Assessment of the M8 Algorithm by Spatial Integrating of Alarms (Case Study: Sarpol-e Zahab Earthquake)

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(Received 10 December 2017 –Accept 3 February 2018)

Abstract

On average, a large and destructive earthquake occurs in the Iranian plateau every few years, in which, usually causes lots of damages. The Van, Saravan and Sarpol-e Zahab earthquakes are three recent events that occurred in this region from 2011 to 2017. According to premonitory phenomena, using earthquake prediction algorithms can be effective in reducing the damages of such events. In this paper, the intermediate-term M8 algorithm is used for retrospective prediction of the Sarpol-e Zahab earthquake. The aim of this research is to evaluate and complete the M8 algorithm performance background in the prediction of the major Iranian plateau earthquakes, and achieve precursory seismic pattern before the Sarpol-e Zahab earthquake. In addition, providing an approach to obtain alarm areas independent of the M8 input values is another important goal in this study. To achieve this propose, the results of alarm areas from different M8 input values were integrated in two ways. Both approaches were successful in predicting the target earthquake. The results showed that the Sarpol-e Zahab earthquake was predictable using the M8 algorithm, also the integration of alarm areas from various M8 statues reduces the area of the total alarm and stabilize it against the changes in the input parameter values. Finally, by considering the M8 functions values, it was found that reaching to the highest value of the maximum aftershocks number was the major precursory phenomena of this earthquake.

Keywords: M8 algorithm, Sarpol-e Zahab earhtquake, earthquake prediction, seismic premonitory phenomena, aftershock

Introduction

History of the Iranian plateau seismicity shows that this region is usually vulnerable to the large earthquakes. Therefore, considering the prediction of large earthquakes in this area in order to increase preparedness and reduce damages is necessary. The

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M8 is an Intermediate-term middle-range prediction algorithm that has yielded good results around the world .The low annual seismicity rate in the Iranian plateau is one of the challenges of using the M8 algorithm in Iran. The recent earthquake in Sarpol-e Zahab with a magnitude of 7.3 is a reason to the re-evaluation of the M8 algorithm. Therefore, the purpose of this paper is to re-evaluate the M8 algorithm in predicting major Iranian plateau earthquakes and also provide a suitable solution to reduce uncertainty and increase the reliability to alarm areas.

Methodology

The M8 is an Intermediate-term algorithm designed to predict earthquakes with magnitudes greater than M_0 (target magnitude). To run the algorithm in an investigation circle, a series of time from t_0(start time of earthquake catalog) to t_{end}(end time) by half-year's increase is formed. From t_b (start time of measurement) and in each t_i (time i), seven values are calculated using four functions. These seven values are obtained by changing the seismic rate threshold ($\widetilde{N}$) in the form of two parameters $\widetilde{N}_1$ = 20 and $\widetilde{N}_2$ = 10 in four functions within the investigation circle. In either case, the lower limit magnitudes are selected, in the way that, the average number of annual earthquakes in the investigation circle is equal to $\widetilde{N}$.

The values of the functions that are greater than Q percent of their values over time are labeled as very large values. The value of Q depends on the type of function. If at least six very large values including the seventh function exist at the time window $(t_i - u, t_i)$, and it repeats in two consecutive times t_i and t_{i+1}, the investigation circle for 5 years will be in alarm status.

Discussions and results

The 7.3 magnitude Sarpol-e Zahab earthquake occurred in Kermanshah province, near Iran and Iraq border, on November 12, 2017. This event was selected as a target earthquake in the M8 algorithm. The characteristics of target and computation earthquakes were selected from the NEIC earthquake catalog. The value of t_0 is equal to 1965 and t_{end} is 01/01/2017.

A dense grid of investigation points was created around the target earthquake. Then, the algorithm was implemented in six modes (1,2), (1,3), (1,4), (2,3), (2,4), (3,4) by changing the values of $\widetilde{N}_1$ and $\widetilde{N}_2$ from one to four,. Consequently, the results of these six modes were integrated by two approaches at t_{end} .In the first method, intersection of the alarm areas at t_{end} were selected as the final alarm area and in the second one, the alarm investigation points at t_{end} in all six modes were selected. Finally, the union of their circle were considered as the final alarm area (Figure 1). Checking the values of the functions in the joint investigation points showed that the value of the seventh function (maximum aftershocks) reaches its maximum value over time before the target earthquake (Figure 2).

