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“Mapping of sinkholes in highly urbanized areas: Queretaro, Mexico”

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Abstract

- **Main Scientific Question**

The highly urbanized areas increase trigger the emergence of sinkholes, how could be assessment their occurrence.

- **Methodology**

Location of the sinkholes on the map of the municipality of Queretaro to identify their evolution in the period 2015 to 2019 and assessment the correlation between urban growth and rainfall

- **Findings**

In Querétaro was found that the rainy season, May to October, is the main cause of development of the sinkholes. Between 2018 and 2019 the presence of sinkholes was more than 100% because inefficient sewer systems

- **Main conclusion**

The documentary analysis and mapping is a framework to identify the occurrence of sinkholes and tendency. In Querétaro mainly are generated in the periphery of the city, may be related with urban growth in the last 30 years.

Why is it so important to study the sinkholes?

Sinkholes is a current problem, affecting highly urbanized cities as well as rural areas, generating severe social, economic and environmental danger.

The formation of large sinkholes can lead to the loss of human life, as is the case with the sinking of Camelinas Prolongation in September 2017, which took the life of one person (image 2).

The field or experimental studies about sinkholes are still scarce, some authors have managed to determine which types of soils or which factor (human or natural) is the one that influences this phenomenon.



Image 1. Sinkhole in University Avenue, Queretaro, Mexico. June 2018. (Photo by Edoardo Rodriguez)



Image 2. Sinkhole in Prolongation Camelinas, Queretaro, Mexico. September 2017. (Milenio 2020)

Methodology

1

The monthly rainfall sheets and the number of sinkholes generated in each month were plotted in order to analyze the influence of rainfall on sinkhole formation in the last 5 years (2015-2019).

2

The use of Geographic Information Systems (GIS), for the mapping of sinkholes, allows us to determine which areas are susceptible to this phenomenon, its determining factor and which is the tendency that they present, in order to take safety measures in time.

3

The points generated from the locations of the sinkholes were placed on the map of the municipality of Queretaro for the years 1990,2000,2010 and 2019, respectively. Was analyzing the urban growth of the last 30 years and formation of sinkholes



