Evaluation of subsidence in western cities of Hamadan province Using radar images

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Introduction

Land subsidence is commonly referred to as vertical downward movements of the earth's surface that can be accompanied by a slight horizontal vector. Land subsidence is a global problem and a morphological phenomenon. This phenomenon is affected by human activities and natural factors that may become a threat to humans and human achievements. The phenomenon of subsidence, although imperceptible and gradual, but is associated with many risks, including the creation of potholes, failure and cracking of buildings, skewing of high facilities, damage to agricultural facilities, breakage and destruction of stairs Roads and network of urban thoroughfares. Therefore, this issue affects the urban areas more, which if not addressed can lead to many human and financial losses. Accordingly, monitoring the rate of land subsidence in order to reduce the negative effects as well as controlling its development process, will be very important and it is necessary to regularly estimate the area subsidence trend. Due to the importance of the issue, in recent years, various studies have been conducted in the field of subsidence and advances in the field of remote sensing have led to monitoring the phenomenon of subsidence, unlike in the past, with greater accuracy and speed. One of the methods that has received a lot of attention in recent years is the radar interference method, which has high accuracy and speed in processing information and monitoring land surface changes, so in this study, this method is used to monitor the situation. Subsidence of cities located in Hamedan-Bahar plain has been used.

Materials and methods

In this study, in accordance with the intended objectives of Sentinel 1 radar images (73 radar images during the period 16/01/2015 to 14/01/20120), the information of piezometric wells in the region (related to the Water and Regional Organization of Hamadan Province) And the 30 m SRTM digital elevation model have been used as research data. Important research tools also include GMT (for radar interference measurement and SBAS time series) and ARCGIS (for mapping). This research has been done in 2 general stages. In the first stage, the amount of subsidence in the area is assessed using radar images. In order to perform this step, radar interferometry and SBAS time series method have been used. In the second stage, the annual drop in groundwater in the region is evaluated. At this stage, in order to assess the annual drop in groundwater in the region, information about 25 piezometric wells located in the study area in the period of 1375 to 1395 has been used.

Discussion and results

The study of subsidence results in the study cities indicates that the average annual subsidence in the urban area of Hamedan was about 23 mm, the highest amount of which was related to the western regions of the city. The average annual subsidence in the urban area of Bahar was about 9 mm, the highest rate of subsidence was in the southern areas of the urban area. The average annual subsidence in the urban area of Salehabad with 6 mm was lower than other cities, but the

average annual subsidence of Lalejin with 47 mm was the highest among cities. Also, in this research, information related to 25 piezometric wells (statistical periods of wells related to the years 1375 to 1695) located in the study area has been used. Examination of the level of water level drop in the studied wells indicates that these wells have faced a lot of water level drop, so the average annual drop of wells is calculated between 100 to 2070 mm. The study of the spatial status of groundwater depletion indicates that the middle areas of the study area have the highest average annual groundwater level depletion.

Conclusion

The results obtained from the assessment of subsidence in the studied urban areas indicate that the highest amount of subsidence occurred in the urban area of Lalejin, so that this area during a period of 5 years (01/16/2015 to 01/14 /2020) had a subsidence between 26 and 234 mm (average annual 47 mm). In this study, the situation of groundwater resources decline has also been evaluated. The results show that the average annual drop of wells in the region is between 100 to 2070 mm, which is the highest rate of decline in the middle areas of the study area, and given that in this region, the highest rate of subsidence also occurred. Given that there is a significant relationship between land subsidence and groundwater level decline (correlation 0.7). In fact, a study of the subsidence of cities in relation to the decline of groundwater resources indicates that the city of Lalejin, due to its location in the middle of the area and the high annual rate of groundwater decline, had the highest rate of subsidence. Also, the results of evaluations have shown that in addition to the decrease of groundwater resources, constructions have also played a role in increasing the rate of subsidence, so that the city of Hamedan has faced less groundwater loss than the city of Bahar, but it had more subsidence. Considering that the highest rate of subsidence occurred in the western, southern and eastern regions of Hamedan urban area and these areas have faced a lot of physical development in recent years, so it can be said that in addition to water loss Underground, the development of construction has also played an important role in the rate of subsidence in this city.

Key Words: Subsidence, Groundwater, Urban areas, Radar Interferometry

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