exceed 1 mm, and over 40 percent of Iran area must receive precipitation. Accordingly, a number of 1548 days of extensive precipitation in the course of study area were recognized. For explanation of the circulation patterns of these events, mean sea level pressure, in a scale of 2.5°×2.5° grid point, NCEP/NCAR reanalysis data from 0° to 100° eastern longitude and 10° to 80° north latitude were collected and a 1548×1189 matrix was created. The Principal Component Analysis (PCA) was used in order to reduce the volume of the matrix. Many researchers have used the PCA and its application in multivariate analysis.

Results and Discussion

The results of PCA over the extensive rain matrix of Iran are shown at table 1. As it can be seen in the table, a number of 48 eigenvalues greater than one which explained 92% of the total variance was obtained. Among these, 15 factors that explained more than 1% of whole the variance were selected. These factors explained 88% of the total variance. Load factor matrix score is the matrix that has a 1548×15 dimension.

Conclusion

In this paper, the connection between circulation patterns on sea level and Iran precipitation was analyzed by applying environment to circulation approach. For this purpose, the daily grid point precipitation with 5.9*5.9 Km dimension obtained 1548 days, with considering a condition that at least precipitation in Iran must be 1 mm and also 40 percent of Iran area must receive the precipitation. Sea level pressures of these days were selected for identification of the main type of the circulation patterns. The (PCA) technique was used for reduction data and with cluster analysis it obtained 5 main circulation pattern types.

The investigation of the relationship between the circulation patterns and the precipitation

events revealed that there are five distinctive precipitation patterns in Iran. These types are including:

Type 1: Interaction between Sudan low pressure and Siberian anticyclone;

Type 2: combination of Mediterranean low pressure -Sudan low pressure and interaction with Azores and European anticyclone;

Type 3: interaction between Sudan low pressure and European high pressure tongue;

Type 4: Interaction among Tibet high pressure, Azores high pressure, and polar low pressure;

Type 5: Thermal low pressures and Indian monsoon system.

Keywords: ***Atmospheric Pattern Classification, Low Pressure Dynamic, Principal Component Analysis, Siberian High Pressure.***

Modelling of Climatic Parameters in Province of Southern Khorasan

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Extended Abstract

Introduction
Climate change has played an important role in all aspects of human life. Therefore, climate predictions in atmospheric general circulation models (GCM) will have particular importance. In this study, downscaling by A1B scenarios, IPCM4 and BCM2 of atmosphere general circulation models in LARS-WG model are used for analysis of climate change impacts on maximum and minimum temperature, solar radiation and precipitation. The data have been gathered from 7 Synoptic stations in province of Southern Khorasan. For this purpose, assessment process of simulation and observation data are conducted by three steps, including calibration, validation and modelling. To evaluate the agreement between the observed and simulated data, two indexes were used; Root Mean Square Error (RMSE) and Coefficient of Determination (CD). The results of analysis in Makesens, Sin's Estimator and Mann-Kendall showed that minimum temperature, maximum temperature and evapotranspiration in all stations will be increased in years of 2011-2060. The results have shown that rainfall in all stations (except Ghaen station) will be decreased and solar radiation in all stations (except Ghaen and Ferdous station) will also be increased. Increasing trend in temperature in Birjand and Ghaen station will be lower and in Tabas Station will be higher. It may be appeared that weak changes in climatic parameters in some stations are related to specific geographical conditions and topography of this region.

Climate change in the past and today would change the pattern of human life and it seems that humans and their activities are causing the global climate change. Uncontrolled growth of

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population, transportation and other human activities, particularly pollution resulted from industries lead to major changes in climate. After the industrial revolution changes in global climate such as increases in extreme climatic events have appeared due to the excessive use of fossil fuels and land use change. At present, this variability has become a major concern of climatologists and weathermen. Therefore, attention to researcher long term forecast about climate parameters for change value help decrease the effects of ill climate change. Atmospheric general circulation models to assess future climate is one of the common methods. Meanwhile, LARS-WG model as one of the general circulation models of the atmosphere is important for future climate change and has led to some efforts by many scholars. The high accuracy of climate data modelling in different climatic stations has been confirmed by many researchers.

Methodology

In this study at first, daily statistics including minimum temperature, maximum temperature, rainfall and radiation related to 7 Synoptic stations in province of Southern Khorasan were obtained from meteorological organization of Iran (Table: 1).

