

Machine Learning and Big Data for SINK HOLES

Sinkholistic.COM



NATIONWIDE SINKHOLE HAZARD AND RISK ASSESSMENT

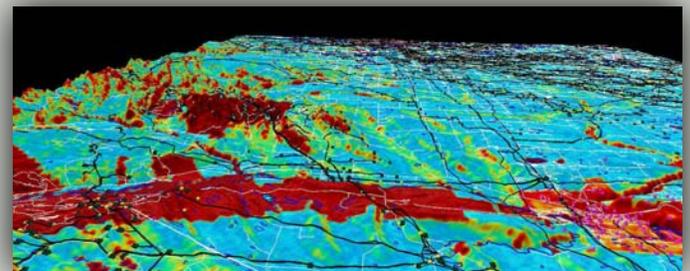
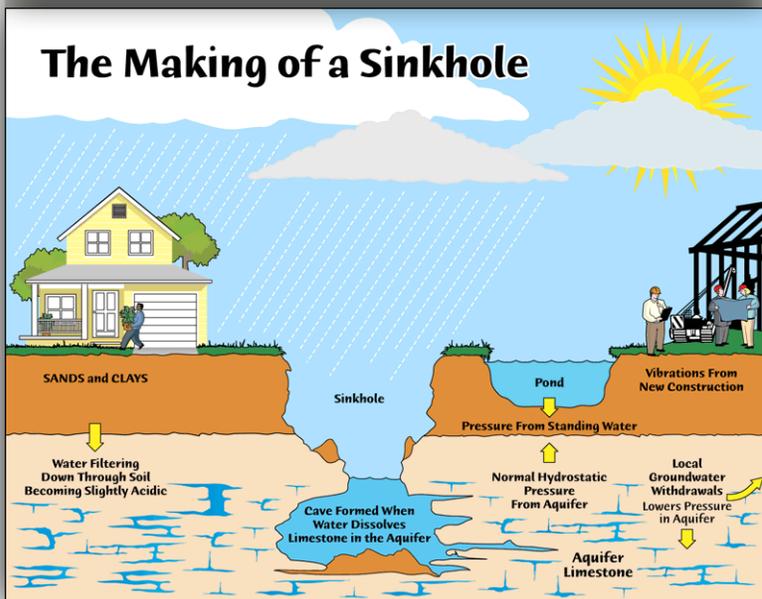
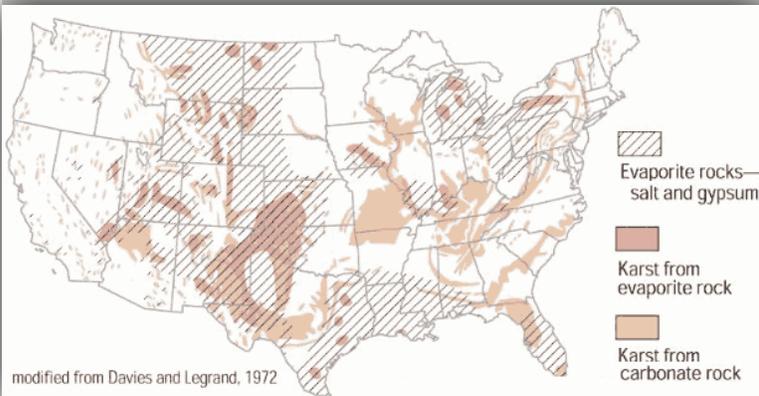
Sinkholes are a natural phenomenon governed by geological and hydraulic processes in the sub-surface. While many state organizations and private firms address the occurrence of sinkholes after they appeared for remediation and insurance purposes, only a few studies exist on the development of a sinkhole hazard and eventually a sinkhole risk map.

Sinkholes occur in different shapes and sizes and can be grouped as follows: i) Dissolution sinkholes, ii) Cover-subsidence sinkholes, and iii) Cover-collapse sinkholes. There are thousands of sinkholes in the US every year with the State of Florida being the most vulnerable, but not the only state in which sinkholes are of great concern. Sinkholes in Florida alone resulted in a total economic loss in excess of \$1.4 billion between

2006-2010. Besides natural processes, anthropogenic causes such as ground-water pumping, wastewater injection, construction, development and mining, can lead to sinkholes. Sinkholes cause the immediate or slowly developing collapse of infrastructure and landforms with potentially severe economic and environmental consequences.

Solution A plethora of data exists on sinkhole location, size, damage caused, and geological/hydraulic setting. Individual states use these data to create maps of sinkhole locations which is an obvious indicator of sinkhole hazard. However, the location alone is not sufficient to fully understand the mechanisms involved to cause a sinkhole and the potential to create sinkholes in the future. This requires an integration effort of all relevant geological and hydrological parameters to develop a sinkhole hazard map. Sinkhole hazard describes the probability for the (re-) occurrence of a sinkhole within a certain time period equivalent to the well established seismic hazard maps. The hazard solely includes the parameters related to sinkhole development, however, by taking into account the vulnerability of the respective region, a sinkhole risk map can be developed. Risk = Hazard * Vulnerability.

All available sinkhole data will be integrated and weighted based on a weighting scheme to derive a hazard parameter and a hazard map. A machine learning algorithm will be implemented to exploit historic sinkholes data and improve the weighting scheme over time. In addition, vulnerability measures (infrastructure, population density etc.) will be added to create a risk parameter and a risk map.



Pipeline routing in southern Alberta, Canada. Background shows the "cost" factor for building a pipeline (red = highest cost, blue = lowest cost) draped over the topography. Existing pipelines shown in black, facilities in green, wells in yellow, survey monuments in pink, roads in white.