Australian Journal of Basic and Applied Sciences, 5(8): 498-506, 2011
ISSN 1991-8178

Health Survey of RTL Method on the Iranian Earthquake Catalog

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Abstract: Many years of human observations of the planets and where they will live have passed, these observations suggest that the Earth is a live organisms and it expands itself. Maybe we reach the conclusion that nature acts contrary to human, but by considering the occurrence of events or by checking out the signs we can prevent heavy damages. These studies on the earthquake led to the discovery of methods that we examine them in this article. RTL method is one of the last methods which have been developed. This method which is the definition of an audio parameter is based on seismic factors of earth that shows the changes of the ground faults as well. In this research work, this method has been used for the compiled catalog of Iran and we will review its response too.

Key words: RTL Method, Seismic catalog of Iran, Prediction Point, earthquake prediction, faults activity

INTRODUCTION

The research which has been done on 30 thousands of earthquakes (Taghizadeh H.), confirms the opinion that the most severe earthquake are on two belts. A coastal belt of western beaches of South and North America and the other belt are started from the Mediterranean coasts and after passing from Turkey, Iran and Afghanistan reach Southeast Asia (Регель В.Р.).

Iran is one of the zones that destructive earthquakes occur in its lands. Being in the direction of earthquake prone Alpine – Himalayan and being under pressure from two sheets of Eurasia and Saudi Arabia (Farzanegan S.) has caused that earthquake with high intensity and great damages to be seen in the catalog of Iran. The final bitter event which caused the death of 40 thousand people occurred in the city of Bam on December 26, 2003 with the power of 6.5 degrees on the Richter (Taghizadeh H.). Some events such as this make us to ask this question that whether we can determine the time and place of earthquakes by geophysical methods or not? In the long and medium interval of times some scientists have achieved remarkable results. One of the methods which are used for prediction of earthquake and description of preparedness stage for earthquake is RTL method.

With this goal we verified the seismic catalog of Iran's earthquake. The catalogue information has been gathered from the resources of the sites MOS, USGS, ISC and historically they belong to the period of years 1900 to 2003. This method was designed by Cobolev G.A. (Zavialov A.D.)

Accordingly, the earth's crust areas prone to earthquakes, the earth crust organizes the crisis, regional position ready for building earthquake high magnitude which this readiness is done by expansion of cracks and small holes and then changing these cracks into bigger ones (Smirnov V.B.)

At the time of existence of some fractures in the walls, it starts in small a size which expands erosion. After that it accelerates with dynamic form. However, the fracture stage is short in the end of erosion stage, in a way that that its conditions that are under of controlling methods, it won't be sufficient. On the other hand, heterogeneity and lack of pressure on the shell on the depth of the place where the earthquake happens, it causes the next problems in the work (Сидорин И.А.).

But measuring the Earth's crust deformation by making various methods it is possible that the division of pressure to be done, so by having some information regarding distribution, we can provide the situation for the next studies.

According to this matter, the possibility of predicting the time and place of earthquake occurrence can be measured. Cobolev G.A., has pointed to this issue in his study (Smirnov V.B.), which at the moment the possibility of exact predict in a short period of time is not possible, at least as long as the physical nature of pre – sighs not to have been fully described (Cobolev G.A., 1999), but prediction in the average level is possible with the current information (Садовский М.А.).

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The physical Information available to determine the time of the physical medium range (six months to a year) is better. Considering the position of the earth's crust in terms of resistance to big explosions (earthquake) we can only assume the hardness of earth in this condition which is equal (Smirnov V.B.). Earthquake preparation process is complementary process. These changes include converting non – homogeneous to homogenous and the change of a small crack into a big crack. Reviewing these changes can provide this possibility of predicting the next powerful earthquake (Pisarenko D.V., 1995).

In fact the formulation of the earthquake center is reflected from the seismic disturbances and also it is led to the location of acoustic events, fraction of activation and all of them lead us to the place of the next macro explosion (Cobolev G.A., 1996).