Table 1: Geographical characteristics of the sample stations

Stations	*LON*	*LAT*	*ElE*
Birjand	59 12	32 52	1491
Boshruyeh	57 27	33 54	885
Ferdous	58 10	34 10	1293
Ghaen	55 05	33 47	845
Khour	58 28	32 56	1117
Nehbandan	58 48	36 16	1213
Tabas	56 55	33 36	711

In Second step, some weather data have been produced by using parameters listed in Lars models. Two BCM2 IPCM4 models for each synoptic station in South Khorasan are used in this study to arrive target modeling data under scenario A1B. After entering data into the model Lars-wg and getting the trends in the observed time series data, we have attempted to reproduce the data at the stations during 2011- 2060.. Finally, the simulated data are compared with observed data using statistical analysis and graphing. They have also examined the ability of the model to simulate meteorological data in stations. The Root Mean Square Error (RMSE) and coefficient of determination (CD)have also been applied. If the RMSE values are closer to zero, this indicates the observed and simulated values are closer to each other and to be more precise answers in each step.

Results and Discussion

The results of the research showed that BCM2-A1B models in Birjand, Boshruyeh, Ferdous, Nehbandan and Tabas and IPCM4-A1B models in Ghaen, have the lowest simulated values. Distribution of annual minimum temperature simulated for the period 2011-2060 shows that the minimum temperature in southern Khorasan province is 0.02 per year and the coefficient of determination of 0.09 is increasing and that the minimum temperature during the five decades can be changed between 11.4 to 12.9 degrees. The simulations conducted by LARS-WG models over the next fifty years will change in the average of minimum temperature among the Synoptic stations of provinces, from 7.5 degrees in Ghaen to 17 degrees in Tabas. The average of maximum temperature will also change from 23 degrees in Ghaen to 30 degrees in Tabas. In province of South Khorasan, the average of minimum temperature is 12 degrees and the average of maximum temperature is 26.6 degrees. Increasing trend of temperature in Birjand and Ghaen stations will be lower and in Tabas Station higher. Obviously, due to the lower temperature, the cities of Ghaen and Birjand will experience more precipitation. Nehbandan, Tabas and Khor will have the highest mean radiation in cities and Birjand will receive the lowest evapotranspiration and radiation and Tabas the highest rates of evapotranspiration.

Conclusion

From the results this can be concluded that BCM2-A1B models in Birjand Boshruyeh, Ferdous, Nehbandan and Tabas and IPCM4-A1B models in Ghaen have the lowest differences imulated values with observed values. Results of LARS model simulations for the next fifty years showed an average low temperature in Ghaen and Birjand cities. The Birjand has the lowest rates of evapotranspiration and Tabas the highest temperature and the least amount of precipitation. Ghaen had not seen much rain, but relative to other stations it will have weak increasing trend. The results of analysis of Makesens, Sin's Estimator and Mann-Kendall showed that in the years from 2011 to 2060 we will experience an increase in the minimum temperature, maximum temperature and evapotranspiration in all the stations and also a decrease in all (except Ghaen station). It will also observe an increasing trend in radiation in all stations except for Ghaen and Ferdous.

Keywords:* *Climate Change, General Circulation Model, Lars-WG, Province of Southern Khorasan, Trend.

Estimation of Surface Temperature and Cropping Intensity in Hamedan Province Using Remote Sensing Data

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Extended Abstract

Introduction

Surface temperature and cropping intensity maps are the most important components of the water requirements in basin scale and are also the most difficult to measure. Conventional methods are very local, ranging from region to field scales. Estimates of the Surface temperature and crop density over the entire area, especially for irrigated areas, are essential. Today, surface temperature, actual cropped area, crop pattern and cropping intensity under different conditions can be estimated by using satellite data and Remote Sensing (RS) techniques. In order to obtain the surface temperature and cropping intensity, a set of satellite images have been used. Estimated temperatures have been compared with measured values at 5 cm soil depth in meteorological stations.

Methodology

The study area is Hamedan Province, in west of Iran and at latitudes between 33^{O} and 33' to 35^{O} and 38' north and longitude 47^{O} 45' to 49^{O} and 36' east. The area of this province is 19546 Km^2. According to Climatic diagram of Emberger its Climate is cold semi- arid with the minimum and maximum temperature of 2/8 and 19/2, respectively.

In this paper, we have used data of five meteorological stations in Hamedan and Kordestan

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provinces. A set of 12 Landsat 7 images during the 1998-2002 have also been used. Geometric and radiometric corrections have been performed on all the images. Normalized Difference Vegetation Index (NDVI) and Soil Adjusted Vegetation Index (SAVI) were established. Based on these indicators the surface temperature (T_s) has been estimated using the SEBAL (Surface Energy Balance Algorithm for Land) algorithm and compared by the measured data reported by meteorological stations of Hamedan province.

