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Application of Differential Interferometry Synthetic Aperture Radar (DInSAR) as a Tool for the Attention of Natural Disasters

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Abstract: In the present work shows the application of the Differential Interferometry Synthetic Aperture Radar (DInSAR) as a tool for the attention of Natural Disasters, he examines a special case for Mexico City, the earthquake on 19 September 2017 he did shake the city once again causing human and material damage. The use of this technique DInSAR as a tool that must be seen within the emergency protocols with the end to give a preliminary damage assessments and power with this mobilizing emergency bodies toward the areas with higher damage. This work shows a preliminary phase shift in the ground Town Hall of Mexico City, reflecting structural damage caused in buildings and buildings of the City.

Keywords: Earthquake, Interferometry, Mexico City, Synthetic Aperture Radar (SAR)

INTRODUCTION

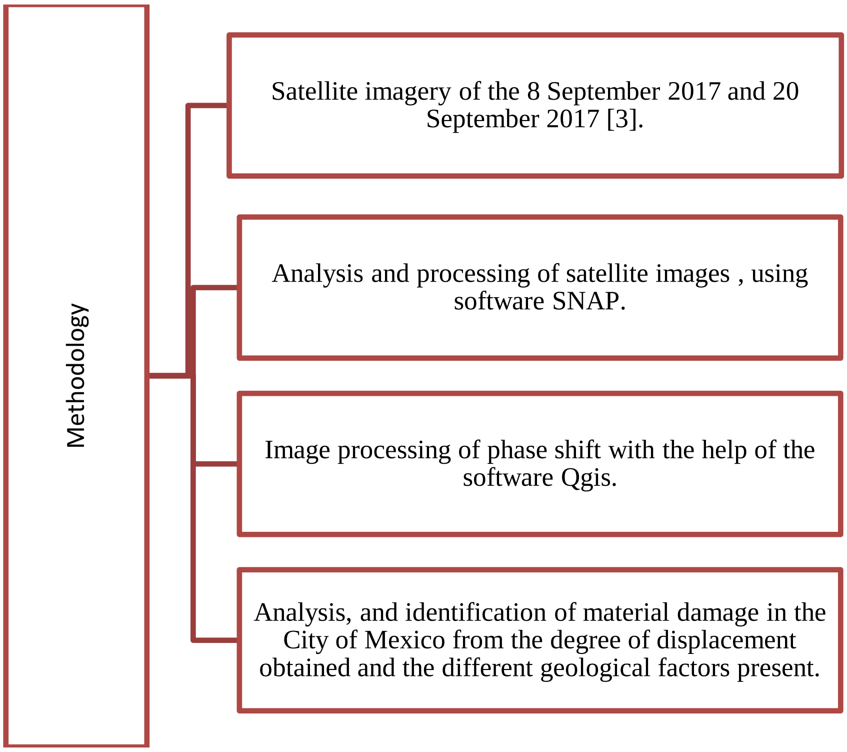
Speak today of an emergency protocol is somewhat controversial in the eyes of the population because most are not informed of what it is and what it is. Emergency institutions have adopted it as the one manual that tells us the procedures to be performed only when an emergency occurs however many of these are not met because the emergency is too large that exceeds the expectations or many times takes us by surprise, as in the case of the earthquakes in where to carry out a procedure for care of the population becomes more of a chore and heavy.

Mexico City is a clear example of these events; such is the case of the earthquake registered on 19 September 2017 where the land returned to shake with great roar releasing energy from its interior causing material damage and human losses. At these times, the incident broke the human and technical capacities of the bodies emergency, which came into conflict and despair at not knowing what points of the city meet.

"In situations we must be prepared", a phrase that we hear every day however, there are situations such as earthquakes that we do not know how, when and where to happen that is why this proposal of collaboration to provide for the population and the emergency bodies a tool that may be to your scope in order to detect which areas are the most affected and that require special attention after the incident thereby saving lives. The proposal is based mainly in the implementation of remote sensing satellite imagery and the application of the tools of the Synthetic Aperture Radar and the software SNAP (Sentinels Application Platform).

