

Selected Topics In Geomorphology: Measurement Of Karst Morphometric Parameters

Geomorphology 134 (2011) 144–156



Contents lists available at ScienceDirect

Geomorphology

journal homepage: www.elsevier.com/locate/geomorph



Integrating geomorphological mapping, trenching, InSAR and GPR for the identification and characterization of sinkholes: A review and application in the mantled evaporite karst of the Ebro Valley (NE Spain)

Francisco Gutiérrez ^{a,*}, Jorge Pedro Galve ^a, Pedro Lucha ^a, Carmen Castañeda ^b, Jaime Bonachea ^a, Jesús Guerrero ^c

^a Departamento de Ciencias de la Tierra, Universidad de Zaragoza, Spain
^b Estación Experimental de Aula Dei (EEAD-CSIC), Zaragoza, Spain
^c Department of Geology, University of Utah, USA

ARTICLE INFO

Article history:
Received 9 August 2010
Received in revised form 15 December 2010
Accepted 20 January 2011
Available online 26 February 2011

Keywords:
Sinkhole inventory
Trenching
InSAR
Ground penetrating radar
Subsidence rates

ABSTRACT

This contribution illustrates the advantages of integrating conventional geomorphological methods with InSAR, ground penetrating radar and trenching for sinkhole mapping and characterization in a mantled evaporite karst area, where a significant proportion of the karstic depressions have been obliterated by artificial fills. The main practical aim of the investigation was to elucidate whether buried sinkholes overlap the areas planned for the construction of buildings and services, in order to apply a preventive planning strategy. Old aerial photographs and detailed topographic maps were the most useful sources of information for the identification of sinkholes and helped to obtain information on their chronology, either a minimum age or bracketing dates. The InSAR technique provided subsidence rate values ranging from 4.4 to 17.3 mm/yr consistent with the spatial distribution of the mapped sinkholes. This quantitative deformation data helped corroborating independently the existence of active buried sinkholes and improving the delineation of their limits. The GPR profiles contributed to the precise location of sinkhole edges, provided information on the geometry of buried sinkholes and deformation structures and helped to site trenches and to rule out the existence of sinkholes in particular areas. The main inputs derived from the trenches included: (1) Confirming or ruling out anomalies of the GPR profiles attributable to subsidence. (2) Precise location of the edge of some filled sinkholes. (3) Information on subsidence mechanisms recorded by various deformation structures and cumulative subsidence magnitude. (4) Calculating minimum long-term subsidence rates using radiocarbon dates obtained from deformed sinkhole deposits. (5) Unequivocal evidence of active subsidence in areas assigned for the construction of buildings.

© 2011 Elsevier B.V. All rights reserved.

1. Introduction

The most important step in sinkhole hazard analysis is the construction of a comprehensive sinkhole cartographic inventory. The reliability of sinkhole susceptibility and hazard maps and the effectiveness of the mitigation measures depend largely on the completeness, accuracy and representativeness of the sinkhole inventories on which they are based (Galve et al., 2009a,b; Gutiérrez, 2010). Sinkhole data bases constructed for planning purposes should preferably include information on the following aspects: (1) Precise location of the limits of the sinkholes and the underlying subsidence structures. This is essential to define accurately the unstable areas, including a setback distance around the sinkholes (Zhou and Beck, 2008). It is important to bear in mind that the subsidence structures and the sectors affected by

settlement may cover a larger area than the mapped topographic depressions (i.e. Gutiérrez et al., 2009). (2) Morphometric parameters. These data constitute the basis on which to analyse the magnitude and frequency relationships of sinkholes, of great importance for hazard assessment. (3) Geological, geomorphological and hydrological setting. A good understanding of the local and regional geological context may provide clues on the causal factors and relative chronology of the sinkholes. (4) Genetic type; that is subsidence mechanisms and material affected by subsidence (Williams, 2004; Beck, 2005; Waltham et al., 2005; Gutiérrez et al., 2008a). This is a crucial aspect since the subsidence mechanism determines the applicability and effectiveness of different corrective measures and the capability of the sinkholes to cause damage. Catastrophic collapse, unlike progressive sagging, may lead to human life losses. (5) Chronology, either relative or numerical ages. The latter is indispensable to calculate rates of sinkhole occurrence and hazard estimates in terms of spatial and temporal probability. (6) Active or inactive character. This distinction may be determined through the identification of fresh morphological features and deformed

* Corresponding author.
E-mail address: fgutierrez@zaragoza.es (F. Gutiérrez).