Rainfall vs Sinkholes

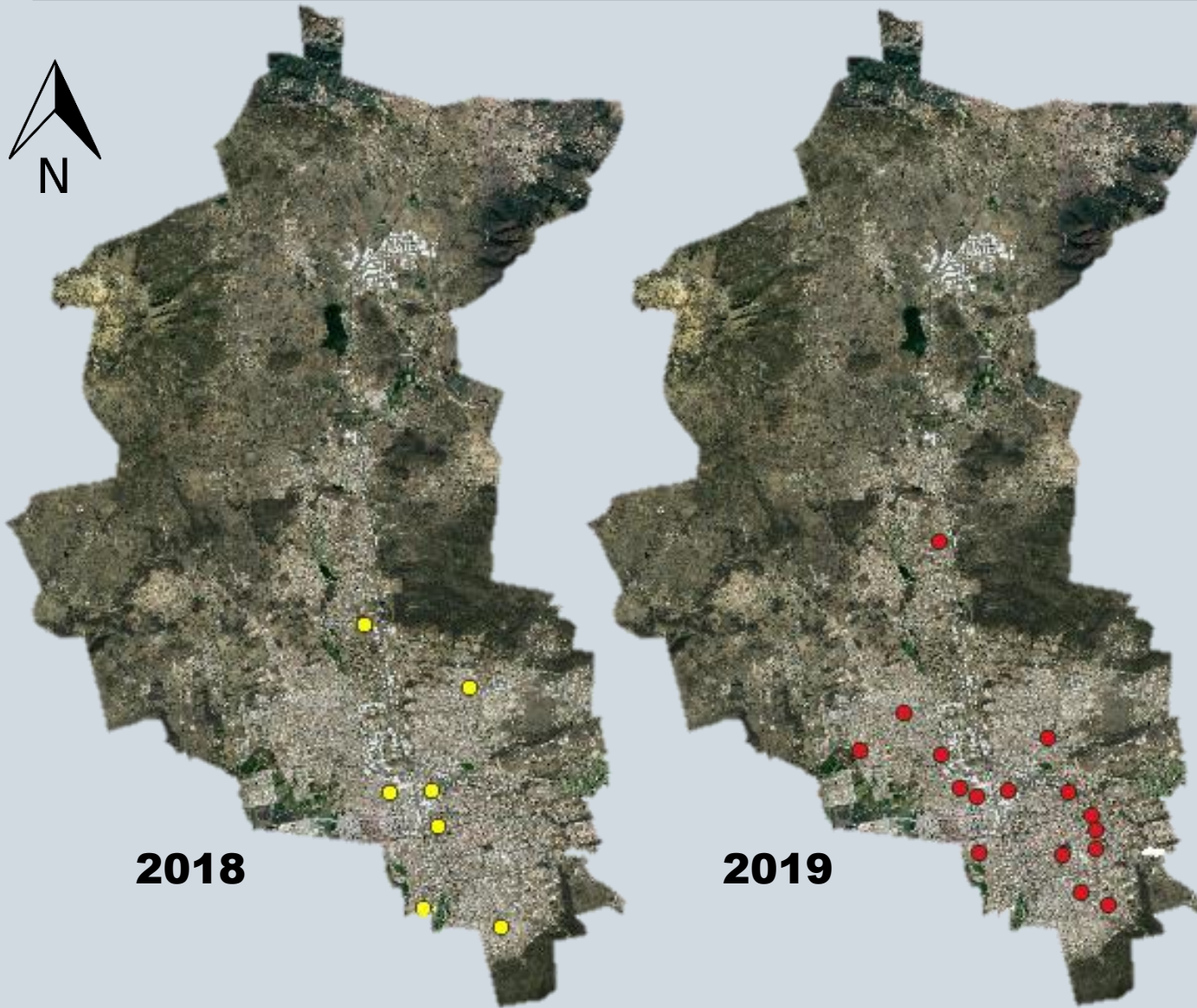


Figure 1.- Location of sinkholes presented in 2018 and 2019.

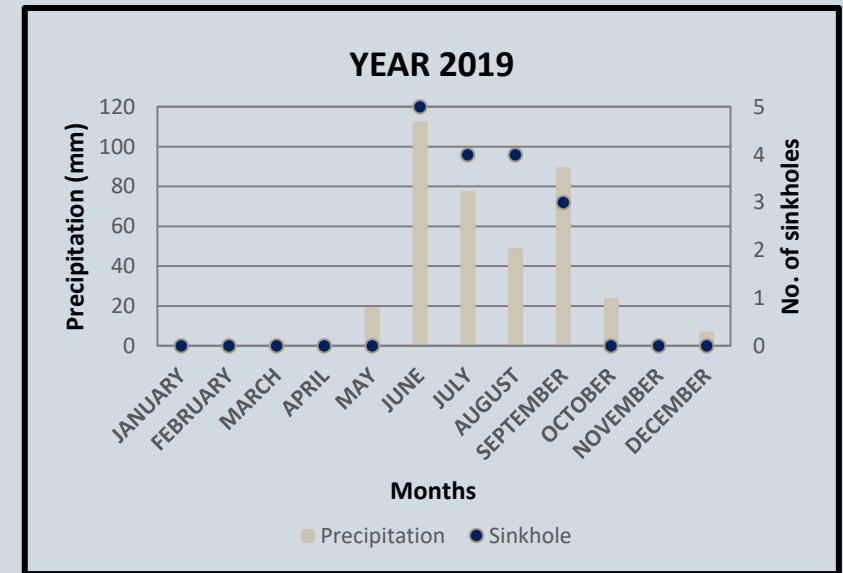
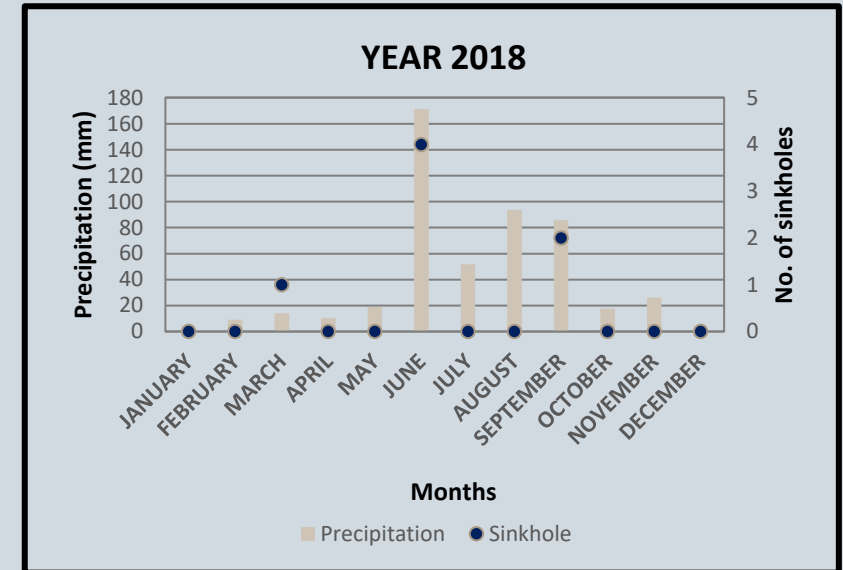


Figure 2 .-Analysis of the influence of rainfall on the formation of sinkholes during 2018 and 2019.

