The role of transmitted moisture changes in occurrence of drought and wet years in Iran

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Received: 25/10/2017 Accepted: 22/05/2019

Extended Abstract

Introduction

Atmospheric moisture resources affecting rainfall in a region are one of the most important issues in atmospheric sciences. In addition, understanding the mechanism of initiation and transfer of atmospheric moisture help know water cycle in a region. The main components of water cycle are the evaporation from land surface and oceans, transfer of water vapor from ocean to land, precipitation over oceans and lands and the recurrence of water from land to the ocean. Consequently, the percentage of moisture flow of a region and the amount of evaporated water could be assessed using atmospheric moisture flow and observed precipitation.

Therefore, the effect of evaporation from water bodies and transfer of atmospheric moisture on precipitation could be determined by mechanism. The spatio-temporal variations of precipitation could be investigated by study of moisture fluctuation due to variations in atmospheric circulation in drought and wet patterns conditions. Therefore, in recent study the difference in atmospheric patterns of drought and wetness conditions, moisture flux and water resources can affect the transfer of moisture over Iran in various atmospheric levels.

Materials and methods

In this study, we have analyzed the data from the ERA interim center of Europe in medium-term forecasts (ECMWF) with a spatial resolution of 1 ° * 1 ° of geographical latitude and longitude for the period 1981-2011.

Precipitation data have also been used in order to find the wet and drought patterns in Iran. Moreover, geo-potential height, specific humidity, zonal and Meridional components of wind in 00 and 12 UTC of 1000, 850, 700, 500 and 300 hPa have been used for analysis of atmospheric moisture source.

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Standardized Z-Index has been used to determine drought and wet patterns over Iran and the percentage of occurrence of the patterns worked out yearly. The year with maximum percentage of occurrence of drought and wet periods is selected for further analysis. In next step, precipitation periods of selected years with precipitation values more than 1 mm and minimum 30 percent of affected area were determined for estimating contribution of water bodies in the periods.

The total vertical divergence of moisture flux were calculated in 1 ° * 1 ° of geographical latitude and longitude networks in lower, middle and upper levels with total atmospheric thickness over Iran for selected years. In the next step, the positive and negative values of moisture flux of each network were derived for Iran and water bodies out of Iran, respectively.

Finally, atmospheric circulation and specific humidity maps of precipitation periods of wet and drought years were prepared and analyzed for 850, 700 and 500 hPa as a indicator of lower, middle and upper levels, respectively.

Results and discussion

The results of calculation of Z-Index showed that the 1995-96 and 1999-2000 were determined as wet and drought years with 87.3 and 98.7 percents, respectively. The humidity flux and percentage of variations for all layers were more in wet year as compared to the drought year.

The transfer of moisture in wet and drought periods was related to Arabian Sea over Iran. The Mediterranean and red seas were in the second order, Persian Gulf in the third order, and black Oman and Caspian seas in the next orders in both wet and drought periods. The Arabian and Caspian seas had no impact on moisture due to the flow patterns in middle atmospheric levels. Therefore, the Mediterranean Sea had the most contribution for transfer of moisture over Iran. In upper levels, the contribution of water resources in transferring the moisture was the same as the middle levels, although, the amount of moisture flux was changed.

The results also revealed that the southern border of the country is the most important direction for the entering moisture, especially at lower atmospheric levels. It might be due to the fact that the southern water bodies and Arabian Sea are the main moisture sources at atmospheric lower levels. In overall, the atmospheric low levels played a significant role in transferring moisture in Iran at all directions and the atmospheric upper levels. Hence, the southern and western directions had more contribution to the process as compared to other directions.

Conclusion

The results showed that the air flow pattern over the region and position of water bodies play a remarkable role for imported moisture variations over Iran. The moisture flux at wet period was more at all levels. In addition, Arabian Sea at atmospheric low level and Mediterranean Sea at medium and upper levels had more contribution for transferring moisture content in Iran. Moreover, the results showed that southern border were in first priority and western borders in second priority for importing moisture at atmospheric lower, medium and upper levels over Iran.

Keywords: Drought, Humidity, Divergence of Humidity Flux, Standardized Z Index, Iran.

Simulation of Gorgan Synoptic Station Temperature and Precipitation with RCP Scenarios

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Received: 08/05/2019 Accepted: 02/09/2019

Extended Abstract

Introduction

The Earth's climate has been constantly changing throughout the planet history. The industrial revolution and human intervention in the environment in the recent decades made special conditions for rising global temperature. Increase in Earth's temperature has modified the climatic balance by which widespread climate changes have been occurred on the Earth's surface. To study the effects of climate change on different systems in future, the climate variables should be initially simulated. There are various methods for simulating climatic variables; the most prudent of them is the use of the outputs of atmosphere-ocean general circulation models (AO- GCMs). Since these models can simulate climatic variables in large spatial and temporal scales, to use these simulated variables in smaller scales, the output of these models should be scaled down by various techniques. The microscopic statistical method, including the SDSM model, has more advantages, especially when it comes to lower costs and quick assessment of the factors affecting climate change.

Method and methods

The purpose of this study is to predict climate change by the SDSM model using the CanESM2 Climate Change Output based on RCP8.5, RCP4.5, RCP2.6 climate change scenarios for the coming periods of 2040-2011, 2070-2041, and 2100- 2071, as well as to study the annual trend of these changes using the Man-Kendall test and the age-related slope estimator. For this purpose, daily data of rainfall and temperature parameters during the statistical period (1981-2010) were collected from the Meteorological Organization. Using Statistical Downscaling Model (SDSM), these climatic parameters were simulated in a monthly scale and compared with the base period (1981-2010). In the SDSM model three types of data are used for the microscopic metering. Working with this model is briefly summarized as follows: 1) Preparing

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predictive data and large scale predictors, 2) quality control of data and conversion (for precipitation data), 3) selection of the best predictor variables, 4) calibrating the model, 5) production of weather forecasting using observational predictors, 6) statistical analysis 7) graphical output of model 8) production of climate scenarios using model climate predictors.