It is proposed that after a disaster to happen as the earthquake on 19 September 2017 use the tools of SNAP of ESA [1] (European Space Agency) and give a preliminary level of displacement that was presented in the different areas adjacent to the epicenter, achieving with it locate the areas most affected.

METODOLOGY



Methodology implemented to carry out the analysis, interpretation and identification of material damage present in the City of Mexico caused by the earthquake on 19 September 2017.

Table 1: equations that implement the software snap to get to the development of Phase [2] [7].

Equation	Implied
1. $\Delta\phi = \frac{4\pi}{\lambda}\left(\rho(t_1) - \rho(t_2)\right) = \frac{4\pi}{\lambda}\Delta_{fcambio}$	Differential Interferometry
2. $\frac{d\phi}{dh} = \frac{2\pi\rho b\cos\,(\theta - \sigma)}{\lambda\rho sen\theta} = \frac{2\pi\rho b\perp}{\lambda\rho sen\theta}$	Topographic sensitivity
3. $\frac{d\phi}{d\Delta\rho} = \frac{4\pi}{\lambda}$	Displacement sensitivity
4. $\sigma_{\phi topo} = \frac{d\phi}{dh}\sigma_h = \frac{4\pi}{\lambda}\frac{b\perp}{\rho sen\theta}\sigma_h$	End of topographic sensitivity
5. $\sigma_{\phi desp} = \frac{d\phi}{d\Delta\rho}\sigma_{\Delta\rho} = \frac{4\pi}{\lambda}\sigma_{\Delta\rho}$	Term of sensitivity to the displacement
6. $\Delta\phi_{topo} = \frac{2\pi\rho}{\lambda}(\rho_1 - \rho_2) = \frac{2\pi\rho}{\lambda}\vec{b}\cdot\vec{l}$ $\Delta\phi_{med} = mod(\Delta\phi_{topo}, 2\pi)$ $\Delta\phi_{desenv}(s,\rho) = \Delta\phi_{topo}(s,\rho) + \Delta\phi_{const}$	Development of Phase

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AREA OF STUDY

Identification of the area of study where we can observe the delimitation of the city. processed image with SNAP, showing interferometry for Mexico City.

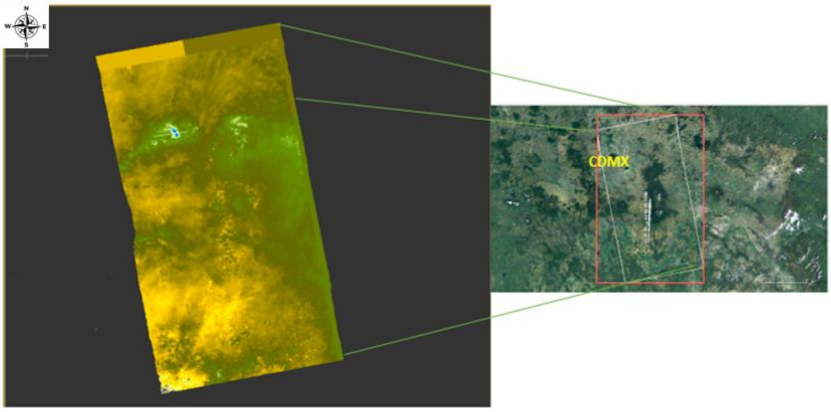

Figure 1: Satellite location of study area, includes epicenter in Morelos, Puebla and Mexico City