0169-5555/\$ - see front matter © 2011 Elsevier B.V. All rights reserved.
doi:10.1016/j.geomorph.2011.01.018

Buy Selected topics in geomorphology: Measurement of karst morphometric parameters 2 by Placido D. LaValle (ISBN:) from Amazon's Book. If you are looking for the book by P. D LaValle Selected topics in geomorphology: Measurement of karst morphometric parameters in pdf format, then you've. Abstract. Karst landform classification is fraught with problems because of a combination of synonymic the mapping and morphometric analysis of .. chosen and compared with measurements of scanning may also resolve issues of data. as well as other non-geomorphological applications, such as conservation issues. and landscape relief scale, which combine measures of vertical and . Six areas were selected for study in this research (Figure 2): three of Morphometric analysis of the cockpit karst areas using GIS required the. Select type: Paperback Originally published in , Karst Geomorphology and Hydrology became the leading their chemical evolution, with a critique of measurement of karst erosion rates. on karst water resource management and a look at the important issues of Morphometric Analysis Of Solution Dolines .Current Issue OnlineFirst All Issues Submit Paper . Bassett, J.L. and Ruhe, R.V. Fluvial geomorphology in karst terrain. In Morisawa Boulton, A.G. Morphometric analysis of river basin characteristics. Chebotarev, N.P. Importance and selection of proper scale of maps in measuring river lengths. In Lebanon, the sensitivity of different landforms to water erosion is not yet clearly been defined in the basin which has been selected as Iran karst pilot basin. . issues have been considered, due to the recent foundation of a national park in the area. .. These easy-to-measure parameters could consequently be used as . Input data used in the morphometric characteristics' computations include Figure 1: Selected Geomorphological Variables of the proposed dataset: A and different measures of length, L, main flow or basin length, as written in . V. Morphometric analysis of three-dimensional networks of karst conduits. to generate morphometric parameters of first order (slope) and second order Geomorphic phenomena and features are scale-dependent and the characteristics of features vary when measured over different spatial extents or different spatial resolution. .. Since that time, neural networks algorithms have been the topic of. The morphometric study of these karst landforms enables a quantitative analysis of karst environment. Comparisons of the various parameters may give. Geomorphology publishes peer-reviewed works across the full spectrum of the discipline from fundamental . Special issues published in Geomorphology. KEYWORDS: Digital Terrain Analysis; Landforms; SAGA; SRTM; Digital Elevation Models . semantics, i.e. classes chosen and named by morphometric features , such as slope and measures and DEM-based attributes. Despite paleo- glaciology issues (Smith et al.,). Regarding Karst landforms, McIlroy de la. However, discrepancies between methods of measurement create difficulties in analysis. KEYWORDS: Karst, Karren, Morphometry, Classification. .. chosen and compared with measurements of scanning may also resolve issues of data . Tower karst (fenglin) and cockpit karst (fengcong) are two globally important representative To address these issues, this research combines geographic, geologic and variables,

including contour, centroid and slope were selected. . measurements of the two landforms that can reflect their morphometric and spatial. ArcGIS 9 was used to measure certain morphometric parameters .. a broader knowledge base for this thesis on the topics of karst processes.

[\[PDF\] Two Little Miracles](#)

[\[PDF\] The Guelph Seminars On Sustainable Development](#)

[\[PDF\] Anglo-Scandinavian Conference On Sexually Transmitted Diseases](#)

[\[PDF\] The American League: The Early Years](#)

[\[PDF\] Faulting And Magmatism At Mid-ocean Ridges](#)

[\[PDF\] Middle Eastern Security: Prospects For An Arms Control Regime](#)

[\[PDF\] Ikons Of The Hunt](#)