Reconstruction of Quaternary Paleo Lake Levels of Urmia by Studying Lake Terraces

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Extanded Abstract

Introduction

Lake Terraces are geomorphological evidence of climate change during quaternary. Location of these terraces location in different elevation shows paleo water lake level fluctuations. Investigation about Urmia Lake terraces was conducted by Bobek (1973).He found those terraces in 45-55 meter above Urmia water level on that time. According to Bobek, development of lake area in paleo Pleistocene period and cold Pleistocene periods was caused by reduction of temperature about 5 centigrade and reduction of evaporation. It is important that we don't have any comprehensive investigation on Urmia lake terraces and many of these terraces and paleo shorelines remained unknown up to now. The aims of this research investigation of quaternary terraces of Urmia Lake represent their elevations and reconstruction of the areas affected by these fluctuations.

Urmia Lake Basin is located in Northwest Iran and in the lowest part of this depression, surrounded by High Mountain with elevation more than 2000 meter above sea level. Urmia Lake is the largest inland lake in Iran and the second largest saltwater lake in the world. Tabriz fault activity causes uplift in this region of northern segment of the fault and it creates a barrier against the flow of surface and underground. This has led to formation of Lake Urmia. This lake is located in a shallow subsidence with an average depth of 6 meters, but its deepest point is the northwest corner with 13 meters deep. There are 102 large and small islands within the limits of the Lake Urmia. Salt water is more than 350 grams per liter.

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Materials and Methods

Geological data, sediment and morphometric data were gathered through library studies and fieldwork. Then, Quaternary sediments in the coastal zone boundaries were reconstructed and paleo lake boundaries were also determined using GIS and RS techniques. Aerial photos, satellite imagery and digital elevation model of SRTM90 m was used. In field work, lake terraces were detected by investigation of sediment laminations, sedimentological characteristics such as Granolometry, color, type, location of strata and specially fossils located in the sediment. Granolometry of the sediments were analyzed in sedimentology lab of Geological survey of Iran using Vibratory Sieve Sahker. Percentage of sand and silt were determined and analyzed using Gradistat 4 software and the curves were plotted. Binocular Microscope was used for paleontology investigation. The elevations of terraces were measured with a Differential Global Positioning system (DGPS). After determining the height of the terrace, the extent of Urmia lake paleo water level was also determined using 150 topographic map sheet at scale of 1:25000. It was related to the block 1:250000 of Tabriz, Urmia, Mahabad and Khoy through a digital elevation model with a resolution of 10 m. Urmia Plao Lake extent was reconstructed based on satellite images.

Discussion

In the recent years, due to the occurrence of hydro- climatic droughts over the past few decades and extensive dam construction on main rivers and high water evaporation, the lake area decreased and experienced significant changes in water level. The lake terraces are the best evidence to reconstruct the paleo geomorphological situation in coastal environment and occurrences of these terraces shows climate change and tectonic phases. Hence, identification of the Urmia Lake terraces was employed to reconstruct the situation of paleo environment. In field studies, the lake terraces were detected by geomorphological, sedimentary structures, sediments grain size and especially fossil collections in the sedimentary layers. Since many terraces are buried in the river sediments, they are very difficult to detect and create the river or human activities such as road construction. Using a sequence of periods of water level fluctuations and long dry periods and wet-laying sedimentary sequences were used for this reconstruction. After identifying the terraces, geographic location and the exact height were also determined using DGPS. In field studies, 24 lake terraces were found in Quaternary sediments. Lowest terraces are located in Islami Island in elevation of 1297 meters and the highest terraces in Damirchi with elevation of 1366 meters.

Conclusion

Elevation of lake terraces are variable from 1297 meter to 1366 meter and consequently the areas affected by fluctuations in lake water levels were different. The maximum extent of lake level fluctuation has occurred in the south part of Urmia Lake. In this region the slope is very low and experienced the slightest change in the water level of the lake. The large extent of this region is affected by water level fluctuations. In the northern and western parts of the lake, impact of water level fluctuations is low due to the steep slope. At an altitude of 1297 meters (terrace Sh-1) the area of the lake was about 9,658 square kilometers. The extent of lake on that time increased about 6560 square kilometers compared to 2011. Gacha Bashi terrace (1311 m in

elevation) in West Golmankhaneh Peninsula is dated by Sabouri (2010) to be resulted about 46,000 years before present. The elevation of the terrace after the gathering and corrections of errors by GPS dual frequency was 1336.6 meter. At that time, the islands of Minadoab, Malekan, Bonab, Azar Shahr, Naghadeh and Mahabad Cities were buried under Urmia lake water. The lake water also reached near the Urmia city. The highest terrace is located near Tsuj (Ts-2) City in Northwest part of the lake parallel to Damirchi DM-1 in Northwest part of Malekan with elevation 1366 meters. The extent of the lake at that time was about 13900 km and the water reached to Tabriz city.

Keywords: eostatic, lake terrace, quaternary, Urmia Lake.

Sources of Dust Storms in South West Iran Using Satellite Images and Weather Maps

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Introduction

The dust storms are one of the climatic hazards in the dry climates of the world. They cause many damages to the environment and humans. One of the aspects of a study to understand the origin of this phenomenon is the formation of foci in the recent years in the areas of research. It has been done in the central regions. The dust storms have gained global scale. This has demonstrated that the primacy of the Sahara has highlighted the importance of some other drylands, including the Middle East, Taklamakan, southwest Asia, central Australia, the Etosha and Mkgadikgadi pans of southern Africa, the Salar de Uyuni of Bolivia and the Great Basin in the USA). The Asiaan dust storms are most frequently originated from Taklamakan Desert of China and the Gobi Desert of Mongolia and their peak is in late winter and early spring. West and southwest part of the Iranian dust are from a local cell. Due to its geographical location in the arid climates of the world, Iran experiences these storms every year; especially in the southwest. That is why this study was undertaken to identify the sources and tracks of these storms in the south west of the country. Dust storms in Khuzestan are likely emerged from sandy deserts, dried lakebeds, or chemically- and naturally-polluted regions in neighboring countries. They are borne upwards and carried by winds to Iran. Those airborne dusts in Khuzestan come from the same source, where is likely an eroded sedimentary environment outside Iran. In general, airborne dusts in Khuzestan are geochemically similar to airborne dusts.