Six statistical parameters including coefficient of determination (R^2), Root Mean Square Error (RMSE), Modeling Efficiency (EF), Mean Error (ME), Coefficient of Residual Mass (CRM) and Mean Absolute Error (MAE) (Equation 7 to 12) have been used to compare surface temperature of satellite images and the temperature reported by meteorological stations.

Results and Discussion

Results of Normalized Difference Vegetation Index (NDVI) and surface temperature imply that there is high and reversed correlation between these indices Results of comparison of surface temperatures in the dense vegetation surrounding meteorology stations with recorded weather temperature in passing time of satellite show that there is not a striking difference between these parameters.

Results show that Root Mean Square Error between surface temperature of SEBAL algorithm and the temperature reported by meteorological stations for different stations is different from 4/4 to 6/6 degree. Results of modeling of Efficiency index show that all stations with efficiency over 10% are acceptable. CRM index for all data show -0/02 and imply that estimated values have a good precision. The results of Mean Absolute Error index and Mean Error imply that the model with 4/2 error and -0/7 deviation degree from surface temperature are estimated and has acceptable precision. Generally, algorithm of assessment index about estimating surface temperature shows that this algorithm has a relative high precision and coefficient correlation.

Conclusion

Results indicated that there is no significant difference between surface temperature using remote sensing data and the statistics reported by meteorological stations. Primary results showed that there was a significant relationship between measured and estimated surface temperature. The results of correlation coefficient were 0.75 and Root Mean Square Error (RMSE) and Mean Absolute Error (MAE) were 5.4°C and 4.2°C, respectively.

Results of the present and performed researches indicate that remote sensing can play a effective role to determine timely maps of plant cover, air temperature and surface temperature and optimizing usage of irrigation resources. By remote sensing and geographical information system can be used as suitable and confident tool to study dispersion and intensity of plant cover, air temperature, and plant level faced with environmental pressure.

Keywords: Crop Density, Hamedan, Remote Sensing, Surface Temperature.

Detection of Geo-potential Height Changes, Vorticity and Sea Level Pressure of Prevailing Circulation Atmospheric Patterns Impacting Iran Climate

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Extended Abstract

Introduction
The changes in behaviour of climate and meteorological parameters are closely related to changes in atmospheric circulation. The analysis of historical atmospheric troposphere circulation is critically important to global and regional climate change and extremes with regard to its dynamical features. The circulation changes are manifested by a gradual reduction in high-latitude sea-level pressure, and an increase in mid-latitude sea-level pressure associated with one phase of the Arctic Oscillation (a hemisphere-scale version of the North Atlantic Oscillation. Recent observations have found that the tropical belt running around the equator has grown wider, and has expanded by around 2° to 5° latitude and into the adjacent subtropical regions since 1979. Global greenhouse gas emissions contribute to expansion of the tropics (about 0.05° per decade)in the northern hemisphere tropics. The effect of black carbon and troposphere ozone emissions are about twice the size of those due to greenhouse gases alone (about 0.07° to 0.12° per decade). The aim of this study is investigation of variability in the intensity of the monthly geo-potential height, vorticity and sea level pressure over synoptic circulation patterns impacting Iran.

Methodology
In order to accomplish this research, daily grid data with spatial resolution of 2.5×2.5 degree during 1/1/1960 to 31/12/2012 have been extracted from NCEP/NCAR database. The monthly average sea level pressure and geo-potential height in level of 1000 hectopascal is calculated to

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detect the action of spatial kernel of each synoptic system. The for this investigation is including daily zonal and meridian wind components (Uwnd and Vwnd) data, geopotential height data for each levels of 1000, 850, 700 and 500 hectopascal levels, and sea level pressure. Vorticity is calculated by Uwnd and Vwnd components. Then monthly mean is also calculated for each levels separately. Although some circulation patterns can operate in special months and seasons of year but trend analysis has been evaluated for each circulation patterns in whole months and seasons. To detect time series trend, nonparametric Mann Kendal statistic test has been applied. The trend has been tested in 95% confidence level. Sen Estimator is used to calculate trend slope rate.