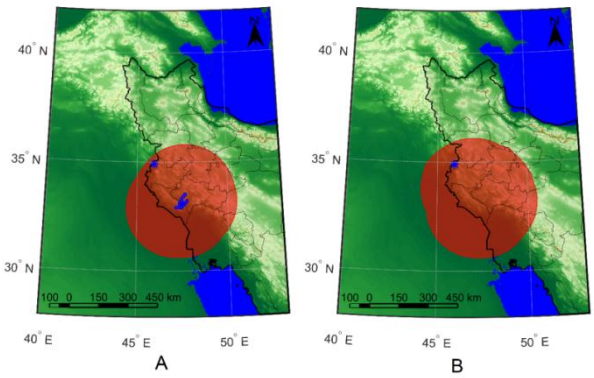

Fig. 1. Integrated alarm maps, the gray regions are alarm areas, the star sign is Sarpol-e Zahab earthquake epicenter, A) The alarm investigation points at t_{end} in all six modes and union of their circles, B) intersection of the alarm areas at t_{end}

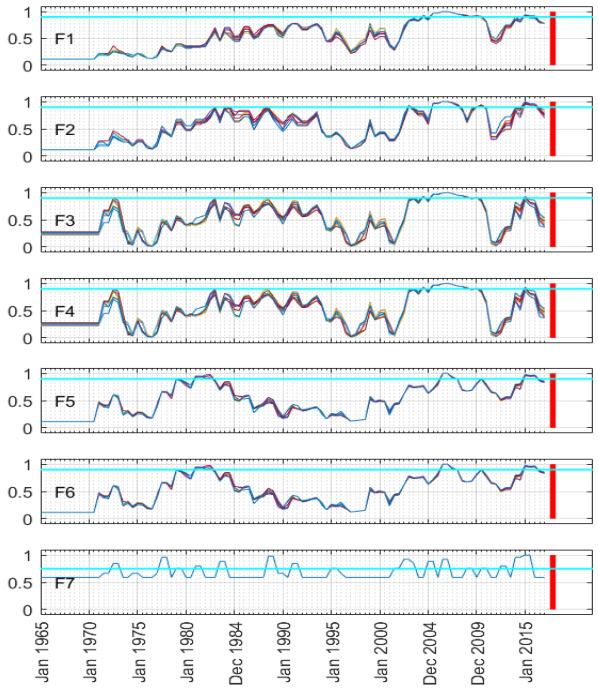

Fig. 2. The value of of the M8 algorithm functions over time for the joint investigation points and $\widetilde{N}_1 = 4$, $\widetilde{N}_2 = 3$ (time of the target earthquake is shown using a thick vertical line)

Conclusion

The retroactive use of the M8 algorithm showed that the SarPol-e-Zahab earthquake was predictable, and another retroactive successful prediction was added to the M8 algorithm achievements in the Iranian plateau. The results showed that the use of a dense grid of investigation points and integration of the M8 results are effective in reducing the spatial uncertainty of the alarm areas. This approach can reduce the effect of selecting input values in M8 results and lead to more stable results. Results also showed that the increase in maximum aftershocks was important premonitory phenomena for the Sarpol-e-Zahab earthquake.

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Geometrical Fractal Analysis of Malard Earthquake (20 November, 2017)

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(Received 4 January 2018 –Accept 3 February 2018)

Abstract

A moderate earthquake (M: 5.1) impacted the urban regions of Malard-Meshkindasht in Alborz province (far west of Tehran) with noticeable crashing of indoor objects that injured people around main shock epicenter in 20 December 2017. In this research, I have used Fibonacci numbers to set 53 years epicenters (IIEES, 1964-2017) based on Perimeter-Area fractal model containing foreshocks, main event and aftershocks onsets. Malard spiral revealed a meaningful geometrical relationship between the recent and recorded earthquakes in catalogue. Several epicenters have been patterned by geometrical angles in self-organized features. Also a set of foreshocks illustrate spiral distributions as well as in aftershocks due to a coherent association with seismic fault systems. Also an integrative spiral has been illustrated in the end of research to realize the hazard of Malard earthquake on NTF. For the time being, there is no inductive case from Malard into NTF because of represented Fibonacci and fractal evidences for this research.