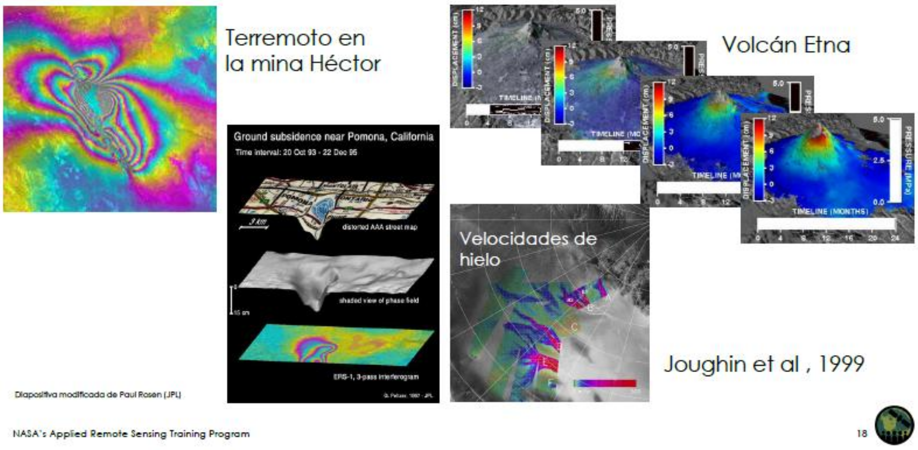

Figure 2: Examples of deformation, NASA Applied Remote Sensing Training Program Results [2] [7].

It is interesting to know that thanks to the implementation of these new technologies and the use of satellite imagery for remote sensing we can give a preliminary of the degree of displacement that suffered areas surrounding the epicenter by means of a comparative satellite images of the before and after the earthquake detecting areas that are at risk thereby mobilize emergency bodies toward those points and save lives. Figure 3 shows a graph where we can observe the movement of a specific area adjacent to the Mexico City.

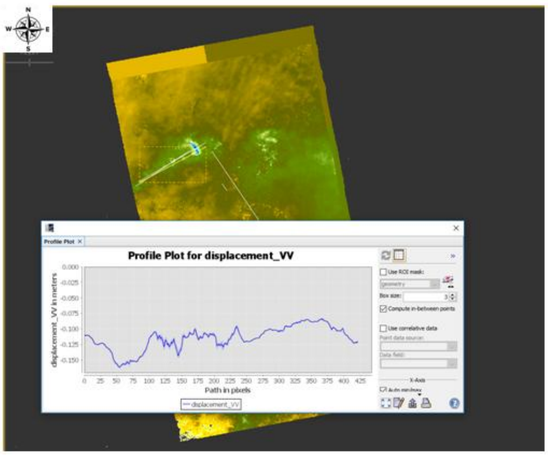

Figure 3. Profile of displacement of the earthquake on 19 September 2017 with epicenter in Morelos using the tool SNAP [7] that [1].

Negative values indicate that both moved in the field of the satellite is to say the values shown indicate that the ground in that area had a maximum displacement of up to 1.5 meters and a minimum of 0.75 meters.

¿HOW DID THE EARTHQUAKE ON 19 SEPTEMBER 2017 TO THE MEXICO CITY?

To do this we make use of the Qgis software (version 2.18.20 "Palma") where we will see in more detail the affected areas in Mexico City.

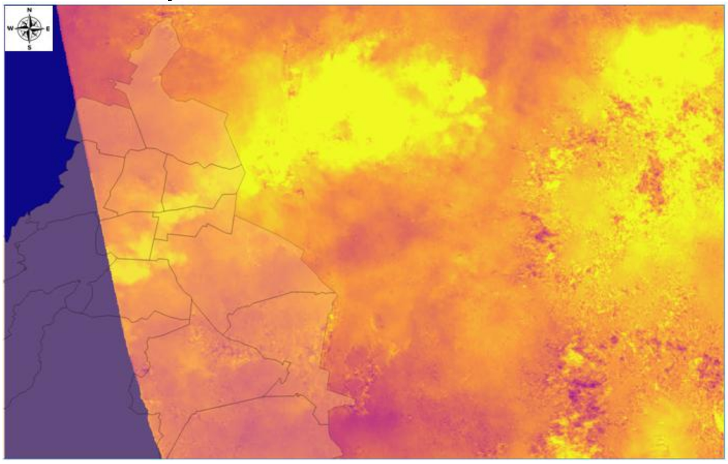

Figure 4. Analysis in Qgis the earthquake of 19 September 2017 with epicenter in Morelos using the tool SNAP [7] that [1].