Materials and Methods

Due to its geographical location in the arid climates of the world, Iran experiences these storms every year; especially in the southwest. That is why this study was undertaken to identify the source and tracks of these storms in the south west of the country. For this purpose the daily

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dust data of 12 meteorological stations in the study area were extracted for the 1990-2012 period. Then, two significant waves were selected in the region of the highest intensity. The synoptic method (to detect other patterns and to create effectively two dust storms) and remote sensing technology (to identify the source regions of dust storms) were studied as a common method for the research.

Their source region was determined through the use of NOAA/AVHRR images and their tracks were identified over the synoptic weather maps of the two widespread and intensive storms. The weather maps were obtained from the NCEP/NCAR site.

Results and Discussion

The map of a low voltage 850 hPa in the study area is based on the high altitude and low altitude in northern Africa. This low-voltage high-power suction air could produce dusts in the vicinity of desert region of Saudi Arabia, especially in the desert sucks. Check maps for pressure waves of dust in 2012 showed the pressure difference between the two systems on high altitude and low altitude in Arabia and the Persian Gulf in the Mediterranean winds of 850 hp near the desert region. The storm also showed a map of the surface low pressure with hot dry winds from Arabia Sudan that is contaminated with dust particles to enter the area. The dust rising and dust particles are studied by processing the satellite imagery (SST NDVI) of the Arabian Peninsula (Rub al Khali) and Oman. According to the South East Arabian and Oman, most of the areas of the region are rising and shifting dust particles.

Conclusion

The results indicated that the frequency of dust storms has increased during the study period. It can be concluded that spatial distribution of the dust storms have been increased from north to south. The synoptic system responsible for the development of the two selected storms was a low pressure over the study period. This system caused the inflow of the dust from the deserts of Arabian Peninsula to the study region. The analysis of the satellite images confirmed this finding.

Keywords: dust storms, frequency analysis, satellite analysis, southwest Iran, synoptic analysis.

Fluctuations of Caspian Sea Level and Its Impacts on Distribution of Archaeological Sites in Southeastern Coasts (1st to 3rd Millennium BC)

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Introduction

Iranian northern plain is surrounded by the Caspian Sea in North and part of the Alborz Mountains in South. These two geomorphologically distinct features have created unique climatic conditions. A plain lush with abundant rainfall is result of the proximity of these two distinct geographical regions. As a consequence, the Iranian Northern plain has been in use by human populations since the prehistoric times.

The significance of coastal regions for human occupations has been documented all over the world. Abundance of food resources, access to the fresh water (rivers), and having clear landmarks have all made the coastal regions ideal geographical zones for human populations. In addition to that, proximity to the major water sources (big lakes, seas, and oceans) would regulate the climatic changes, and prohibits drastic alternations of the environment. Archaeological data have shown that coastal regions have also been used for human movements through prehistoric and historic times. Repeated exodus out of Africa is among such events.

Caspian Sea is the largest lake on the earth. Due to its closed drainage basin, Caspian Sea has experienced distinctive fluctuations over time. Paleoclimatic data have shown that the minimum water level of the Caspian Sea was -113 m and the maximum reached +50 m. During each fluctuation episode vast areas have been revealed and large land resources were r concealed.

Archaeological Research on the Southeastern Part of the Caspian Sea: The Southeastern areas of the Caspian Sea have witnessed archaeological research since the mid twenty century. Since the time, numerous archaeological surveys and excavations have been conducted at this region. The researches have provided clear understanding of the settlement patterns during many archaeological periods. Among such periods, Bronze Age (3rd millennium B.C. to 500 B.C.) has received the most attention by researchers. It has been proven that the Southeastern

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areas of the Caspian Sea hosted some of the most well-known Bronze Age archaeological sites of Iran. Among them, Gohar Tepe, Yarim Tepe, Shah Tepe, and Tepe Kelar have experienced several archaeological field missions to reveal tremendous amount of data concerning the socioeconomic structure of the people during the Bronze Age. What did really take place after this period is relatively unknown because the size and type of the archaeological settlements were drastically decreased. Some have claimed migrations to or out of the region and some have even proposed a clear change in the life style due to the apparent shift in the climatic conditions.

Climatic data indicates that during the Bronze Age, the Caspian Sea level was more or less stable in was -35 m. The sea level elevated only 1m during a 500 year period. This implies a stable climatic condition. Around 700 AD, the sea level dropped dramatically to -42 m and finally around 1300 AD the region witnessed the largest sea advancement (-22.5m).

There is no enough archaeological evidence prior to 1300 A.D. as ever reported from the immediate coastal regions and their adjacent areas at the Southeastern Caspian Sea. For years, many archaeologists interpreted this gap as an evidence of abounding the region because of some unknown causes.

Materials and Methods

After reviewing the Caspian Sea fluctuations, this paper attempts to reconstruct the coastline at the lowest and highest variability. The lines needed for this study were calculated using topographic maps and hydrographic basin of the Caspian Sea with the help of "National Center for Caspian Studies". After preparation of the GIS maps, the greatest regressions were marked on them. The maps indicate that the coastlines at the beginning of 3000 BC have been situated far behind the contemporary shore lines.