Keywords: Geometrical analysis, Fractal, Earthquake spiral, Malard.

Introduction

Fibonacci numbers are famous series in mathematics for introducing golden sequences in natural creatures [1]. In this sequence, each number is found by adding up two numbers before it. Starting with 0 and 1, the sequence goes 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, and so forth. Written as a rule, the expression is:

$$F_n = F_{n-1} + Fx_{n-2} \quad (1)$$

Where, Fn is obtained Fibo-number, and Fn-1, Fn-2 are two sequences before Fn respectively [1].

Both real sets and integer sequences impressed many of natural phenomena, and therefore known as the mathematical keys for terrestrial and infra-terrestrial solutions. For instance, earthquakes have close and meaningful relations with rectangular spiral distributions as a result of spatio-temporal evolution in nature.

A simple sequence of Fibo-numbers is shown as below:

1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, …, Fn

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In above sequence, a ratio of (Fn/Fn-1) gives constant value (golden ratio, Ø) equal with 1.618.

Ø=Fn/F(n-1) = 1.618 (2)

This ratio has important roles in geosciences such as a main role in earthquake distribution geometrically. From geodynamical points, crustal motions regulate themselves by Ø to originate self-organized patterns on the basis of chaos theory [2]. Two types of golden ratios (1/618 and 1/133) are involved in golden shapes such as triangles, golden circles and golden rectangles [3,4]. Also a simple distribution of earthquakes can be seen in Gnomons and circles around the main shock events. Malard circle has two unequal arcs which one of them has golden angle equal with 137.5 degree of angle. The third is golden rectangle which has spiral function to correlate with geological patterns [3]. For example, earthquakes and their focal distributions are relevant process to golden rectangles with affinity to appear in spiral distributions as is it shown in Figure 1.

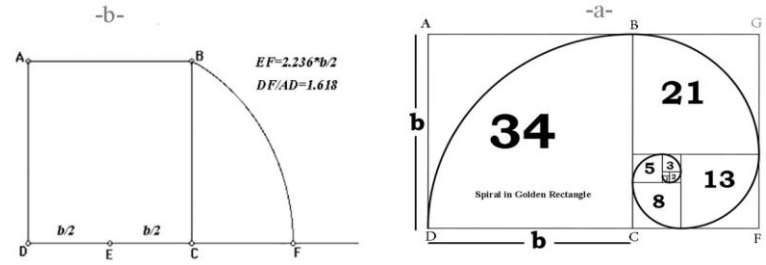

Fig. 1. Spiral function of earthquakes based on a golden rectangular distribution.

AGFD (3-a) is a rectangle that is reproduced by a simple ABCD square (3-b) within a multiple statement as below:

$(0.5b)*(5^{1/2})$ = FD [Where: FD/CD = 1.618 (3)

Methodology

Here, a golden geometrical distribution of half century earthquakes is well done by applying Fibonacci numbers into IIEES catalogue. Natural earthquakes usually array in spirals and therefore geoscientists are interested to start a seismic spatial interpretation according to Fractals and Fibo-sequences [2,4,5]. At least, 53 years backgrounds of Malard seismic events (IIEES, since 1964) facilitate this opportunity to answer the question of "where is the next destructive earthquake in regional local scale?"

It means, with a dense and accurate catalogue, scientists will be able to locate the future earthquakes based on geometrical precursors. Also we know that Fibonacci numbers have close impressions to nature as a key for earthquake prediction [3,4].

According to post prediction algorithm, a main shock record such as Malard event (20 Dec., 2017) , not only initialized post seismic processes, but is relevant to long term catalogues as a regional Fibonacci variable. In practice, Alborz seismic databases including location of epicenters [6,7] and structural lineaments [8], have been gridded by GIS facilities to reveal geometrical relationships of the epicenters to illustrate golden peculiarities of Malard earthquakes.

Discussions

Malard earthquake (2017-12-20) seems to be initial point for a short range of post seismic events, which many of them should be considered as aftershocks activities. In Figure 2-a, meaningful triangular distribution can be seen in north side of Malard main shock epicenter. Also, an obvious golden circle (within radius lesser than 2 Km from main shock event) can be seen in Figure 2-b as below.