RTL Method Description:

Initially this parameter in 1996 this research activity was proposed by Cobolev G.A., and his colleagues (Cobolev G.A., 1995). The algorithm was designed for earthquakes of high magnitude for the region of Kamchatka (a region in Russia) and then it was confirmed in the laboratory.

It is based on these principles that Sobolev G.A., divided them into two categories of silent and active earthquake centers. At this time the phenomenon of silence would be seen in most of the times which shows energy and activation process following the fractions (Sttorchak D.A.).

Of course the lack of seismic devices or insufficient energy is considered as the problems of this plan. Cobolev G.A., suggested that the effect of silence and activation must be stronger in a way that it is felt near the earthquake center; this effect is adapted to the earthquakes which have occurred in the past (Mikosch T.). In fact, this method of pre – earthquake forecast is based on the effects on each other and designed it is considered as SEISMOLAP methods (Panomarov A.B.).

RTL parameter concept to the point of coordinates (x,y) at time t in space and time, which is calculated according to the information of earthquakes. The earthquakes that occurred in the space and time of [r_{max},t_{max}], and under the following conditions (Smirnov V.B.):

$$r_i = \sqrt{(xi-x)2+(yi-y)2} \le r_{max}$$

$$0 \le t - t_I \le t_{max}$$

Here x_i and y_i coordinates are based on epicenter (in general terms by three strong earthquakes where z_i, y_i, x_i are the coordinates of the geocentric earthquakes) and t_i is the time of its occurrence (Федотов С.А.). RTL parameter introduces itself in three functions. The function is sourced from the epicenter R, a function of time T and a function o of earthquake center size L (Peznchenko U.V.).

$$R(X,Y,Z,t)= [\sum_{i=1}^{n} exp(-\frac{ri}{r0})] - Rs$$

$$T(X,Y,Z,t)=[\sum_{i=1}^{n} exp(-\frac{t-ti}{t0})] - Ts$$

$$L(X,Y,Z,t)=[\sum_{i=1}^{n} exp(-\frac{li}{ri})^P] - Ls$$

The conclusion of this method has a scheme on the whole n and it will be done in the area [r_{max},t_{max}] (Шебалин Н.В.).

In this phrase, the r_0 characters in these terms can be weakened by an earthquake r_i passing to their distance from the point (x,y,z), for those that RTL parameter is calculated (the point is called prediction point). The quantity of l_i is the earthquake explosion center length which is linked to energy function with the formula $\lg l_i=0.244\lg k_t-2.266$ (Slavina L.B.). Size of explosion during an earthquake in central i has a bilateral relation with energy (Голицын Г.С.).

- *r_i,t_i matches the ratio of time and epicenter of passing earthquakes to time and epicenter coordinates of a powerful earthquake (Prediction point).*
- r_0=50 km (fixed), representing the function modifiers of distance effect of epicenter for the passed earthquakes toward a powerful earthquake (prediction point).
- t_0=1 year (fixed), representing a function for correcting the time of the previous earthquakes toward the powerful earthquake (prediction point).

Power indicator p, represents the share of each earthquake that has passed from that area. For example, if $p=1$, it means the contribution is proportional to the relation of during of explosion toward the distance of geocentric I, the high point of earthquake has been assumed at the time when $p=2$ or $p=3$, i.e., the share (deposit) tailored field (volume) and when $p=0$, i.e., the share of each earthquake that have occurred in the past is independent from the modifier functions of time and place and during of its centrality (Smirnov V.B.).

In this series of calculations for $p=1$ catalogue of Iran is presumed and the calculations have taken place via a time of one year with the steps of 15 days. Three function. R_s, T_s, L_s are the corrective function of time and place and the length of its center (Smirnov V.B.).