Conclusion

By combining the climatic and archaeological data, this research has shown that in contrast to the former claims concerning the absence of archaeological settlements at the Southeastern the Caspian Sea, majority of archaeological settlements have been buried under the sediments left by the periodic fluctuations of the Caspian Sea. Among these flactuations, the 1300 A.D. advancement has had the most effective. The Purpose of this research is that all archaeological surveys at the mentioned region must take the sea fluctuations into account prior to the actual field work.

Keywords: archaeological sites, Bronze Age, Caspian Sea, sea level fluctuations.

Trend Analysis of the Recent Seasonal Changes in Subtropical Jet Stream in Climateof Iran

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Introduction

According to the definition of World Meteorology Organization (WMO), as the speed of the air mass is more than 30 meters per second, the jetstream will arise. The core of the jetstream is with baroclinic atmosphere due to the large difference in temperature and wind speed. There are two west jetstreams in the northern hemisphere. The northern jet stream is called polar front jetstream and the southern is called subtropical jetstream. Polar Front Jet Stream produce intense temperature gradient by polar air mass and tropical Polar Front Jet Stream is produced by strong temperature gradient of polar and subtropical air. The subtropical jetstream is produced by temperature gradient in tropopause as limited to the upper troposphere. Subtropical jetstream situation is able to show a seasonal shift, this seasonal displacement of subtropical jet stream can cause the tropical and extra tropical alternative regimes on climate of Iran. The seasonal movement of extra tropical jetstream causes intermittent exposure regimes in tropical and extra tropical. When the jetstream is located over the south of Iran in the cold period of the year, extra tropical climatic factors enter into Iran such as westerliesand cyclones. While jet stream is in northern part of Iran in the warm period of the year, tropical climatic factors will enter Iran. Therefore, recognition of position of this phenomenon is necessary for detecting temporal changes of the other spatial atmospheric phenomena affecting the climate of Iran. On the other hand, possible behaviors in different situations can be recognized by accessing to the jet stream event.

Studies have indicated that the mean latitude of the sub-tropical jet stream in both hemispheres have shifted toward the poles over the last few decades; while, the little changes in the jet stream position has huge effects on the distribution of temperature, precipitation and

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weather patterns. Therefore, it seems necessary to analysize the climate phenomenon, more than ever.

Materials and Methods

In this present research, the related data to the zonal (U) and meridional (V) wind components of for a 60 years period (from 20-80 north degree and -10/-120 east degree and in 200 hap) has been derived from National Center for Environmental Prediction/National Center for Atmospheric Research (NCEP/NCAR) in order to investigate the subtropical jet stream's seasonal trends. To perform seasonal analysis, the data have been separated in seasonal scale by MATLAB. According to the placement of maximum speed in all of the seasons in 200 hap high level, the computation of related process is centralized on these high level data. The computation has been accomplished by liner regression and by the use of Least Square Error (LSE) method. Their result of spatial distribution has been drawn by SURFER software.

Results and Discussion

The results of descriptive analysis in this research show that the maximum speed has been occured in winter and the minimum speed in the summer. The altitudinal range of this phenomenon in the winter is more than the summer. The results of review processing in 4 seasons have been exposed in the study area and the significant trend is 10, 2.9, 11, and 10 % for spring, summer, fall and winter, respectively. The interesting point in this result represents the maximum occurrence of significant equinox seasons. However, the researches were mainly conducted on winter season and there isn't any research about equinox seasons.

Conclusion

The results of this study have revealed that subtropical jet stream's intensity is likely to be reduced in fall and spring in the future century. The results are in a confidence level of 95%. On the other hand, investigation about the zonal and meridional wind component trends of jet stream has displayed in the seasonal changes. The maximum percentage of Eastward changes has occurred in winter than any other season of the year. This has surrounded 7.4 percent of the area. These are occurred in conformity of the jet stream axis in east of Iran, Afghanistan, Pakistan, and India. Northward changes have represented the highest rate in the spring and fall with 10.6, 8.4 percents in the core of jet stream. In summer the trend is significant only in 2.5 percent of the study area. The major changes have occurred in the input and output of jet stream core, and eastward changes has occurred only in this season in winter, northward changes has occurred in 0.7 percent of the area and the eastward changes has occurred in 7.4 percent of the area.

Keywords: jet stream, meridional component, trend, zonal component.

The Role of Saudi Arabian Sub-Tropical High Pressure on the Rainfall Systems on South and Southwest Iran

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Introduction

Subtropical high pressure is one of the main elements of the general circulation of the atmosphere. Annual motion of the circulation plays an important role in movement path of pressure systems and westerlies. Hence, large parts of the planet are affected directly and indirectly by this system. Sometimes the high pressure called the subtropical high pressure belt. It's shown as several cells within 15 - 35 north and south latitudes on the atmosphere map. According to the seasonal changes, the high pressure could be divided into 5-6 single cells. Saudi Arabia cell is one of the high-pressure cells in the cold period. It is generally an independent cell over the Red Sea to the Indian subcontinent and appears in warm period over the North-West of Arabian Peninsula, South West Iran and southern Iraq independently or as merged cells with Africa desert and Azores.

Materials and Methods

To determine the role of Saudi high- pressure on the rainfall in the southern part of Iran, daily rainfall data for all synoptic stations in Khuzestan, Kohkilooyeh, Char Mohall Bakhtaran, Fars, Busher and Hormzgan provinces were extracted in 10 years period (2000-2009). In southern parts of the country rainfall is generally regional. Up to 41 extremely rainfall systems have been determined, as 50% of selected stations have precipitation. Then, position of the Saudi high pressure center were determined in peak rainy day of the system on the 500,700, 850, 1000 h Pa level maps.

To determine the more precise high pressure centers, contour distances of 5 geopotential meters were selected on geopotential maps.To analyze the dominated patterns in system arrangement, and the Saudi high pressure role on the precipitation area, one synoptic patterns

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type more similar to other systems was analyzed. In this analysis, 500, 700, 850 hpa sea level pressure and elevation maps, and 500،700،850،1000 hpa zonal (U) and meridinal (V) wind components and specific humidity quadruplet level maps were used.

