

# Vulnerability zoning of seismic points in Iran's Provinces based on temperature variations and seismic events using MODIS images of MOD11A1 and the GIS

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## Extended Abstract

### Introduction

In order to analyze the reduction of the impacts of natural hazards, particularly the earthquakes, four basic constituents such as conceptual understanding of development, vulnerability, recognition of the concept of risk, conceptual understanding of capacity building, and also, the recognition of risk management approaches are essential. Earthquakes and mass movements are a function of environmental factors, and identifying and segregation of seismic areas and hazard zonation is an important step in assessing environmental hazards. Therefore, Geographic Information Systems (GIS) and multi-criteria decision-making systems are the appropriate tools for zoning land in relation to seismic hazard. In this regard, the study of earthquakes and the areas with high seismic potential for all-round planning and management is imperative and inevitable. Therefore, the present research aims to study the vulnerable areas against natural hazards in Iran.

### Materials & Methods

The present research is descriptive-analytical with regard to the nature of the problem and the study subject, and is a type of applied studies with an emphasis on quantitative methods. The purpose of the study is to investigate the vulnerable areas against natural hazards with an emphasis on earthquakes (Case study: Iran). In this research, the Modis Image (MOD11A1 product) of Terra satellite was used for the years 2000 to 2018. These images have a resolution of one kilometer. Therefore, each pixel of these images covers an area of about 100 hectares of land. To identify the sites with high seismic potential, criteria such as: altitude, earth temperature, the numbers of seismic events between the years of 2000 and 2018 were taken into consideration. In order to calculate the density and intensity of the earthquakes occurring, the data from the United States geological site (related to Iran) was used, and the final output was calculated by the interpolation methods of geo-statistical IDW model - a technique which predicts unknown points based on the correlation between the measured points and their spatial structure - and the arithmetic overlapping in the GIS environment. All processes and data analysis were used in the GIS environment and eventually the overlay of the final output was determined in the form of a map (vulnerability).

### Results & Discussion

In order to measure the impact of effective factors on earthquakes, the analytical software mentioned in the

research methodology section was used and also, to determine the indexes effective in determining low and high risk areas for identifying the seismicity and land evaluation for different types of activities and the amount of importance of each of these criteria relative to each other with regard to the present state and the collected information and the investigation and study of the books, previous plans and experts' opinions have been implemented, which has ultimately entered into the GIS in the forms of information layers. In the next stage, the information layers are given weight proportional to the degree of importance and its effect on the selection of the appropriate field. In order to achieve these indices, a series of maps and databases were needed so these were prepared in the GIS environment. In this research, it is assumed that by analyzing long-term time series of satellite data, such modifications can be monitored. Therefore, in this research, the profile of temperature changes was analyzed using the MOD11A1 product of the Modis sensor during the years 2000 and 2018 in Iran. the results of the research show that the temperature variation pattern for each class is different, and in general, show the increase, stability, and then logical increment over the 18-year period, which can help researchers to identify temperature changes and consequently, to select the appropriate time period to take an image to investigate the changes in the coverage of the study area.

### Conclusion

The study area, with regard to the mainly low topography, tectonic activity and high seismicity, diverse geological and climatic conditions, have the major natural conditions for the creation of a wide range of earthquakes, and these earthquakes bring a lot of financial losses to the region annually but unfortunately, all periodic studies have been carried out without accurate and efficient planning by the relevant authorities to date. Therefore, studying and zoning of susceptible seismic areas is necessary from an absolutely scientific view. Given the obtained finalized map and the study of temperature changes and occurring events, it can be concluded that parts of the south and southwest (Bushehr, Kermanshah, Hormozgan, Khuzestan, Ilam) are very vulnerable and exposed to severe damages. Also, the latitudes related to the central half and the southeast of the country (Kerman, Sistan and Baluchestan, southwest of southern Khorasan, east of Yazd) are exposed to moderate to high damages, and the northern part of the country (Golestan, Mazandaran, Gilan, Ardebil) are located in low damage zone because with regard to the thermal investigations within the framework of the seismic identification, they are located in the high to low thermal zones. Therefore. We find out that more than one third of Iran is faced with high, one third with moderate and one third with relatively low risk. One of the main causes of the earthquake is the high heat inside the Earth where is very hot and reaches to five to six thousand degrees Celsius. Wherever there is heat, there is movement as well, so the heat of the Earth's center moves to the top layers and displace them.

**Keywords:** Earthquake, Vulnerability, Temperature variations, Seismic events, MODIS MOD11A1 images, GIS, Iran