By measuring the parameter of RTL which has the highest accuracy, the deviations and changes of von seismic regime is considered in a period of several years. Falling from high levels of seismic zero stand corresponds to a level that von level of zero matches with fraction of activation and indeed these parameters reflect the changes and earth crust as an audio sign as a result we can consider it as a sign for prediction of earthquake and to use it as RTL algorithm to determine the seismicity (Willemann R.J., 1998).

RTL Test Method on a Catalog of Iran Quake:

It has been obtained for seismicity Risk Analysis for Iran Earthquake Catalog and for each event, the energy class has been calculated by the formula $K=AM_b+B$ where $A=2.89$ $B=-2.73$ is [3.11]. The scale is needed for computations in RTL algorithm (Willemann R.J.).

To analyze this method, some searching has taken place in the catalog and an area near Tehran city has been chosen which we have complete information regarding them and they include the three following events:

1– 1/5/1998 (38.55 latitude and 48.41 longitude, $M=6$
2– 9/4/2000 (Latitude 40.32 and longitude 50.09), $M=5.88$
3– 7/4/2002 (Latitude 37.67 and longitude 48.93), $M=6.3$

Their rows of large events in a magnitude are greater than $M_b>5.5$ in Iran. Of course, given the earthquake of 2002 in terms of information is more reliable because they have to adopt general seismic network journalism in 1980 from the perspective of quantitative and qualitative data entries significantly grow (Young J.B.).
In Figure 1, earthquake location with magnitude over 5.5 ($M_b \geq 5.5$) has been determined.

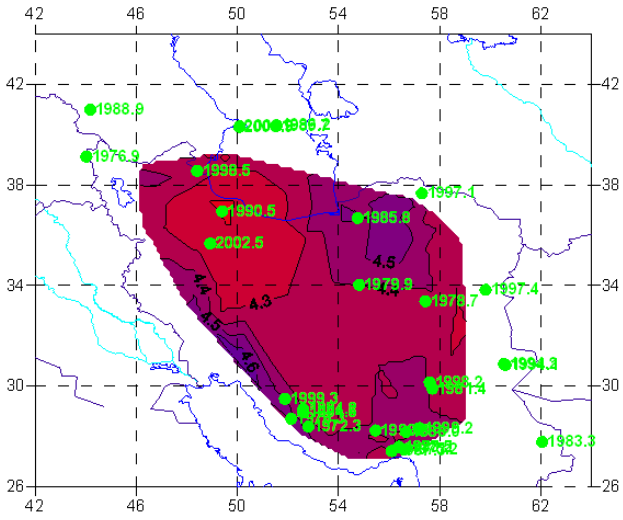


Fig. 1: Earthquake location with magnitude over 5.5 ($M_b \geq 5.5$)

In Figure 2, changes of RTL characters are shown. As mentioned it shows the regional activities by this form that the designed algorithms have high sensitivity and accuracy and the diagram of this parameter at the time of falling from zero is silence stage and at the time of peak is fraction activation stage.

In this Figure, the parameter diagram of RTL is reviewed and the situation of this parameter before ant at the time of earthquake has been shown.

This parameter is based on average unit and they have been calculated according to the von minor changes (unit of sound).