Results and Discussion

The overall results of the study are as follows:

1. Saudi Arabian high pressure, on the Sea Level Map, just in half of cases had closed center and for other cases doesn't appear on the map and mostly shown as ridge of high pressure on Tibet.

2. Saudi Arabian high pressure is specified on the 500, 700, and 850 hPa maps level and sometimes comes with 4 - 5 closed counter.

3. Generally high pressure centers are in 15 - 30 north degree latitudes and 75-60 east degree longitudes (on the Oman and Arab Sea).

4. vertical axes show the center of anticyclones from 1000 hps to 500 hpa declination over south east.

5. Abetment anticyclones are the prevailing machomise in the air subsidence from upper level of trophosphere to lower level and caused the air temperature by debating heating with increased potential.

6. By Eastward movement of Saudi Arabian pressure, Eastern Mediterranean trough is developed in lower latitudes and often extended to 10 north degree latitudes.

7. Zonal currents had east and meridinal current in all levels on Arabian… These conditions show adductive moisture by Arab and Oman warm seas into Sudan systems.

8. U wind over Saudi Arabia is west and V wind is in the south. This flow indicated a humid fluex in upper level.

9. In all case studies, the high humidity cells are located on Etoupi and south Sudan. This flow of humidity is diverged from Oman warm sea towards west and then by convection has suddan low so that specific humidity map showed that this humidity suddan low trough is advected over Iran.

Conclusion

Saudi Arabia high pressure is one of the subtropical high pressure systems affecting rainfall areas and periods in Iran. Zonal (west - east) and meridional displacement (North- South) is a very important factor in the development, strengthening and accession of Sudan system in cold period. When the pattern of Saudi Arabia high pressure system movement is prevented from formation, strengthening and accession of, the main parts of Iran is prevented and the country is faced with decreasing rainfall. However, its good position will result in deepening ability of Mediterranean trough and strengthening of Sudan system.

Keywords: Iran, rainfall systems, Saudi Arabian sub-tropical high pressure, south and southwest.

Identification of Synoptic Patterns Influencing Formation of Temperature Anomalies in Iran and Europe

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Introduction

Climate is a system consisting of atmosphere, lithosphere, cryosphere, hydrosphere, and biosphere. This system is involved in the exchange of energy and moisture among these five components. The exchanges link the atmosphere as the central component of the climate to other spheres. Changes do not occur separately in this system; rather change in one component contributes to reaction of other components. In synoptic scale, changes in each of these components cause changes in atmosphere patterns and changes in the climate of regions are affected by these patterns. In terms of climate, Iran is located in transition zone and influenced by different weather patterns in different seasons of the year. One of the effective ways to understand the changes and occurrence of temperature extremes is to identify the effective mechanisms in their formation. This study examines the effective synoptic patterns during the different temperature conditions between Iran and Europe to detect their relations in the past.

Materials and Methods

In order to fulfill the present study, statistical-synoptic methods were used. To determine cold and hot cycles, data of maximum, minimum, and average daily temperatures in 30 synoptic stations in Iran and 19 synoptic stations in Europe were used for the identical statistical periods of 50 years (1950-2010). The years and days with a minimum of ±0.2 score in 70% of stations and the average of ±0.5 for the sum of stations in those years and days were selected as samples for examination. After processing the data, a total of 220 cold and 117 hot days were extracted. Principal Components Analysis (PCA) and hierarchical clustering was used as techniquesto determine the synoptic patterns of warm and cold periods. Due to the similarity of patterns,

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finally 6 overall patterns were obtained for the cold cycle and 5 overall patterns for the hot cycle. Finally, the data for Earth surface temperature, sea level pressure, geopotential height, and V wind were received and the synoptic maps were prepared and interpreted.