Evolution of Sinkholes in Queretaro City

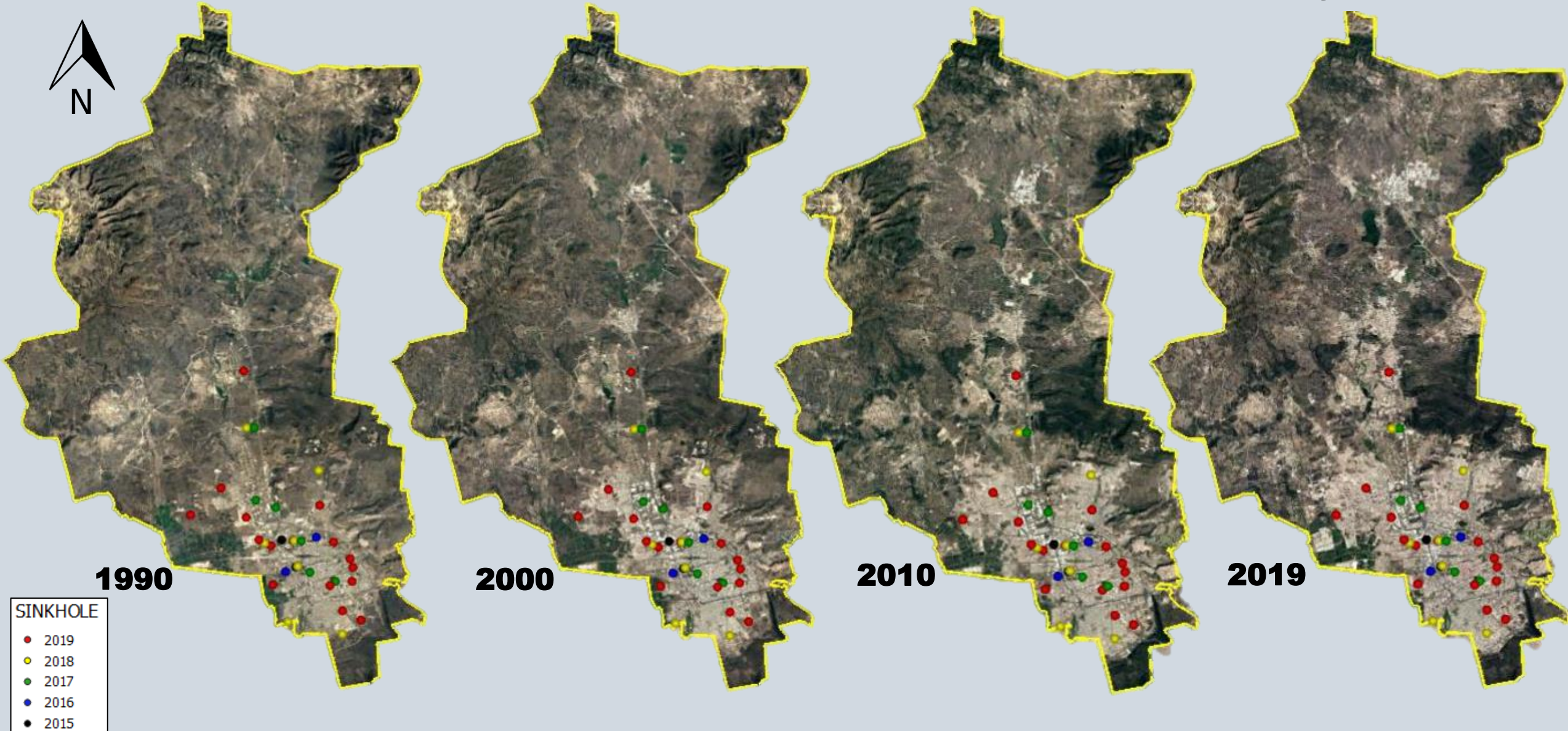


Figure 3- Analysis of the influence of urban growth over the last 30 years on the formation of new sinkholes (2015-2019).

Conclusions



The mapping analysis indicates that this type of sinkholes shows a tendency to be generated in the periphery of the capital of Querétaro, because they are areas of potential urban growth, as well as exceeding the service capacity of the sewage and potable water systems, regardless of the construction process of this type of work.



In 2018, at least seven major sinkholes were generated in the urban area, while in 2019, 16 sinkholes were reported, most of which have been considered to be caused by a rupture in potable water and sewage pipes, which is a double increase.



The results show that the rainy season covers the months of May to October, being June where the greatest amount of precipitation and sinkhole occurs, because wastewater systems are saturated with domestic water plus rainwater load.

Thanks for your attention!

Our sincere thanks to the European Geoscience Union for the opportunity to participate in the 2020 General Assembly.

To Mexico, which funded and enabled me to carry out this work, through the National Council for Science and Technology (CONACYT).

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