



Fusing surface and subsurface geodata: a case study on Cretan karst landforms

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A complex of enclosed karst depressions near Kritsa-Latō (Dikti Mountains, Eastern Crete) was analysed with regard to its surface and subsurface topography using a new multi-method approach. Based on a combination of terrestrial laser scanning, electrical resistivity tomography (ERT) and geographic information systems, crucial geophysical and morphometric parameters were derived in order to provide first-time insights into the formation, size and archive function of dolines. High-resolution digital elevation models allowed conducting topographical analyses with special respect to micro-relief attributes and traces of former land use, as well as placing all findings into a 3D context for enhanced interpretation. As shown by the ERT-results, the subsurface is characterised by a distinct three-part segmentation. Above the bedrock, a highly fractured epikarst zone exhibits features typical of buried karst systems, such as subterraneous sinkholes and pinnacles. In contrast, the near-surface sections completely consist of loose sedimentary infills with thicknesses of up to 25m. Regarding the morphometric properties of the whole landform that were derived from the TLS-data, a funnel-like geometry typical of solution dolines can be observed. This fact is stressed by a characteristic average slope inclination below 30°. However, collapse processes during the initial stage of sinkhole formation cannot be excluded, as suggested by several escarpments in the uppermost parts of the slopes and the rim. The spatial orientation evidently runs along a fault north of the depression, which can be verified in terms of a big scarp in the 3D data set. Consequently, both limestone dissolution and local tectonics led to the development of an extensive sediment trap. Since the dip towards the bottom exhibits significant uniformity, surface runoff and colluviation are mainly directed towards the doline centre without being hampered or delayed by terraces and rims – a fact that helps explain the remarkable amount of sediments deposited therein. As shown by the case study in Kritsa-Latō, comprehensive geodata sets are indispensable in order to understand the functional principle of karst landforms. The findings help improve the understanding of the landscape evolution and the development of enclosed depressions in East Crete. Terrestrial laser scanning, which has not been used in karst research so far, and tomographical mapping prove to be particularly suitable for integral surface and subsurface prospecting and therefore promise substantial potential for future studies.