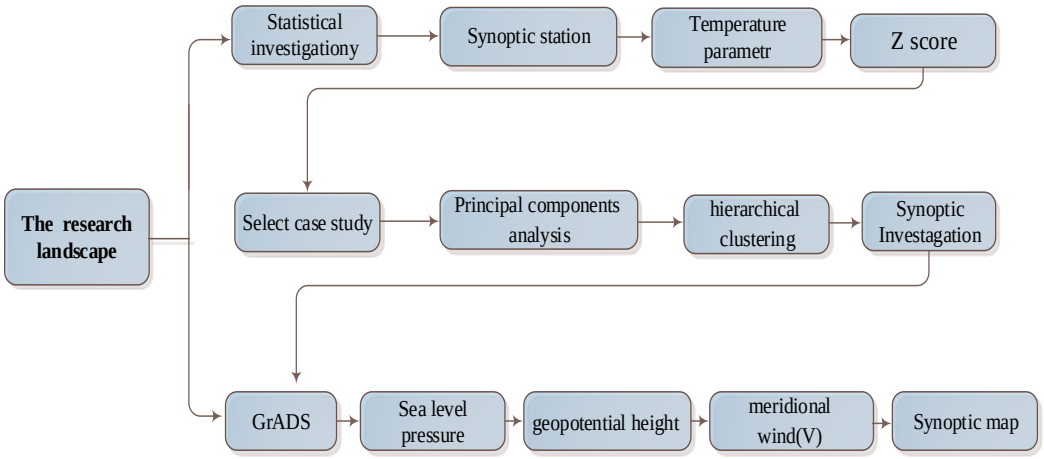

Fig. 1. Steps of the Research Process

Results and Discussion

Statistical analysis of the average temperature data for the study period indicates some different situations. These situations are: 1) identical cold period in Iran and Europe, this cold period is more visible between 1956-1976, 2) identical hot period for Iran and Europe, one of the hot periods with a suitable hot sequential is between 1998-2010, 3) the period of hot Iran and cold Europe, recorded in 1963, 1970, and 1987, 4) the period of cold Iran and hot Europe, observed in 1983, 1989, and 1992. In the results, the year 1972 was identified as the coldest and 2010 as the hottest year for Iran in the study period. Based on the obtained data from the principal component analysis and clustering, six overall patterns were obtained for the cold period, with highest frequency in Omega blocking (19) and Europe stack (12). Blocking system disrupts the normal flow of west winds, and turns tp dominate flows from U to V states. As a result, the location of blocking system plays an important role in creating atmosphere patterns and climate conditions in the affected areas. Generally, in cold periods, turning of west winds to V winds as a result of the dominance of identified patterns has caused advection and falling of cold air in the shape of North flows to the region under study with temperature records lower than average. In hot periods, based on the results of clustering, factor scores and combination of similar patterns, finally 4 atmosphere patterns were identified which led to strengthening of the subtropical high pressure belt on Iran, with two patterns of Europe stack (14) and north position of subtropical high pressure belt (12) with highest frequencies. The abnormality of west winds and their meridional blowing helps advection of hot air in the back of stack and the front of west trough and also meridional direction and strengthening of the subtropical pressure, with temperature records higher than usual. Moreover, it has increased the retreating of west winds, movement and positioning of high pressure belt over summer over northern latitude of the region.

Conclusion

Although climatic conditions of any region are affected by various factors and also different from its surrounding areas, some climate phenomena of same origin can operate at a larger scalein different areas. The present study aims at determining the identical synchronic temperature cycles in Iran and Europe according to synoptic patterns. To achieve this goal, temperature data of synoptic stations in Iran and Europe and data of various atmosphere paterns were used. Processing of the temperature data of the selected stations in Iran and Europe indicates identical/synchronized and opposing temperature cycles between the two regions.

Processing the temperature data in Iran indicates the frequency of cold cycles in the past and significant increase of hot years in the recent decades especially between 1990 and 2010,. Thus, 1972 was identified as the coldest and 2010 as the hottest year during the study period. Synoptic results show that formation of blocking systems and their movement in west wind contours was the main cause of cold cycles. In cold cycles under study, positioning of the region under study in the eastern part of Omega blocking and positioning of a strong stack over Europe and movement of west wind contours and their stretching towards upper width can lead to movement of cold air in the upper width to Iran region. In hot cycle, fostering and expansion of subtropical high pressure centers and belts play an important role in shaping hot abnormal cycles. Synoptic maps during hot cycles indicate the progress of subtropical high pressure belt in U and V directions. Unusual movement of the system contours to north widths in addition to pushing back the west winds by hot air advection in lower width has caused hot years in the region under study.

Keywords: ***advection, blocking, principal component analysis, subtropical high pressure, temperature patterns.***

Zonation of the Intensity of Carbonaceous Rocks in Southern Zagros (Case Study: Seif Abad-e-Laghar Basin)

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Introduction

The Iran has vast areas of karst landforms due to the relatively high carbonaceous rocks deposited during different geologic eras. Karst landforms are noteworthy for investigation from many aspects. The primary importance of these regions is the considerable amount of underground water stored in karst formations. These reserves are favorable, both in quality and quantity, as natural resource for human. In addition to the studies performed to identify karstic regions of Iran, studying the geomorphologic aspect of karstic areas could be a noticeable contribution tothe studies related to underground water resources. In a total review, necessary and effective factors for karst formation and development are divided into chemical, physical and hydrological groups. Usually seven elements act together to form karstic landforms: precipitation, elevation, lithology, carbonate rock thickness, Carbon Dioxide pressure, temperature and Tectonics. Although all these elements would act as an independent factor, the dissolution of karst in the real world is mainly affected by two major factors: precipitation and temperature. It should be mentioned that when temperature is low, precipitation variation has little effect on karst dissolution rates, but, when temperature rises to 16–20°C, karst dissolution rates rise quickly as precipitation increases. Since the carbonate rocks are solvent to acids, and since the temperature and precipitation cause the formation of Carbonic Acid by solving CO^2 into precipitation water, the two mentioned factors highly control the karst Process. Furthermore, the karst dissolution is a function of water and temperatureand any factor that could increase the contact between karstic lands and water- such as drainage network, faults,

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and etc- may also increase karst dissolution. Therefore, in this research, the authors have tried to make a zonation of the mentioned basin for karst dissolution suitability using Fuzzy Gamma coefficient.

Materials and Methods

A) Study area

The study area of the research is Seif Abad-e-Laghar which is located between northern latitudes of 27°50' and 28°06 and eastern longitudes of 52°51 and 53°16. Seif Abad is a sub-basin of the Mond great basin located in the Kazeroun County. The area has an area of 1244.82 square kilometers and a perimeter of 192.2 kilometers. The average precipitation of the basin is 298.5 millimeters and the average temperature is 22.7 C° degrees. There are 12 wells to measure the quality and quantity of underground water in the study area.

B) Materials

In order to perform the study, after reviewing previous studies, 9 parameters were selected as final variables: precipitation, temperature, sinkhole density, distance from sinkholes, drainage network density, distance from streams, faults density, distance from faults, and slope. To achieve these variables, data were gathered from different sources: climatic data were obtained from Iran meteorology organization, hydrology data were obtained from Iran Water Company and Fars Province's regional water. Physiological data were also extracted from the Digital Elevation Model (DEM) of the region. Then, data were entered into ArcGIS 9.3 to produce the variables using spatial analysis functions and ArcHydro tools.