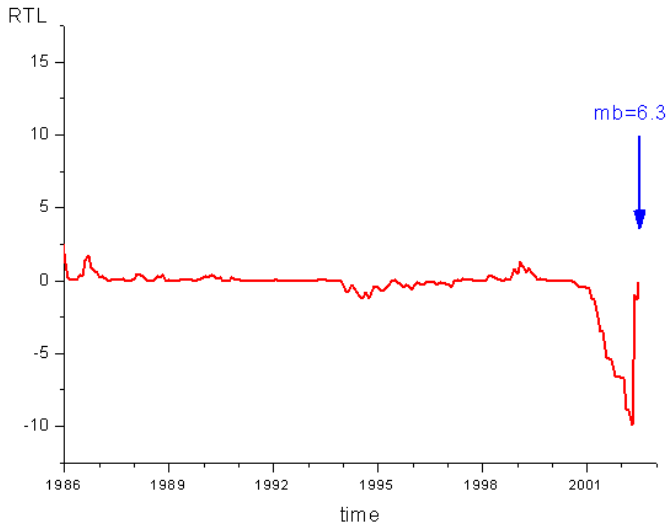


Fig. 2: Curve of parameters RTL changes

In Figure 2, it is seen before the earthquake 07/04/2002, both stages of preparedness i.e. silence and activation are visible. The disorder quantity is several times the ratio of von has a falling level of several years for RTL, 2.2 years before the event disorders started in seismic disturbance and in Figure 3 it is seen that how silence is replaced by fraction activation.

In these figures, the seismic disorders field has been consistent on the latitude and longitude. Development disorders in blue color show silence and the red color indicate activation. Earthquake center of 2002 is seen in the final form.

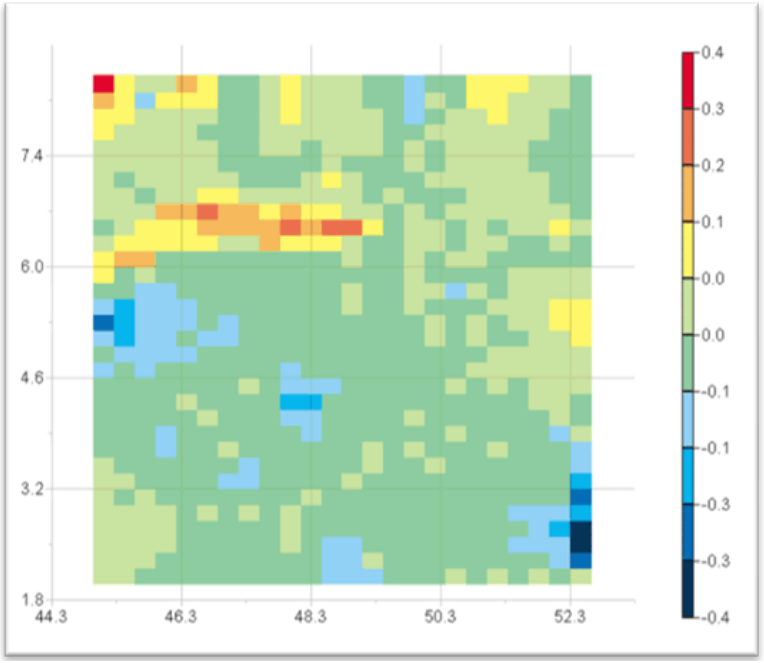
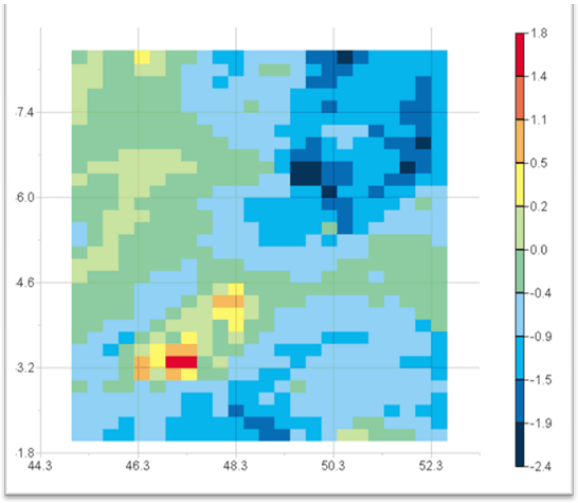
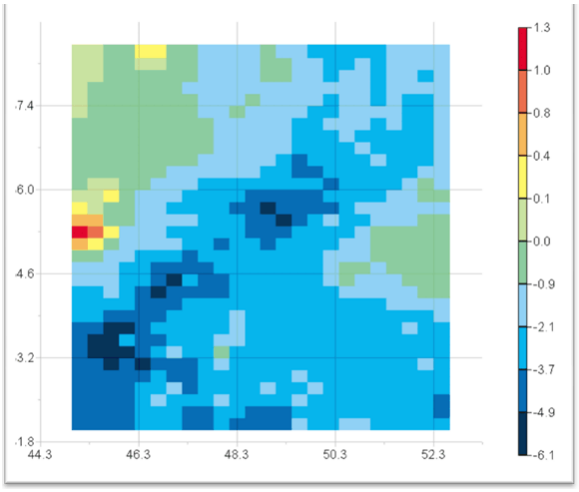