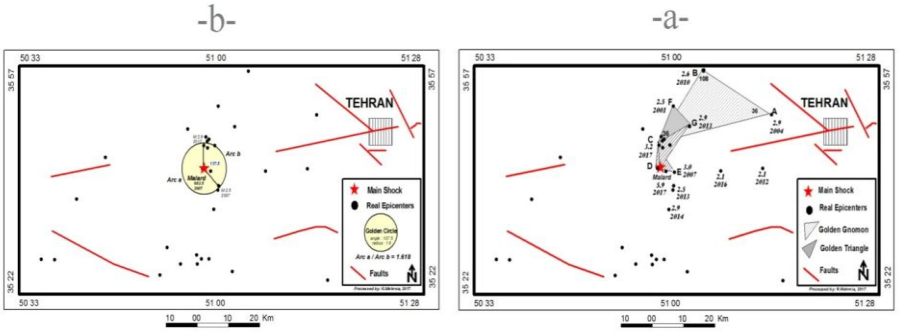

Fig. 2, a) two kinds of golden triangles (ordinary and gnomons) in Malard seismic pattern. b) A symmetric golden circle with approximate radius =1.6 near Malard main shock region.

As a primary result, above mentioned facts indicate to natural seismic resources of Malard-Meshkindasht activities, and as second, a rectangular distribution of magnitudes (M>2, since 1964) give rises to spiral function, which contain two types of post seismic potentials (High and Low PSP) shown in Figure 3.

Malard spiral is a dependent geometrical variable to post seismic events as well as its dependency to foreshocks base on Perimeter-Area fractal applied in catalogue. This spiral is Meridian type with west seen affinity that is centralized by Malard seismic events in Dec. 2017.

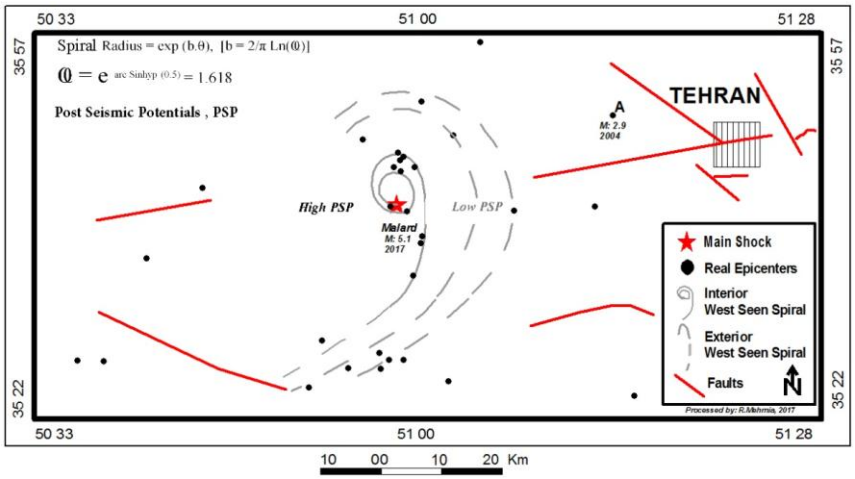

Fig. 3, Spiral distribution of Malard earthquakes (Ref. Database: IIEES, 1964-2017)

Conclusion

-This research introduced geometrical fractal analysis of 53 years catalogue (Malard region) as recently active zone in eastern part of Alborz province.

-Rectangular distribution of Malard earthquakes, make an easier and accurate forecasting of future events (usually aftershocks or other seismic activities) that is originated from main resources maybe encircled by golden circles and limited by fractals.

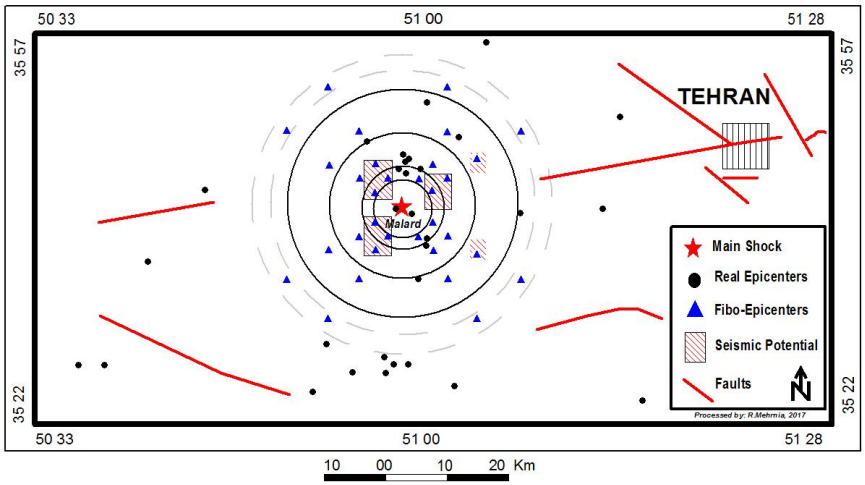

Figure 4. A Fractal separation in random - regular Fibonacci sequences in Malard seismic events (20 Dec. 2017)