In order to combine the variables, the Fuzzy Gamma was employed. Based on Fuzzy sets theory, a fuzzy set is a set in which the amount of membership for each factor is between zero and one. The membership degree is determined using experts' ideas. Then, the fuzzy combination functions are used. Five functions of fuzzy subscription, fuzzy community, fuzzy multiplication, and fuzzy sum are used to combine the factor sets. In this research, various Gamma coefficients were used to make zonation of the intensity of karst dissolution. To choose the most appropriate gamma coefficient for such mean, a correlation coefficient between each layer derived from gamma estimation and interpolated Calcium ion layer (as a factor of dissolved carbonate). The coefficients showed that the highest correlation exists between gamma 0.4 and the calcium ion interpolated layer. Hence, the gamma 0.4 was employed to calculate the final zonation map.

Results and Discussion

After converting the factors into fuzzy layers and applying the gamma 0.4 and combining the data, the final map was calculated and drawn. Then, the final map was divided into 5 classes of very low, low, moderate, high, and very high. It was based on standard deviation. The results showed that the basin is in a low dissolution rate. The spatial distribution of karst dissolution is also heterogeneous. According to the relative homogeneity of precipitation, temperature, drainage density and distance from streams in the basin, these factors do not seem to be as much effective as other factors. Elaborately, regions with high karst dissolution are mainly coincident with the areas with high sinkhole and fault density, and low slope. Generally, the main direction of regions with high and low dissolution is fubction of the general elevation and topography in

northwestern- southeastern direction. In a geological view, the area with maximum dissolution rate is located on the terrace deposits. A part of the second erosion area is also located on the terrace deposits and the other part is located on the Bangestan. Studying the area of each dissolution class shows that more than 80 percent of the basin's area is in very low and low classes and only 2.82 and 3.93 percent of the basin is in very high and high dissolution classes, respectively. Therefore, it could be concluded that the basin has a low dissolution of carbonate rocks. Thismight be due to the low precipitation rate over the basin.

Conclusion

The dissolution of carbonate rocks seems to be significantly dependent upon precipitation rate and temperature. However, it is also affected by some other variables such as the purity, thickness, and the age of the carbonate rocks, which are not studied in this paper. In this research, it was revealed that the gamma 0.4 coefficient works the best in predicting and interpolating the carbonate rocks dissolution rate.The minimum and maximum dissolution areas are located respectively in north and southwest of the basin. Besides, the maximum dissolution in non-carbonaceous and carbonaceous rocks occurs in terrace deposits and Bangestan group, respectively. Furthermore, the minimum dissolution rate was estimated in Bakhtiari Conglomerate (non-carbonaceous) and Asmari and Jahrum Formations (carbonaceous).

Keywords: fuzzy Gamma, karst dissolution, limestone, Seif Abad-e- Laghar Basin.

The Role of Subtropical Jet-Stream in Daily Precipitation More Than 10 mm in Zayanderood Basin

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Introduction

Zayanderood basin is one of the major internal river basins in the central Iran, where Zayanderood River is the only permanent river. Fluctuations in rainfall in recent years have affected different areas of Iran. Because of the dependence of the provinces of Isfahan, Yazd, and Kerman on water resources of this basin, changes and fluctuations in precipitation within this watershed have had many social and economic consequences with bad outcomes in regional, national and international dimensions. Therefore, knowledge of mechanisms governing the procurement and availability of water resources in the basin can be helpful to develop strategies to deal with social and economic stresses. This can happen with more confidence, planning and proper management of water resources in the basin.

Due to the importance of rainfall as a component of water supply in arid countries such as Iran, much research effort has been focused on understanding the rainfall mechanisms and its adverse effects. Among researches conducted in this field, we can note Moradi (1996: 54), J. cream (1999: 130), Nasir Ghaemi (1999: 184), J. and Zulfikar (2005: 234), B. et al (2012: 85), and Light and Ayldrmy (2012: 197). This study aimed at identifying the synoptic patterns of precipitation of more than 10 mm as an effective kind of rainfall to provide water supply and understand the origin and characteristics of precipitation patterns contributing to more rainfall. This would lead to a better planning process that could facilitate the optimal utilization of water resources in this basin.

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Materials and Methods

The research method is an inductive and synoptic method on environmental circulation. The daily rainfall data were obtained from synoptic, climatological and rain gauge stations in the watershed basin within the period of 1987-2011. The days during which at least two stations had more than 10 mm of rainfall were recorded and extracted and then the daily precipitation values in the basin stations were grouped. Finally, the days were up to 266. The data file maps of geopotential heights at 1000, 500 and 300 mb levels and orbital wind (U-wind) data from were extracted. After storing the data within the time period, theywere taken and sorted to be processed by Excel using writing macros. It should be mentioned that the digital data were produced for mapping in the form of latitude X, longitude Y, and Z geopotential heights for 365 or 366 days per year. The advantage of this method, compared to other methods, was that during 365 days of one year, length, width and related components could be available as a kind of Excel file. The data were filtered in the study day for each year. Thus, based on daily precipitation of more than 10 mm in the basin, data maps of 266 days were prepared. For the purpose of getting the weather patterns, the **S** method along with Synoptic and Principal Components Analysis (PCA) without rotation was used for classification. As the last step, cluster analysis with Ward method was carried out on factor loadings and 266 days were classified into 4 groups. The Ward method was used for the determination of the clusters and the Squared Euclidean Distance was used to determine the distance between clusters.

Results and Discussion

Based on the results of Principal Component Analysis, 266 days in a year were summarized in 9 factors. The first factor alone would explain 38.1 percent of variation in the data and a total of 3 factors could explain 86.1 percent of variation in the data. Therefore, by dividing the days into four groups, the maximum correlations within the group and the highest diffraction between groups were obtained. Thus, these four patterns of rainfall were found to cause river basin rainfall of more than 10 mm.

Pattern 1: Dept trough Siberian - Eastern Mediterranean Sea; the geopotential height maps at 500 mb load in pattern 1 showed a curved trough in North- East, South West, which had been stuck on the Black Sea and East Mediterranean. According to this model, Zayanderood basin was located in the Eastern side of the trough. This process led to the ascent of air over Zayanderood basin and the occurrence of rainfall in the region. In this model, Zayanderood basin was placed on the left of the air rising in the east-west of the axis of Jetstream and associated with the creation of precipitation.

