Identification of karst depressions through Digital Elevation Models and high resolution satellite images

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Digital Elevation Models are numerical representations of the topography in a regular grid of points, which are obtained by vectoring contour lines, as well as aerial and orbital data. From these images it is possible to carry out various analyses, such as the delimitation of hydrographic basins, calculation of flow accumulation, delimiting elevations and depressions in the terrain, as well as performing the geomorphological mapping of the landscape. In view of this, several methodologies emerged with the purpose of identifying specific features on the ground, such as sinkholes. An example of a method used to identify features of this type is the semi-automatic sinkhole identification technique, which consists of calculating the difference between a filled DEM (procedure performed by the Fill tool in ArcGis software) and the original DEM. The difference between these two products generates areas of endorheic flow accumulation, on which morphometric indices and neighborhood criteria are applied, making it possible to identify the location and shape of these probable sinkholes. However, despite the functionality of the method, validation is a fundamental step, and fieldwork is a very expensive solution for the researcher. In view of this, this work aims to propose the alternative validation of data generated by the semiautomatic method through high resolution satellite images. The research had Central Brazil as its study area, more precisely the northwest region of the Tocantins Basin, where the karst relief is expressive and well developed. The image used for the application of the semiautomatic method was the Copernicus DEM (resolution of 30 meters) and for its subsequent validation, images from the SENTINEL 2 satellite (resolution of 10 meters) were used together with Google Earth images. With the application of the semi-automatic sinkhole identification method, 16.712 depressed features were identified in the terrain, in an area of approximately 30,000 km², however, through the visual inspection of the generated data, it was observed that many polygons were more related to the carving of the drainage channel than with karst features. In view of this, the validation of these polygons were carried out through images from the SENTINEL satellite, where, through visual analysis, about 1.332 depressed features remained. The criteria used for validation was the identification of circular features that had water inside them or that indicated they were undergoing processes of rock dissolution. Vegetation was also another criterion, considering that in places with sinkholes, they tend to be more humid and consequently have a greener vegetation. It was concluded with this study that the semiautomatic method presented good results when analyzed together with satellite images, allowing the analysis of large areas in a short period of time and with low costs, being, therefore, a good validation procedure in alternative to field work.