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Use of a free and open access high-resolution Digital Terrain Model for the identification of surface karst forms

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The typical geomorphological forms of karst such as dolines or poljés can play an important role in surface runoff by constituting preferential infiltration points for rainwater directly towards the water table. Their identification is therefore important to evaluate the modalities of groundwater recharge, the orientation of the current and past drainage axes within the aquifers and also to evaluate the groundwater vulnerability. As such, many multi-criteria methodologies (Paprika, RISK, etc.) include this indicator of surface karstic forms presence in the vulnerability maps of water catchments.

Their identification and characterization (depth, asymmetry, nature of the bottom, etc.) is however delicate and tedious since it is often based on the field reconnaissance which is long and dependent on soil conditions (presence of vegetation or crops). The resulting mapping is rarely exhaustive. However, the democratization of LiDAR surveys offering high-resolution digital terrain models paves the way for semi-automatically, quickly and over a much larger area detection of these shapes.

On the territory of the Eaux-SCARS regional project (https://sigesaqi.brgm.fr/-Projet-Eaux-SCARS-.html), aiming to understand the functioning of the CArbonate aquifers of the north aquitain Basin in France and in particular the conditions of surface infiltration towards the aquifers. The DTM HR, resulting from Lidar surveys, called RGE Alti V2® and made freely available by the French National Institute of Geographic and Forest Information (IGN), could be used to establish a first inventory of the dolines.

A methodology has been developed to identify the hollows by calculating the contour lines at 1m intervals. These hollows are then qualified in order to distinguish those likely to be real dolines by using the Miller circularity index, their proximity to the building or the road network, the latter being able to cause dips that do not correspond to dolines. Beyond this identification, it is possible to characterize their average and maximum slope, their orientation or their geology.

This method has been compared with others (Cartannaz, 2015) and the results confronted to inventories and maps obtained from bibliography and field work. The results show the potential of the method to improve the knowledge of the study area karst geomorphology and characterize the vulnerability of aquifers.

Beyond the method, it is worth highlighting the use of the RGE Alti V2® offering a high-resolution DTM over the whole of France and allowing the method to be applied to departmental extensions at a lower cost and without the need to carry out an expensive and localized lidar survey.

Nearly 15,000 potential dolines have thus been identified over the 22,000 km² of Eaux-Scars territory and provide decision support map. Their validation must be continued in order to be able to use it in the future. However, the use of these data seems promising to improve the location of the various geomorphological forms, to obtain a large-scale inventory and to identify forms invisible to the naked eye in the field.