Pattern 2: Mediterranean pattern; This model could explain (21.4%) conditions in the upper, middle and ground surface levels of the atmosphere for the occurrence of precipitation of more than ten millimeters in Zayanderood basin. In other words, the typical pattern of occurrence of this precipitation belongs to the Mediterranean pattern. In this model, the alignment of Jetstream with little curving to north-east was located between the Red Sea and Persian Gulf towards the center-left output of Jet stream axis. This influences air advection ascent on the East axis of Western wind wave. The location of trough axis in the central Mediterranean Sea was associated with the core center position of subtropical Jetstream.

Pattern 3: Red Sea - Black Sea trough pattern; the average holding position of the trough on

this model was located on the Red Sea and the average holding position of Jetstream was located between the Black Sea and the Persian Gulf on the Arabian Peninsula. Adaptation of the left output to axis Jetstream on air advection ascent in the East-West axis wind led to increased instability of waves and heavy precipitation in this model. The most typical pattern was the Sudanese form in this pattern.

Pattern 4: Trough of Turkey – Red Sea; on the map with the height of 500 mb, we observed that a trough was located on the Turkey – Red Sea in the West of Iran. This was converted to the stack in the more northern latitudes of Russia. The transition region from the trough to stack was located in the North West of Caspian Sea. A very low core speed at the level of 200 mb was obvious above this area.

Conclusion

The subtropical jet-Stream on daily precipitation of more than 10 mm and more than ten mm affected the water supply in Zayanderood basin. These were analyzed to come to a good understanding of the effective systems of this precipitation. By using Factor Component Analysis and hierarchical clustering techniques, daily maps with precipitation of more than ten mm were classified into four patterns in Zayanderood basin. Our study indicated that East Europe with trough East Mediterranean and the Red Sea had comparatively heavier precipitation in the basin. Furthermore, the location of the center of the low height in 1000 mb level played a key role in the suction of Mediterranean and Red Sea moisture to low pressure systems of precipitation. On the other hand, the core position of subtropical Jet-stream in the creation of the ten mm rainfall was very effective in Zayanderood basin. This was especially the case when Subtropical jet stream core speed coincided with the core speed of the polar front Jet-stream. In this situation, it was found to have more influence on the creation of an effective rainfall. All models, as determined by means of maps, showed that overlaying of the left output of subtropical jet stream core on the upwelling of westerly winds wave in the left position of trough was very effective in increasing positive vortices and intensifying instability. Our review also revealed that compliance of the trough axis with the mid-latitude trough in the Western Iran was more important in enhancement and creation of instability and precipitation in comparison to the adaptation level of 500 mb of synoptic conditions with the surface pressure. Other results also showed that the influence of the mid-latitude trough was associated with subtropical jet stream. This can lead to the establishment, development and expansion of the low pressure of Red Sea. Strengthening of the subtropical jet in the Red Sea was mainly because of the influence of mid-latitude trough in the East Mediterranean. These factors could increase the pressure gradient over the region.

Keywords: factor analysis, precipitation, subtropical jet-stream, Zayanderood Basin.

The Use of Climate Desing Knowledge in Urban Spaces Design Emphasizing on Thermal Comfort– Design Realization and Results of Soheil Project

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Introduction

Science of climatic design is defined as a set of theoretical principles and practical methods of management. The knowledge wants to provide a suitable living environment leading to healthy life based on sustainable development and the coherence relationship between the concepts of climatology, architecture and urban design. This attempts to provide aesthetic elements as the main criteria for the development of cities along with making profound effects on the use of sustainable energy with thermal comfort and reduction of energy costs. Therefore, the metropolitan such as Tehran is evident in this case. In addition to loss of preparation in providing thermal comfort conditions in the space activities, no consistent pattern, standard and desirability are observed for the development of its space, except inspecial cases. As a result, principles of climatic design could be used as an important factor in the context of solving the problems. In this case, using the Micro-climate simulation models is necessary for a better understanding and detailed calculations of the way of operation and influence of climatic elements in the design of urban spaces. This seems essential to achieve a consistent and stable pattern by providing thermal comfort conditions. Because, using these models can contributes to estimation of the performance of designed space to take the benefit of effective climatic elements influencing thermal comfort. According to what stated, the presented study focused on assessment ability and rules of climatic design knowledge in creation of a Good Life Center, using three-dimensional microclimate model ENVI_met®. Moreover, observation of the ability

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of climatic design principles in creation of a real space in the city is based on thermal comfort conditions as another aspect of this research.

Materials and Methods

In this study, for designing a site based on climatic design principles, first atmospheric data on the required variables were collected from Mehrabad Airport Weather Station. They were analysed in Autodesk Ecotect-Analysis software. Thereafter, output data from Autodesk Ecotect software were merged by techniques of library and review of the studies. This finally will lead to the design of the site. In the final stage, the pattern designed in the Envi-met model (version 4) was simulated.

Results and Discussion

Results of this research indicated that how the climatic design science principles in creation of urban space contribute to creation of an environment based on thermal comfort suitability. For example, evaluation of massing site, deviation of main façade of masses with flexibility in using radiation energy,predominant wind flows,the use of vegetation in the green roofs, brick on sidewalk surface, and applying networks of gullies made the area able to create thermal comfort for all seasons.

Therefore, site simulation results in the microclimate model ENVI_met ® showed that temperature and relative humidity of designed space in the warmest month (July) were 24.60 ^{o}C and 50%, respectively. This is in comparison with maximum average temperature of 37 ^{o}C and relative humidity of 20% in the coldest month (October) because of use of solar energy.Effective temperature level in designed space reached up to 15 ^{o}C while maximum average temperature of environment was 9 ^{o}C. Thus, it can be argued that biosphere designed on the basis of principles of climate designing science will be a good bio-climatic state. The complex is agreeable with natural environment and human condition.