In figure 4, forecasted areas (red hatched), have been determined by cross-cutting the isosceles of golden rectangles (Fibo-grids). Therefore, many of Fibo-epicenters are shown on this figure, but few of them are involved with PSP.

- Rectangular distribution of Malard earthquakes makes an accurate way to forecast the future events (aftershocks) originate from main seismic resources by both fractal and Fibo analysis of catalogue.

-For the time being, Malard aftershocks maybe continued toward the west to complete seismic gaps in this cycle (high PSP, Figure 3). Also a rare scenario maybe occurred in west or east directions due to triggering Eshtehard fault or NTF system respectively. Moreover, from geometrical points of view, this scenario is temporary with no longer effects after a monthly reducing in post seismic activities.

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Terminology, the Key of Environmental Hazard Management

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(Received 19 November 2017 –Accept 3 February 2018)

Abstract

Widespread use of apparently synonymous vocabulary in the environmental hazards science is not an unfamiliar issue for specialists in this field. Therefore, the research question is whether the words such as natural disasters, natural emergency, or natural hazards have the same meaning? And do these words really have same meanings? If the answer is negative, what are the implications for the use of synonymous vocabulary? This article attempts to answer these questions by using discourse analysis, and the method of PDAM, as well as selecting ten academic titles and three texts, which have been obtained from texts in the domain of these sciences. The results of this study show that linguistic features such as semantic and linguistic have a significant impact in research and theoretical of sciences such as epistemology, ontology, and epistemology. Extreme issues will be executed as it can be claimed that management of environmental hazards is much more promising rather than focusing on the recognition of the physical phenomenon, and the formulation of managerial and operational frameworks, and the precise explanation of specialized vocabulary.

Keywords: Terminology, environmental hazard management, discourse analysis, method of PDAM,

Introduction

Interpretations in Environmental Hazards Management in Iran shows a relative failure to reduce harmful effects, injuries, and consequences. There was a poor management regarding to this issue, while a large number of organizations, universities, and research institutes have been conducting research in this field in recent years, and there are still at the time of the disasters. So the main questions of this research are: What is the root of this failure? Why, nowadays, our scientific community does not agree on the use of the terms of this science?

Materials and methods

For this research, triple steps have been performed as follows. In the first stage of the research, the method of the discourse analysis method was used. The second step

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was to analyze the causes of the use of synonyms, spatially in Farsi, and in the third step, some of the consequences of the use of synonymous vocabulary in the field of environmental hazards have been done. The second and third parts of the research were conducted using the library-analytical method.

Results and Discussion

First stage

Exploring the texts, using the practical discourse analysis as "PDAM" on the diversity of terms, the following results were briefly gained:

1.1 Widespread ambiguity is in the concepts and vocabulary of environmental hazards.

1.2 The lack and uncertainty of the rules related to disaster management.

1.3 Lack of transparency in job descriptions within rules and regulations.

Second stage

Paying attention to concepts such as synonym, polysemy, and linguistic relativism implies that:

2.1 Proper language usage is important.

2.2 Language is not merely a duty to communicate.

2.3 Vocabulary in any language contains more complex concepts beyond their communication function.

2.4 The absence of a word for a concept in a language is due to the lack of concepts and implications of the term.

2.5 The lack of words for a concept in a language undermine the understanding of that concept by users of that language.

2.6 The absence of explicit and precise terms for a concept in a language result in synonymous and meaningful uses, which will cause confusion and increasing distraction from the audience.

Third stage

Each research is based on deep philosophical and theoretical foundations. In fact, the question or hypothesis is a subject that depends on the researcher's view of ontology, epistemology, paradigms, and methodology [27]. The very important point is that all of the above-mentioned components are dependent on the vocabulary and terminology; in other words, the vocabulary and specialized reform of each discipline are an integral part of any of the research phases.

