ICG2022-82, updated on 28 May 2023
https://doi.org/10.5194/icg2022-82
10th International Conference on Geomorphology

Morphometry, distribution, and evolution of sinkholes on the western shore of the Dead Sea

Jorge Sevil and Francisco Gutiérrez
Department of Earth Sciences, University of Zaragoza, Zaragoza, Spain.

Sinkhole development causes significant economic losses in many karst regions worldwide. Very often, the subsidence damage is related to sinkholes induced by various types of human activity that involve alterations in the surface and/or underground hydrological systems. One of the most striking examples of human-induced sinkhole hazard is found in the rapidly evolving eogenetic salt karst of the Dead Sea. Here, the decline of the lake level caused by the use of the water in the catchment (diversion from the Jordan River) and the lake basin (pumping to evaporation ponds) has resulted in the lakeward displacement of the brackish water - fresh water interface and the development of thousands of sinkholes since 1980s. The sagging and collapse sinkholes developed in the mud flats and gravelly alluvial fans at the lake margins tend to form tightly packed alignment and clusters. These can evolve by various processes (new sinkhole occurrence, lateral growth by mass wasting, coalescence) into expanding compound subsidence depressions as much as thousands of square meters in area. Sinkhole damage in the area includes the destruction of human structures (e.g., roads, touristic facilities, dikes in the evaporation ponds) and accidents involving the shallowing of people. The extremely high activity of the sinkhole areas not only pose a major threat, but also offers and exceptional opportunity to study quantitatively their spatial and temporal evolution. The results of the analyses have implications for hazard assessment (e.g., distribution of new sinkholes, probability of occurrence, frequency-size relationships). This work analyses the geomorphological evolution between 2005 and 2021 of an area on the western shore of the Dead Sea south of the Nahal Darga alluvial fan, including several sinkhole clusters and hundreds of new sinkholes. Time-lapse cartographic inventories have been produced using aerial and satellite imagery from multiple dates, high-resolution photogrammetric models produced using aerial photographs taken from drones, and field surveys. The quantitative analysis of the sinkholes (e.g., morphometry) and their evolution patterns have been carried out coupling GIS and R software environments.