Results and discussion

According to the results, it was found that during the 21st century the temperature in the station of Gorgan has increasing trend and precipitation has decreasing trend. In three scenarios RCP8.5, RCP4.5, RCP2.6 there is a decrease in rainfall in the two periods of near future (2040-2011), and the middle (2041-2070) from February to August and in the distant future period (2071-2100) from December to August. The highest precipitation decline occurs in the near future period in June, July and August, with 19.1, 20.9, and 20 mm, and in the middle and the distant future period in May from 28.8 till 47.15 mm. Generally, in all the scenarios, as we move towards the end of the 21st century, the average rainfall will be reduced, and the decrease in the RCP 8.5 scenario is more than the other two scenarios. Given temperature conditions, the general trend of temperature variables in future periods is consistent with the trend of these variables in the base period, with the difference that the temperature will increase slightly in the winter and spring until mid-summer, but from late summer to late fall it will experience a decrease. In the upcoming period, at first the temperatures will be higher in June and in the upcoming mid and in later periods it will be higher in May than that in other months. Moreover, moving from the near future towards the end of the century, the temperature will increase. The augmentation in the RCP 8.5 scenario is more than those of the two other scenarios. However, with the annual precipitation rate, RCP 4.5 and RCP 8.5 scenarios are meaningful and decreasing. In the case of maximum, minimum and mean temperature variations, there is a significant increase. Also, the precipitation drop and temperature rise in the end of the century. The values in the RCP 8.5 scenario are more than those of RCP 2.6 and RCP 4.5 scenarios.

Conclusion

In this research, the simulation of climatic parameters of temperature and precipitation was carried out using several linear models of SDSM and general atmospheric circulation models in Gorgan. The output of the CanESM2 model was simulated under RCP8.5, RCP4.5, RCP2.6 scenarios for subsequent periods in 21 steps. The results showed that temperature data show better correlation with observation data (compared with rainfall data). According to the results, it was found that during the 21st century the temperature and the precipitation would have increasing and decreasing trends, respectively. At Gorgan Station, in the three scenarios RCP8.5, RCP4.5, RCP2.6, in the two near future (2040-2011) and mid-term (2041-2070) from February to August and in the distant future period (2071-2100) between December and August, we observe a decline in rainfall. The highest precipitation values is in the period in June, July and August, at 19.1, 20.9, and 20 mm, and in the middle and long distances in each of the three scenarios it is from May 28.8 to 47.15 mm. In general, in all scenarios the average rainfall will be reduced, as we move towards the end of the 21st century. This decrease in the scenario RCP 8.5 is more than that of the other two scenarios. Regarding temperature variables, the general trend of the variables in future periods is consistent with the trend of these variables in the base period, with the difference that the temperature increased slightly in the winter and spring until

mid-summer but with decrease from late summer to late fall. In the upcoming period, the higher temperatures will be more frequent in June and in the upcoming mid and later periods in May than in other months. Also, in the near future towards the end of the century, the temperature will increase higher. This increase the temperatur in the RCP 8.5 scenario is more than those of two other scenarios. It can also be argued that the increase in temperature and precipitation in the spring and summer and the rising rainfall in the autumn seems to be favorable for planning of water resources, and in particular, the planning for the agricultural sector. The trends and drought conditions should be regarded environmental management in order to minimize the potential negative effects of climate change in the study area.

Keywords: precipitation, climate change, temperature, SDSM.

Zoning the Areas Susceptible to Urban Development with Emphasis on Geomorphological Limitations and Hazards (Case Study: Kermanshah City)

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Received: 08/10/2018 Accepted: 08/09/2019

Extended Abstract

Introduction

Urbanization and urban development are one of the most important aspects of human civilization, which leads to the transformation of the environment (Ronald, 1973, 5). Urban development occurs in the context of geomorphologic landforms. The geomorphologic hazards and restrictions influence the urban development process and, if not carefully studied, would have detrimental financial consequences on human societies. Cities in the developing world have grown dramatically in the past several decades, with the size of the city of Kermanshah rising sevenfold over the course of four decades. Given geomorphology of the Navidisi Plain of Kermanshah, the city has serious geomorphological limitations for urban physical development. Therefore, zoning and recognizing the areas susceptible to physical development with a geomorphological approach can be the basis for urban development plans and it can lead to proper planning of civil engineering and scientific management of the city. The purpose of this research is to identify the areas susceptible to physical development in Kermanshah city in the future.

Materials and methods

In this research, at first, the physical development in Kermanshah city over 4 decades was determined with the use of Landsat satellite images related to the sensors of MSS and OLI of using the supervised classification method. The map of zoning the areas susceptible to physical development in Kermanshah city using fuzzy model is based on topographic slope parameters, altitude, distance from main faults and sub faults, distance from main waterway, the submarine, lithology, geomorphologic landforms and distance from the city center. The final zoning map of the areas susceptible to physical development in Kermanshah city has been investigated based on land use restrictions.

Results and discussion

Analysis of the urban districts of Kermanshah during the years 1977 and 2017 shows that physical development occurred irregularly in all directions and the city highly physically developed in the northern part of the city between the Ghareh Souz and the highlands of

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Ankhebahestan. The physical development of Kermanshah city in the last four decades was subject to topographic conditions. The areas in the southern, southwest, and southeastern directions have limited the physical development of Kermanshah to other areas. The physical development of the city over the past 40 years has not followed a particular order. After the fuzzy membership layers are prepared, the nine parameters have been overlaid using the gamma operator 0.8 as the best fitting coefficient and a map was developed of the physical development of Kermanshah. The map was divided into five classes using natural fractures. Four classes with unsuitable condition represent more than half of the study area and the appropriate classes include about 26% of the area.

Conclusion

Inappropriate areas include the highlands of Prao-Bisotun in the north part of the city, the White Mountain in the south part of the city and the area around the Qara-Ansu River in the Kermanshah plain. The inappropriateness of mountainous regions is due to the outcrops of limestone formations, slopes and altitudes, the presence of the main and secondary faults, and the activation geological processes. The urban expansion limits by the Qar-e-Sou River is due to the loose river sediments, the risk of flooding and the existence of the original Qara-Sos fault. The mountainous areas are also not suitable for physical development due to the presence of topographical and lithological limitations. Suitable areas can be suggestedfor alluvial plain with appropriate topographic conditions and outcrops of quaternary deposits and a suitable distance from faults and drainage networks. The area of the zones suitable for urban development after land use interference and the distance from the city is about 50 square kilometers. Given the appropriate distance from faults and waterways in suitable topographic areas and mainly on quaternary deposits is located in the alluvand plain in the west and east Kermanshah. Finally, it can be argured that the current range of the city of Kermanshah, as well as the surrounding areas due to geomorphologic conditions, has the risk of destructive hazards over the past few decades. The physical development of Kermanshah has occurred with no regard to these restrictions. Therefore, a comprehensive plan for the high risk areas of Kermanshah city has been developed and then proposed areas for the urban development of the city is presented according to the socio-economic conditions.