Conclusion

The results of this research indicated that the terms in the language contains more complex concepts than their communication function, so it is very important that the vocabularies of the environmental hazards would be provided by an official authority in the country. Since terminology is very essential in environmental perceptions, the United Nations Office for the Reducing of the Risk of Crisis has provided a unique glossary, which includes an accurate definition of fifty-three

words on its website. This glossary has been translated into English, French, Russian, Chinese, Japanese, and Arabic. The editors of this specialized dictionary in its second edition, which took place in 2015, stated in its introduction section that the terms used to refine the thirty-five thousand documents and scientific reports have been extracted. Undoubtedly, less science has so far been emphasized on the use of specialized vocabulary. Therefore, it is suggested that the Disaster Management Agency of the country, as an official reference, translate this dictionary into Persian with the help of experts.

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The Role of Mass Media in Leading Public Opinion at Water Hazards

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(Resaved 3December 2017 – Accept 3 February 2018)

Abstract

Introduction: The subject of this research is the role of mass media in water hazard for leading public opinion. The purpose of this research is to present the state of the country's water resources on the one hand and show the role of mass media in preventing the intensification of the water hazard in Iran on the other.

Materials and methods: In this research, 10 experts from the field of agriculture, environment, natural resources, as well as media and communications science experts have been used for deep interviews. Then using open and axial coding to analyze the findings in sub-groups and the main group.

Discus and Results: According to the findings of this study, Iran is at hazard in the water sector now, and has not reached a crisis. So here the role of mass media is very important. Mass media at the hazard stage have three important tasks: prevention, preparedness and anticipation.

Conclusion: According to the findings of this research, in the process of preventing mass media, they can put culture, education, supervision, and demand on the agenda. At the stage of their preparation, they can deepen social solidarity with proper education for the citizens, and in the stage of forecasting, they will be able to inform the audience about the country's water resources. According to the results of the research, the mass media, together with the water authorities, will prevent the country from catching the risk of a water crisis.

Keywords: Water Hazard, Hazard Science, Mass Media, Public Opinion, Hazards Management

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The Trend of Sea Level Pressure Changes in Iran with Emphasis on Climate Hazards

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(Received 9 January 2018 – Accepted 3 February 2018)

Abstract

The occurrence of climatic hazards is one of the main characteristics of the climate of Iran, which it always has economic, social, and financial losses. Undoubtedly, the first step in reducing the climate impact of the country is to identify the causes of these hazards. Sea level pressure is one of the most important climatic elements that can affect important climatic factors such as temperature, rainfall and wind that cause climate hazards. Increase or decrease severity and the expansion of the eastern and northern levels of sea level pressure centers is one of major determinants of dry and humid periods in Iran. The study of published works and resources shows that a comprehensive study is required on changes in Iranian sea surface pressure in different seasons. Therefore, the purpose of this study is to reveal the trend of sea level pressure changes in different seasons. For this purpose, sea level data with NC format at 12 GMT Obtained from the NCEP / NCAR database from 1948 to 2016. Afterward, to obtain the seasonal categorization and mapping, the next steps were converted to TXT, Matlab, EXCEL, and GIS formats. Then, long-term changes in sea surface pressure were revealed. Study of time series trend diagram as well as values of mean, average, minimum, and average of maximum sea level pressure with the Mann Kendall test in different seasons showed that the level of significance level in all cases is smaller than 0.05, and the average annual pressure level of the Iranian sea has a significant upward trend, which is increasing by 0.047 hpa per year. The average 10-year map of Iran's surface pressure was similar in different seasons, and the average pressure dropped from the north of Iran to the south. Anomalous maps of the mean of ten years of sea-surface pressure showed that anomalous amounts have reached their highest positive levels in recent decades. Considering the importance of the issue and the vulnerability of the country to environmental hazards, it is clear that climate risk management will have a higher chance of success and credibility with increasing sea-level pressure.

Keywords: sea level pressure, Mann-Kendall trend tests, anomaly, climate hazards.