Conclusion

Improvement of thermal comfort conditions in urban areas, especially open spaces, is the main aim of each bioclimatic design. Thus, the sufficient knowledge about the most important tools of science of climate designing is very important. Results of designing of a real urban project with area of 9207 square meter is based on the principles of science of climate designing and simulation in the three-dimensional microclimate model by ENVI_met®. This indicated that designing and building a mass-based investment analysis chart (S.R.W.R) is the result of combination of both solar radiation and wind rose region. As one of the tools of the science, this analysis directed the urban spatial structure in the forms that sidewalk networks during days of July are exposed to direct sunlightwith breezein peak hours ofdaily temperature and that in winter while receiving direct radiation of sunlight at noon the temperature is effectively increased up to 15 C° degrees on the sidewalk networks. The use and suggestion of cold traditional flooring techniques in sidewalk networks are application of brick in contrast with modern floorings such as asphalt. The widespread use of vegetation in green roof patterns and networks of gullies are supplement to increase the effects of designing and securing the thermal comfort conditions in context of the site. This could be as general principles of rules the

knowledge in designing of urban spaces in the areas with dry and warm summers. These are the principles that their application in designing fabric site created space that decreased the average of maximum air temperature from 37 C° degrees up to 24.60 C° degrees in July. In general, there is a claim that the use of the knowledge in design of urban spaces provides stable coherent pattern in the structure of urban space and different patterns of fabric in comparison with each other, in addition to supplying thermal comfort conditions.

Keywords: climatic design, Envi-met, Tehran, temperature, thermal comfort.

Analysis of the intensity of Alluvial Fans Hazards in South Binalud Based on Acceptability of Morphotectonic Indices

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Introduction

Alluvial fans are depositional landforms developed on a confined channel emerged from a drainage basin, i.e. between a mountain range and a plain. An alluvial fan is a fan- or cone-shaped deposit of sediments crossed and built up by streams. If a fan is built up by debris flows, it is properly called a debris cone or colluvial fan. These flows come from a single point source at the apex of the fan. They move to occupy the positions on the fan surface over time. The fans are typically found where a canyon draining mountainous terrain enter out onto a flatter plain, and especially along fault-bounded mountain fronts.

Alluvial fans have gentle slope, cone-to fan-shaped landforms created over thousands to millions of years by deposition of eroded sediments at the base of mountain ranges. They are easily recognized in arid, to semi-arid environments such as that of the bajada of southern Binalud. A convergence of neighboring alluvial fans into a single apron of deposits against a slope is called a bajada, or compound alluvial fan. The term active refers to that portion of an alluvial fan where deposition, erosion, and unstable flow paths are possible. If flooding and deposition have occurred on a part of an alluvial fan in the past 100 years, that part of the fan can be considered active. This conclusion can be supported by historic records, photographs, aerial photography, and engineering and geomorphic information. The main objective of this paper is to study the relationship between morphotectonic properties and alluvial fans hazard intensity in the alluvial fans located in the areas of southern Binalud.This is to understand vulnerability of settlements established in these fans. Alluvial fans can be a source of major hazards. Recognizing the type of depositional process (e.g. debris flows, rock avalanches, and sheet floods) in the early stage of urban planning and land development will prevent loss of lives and damages to infrastructure. According to the correlation between active tectonic and hazard intensity, the study has analyzed urban vulnerability of alluvial fans.

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Materials and Methods

To analyze urban vulnerability and hazard intensity of the alluvial fans, the research employed four morphotectonic indices including Vf, AF, Smf and fan conically index, and tectonic degree of each alluvial fan. Then, using acceptability index and central weight vector was measured for utility of each morphotectonic index by weight vector and effectiveness on urban vulnerability. The rank acceptability index describes the share of parameter values granting alternative xi rank r. The most acceptable (best) alternatives are those with high acceptability for the best (smallest) ranks.

The central weight vector is defined as the expected center of gravity of the favorable weight space. The confidence factor is defined as the probability for an alternative to be the preferred one with the preferences expressed by its central weight vector. Ultimately three hazard classes were identified for risks of alluvial fans.

Results and Discussion

The results of the study indicated that three alluvial fans involving Bozmehran 1, Kharv and Darroud have been gained most acceptability for the first rank. The results showed that Vf and Smf are main morphotectonic indices to high acceptability for Kharv and Darroud. This status in the Bozmehran1 was approximately equal for all. The vulnerability classification showed that alluvial fan of Bozmehran 1 has high intensity and then population of this region is in face of geomorphological hazards. This condition is also true for Bozmehran 2.

The acceptability analysis for Nishabur city as the main settlement established in the alluvial fan is different. The result showed that Nishabur obtained moderate vulnerability class which refers to ratio of alluvial fan shape in this area. In spite of active tectonic for AF and Vf, shape ratio 1 for this alluvial fan decline the effects of other tectonic indices. In general, landslide and flooding hazards are probable and possible according to the faults and climate conditions in Binalud. Therefore, a risk management is needed to manage the urban areas developed on the alluvial fan located on Binalud.

Conclusion

Alluvial fans are flat to gently-sloping masses of loose rock material (largely sand and gravel) that are shaped like an open fan. They are formed at the base of mountains where fast-flowing streams meet relatively-flat surfaces of basin floors or broad valleys. In this research, correlation between tectonic condition and hazard potential has been analyzed on the alluvial fans located in south Binalud using acceptability index. It can also be concluded that the cities of Bozmehran, Kharv and Darroud are highly vulnerable to the hazards.

Keywords: acceptability index, central weight vector, morphotectonic, vulnerability.