Keywords: zoning, urban development, geomorphologic hazards, Kermanshah city, fuzzy model.

Quantitative and Morphological Analysis of Longitudinal Profile of Northern Alborz Rivers in Mazandaran Province

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Received: 16/05/2019 Accepted: 16/09/2019

Extended Abstract

Introduction

The longitudinal profile of river is one of the main components of the fluvial system. It is result from the interaction between lithology, tectonics, fluvial incision and base level change. The longitudinal profile of the rivers that are in a Equilibrium state have concave form, but several factors cause changes to the longitudinal profile of the river, including lowering base level, rock resistance, structural control, sediment input, non-fluvial processes, bed load effects, and human changes. Alborz Mountains are considered as one of the geomorphological zone of Iran, which geological, climatological and vegetation characteristics have created a special geographic landscape. In this study, longitudinal profiles of the northern Alborz rivers (Mazandaran province), as part of the Caspian Sea basin, have been investigated in this research. The aim of this research is to make a quantitative analysis of the longitudinal profile of the rivers in the region.

Methods and material

The longitudinal profiles of 15 rivers in the northern Alborz were investigated by quantitative measures. The drainage network was extracted by the 12.5-m DEM and longitudinal profiles of the fifteen trunk channels were extracted using the ArcGIS 10.3. Geological maps were used to interpret lithology and fault distribution. The form of longitudinal profiles was measured by the concavity index (CI) and SLK index. The longitudinal gradient index (SL) was also calculated for each segment of the profiles. The concavity index was computed based on deviations from a straight line profile *(Philips and Lutz, 2008)***.** The SL Index analysis was performed with Hack's (1973) method. The SLK index for the longitudinal profile of the river was calculated by normalizing the distances in the horizontal axis and the elevation in the vertical axis.

To normalize the values (SLK), in the horizontal axis of the graph, the normalized distances are represented as (d / D), where d is the distance between the specific points along the longitudinal profile and D is the total length of the profile. In the vertical axis of normalized height (e / E) the e is the elevation of specific points along the longitudinal profile and E is the

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elevation difference between the beginning and the end of the longitudinal profile (Vojtco et al., 2012). The maximum amount of concavity along the SLK profile was determined as Z_{max}.

Results and discussion

The northern Alborz Rivers do not have smooth concave profiles and there are numerous knickpoints in their longitudinal profiles. In all cases, the best fit (R^2) of regression has been matched with polynomial equations of degrees 2, 3 and 4. The coefficient of determination of these regression equations was very high (>0.96). Some of the rivers such as Kheyrood, Kojur and Noor have a convex profile with concavity index of -4, -4, and -11, respectively. A number of other rivers such as Tajen, Babol, Sardabrood and Chalakrood with CI 8, 7.5, 9 and 8, respectively, have more concavity than other rivers.

Based on the relative concavity index (CI_{rel}), 20% of the longitudinal profile of the North Alborz in the convex form (CIrel <0), 53% had a relatively straight or very low concavity (0 <CIrel <0.2), 27% moderate concavity. No river has a very high relative concavity index (more than 0.5). The results obtained from the Z_{max} of SLK index show that khojour and Noor Rivers have a convex longitudinal profile with negative coefficients. Other rivers also have a Z_{max} between 0.2 and 0.3 and Babolrod has the highest value of 0.7 compared with other rivers. In each of the longitudinal profiles of the rivers, SL values were calculated in different segments. The highest and lowest mean values of SL are related to the rivers of Kojur and Babol, respectively. Changes in SL values and Knickpoints were investigated based on three factors of tectonic, lithology and human. A total of 98 faults crossed the rivers in the study area have only caused 20 knickpoints, which 70% are located in the western part and 30% in the eastern part of the northern Alborz. Lithology factor in 53% of the cases has changed the longitudinal gradient and the SL values, which is 33 percent in the western part and 20 percent in the eastern part of the northern Alborz.

Given the good correlation coefficient (0.73) between the SLK index and the CI index, the SLK index is used for clustering. The studied rivers were classified into three groups based on concavity of longitudinal profile and the position of maximum concavity. The first group includes rivers with a concavity of between 0.13 and 0.47 and the maximum concavity is in the second quartile of the profile. In this group, 80% of the North Alborz Rivers are located in the state and they are all in the transverse valleys. In the second group, the value of concavity index of longitudinal profile was negative, that is, they have a convex shape and maximum convexity is in the third quartile. The rivers in the longitudinal valley are in this group in which the concavity is less than 0.1 and the maximum concavity is in the second quartile of the profile. The analysis of longitudinal gradient index (SL) in the northern Alborz Rivers shows that 53% of knickpoints are due to lithologic changes, 45% due to the activity of faults and 2% due to dam construction. In the 98 fault lines that crossing rivers, only 20% of them have broken the longitudinal profile. The effects of lithology on longitudinal profile were analyzed by statistical test. The results show that the sig value is less than 0.05 and the hypothesis is rejected zero for Safarood, Cheshmeh Kileh, Sardabrood, Chalous, Noor, Heraz, Talar and Neka catchments. The type of lithology has a significant difference in longitudinal profile formation. The effect of faults in the longitudinal profile of the rivers in west and east parts of Mazandaran province was 70% and 30%, respectively.

Conclusion

In the longitudinal valleys, the rivers have a convex profile, where uplift (active tectonics) is dominant. In these valleys, the rate of uplift is greater than the amount of river incision and the river can not create an equilibrium profile.The longitudinal profile of the rivers in the transverse valleys is concave–convex with erosion steps that indicate long-term predominance of erosional processes. Their profile is due to the high altitude difference, short distance to the base level (Caspian Sea) and lithological resistance. It seems that river icision has overcome the tectonics and the lithological factor has more effect on the longitudinal profile of the Northen Alborz Rivers.