For analysis overcomes the shape of Mexico City provided by INEGI [4] to the image (.TIFF format) of displacement processed with SNAP [7] to observe in that City Halls in the city affect these movements more noticeable. To complement the study of the damage that generated the earthquake on 19 September 2017 in the City of Mexico resumed points of immovable property which resulted with severe structural damage (red), habitable (green) and those who need a more detailed analysis (whites).

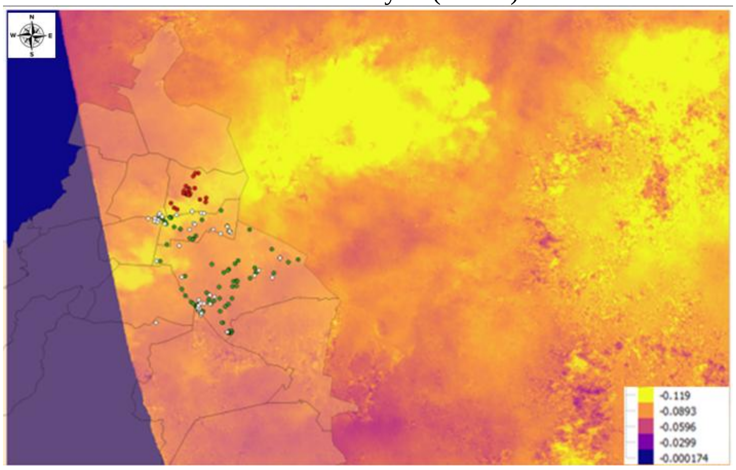

Figure 5. Relationship of buildings damaged in the City of Mexico with Qgis the earthquake of 19 September 2017 versus displacement map analyzed with the tool SNAP.

We note that in making the analysis in Qgis SUPERIMPOSING the buildings damaged in their different categories and the displacement map, both agree throwing the most affected areas. The yellow color shows us areas with up to 1.19 m of displacement which are consistent with the red dots of buildings that were severely damaged in the Venustiano Carranza delegation of Mexico City.

Now, once detected the areas with the greatest displacement and corroborated the material damage which it caused in some mayoralties recourse is hard to the structural information, geological and seismic to make a historical analysis and to be able to find a relationship of the degree of displacement and the phenomena that have occurred.

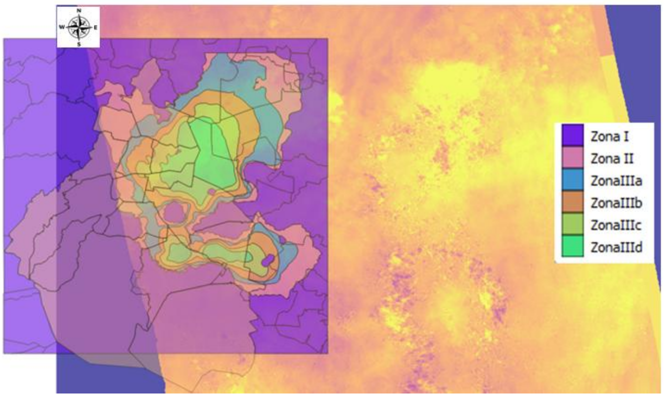

Figure 6. Seismic zonation of Mexico City processed in Qgis with data provided by CENAPRED [6].

Where the area I shows the part that corresponds to Lomas, which is located in the top of the basin of Mexico, formed by soils of high resistance, the area II corresponds to the transition area with intermediate characteristics and finally in the area IIIa to IIId is known as the area of lake, which on the map ranges from light to dark green, orange, and red. The latter is characterized to have very soft lacustrine deposits with high water content. According to the previously analysis echos the high content of water make that amplify the seismic waves and sand liquefaction, causing landslides causing the surrounding buildings lose verticality.