Results and Discussion

Siberian anticyclone, Sudan cyclone, Mediterranean region cyclones (East Mediterranean, Mediterranean and Black sea) and Monsoon and Persian Gulf cyclones have been selected according to the maps of sea level pressure and geopotential monthly means. In total vorticity, geopotential height in different levels and sea level pressure have significant trend in 95% confidence level. The highest variation is observed for high levels at 700 and 500 hectopascal. In winter season, sea level pressure, vorticity and geopotential in 1000, 850, 700 and 500 hectopascal levels don’t show significant trend. While in spring and summer the trend of vorticity in four selected levels is significant and negative, geopotential height and sea level pressure have positive significant trend. Over cyclonic systems in Mediterranean region, the sea level pressure and geopotential height show increasing trend especially in winter season. The slope positive trend on the Sudan is significant in winter. The trend of geopotential height in four selected levels in winter is positive and significant. In other seasons, the trend is positive except in 1000 hectopascal level. Over Monsoon cyclone system in all seasons, geopotential height is increasing from 1000 to 500 hectopascal levels. Vorticity trend in low levels at 1000 and 850 hectopascal is positive. The increasing geopotential height over Persian Gulf is smaller than other atmospheric circulation patterns especially in low levels. Vorticity rate contrary to other systems is increasing.

Conclusion

Increasing sea level pressure and geopotential height over cyclonic circulation patterns of Sudan and Mediterranean regions especially in cold seasons of year (winter and autumn) result in a decrease in systems cyclonic action, sea level gradient pressure, instability and precipitation in region. In warm seasons of year (spring and summer) negative trend of vorticity and positive trend of sea level pressure and geopotential height result in decrease in warm seasons precipitation and increase in stability. The results of this study agree with findings of some other researchers about increase in warming of troposphere, changes in synoptic systems intensity, instability increase and negative vorticity increase in north hemisphere.

Keywords: ***Geopotential Height, Iran, Sea Level Pressure, Synoptic Systems, Vorticity Changes.***

Spatial Analysis for Production of Climate Classification Maps, West Part of Urmia Lake

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Extended Abstract

Introduction
In the modern era of communication, by increasing population the resources would be relatively scarce. Therefore, in order to deal with environmental serious problems and complex human-climate relationship in all dimensions of spatiotemporal and land use planning and programming practices, the climatic zone map was a sustainable developmental tool in the study area.

Methodology
The climate zones are recognized by investigating the analysis of various climatic factors, different empirical methods and spatial and nonspatial quantitative methods. The natural environmental areas have differential climate zones. Accordingly, different climate zones of Iran especially climate factors and local variables are neither studied nor recognized. Hence, the main purpose of the present study is to produce climate zones map of west part of Urmia Lake by the simultaneous analysis of spatial and nonspatial climate data. West area of Lake Urmia is studied in the present paper as a region of environmental problems; it is the main part of Urmia Township that contains Urmia city. This is the largest and capital city of West Azerbaijan Province. Various climate factors whether of local or global influences affect formation of climate types in the area. Inherent factors are (or genetical) global wind systems like westerlies, polar cell systems and complex local natural circumstances, vegetation cover, superficial water resources, elevation, geomorphology and topographic conditions, geographical directions, and geographical latitude and longitude. Climate producer factors have different properties. Accordingly, analyses of the obtained data are very difficult, so the spatial analysis methods are

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proposed as powerful tools for simultaneous analysis of the different data. In this research, diverse climate data and factors from various resources in different stations of the studied area such as Urmia, Naghadeh, Salmas, Oshnavieyeh, and kahriz together with height and geographical directions data have been analyzed to produce map of different climate zone. Hereby, analysis of different types of data such as spatial and nonspatial data is one of the most difficult challenges in climatic researches. In order to solve this challenge, GIS spatial analysis techniques, spatial and multivariate analysis algorithms such as Maximum Likelihood analysis (MLS), Principal Component Analysis (PCA) and Iterative Self Organizing Data Analysis Technique (ISO data) have been used to analyze different types of data. Structure of variables has been verified by application of the multivariate analysis of PCA method. The number and nature of the factors have also been analyzed to specify the rate and find out how they are affected by climate properties of the study area. By using PCA methods the effective factors have been employed to determine contribution rate of each factor in development of climate area.

Results and Discussion

The results show that there are 4 different climate types: mountainous cold, wet, semi – wet and semi – arid climates in the west part of Urmia Lake area. It is also shown that the local factors (such as height, geomorphologic features including aspect, slope, spatial arrangement of mountains and etc. under the control of external factors such as west, north and southwest wind systems entering into the area, play an important role in the formation of climate types. They also act as a reinforcement or adjustment of climatic conditions. Here, in survey of the present study, the term of named as morpho–climatic subject is as a new phase in studies of climatology.