Keywords: river lonitudinal profile, Cancavity Index, Northen Alborz, Mazandaran.

Evaluation of Landuse Changes with Emphasis on Green Land Use Planning in Kashan Plain Watershed

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Received: 20/10/2018 Accepted: 22/09/2019

Extended Abstract

Introduction

Land use is generally referred to as the use of lands in the present state. Land cover and its changes can cause greenhouse gas emissions leading to climate change. Climate change and land use can interact with each other. This is of great importance in sensitive environments especially in arid and desert areas. These areas are sensitive to climate change and land use. In the case of climate change detection, the drought has been considered in recent years. Iran is one of the countries suffered heavy from this natural threat because of being in the arid and desert region of the world. Various researchers have pointed to the relationship between land and climate change around the world (Cuo, Zhang, GAO, Hao, Cairang, 2013; Delgado, Gaspari, Kruse, 2015). The purpose of this study was to investigate the relationship between land use and land use planningin in relation to climate change. This research proposes the new Land Use Planning approach in relation to land use as a management tool for climate change mitigation and carbon footprint reduction.

Material and methodes

Study area

Kashan watershed covers about 5574 square kilometers of the area and located in the north Isfahan province and southwest Tehran. The climate of the study area is classified in arid or desert climate. In the plain it is classified in the semi-arid climate. The tools and methods in this research include:

A. Land use

In order to study land use changes, we have used landsat images incuding Landsat 5 MSS images, 1985; Landsat-7 ETM+ images, 2000, and Landsat 8 OLI, 2017.

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B. Climate change

a) Weather data available over the 30 year period from 1988 until 2017 at 7 meteorological stations: Kashan, Isfahan, Golpaiegan, Natanz, Meime, Ardestan, Najafabad (table1). The historical data were obtained from the Islamic Republic of Iran Meteorological Organization (IRIMO)
b) The model was validated using three methods: 1) Coefficient of Determination (R^2), 2) root-mean-square error (RMSE), 3) Mean Squared Error (MAE)

C. Low Carbon Land Use Planning (Green land use planning)

Green land use planning (GLUP) is to determine the suitable use of each region based on its potential, so that a land use with lower carbon levels can be selected in place of more carbon levels.

C1. Standardization of constraints and limitations
C2. Weighing the constraints and limitations
C3. Multi-criteria evaluation by weighted linear combination (WLC)

Results and discussion

Classification of images

The results of the changes showed that agricultural land use area increased by 5.7%, bare land area by 0.61%, and residental area by 0.32% of the total study area during the period (1985-2000). Range land, Sanddune Salt land, and Garden have decreased by 5.05, 0.92, 0.57 and 0.1%, respectively. The results of investigating the changes during the time period (2000-2017) show that salt land, residental and garden areas are increased by 12.20, 1.07 and 0.28 percent, respectively. Range land, agriculture, bare land and sanddune area were 5.62, 4.69, 2.52 and 0.73 percent, respectively.

Validation of downscaling model

The results of the indicators show that the SDSM model has a more accuracy than the daily scale in the monthly and seasonal and annual scales for the downscaling the precipitation parameter in the studied watershed. In general, this model has a good performance for downscaling the region precipitation.

The results of Validation of downscaling model

Based on the results of the SDSM, RCP4.5 predicts the lowest average rainfall of 0.2 in December and the highest average rainfall of .08 in May.

Drought assessment

The results of 12 month SPI index for the study period during 1950-2050 show that in 1985 there was a drought in the range from 1.5 to 1.99, which indicates the severe drought on the studied area. In 2000, the drought is located in the 0.99-99 range, which represents a near-normal drought. In 2017, the average 12-month SPI is reduced, and drought is in the 1.99-to-1.5- range, which indicates hard drought. Based on the SPI index for the next years 2030 (2011-2050), under the 4.5 scenario, the drought is reduced compared to the baseline and is located on the range of -2 and less range, which indicates a severe drought, indicating that the monthly precipitation will decrease in 2030 during the climate change.

Evaluation *of* ecological *land* capability

Ecological capability was evaluated for 8 land uses including Agriculture, range land, forestry, conservation, Extensive and intensive tourism and urban and rural development.

Green Land Use Planning (Low Carbon Land Use Planning)

The green land use planning map was created with priority for land uses with less water consumption and less carbon to reduce the impact of climate change on the Kashan plain watershed.

Conclusion

The trend of change in Kashan plain watershed shows that at the same time when the study began, the increasing trend of climate change (1985) developed the agricultural, residential and industrial land araes.

In general, these applications have the greatest impact on the rate of evapotranspiration and reduction of water resources and increased greenhouse gas emissions. With the continuation of the climate change trend and the negative trend of drought, the agricultural land and range land areas have decreased and increased against the salt land areas. This situation is due to the reduction of agricultural land efficiency due to soil salinity and drying of irrigation wells and the abandonment of these lands, especially in the salt lake and the northern lands of Aran, Bidgol, Abu Zayedabad and Nasr Abad.

Keywords: Land use change, climate change, green land use planning (Low carbon land use), Kashan plain watershed.

Measuring the rate of dust falling and its spatial analysis in 22 districts of Tehran

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Received: 09/01/2019 Accepted: 22/09/2019

Extended Abstract

Introduction

Dusts are referred to as aerosol particles are made up of different sources of land and humanization; they fall on the surface due to their size and density (Salman Zadeh et al., 2012). This phenomenon can damage infrastructures, telecommunications and agricultural products and affect transport through reduced visibility and cause a lot of economic damage (Song et al., 2007, Cao et al., 2016). The purpose of this study is to measure andspatial analysis of the city of Tehran in a one-year statistical period.