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Evaluating and Explanation of Moral Hazards and Adverse Selection in Capital Market and the Role of Ethics in their Reduction

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(Received 10 January 2018 – Accepted 24 February 2018)

Abstract

This research has been done to study and clarify the moral hazards and adverse selection in the capital market and the role of ethics in its reduction. It has methodically worked on the qualitative and interpretative structures and has tried to figure the case descriptively and analytically out according to the qualitative method, using library and internet resources. To create transparency in a capital market, information availability is the most important factor. The clearer the capital market information (symmetric information) is, the more effective will be this market on the economic growth and development. One of the results of information asymmetry is the abuse of the party with more information or, in other words, their moral hazard, in the consequence of which the other party with less information will make an adverse selection. Therefore, compiling rules and ethics charters based on moralities which go with religious and national culture, can reduce the monitoring cost and guarantee the rules execution. These will lead to create trust and honesty in the market and enhance transparency in the capital market.

Keywords: moral hazard(s), adverse selection, capital market, ethics, Islamic ethics

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Locating Suitable Directions for Kamyaran Urban Development through a Hazardology Approach based on the Application of Geomorphologically Restricted Areas

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(Received 3 February 2018 – Accepted 16 March 2018)

Introduction

The location of Settlements and other facilities created by humans is fully influenced by environmental factors, especially Geomorphology and Geology. Establishment and growth of cities, irrespective of the capabilities of the land and its talents, have many destructive and harmful effects, and increase the multiplicity of financial and mortal damages in times of crisis. From the hazardology and management point of view, most of the damages are related to the incorrect placement of buildings and structures. Therefore, the importance and necessity of recognizing the characteristics of natural environments to identify the appropriate points for the construction of buildings, is very noticeable.

In this way, through the study of Geomorphology, effective steps can be taken to select the most appropriate location for the expansion of cities and take serious action to prevent or counteract with risk of natural phenomena.

Methodology

The present research is based on a managerial and hazardology approach, aiming locating the areas susceptible to urban development using the forbidden areas method. For this purpose, to provide a theoretical framework, the existing literature have been reviewed. Then, along with the application of specific methods in the field of software, expert discussions were used. To select the areas prudent for the desired purposes, eight criteria and effective environmental parameters including elevation, slope, aspect, distance from the river, land use, lithology, distance from the fault and urban areas and their layers were provided. Then, according to the existing standards and experts' opinions, the forbidden areas were identified. Other areas of study outside of the forbidden areas were identified as suitable zoned for future urban development. In doing so, the Fuzzy logic and ANP models, the value of each layer was calculated. Fuzzy Gamma operator has been used to modulate the high sensitivity of the Fuzzy operator. Finally, overlapping the layers, map which

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entails both forbidden areas and those susceptible for urban development, was created.

Discussion

In the first stage, the effective environmental parameters in the survey of the favorable areas of urban development of Kamyaran, include Geological parameters (Lithology and Fault), Geomorphological parameters (Slope, Aspect, Elevation), Hydrogeomorphological parameters (River) and, finally, Human parameters (Land use and Distance from Urban areas) as effective information layers were considered. Then the layers were Fuzzy and the banned areas were determined. Investigating the parameters in the study area showed that in terms of lithology, most of the study areas is covered by Quaternary Sediments. The Location of urban areas in different parts of the city is not significantly different. However, there are several fault lines in the northeastern range that limits the city's expansion in this direction. In terms of topographic parameters, apart from the northeastern mountainous masses with a height of more than 1800 meters and a slope of more than 30 percent, there are no special restrictions on other parts of the area. The surface water currents of the area are drained by the slope of the south and southwest of the area. Therefore, in relation to the risks such as urban flood and due to tissues of sediment of the area, respecting the buffer is essential that in this study, 200 meters of the river was estimated. According to the study of environmental variables and the application of prohibited areas, it can be concluded that suitable zones are mainly located at a close distance from the current urban areas. They all have low Slope, low Elevation, south Aspect and proper distance from the rivers and fault lines.

Conclusion

The findings of this research show that the area of research is 166 square kilometers. 37 percent, equivalent to 4.61 square kilometers of study area, were among the forbidden areas. In terms of Neotectonic, Lithological, Topographic and Hydromorphological parameters, it is in some way at risk. This range is often found in the northeastern part of the study area. Since the current area of the city is about 5 square kilometers, it can be concluded that the city has the optimal development space for several years on low-risk route. Therefore, it can be said that existing research based on the application of prohibited areas and system approach is the basis for efficient spatial management of urban and around cities development.