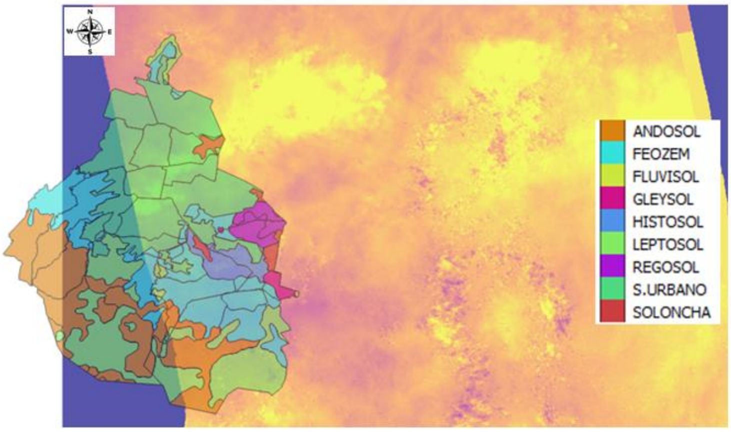

Figure 7. Type of soil of Mexico City digitized geological letters of the INEGI [4].

It shows the type of soil that is located in the City of Mexico which goes from one of volcanic origin up to one of the lake type.

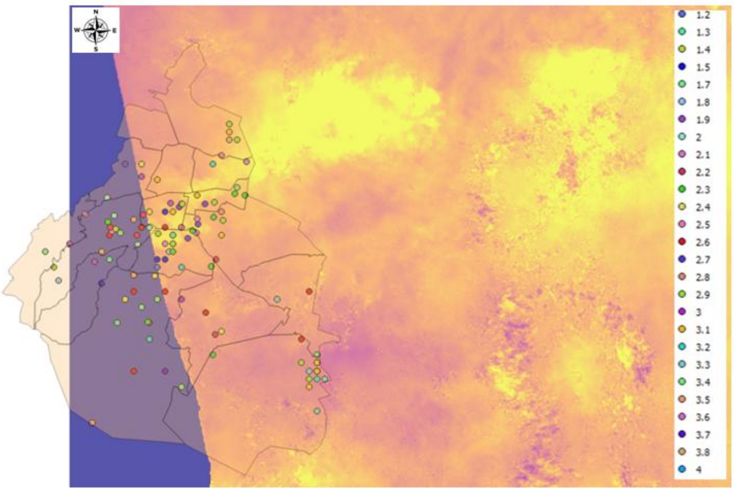

Figure 8. Microseisms registered in the last three decades of Mexico City processed in QGIS with data from the National Seismic Service [5].

In Figure 8 analyzes the spatial distribution of microseisms that have shaken to Mexico City in the past three decades, as can be seen the Microseisms fall within the category of 1 to 4 degrees. Until this analysis shows that most of them consistent with the trend of increased displacement obtained with synthetic aperture radar (yellow frame).

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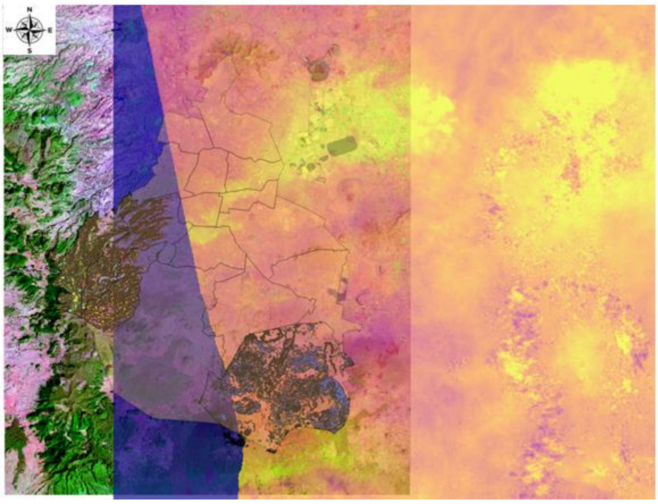

Figure 9. A relief map of slopes slip present in the mayoralties Magdalena Contreras, Alvaro Obregón and Milpa Alta processed in QGIS with data from INEGI [4].