Materials and methods

In this research, we used the laboratory method to measure falling dust, collecting dust using Marble Dust Collector. For this purpose, the falling dust was collected using a Marble Dust Collector in 28 stations in Tehran during the statistical period. In order to analyze the spatial distribution of dust and falling dust analysis, we used factors includingthe air quality control company, the number of construction urban under construction in Tehran from Tehran Municipality Organization, mean maximum wind speed parameters, average relative humidity, days of rainfall above 5 mm, the average temperature from the Iran meteorological organization in one-year statistical period (2017) to enter the ArcMap10.5 environment and preparing the desired layers. Statistical analysis of the data showed that the dust distribution have regional (trend) behavior. Therefore, universal trend is better suited. Due to the high preconditions of universal trend in the area with fewer meteorological stations (Chitgar, Geophysics, Mehrabad

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and Shemiran) is not applicable. Therefore, the IDW method was selected for climatic parameters. Also, the vegetation cover and factories layer were taken to analyze by Euclidean Distance of these complications in GIS for Tehran. Then, all the layers were weighed to determine the weights for using the Reclassify tool. Then, using Expert Choice software, we compared all the layers in pairwise comparison to estimate the value of each layer relative to the other layers. We multiplied the values obtained at each level and transferred all layers to the Fuzzy Overlay tool. The final map of the spatial analysis of falling dust in Tehran city was obtained by using the Gamma 0.9 function. Also, daily speed and wind direction data were received from the Meteorological Organization of the country during the one-year statistical period (30/9/97- 1/10/96). With the help of the WRPLOT software for statistical analysis and the location of the wind, the windrose was drawn.

Results and discussion

The results of computations performed on the data from the collecting of falling dust in Tehran showed that the weights of falling dust in the winter of 2017 is 18943.5 tons, in the spring of 2018 it is equivalent to 27119.5 tons, in the summer of 2018/ it is equivalent to 17111.2 tons and in the fall of 2018 it is equivalent to 23002.3 tons. Also, the results showed that the highest falling dust was collected in spring, autumn, winter and summer, in order of volume. The spatial analysis of Tehran's falling dust is a combination of 9 layers, based on the weight assigned to each. The results showed that the highest amount of dust in the winter of 2017 was found in west Tehran. We had the lowest amount of falling dust in the north and northeast (regions 1 and 4). In the spring, summer and autumn of 2018, the density of the most falling dust was displaced slightly eastward and settled in the southwest. The lowest amount of dusts in these seasons was located in the north and northeast. The halo with the lowest amount of dust falling has expanded further in the autumn than spring and summer.

Conclusion

The results of this study showed that the spatial distribution of falling dust varies in different seasons. Analysis of the results showed that the source of falling dust in the city of Tehran is not uniform throughout the year. Field surveys have showed that the increase in falling dust in different parts of Tehran is directly related to urban construction. In the statistical year of the study, construction and subsequent falling dust has been less in eastern Tehran than that in west. This increase is also associated with pm10. The largest amount of pm10 was reported from the west and southwest, which simultaneously collected the highest amount of falling dust. The highest density of factories and the lowest vegetation density are in these areas. The climatic factors also contributed to these conditions. It was reported that the highest number of rainy days to exceed 5 mm was reported in north and north east of Tehran, where the lowest amount of dust was collected. The highest average temperature in different seasons is reported from Southwest Tehran where it has the highest amount of falling dust in spring, summer and autumn. In winter, climate conditions were slightly different from other seasons. The highest relative humidity reported in other seasons from the West has been reported from north and northeast of this season. The dust collected in winter is higher in the west than that in the southwest. The average maximum wind speed, which is in the west and south, it is in the winter, spring and autumn to the west and southwest. The particles are originating to some extent from

Quds, Shahriar, and Malard cities, especially the sand dune areas. They are abandoned in agricultural land in Baharestan, Islam-Shahr and Robat-Karim, and then dust from these areas enters west Tehran. In addition, the wind disperses the dusts generated by construction around the city. In the summer, in addition to the west and southwest, there is wind for north and south east. The northern wind comes from Shemiranat, bringing fresh air to the north and north-east of Tehran. The southeast wind passes from the Pakdasht cement factories in Tehran and also over the abandoned agricultural land of Varamin. The low wind speed in these areas gives more time to hangs off more particles. However, climatic conditions with the lowest relative humidity, the highest temperature, and a lack of rainfall above 5 mm also help to pollute the southern part of Tehran.

Keywords: ***Spatial analysis, Sediment trap, Tehran City, falling dust.***

Modeling and spatial analysis of snow depth in Northern Iran based on database from European Centre for Medium-Range Weather Forecasts (ECMWF)

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Received: 22/10/2018 Accepted: 14/10/2019

Extended Abstract:

Introduction

Snow is an important component of the climate system over the mid- and high-latitude regions of the Earth. Its high shortwave albedo and low heat conductivity modulate heat and radiation fluxes at the Earth's surface. Thus, it can directly modulate regional temperature evolution and ultimately atmospheric circulation patterns. Moreover, because snow serves as a temporary water reservoir, snow variability impacts soil moisture, evaporation and ultimately precipitation processes). As a result, snow cover has an essential influence on ecological) and economical systems. Vice versa, snow cover itself is determined by climate variations. Recent Arctic warming has severely impacted spring snow cover. This study aimed to evaluate the snow depth it the north of Iran. The results of this study can be used in the field of water resources, flooding and climate change will be useful.

Materials and methods

The present study aimed at evaluating modeling and spatial analysis of snow depth based on the data from the European Centre for Medium-Range Weather Forecasts (ECMWF) of the ERA-Interim version with a 0.125 × 0.125 arc-spatial resolution. In this regard, the temporal changes of the snow depth in the North Country were also evaluated. This study examined the monthly data of the 6-level 3 product (MYD08_M3_6), Normalized Difference Vegetation Index (NDVI) of the Terra Satellite. Modeling of spatial relationships between snow depth and

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geographic parameters and NDVI was obtained by OLS and GWR models. The coefficients of regression equations obtained for the relationships were used in the area after calculation. Several criteria have been proposed for selecting the appropriate bandwidth. In this study, the Akaike information criterion (AIC) was used to select the core bandwidth.

Results and discussion

The average depth of snow in the northern zone of Iran ranges from 0.006 to 1.748 cm for winter and autumn, respectively. The northern area of Iran in this season is 1.34 cm. In winter, the maximum average snow depth in the northern zone of Iran in February is 1.748 cm. The maximum amount of standard deviation occurred in the same season. In general, in winter, the maximum snow depth in the northern zone of Iran is more than that in the other months of the year. The third quartile can be considered as the maximum snowfall and the first quartile is the northern border of the northern northwest of Iran, which can then be classified as the northern part of Iran's snowfall. In winter one-fourth of the year, the northern zone of Iran has a snow depth of more than 1.98 cm. The significant difference between Moran's I and Geary's c expected and Moran's I and Geary's measured has shown that the spatial autocorrelation values calculated for each month really fluctuate and the value cannot be due to the magnitude of the data and changes caused by around the mean.

