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Sinkhole development in the Central Styrian Karst: From sinkhole inventory to landscape evolution

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This contribution deals quantitatively with surface karst morphology in context of landscape evolution in one of the major karst regions in Styria (Austria), referred as Central Styrian Karst. The densely vegetated terrain is located in the central part of the Federal Province of Styria, ranging approximately 40km north to south and 50 km west to east. Although the Central Styrian Karst is well-known for endokarst features (more than 900 caves are registered in the area), less attention has been given to aspects of sinkhole distribution as well as sinkhole development. The main rock types of the Central Styrian Karst are low-grade metamorphic Paleozoic sedimentary rocks (mainly high karstified Devonian and Silurian limestones and dolomites overlaying sandstone and slates).
Two different (semi-) automated sinkhole delineation algorithms are applied on high resolution digital terrain models (1m x 1m raster resolution) derived from airborne laser scanning: (a) boundary extraction based on the outermost closed contour line and (b) a modified drainage correction algorithm for digital terrain models. The resulted features are merged in a combined sinkhole inventory for further investigations. To analyse the morphological development of the features, geophysical measurements (ground-penetrating radar and electrical resistivity tomography) are applied for selected study sites.
The combined sinkhole inventory contains more than 840 individual features. These features are analysed statistically regarding spatial distribution, shape geometry (e.g. bowl, funnel), elongation and volume. First results indicate a significant clustered pattern of sinkholes. Based on shape characteristics, the majority of sinkholes are assumed to be of solution origin. Nevertheless, geophysical exploration identifies several features of collapse-, or subsidence origin. Furthermore, the distribution of sinkholes is correlated with pronounced cave levels in the study area and parallelized with plantation surfaces.