Conclusion

Investigation of the results shows that the local condition and factors like geomorphology and topographic characteristics of a region in different scales under the control of external factors such as west, north and southwest wind systems play an important role in development of different climate types such as different patterns of the micro regional and local climates. This can be concluded that climate properties are developed by the influence of both geomorphologic and weather conditions of a specific region.

Keywords: ***Climate Zonation, ISO Data, Maximum Likelihood Classification, Spatial Analysis, Urmia Lake.***

Determining Planting Dates for Spring Safflower by Temperature and Digital Elevation Model in Esfahan Province

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Extended Abstract

Introduction
Planting date plays main role in crop performance. Planting date through correspondence with the climatic elements affect vegetative and reproductive growth and ultimately affect the quality and quantity of crops. Among the climatic elements, temperature and day length are more important under irrigated condition. It is necessary to mention that the majority of crops cultivated in Iran are indifferent to day length. The temperature is the most important element in controlling their growth period. By using long-term weather data and related software such as Arc map we can determine the suitable planting dates for a wide area. Therefore, by eliminating field experiment and avoiding large amount of time and cost, much can be saved. The purpose of this study is to determine the best planting dates for spring safflower in different parts of Esfahan province in order to gain the maximum performance in any climatic zone.

Methodology
The minimum, maximum and mean temperature of 51 synoptic and climatic stations of Esfahan province and other neighbouring provinces from 1961 to 2011 have been used to determine the appropriate planting dates of spring safflower in Esfahan province. Using the mean temperature and Kriging method, Esfahan province is divided into three zones including zone 1 (warm), zone 2 (moderate) and zone 3 (cold). For determining the planting dates of spring safflower in different part of Esfahan province daily mean and minimum temperature from January to October as average of 15 days have been calculated and related maps were plotted in GIS environment. Interpolation of temperature was done by Digital Elevation Model (DEM) and

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regression analysis between temperature and height in the GIS environment. Beginning of planting dates in warm, moderate and cold regions were considered to reach mean of temperature to 7, 9 and 12°C, respectively. For determining the growth inhibitory of high temperatures, average of the 15-days mean and maximum temperature calculated from June to September and related maps were plotted in GIS environment. The daily mean temperature of 30°C and the maximum temperature of 37°C are considered as high-temperature inhibition.

Results and Discussion

Delay in spring planting of safflower accelerates the development stages, decrease vegetative growth and yield components, and ultimately cause safflower yield reduction. Early planting dates due to production of higher seed yield are recommended. Thus, if the thermal requirements of safflower provide the safflower cultivation, earlier and higher yield will be achieved.

In the first thermal zone, information layers of the regions were combined that in them mean temperature is reached to 7°C and the minimum temperature to above 0°C. Therefore, in mid-January the eastern and northern half of the province is appropriate for safflower cultivation. In this zone, in east and north parts of the province the planting dates start at January 19 and end in March 6. Khorobiabanak and Biazehbiabanak are stations that located in this region. In the second thermal zone, information layers of the regions were combined that in them mean temperature reached to 9°C and the minimum temperature reached above 0°C. Therefore, in mid-March the areas of south-eastern and central provinces were added to the previous range. In this zone, on some parts in south of the province the planting dates start at March 7 and end at April 4. Esfahan, Kabootarabad, Palayeshgahe Esfahan, Najafabad, and Balan stations are located in this region. In the third thermal zone, information layers of the regions were combined that in them mean temperature reached to 12°C and minimum temperature reached above 0°C. Therefore, in mid-April, additional narrow strip of the north-west to the south of the province was added to the previous range. In this zone, in the other parts of the province the planting dates start at April 5 and end at May 21. Golpaygan, Meymeh, Abyaneh, Daran, Singerd, Chadegan, Emam Gheys, Mehrgerd and Hamgin, Damaneh Freydan, Freydoon Shahr, Badijan, Hana and Khonsar stations are located in this zone. It is noteworthy that in the west and north western part of the province some regions with 2338 to 4405 m height are not suitable for safflower planting due to low temperature.

Conclusion

Based on the results in the first, second and third thermal zones, planting dates in the province is generally started from January and continue to May.. By considering temperature requirements of safflower the suitable planting date must be considered. Cultivation and planting shall not face to limited temperature and in every zone the first planting date is the best time for planting.

Keywords: Digital Elevation Model, Kriging, Planting Date, Spring Safflower, Temperature.

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