Conclusion

The results indicated that the winter season with mantle cubes show 1.34 cm maximum snow depth during the seasons. Winter also has the highest snow depth variability. The highest snow depth was obtained with an average of 1.74 cm in February. Based on the results of the study, using quartz statistics, in winter one-quarter of the northern zone of Iran has a snow depth of more than 1.98 cm, which is the maximum value among seasons. The spatial dependence of the depth of snow on universal Moran methods has been rejected by the hypothesis that there is no relation between the depth of snow in the northern zone of Iran, and the Geary's c method has also shown that snowfall areas with high snow depth are relatively relative in terms of geographic patterns and a behavior They show clusters of their own. Correlations obtained with snow depth with longitude and vegetation index of NDVI have a significant reverse relationship and its relationship with latitude and elevation is a significant direct relationship. Modeling with GWR and OLS has also documented that the GWR method has a higher ability to justify the spatial association of snow depth with geographic parameters. The results of the GWR model show that the relationship between snow depth and geographic parameters, especially elevation, does not follow a linear model. Elevation in the mountain range of Alborz and northwestern Iran covers mountainous areas with significant snow depth.

Keywords: Snow Depth, Space Modeling, GWR Method, ERA Interim, Northern Zone of Iran.

Modeling and Monitoring Drought in Southwest Iran Using the New Fuzzy Index

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Received: 01/04/2019 Accepted: 23/10/2019

Extended abstract

Introduction

Drought is one of the natural hazards during which the environment and human activities may experience considerable irreparable damages. In recent years, different regions of the world have experienced severe drought (Mirzai et al., 2015: 98). Also, drought is one of the most important natural disasters affecting agriculture and water resources, it is is abundant especially in arid and semi-arid regions (Shamsenya et al., 2008: 165). Drought changes are remarkable for optimal management of water resources utilization (Alizadeh, 2017: 169). Drought is also referred to as a climate phenomenon with a lack of humidity and rainfall relative to normal conditions. This phenomenon strongly affects all aspects of human activity (Zeinali and Safarian Zangier, 2017). Given the studies in Iran and other regions, this study attempted to model the drought phenomenon in southwest part of Iran.

Material and methods

In this study, drought modeling in southwest Iran was carried out using climatic data of rainfall, temperature, sunshine, minimum relative humidity and wind speed in6 and 12 months scale for a 32 years period (1987 - 2018) in five provinces of Khuzestan, Lorestan, Ilam, Kermanshah and Hamedan based on 15 stations. The analysis is implemneted using a new index modeling called the TIBI Architectural Index, fuzzyized from four indices (SET, SPI, SEB, and MCZI) based on the data from World Meteorological Organization.

Fuzzy index T.I.B.I

The fuzzy index (T.I.B.I) is presented to resolve some of the disadvantages of the SPEI index. The index T.I.B.I was derived from the integration of the indicators (SET, SPI, SEB, MCZI),

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which is the result of drought fuzzy modeling architecture that is designed using fuzzy logic in a fuzzy inference system.

Results and discussion

In order to investigate the effects of drought fluctuations in drought conditions, it is possible to find changes in the parameters (SET, SPI, SEB, and MCZI) in the TIBI index. Given the large number of stations, for the sake of better understanding, only the drought series chart, East Islamabad station at two 6 and 12-month scale was presented in Figures 7 and 8 (Figures 7 and 8). The above-mentioned red dot indicates a 6-month drought margin with a value of 0.44 and more. This represents a 0.44 and a magnitude 12-month scale. The analysis of these forms shows that at Islamabad-West station at 6 and 12-month scale, the temperature was different in the drought environment, which was decreasing in the 6-month scale from April 1994 to August 1997. This month has been gaining momentum, from July 1996 through 2003, an incremental increase. If the impact of rainfall on a 12-month scale is weaker than the 6-month scale between May 1994 and November 1997, the declining trend will be followed by a 12-month-long drought after June 1997 to December 2002, followed by a similar pattern. The indicators (SET, SPI, SEB, and MCZI) affect the TIBI index and show some trends, indicating that the new TIBI fuzzy index reflects the four indicators well and the scale drought classes were presented in Table 5. The T.I.B.I index on a 12-month scale shows a sharper shape than scale 6.

Conclusion

One of the natural hazards that have affected the country in recent years is the risk of drought. One of these areas affected by drought was the southeastern part of Iran, where researchers conducted many studies to monitor drought in Southwest Iran with different models but did not adequately address the issue. The purpose of this study is to model and monitor the drought phenomenon in southwest Iran using a new fuzzy index in the 6 and 12-month scale. In the study area, the intensity and frequency of drought are more than 6 months on a 12-month scale. Drought persistence is more than 12 months. Short-term droughts were less sustained and affected by rainfall and temperature parameters. While the severity of drought in the long periods of time was less responsive to temperature and precipitation variations.The trend of drought in the south-west of Iran was increasing and the temperature trend was more rapid, increasing and increasing trend. The highest frequency of drought occurrence was at the 6th and 12th month scale, Islamabad-West station and the lowest rate was 6 Hamadan airport scale and 12-month scale Khorram Abad station. The percentages of drought frequency in Hamedan Nogheh, Islamabad and Zarapulzahab stations were higher the 6-month scale than those values in the 12-month scale.

Keywords: T.I.B.I index, SAW Model, Fuzzy Logic, MatLab, Modeling.

A Comparative Study on the Trend of Temperature Inversions in Iranian Metropolises; Tehran, Mashhad and Tabriz

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Received: 12/03/2019 Accepted: 23/11/20191

Extended Abstract

Introduction
The temperature in the troposphere usually decreases with increasing height, therefore, with increasing distance from the ground, the air temperature will be lower (roughly 0.6 degrees Celsius per 100 meters). However, daily atmosphere evaluation shows unlike the above description, in many cases the opposite is seen to be called inversion. The purpose of this study is to investigate the adaptive trend of inversion of the temperature of the boundary layer of Tehran, Mashhad and Tabriz metropolis in 2007-2017 on the daily, monthly and annual time scale.