Figure 9 shows a map generated from vector data, we can see that the higher elevations will find in the south and west of the city. In the same way you have marked the Mayoralties Magdalena Contreras, Alvaro Obregón and Milpa Alta since these are the mayors who have further slide, used these data to see how it is that the shaded yellow line that represents the largest displacement processed with synthetic aperture radar passes along the city culminates precisely to skirts of the mayoralties Álvaro Obregón and Magdalena Contreras who regularly present landslides, this brings us to think of a geological phenomenon which does not have registration and that is consistent with each of the analysis methods established.

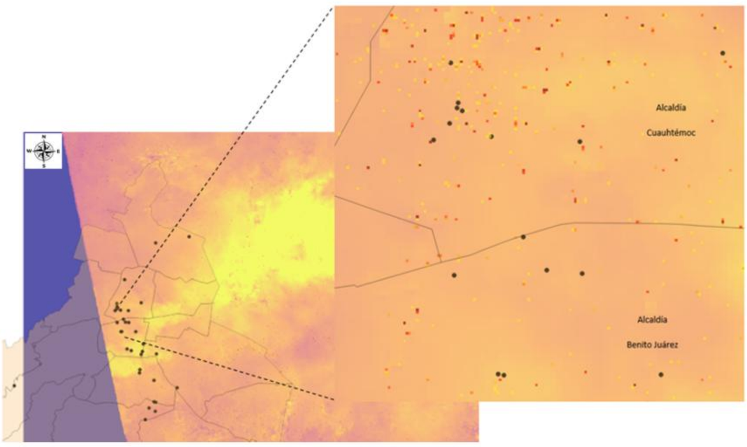

Figure 10. Relationship of buildings collapsed during the earthquake on 19 September 2017 versus points obtained and processed by the NASA [2] for the identification of properties damaged by reason of the earthquake, superimposed with the image offset processed with synthetic aperture radar.

Figure 10 shows the microscale analysis established to superimpose the data processed by NASA (points of red, orange and yellow) [2], the image offset processed with SNAP [7] and real estate collapsed during the earthquake on 19 September 2017. In it we can see that the data provided and processed by the NASA [2] agree with most of the buildings collapsed in the city and both in turn are consistent with the image that shows the larger the shift in that area, confirming that the city suffered a structural dislocation which is reflected in the buildings adjacent to it.

CONCLUSION

The use and application of this technique allows us to verify that this tool (SNAP) [7] is of great utility for emergencies after the incident mobilizing emergency services to areas that were with greater impact, saving lives and generating preventive culture situations that many times we take you by surprise. In the course of analysis with the different geologic events present in the City of Mexico appreciated the great relationship that exists between them, while the image of synthetic aperture radar shows us the movement that took place in the same area leads us to conclude that this technique is of great utility allowing us to give a wider perspective. It will continue to work with analysis of future events with the aim of improving the technique and in the future make it a tool for professional use for the analysis of natural disasters in Mexico.

REFERENCES

[1]. European Space Agency http://www.esa.int/ESA
[2]. Administration The National Aeronautical and Space Administration Https://www.nasa.gov/
[3]. Alaska Satellite Facility Https://vertex.daac.asf.alaska.edu/
[4]. The National Institute of Statistics and Geography, INEGI Http://www.inegi.org.mx
[5]. National Seismic Service Http://www.ssn.unam.mx/
[6]. The National Disaster Center Https://www.gob.mx/cenapred
[7]. Applied Remote Sensing Training https://arset.gsfc.nasa.gov/