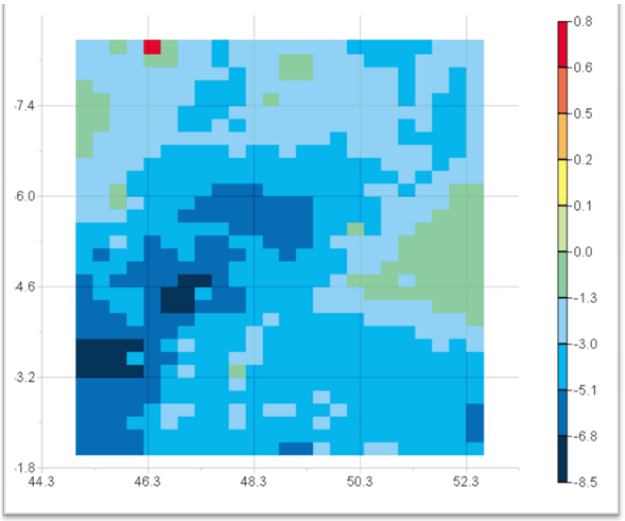
Fig. 3: The position of seismic silence disorders before earthquake



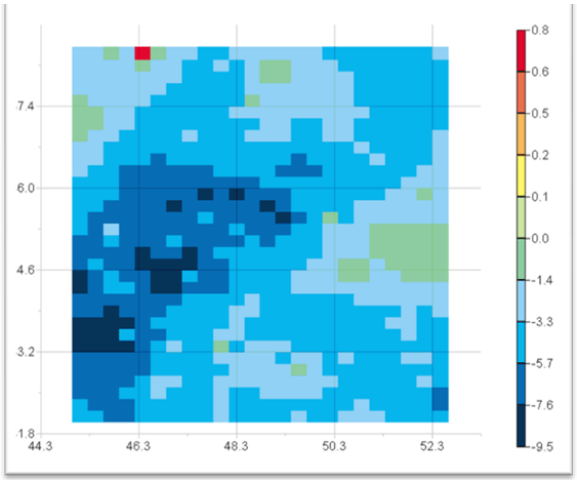
28 months before the earthquake



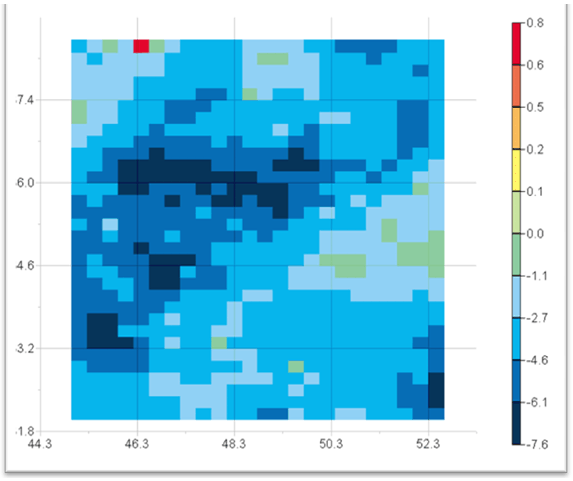
Twenty two months before the earthquake



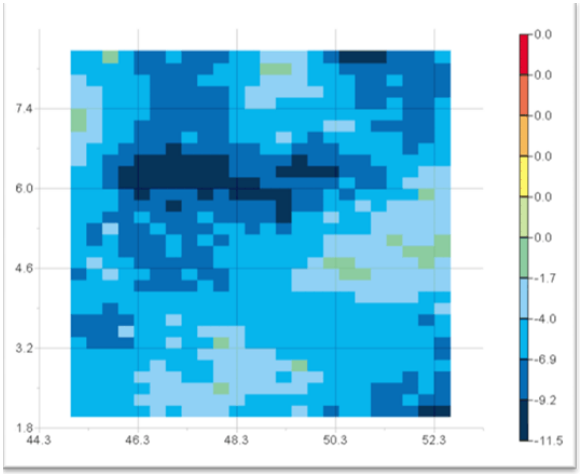
Sixteen months before the earthquake



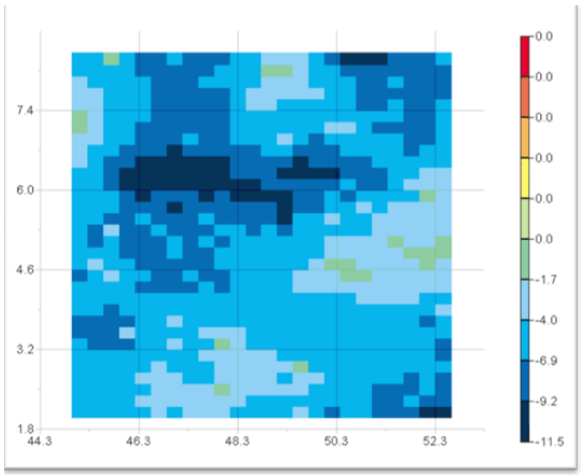
Eleven months before the earthquake



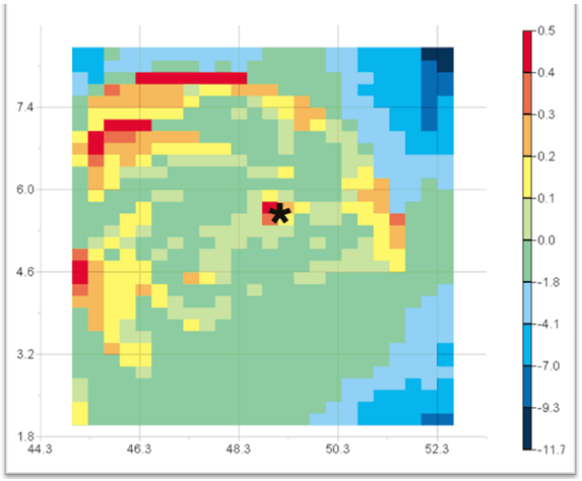
Eight months to earthquake



Five months to earthquake



Two months before the earthquake



Before the earthquake and epicenter position

Result:

In this research work, the review of RTL method on Iran's catalog was done. Under the application of this method in the graph parameter RTL based on time before occurrence of earthquake of 07/04/2002 was observed with the power of 6.3 deviations from the zero level.

This means being involved with the experimental data and physical principles we can use algorithm. Catalog data accuracy and precision is one of the main conditions of response in this method.

For the purpose of possibility measurement of places the formulation of model for the disorders before the earthquake is necessary and it has been completed by algorithm and it has been used by Cobolev G.A., in the Kamchatka earthquake.

In his work, more than 68% of the cases have been predicted correctly (Smirnov V.B.). This formulation is considered as some maps of disorders which is determined according to the latitude and longitude. By adding the appearance and changes in pre – displayer, the ability of this algorithm will be increased in preparedness period and determination of time and place of earthquake occurrence.

The base of this work is getting the result of RTL based on the information of National Earthquake Catalog and regional service area of seismic observations. Currently, based on the benefiting from electronic facilities, information required for research is available and also the level of errors has been reduced in sizes and gathering information.

We can obtain these information for the row of the seismic areas and to update it and to analyze them practically in the real time regime (current time), this could be considered as the most important section of responsibilities in seismic researches; so that we can consider the critical events in the way of occurrence.

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