Materials and methods
The atmospheric sounding data from the Meteorological stations of Tehran, Mashhad and Tabriz for the years 2007-2017 were extracted from the Wyoming climate database at 0 o'clock. In order to determine the types of temperature inversion in each metropolis, the graphs of the atmospheric data of each station were mapped using RAOB software and the total number of days with temperature inversion was extracted at the stations. Three types of radiation, superstructure and frontal inversion were identified as three main types and four other types as combinational types of these three types of inversion. Then the frequency distribution and percent of each of the seven inversion types were calculated for each station in the 12 months of

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the year. The eleven-year process of each inversion type was determined using the non-parametric Man-Kendall method and the estimator of the Estimator slope and compared with each other.

Results and discussion

Results of this analysis indicated that from the seven inversion types, the inversion type of radiation in the three stations under study in all months of the year has been quite decreasing and showed a significant trend at 95% and 99% levels. The subsurface inversion type at all three stations showed a positive and significant trend at 95% and 99% levels in the most months of the year.

The trend of forward inversions in the stations under study has been decreasing for the most of the months (the Z score and Sen's Estimator Slope is negative). Radiation-submerged-frontal combined type inversion in the study period in all studied stations in most months has no significant trend. Among the seven types of inversion observed at the studied stations, the combination of radiation-subsidence type has the most significant and incremental trend in all three stations. In all the stations, for 6 months of the year, the increasing frequency of radiation-subsidence type at 95% and 99% confidence levels was significant and the most frequent increase in this type of inversion occurred in the winter and autumn seasons. The combined type of radial-frontal inversion and the Subsidence- frontal type at all stations in Tehran, Mashhad and Tabriz have not been significantly trendy for most of the months. The investigation results of the number of inversion layers in the stations showed that in all three stations in all months of the year, the number of inversion layers increased significantly at 99% and 95% confidence levels. An annual review of the frequency of inversion days in all three stations showed a significant increase in the annual scale. In this study, using the inversion layer temperature difference, the thickness of the inversion layer and the station height were used to calculate the intensity of the inversions.

$$I = \frac{(\Delta\theta)2}{3 + Z(\Delta z)} \qquad (1)$$

The inversions were calculated only for inversions of the surface of the earth up to the surface of 500 hPa, then by applying the two conditions of the Haffter ((Δθ / (Δz)> 0/005 km ^ (-1) and $\theta_t - \theta_b > 2$) Critical inversion was investigated by the total inversion occurred and the severity of the inversions trends. The results of applying the Mann-Kendall test and the Sen's Estimator Slope on the data of the severity of critical inversions in different months of the year showed that except for the months of October, November and December at the Mehrabad station, the rate of critical invertebrates was significant at 95 % level. For the rest of the months, the trend of severity of critical inversions has been increasing, but they are not significant at all levels of confidence. In February, the trend of inversion was decreasing in all three stations.

Conclusion

The results indicated that the radiation type inversion occurred in the period 2007-2017 at all three stations decreased significantly. Conversely, the subsidence inversion type showed a significant increase in all three stations. Radiation- Subsidence combined type had a significant increase in all three stations. It can be concluded that the types of inversion in the period of

2007-2017 have changed from pure inversion types to combine and multi-layer types and, specifically, to the Radiation- Subsidence type. The significance of the increasing trend of inversion layers was also confirmed by statistical tests. Despite the increasing trend of the inversions during the statistical period, this trend has not been significant at any confidence level. However, the intensity of inversions other than in the fall of Tehran station at other stations did not have a significant trend, although they have experienced a positive slope for many months. Several factors, including the release of high heat energy, the increase of greenhouse gases, as well as the increase in population and land use change, the change in surface evolution from heat transfer, pollutant emissions, evapotranspiration and land cover due to the impact of wind currents are considered as the reasons for this increased air stability in the boundary layer and the local climate change of these metropolises.

Keywords: Temperature inversion trend, Inversion intensity, Tehran, Mashhad, Tabriz.

Synoptic Analysis and Identification of Hail Flow Days in Western Iran (Case Study: Zab Basin, West Azerbaijan)

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Received: 13/03/2019 Accepted: 23/11/2019

Extended Abstract

Introduction

Hail is considered as one of the most important atmospheric hazards as a consequence of a thunderstorm having harmful effects on the environment every year. Hailstorms usually occur from the clouds of cumulonimbus and are often thunderstorms and generally accompanied by thunderstorms, especially in spring. In general, hail is the product of intense convection found in a thunderstorm. To analyze and predict the mechanisms of each climatic phenomenon, one needs to have a detailed understanding of the main components of its climatic systems.

Since hail in the Zab basin annually causes significant damages, especially in agriculture and livestock, the aim of this study is to investigate the synoptic patterns of hail in the Zab basin in order to reduce the damaging effects. The climatic phenomenon is on different parts. The Zab Minor catchment in northwestern and northwest part of Kurdistan Province, southwestern Iran, consists of Piranshahr, Sardasht and Baneh counties.

Material and methods

In this study, an environmental circulation approach was used to identify the circulation patterns of the days associated with hail in the west of the country. In this study, the code of days associated with the hail of Sardasht, Piranshahr and Baneh synoptic stations (with the longest statistical period between provincial stations) was obtained from the establishment (1992) up to year 2016 from the Meteorological Organization of Iran and then according to the code. The intensity of days associated with the hail event was identified during the study period. To identify large-scale synoptic patterns of day-event hail phenomena, hectopascal altitude and sea-level pressure data from open NCEP / NCAR analysis data on daytime events ranging from 0 °

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C to 120 ° C and 0 ° C to 90 ° N They were prepared. Also, to determine the moisture flux of hail event days, Schulz and Benacus moisture flux equation was used.

Results and discussion

The purpose of this study is to establish an appropriate classification of atmospheric patterns in relation to hail events and the climatic characteristics that cause them in the Zab Basin. Using the NCEP / NCAR Center data, it is possible to analyze synoptically and identify the circulation patterns that coincide with these events. Cluster analysis of sea level pressure and geopotential height data revealed three weak, moderate and severe circulation patterns associated with hail precipitation. Finally, in order to identify the most important systems, intra-group correlation was performed between each cluster, and the day that had the highest correlation with other days in one cluster was selected as the representative day of the circulation pattern of the cluster and the basis of this study was analyzed.

Conclusion

In the study of the synoptic patterns of hail precipitation according to the obtained results, the model best justified the hail precipitation is presented for the Zab basin. In the first model, with low hail precipitation, we observed a contrast between warm and humid low-pressure Sudan systems and high-pressure European cold tabs on the study area.

In the second pattern at sea level with the formation of a low pressure center on Iraq, this low pressure is reinforced by the development of warm and humid air through the Sudanese system and the formation of a high-pressure belt across the northern Iranian strip, which, with its rotation and rotation, drives cold air. The study area has provided conditions for frontalisation in the area.

In the third model, Sudan's low sea level is strengthened so that its tongues stretch to the northwest and northwest Iran, which inject hot and humid air and create convergence conditions over the study area. The Siberian high pressure on the north of Iran is also at its peak, and its tabs and motions cause very cold air to fall over the study area, and in this case the very cold northern and warm southern humid conditions make for the front. The region created instability due to the specual circumstances.

Previous research on hail precipitation or only the role of Sudanese high or low pressure northern Sudan in hail precipitation events has shown that hail precipitation in western Iran necessitates confrontation of air masses. The cold north is warm and humid south and the strongest hailstorms occurred when these air masses penetrated the study area at peak times and created conditions for overburden and instability with the help of high-level currents. They cause severe vertical motions in the atmosphere and, as a result, hail over the region.

Keywords: Synoptic analysis, Northern Highlands, Mediterranean Nave, Hail precipitation, Zab Basin.

Co-citation Analysis of Human-Environment Relationship in Geomorphology from 1970 to 2018

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Received: 13/10/2019 Accepted: 10/12/2019

Extended Abstract

Introduction

Geography has always been based on the three basic elements of human, the environment and the relationship between them. Depending on what the concept of man has been in different eras, it has led to the formation of numerous approaches such as classical geography, regional, spatial and phenomenological. However, the introduction of a systematic approach to geography had many implications including the formation of the human ideal which is called "sustainable development", and led to the participation of different branches of environmental science in sharing and providing solutions for achieving sustainable development. A review of past research shows that Geomorphology has a closer look at the relationship between humans and the environment. It should, therefore, be examined that what has Geomorphology to offer the global environmental change debate and how might this contribution be framed. To answer this statement, the views of scientists must be examined through the process of research related to the relationship between man and the environment during the short life of geomorphological knowledge and this is exactly what was used in this study with the help of CiteSpace software for citation analysis. Using this method, we can examine the relationships between the factors influencing the production of a particular research along with its historical trends in explaining the intellectual structures of knowledge. The purpose of the present study is to use the data available in the Web Of Science database and CiteSpace software to analyze researchers spatially and temporally; Clustering strategic keywords with the help of indicators such as centrality and finally, examining the thoughts of influential researchers in each cluster in order to understand the scientific structure of knowledge in the field of human-environment relationship in geomorphology

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Material and Methods

In this study, CiteSpace software was used for statistical analysis of scientific citation data. Thus, in the first step, all the researches from 1970 to 2018 were extracted through web filtering (CiteSpace raw data provider) and after monitoring, a set of 456 articles was obtained. After entering this data into the software, charts of the quantities of articles and citations, journals and active countries/institutes, burst-detection, country/institute co-citation maps and co-author map were prepared for further analysis. Then, the present research period was categorized into seven clusters by calculating the centrality of keywords and using the year of production of each word. Each cluster that encompasses a specific time period was analyzed with the help of parameters such as the number of research and citations, the most strategic keywords, the most cited and most famous authors, the external scientific influencers factors, the relationship of other keywords to the strategic word in the tf-idf chart. It was also tried to study the trends of geomorphological knowledge in each of the clusters according to the domestic writers' research and comparing with the results obtained from CiteSpace software.

Results and Discussion

According to co-citation analyses, the leading geomorphology journal in terms of number of research and citation indexes among all the journals indexed in the WOS database indicates the importance of geomorphological knowledge in addressing the issue of human-environment communication among the various branches of environmental science. The analysis of the distribution of countries and institutes in relation to the research shows that the results are consistent with the Pareto law. It can also be pointed out that countries' backgrounds influence their ranking as top countries in terms of number of studies although the results show that the research topic is more important for countries. According to the authors' co-citation map, the core of the researchers is made up of authors such as Phillips, Schumm, Goudie and Gregory. The results of comparing the Burst-detection and the In-network citation indicate a low citation among authors with high Burst-detection. Violation of this rule in the case of Schumm shows that in addition to presenting a new idea, he has remained an important citation index throughout the entire period studied. Keyword analysis shows that "Geomorphology, climate change and Holocene" have the highest frequency, "Geomorphology and vegetation" have the highest sustainability and "environmental change, climate change and human impact" have the most Burst-detection. The centrality index also identified the most strategic words that resulted in the clustering of the entire research period into seven clusters to identify the scientific structure of knowledge in the present study.

Conclusion

According to the information obtained until 2000, the focus of most geomorphologists was on geomorphology knowledge as a general trend of environmental science research that was most influenced by global conferences on climate and human environment. The geomorphologists' systematic view is quite evident in order to provide a solution to the issues between the landscape and human impact in the second period between 2000 and 2002. Co-citation studies in 2002-2003 suggest a new approach to solving problems in human-environment interactions under the heading of combined geo-ecological research in geomorphological knowledge. In the fourth period, in 2003-2005, geomorphologists have used the fluvial Geomorphology-related

topics to better illustrate human impacts on the environment. In the next period (2005-2008) was made a rethinking of the geo-archeological studies of ancient times and early humans. Also a common point of most research in this period is the use of river/sedimentary Geomorphology and vegetation data which includes the strategic keywords of the previous period (2005-2003) and the next period (2009-2008) respectively. Because of the use of the sediment keyword and thus a more specialized perspective at environmental protection, the sixth period can be cited as a turning point in determining the extent of geomorphologists' involvement in human-environment research. In the last period, the 'Environmental Change' strategic keywords remained unchanged for 9 years (unlike all six previous periods in the 17 years ending 2009 with 35 strategic keywords) which shows that geomorphologists have reached an agreement in human and environmental research. And more importantly, it may be the answer to the basic question in the introduction to this study; what has geomorphology conducted to offer the global environmental change debate? and how might this contribution be framed in the field?

Keywords: Human, Geomorphology, Environment, Citespace, WOS.