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Delineation of karst terranes in complex environments: Application of modern developments in the wavelet theory and data mining

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Karst areas occupy about 14% of the world land. Karst terranes of different origin have caused difficult conditions for building, industrial activity and tourism, and are the source of heightened danger for environment. Mapping of karst (sinkhole) hazards, obviously, will be one of the most significant problems of engineering geophysics in the XXI century.

Taking into account the complexity of geological media, some unfavourable environments and known ambiguity of geophysical data analysis, a single geophysical method examination might be insufficient. Wavelet methodology as whole has a significant impact on cardinal problems of geophysical signal processing such as: denoising of signals, enhancement of signals and distinguishing of signals with closely related characteristics and integrated analysis of different geophysical fields (satellite, airborne, earth surface or underground observed data).

We developed a ***three-phase approach*** to the integrated geophysical localization of subsurface karsts (the same approach could be used for following monitoring of karst dynamics). The ***first phase*** consists of modeling devoted to compute various geophysical effects characterizing karst phenomena. The ***second phase*** determines development of the signal processing approaches to analyzing of profile or areal geophysical observations. Finally, at the ***third phase*** provides integration of these methods in order to create a new method of the combined interpretation of different geophysical data. In the base of our combine geophysical analysis we put modern developments in the wavelet technique of the signal and image processing. The development of the integrated methodology of geophysical field examination will enable to recognizing the karst terranes even by a small ratio of “useful signal – noise” in complex geological environments.

For analyzing the geophysical data, we used a technique based on the algorithm to characterize a geophysical image by a limited number of parameters. This set of parameters serves as a signature of the image and is to be utilized for discrimination of images containing karst cavity (**K**) from the images non-containing karst (**N**). The constructed algorithm consists of the following main phases: (a) collection of the database, (b) characterization of geophysical images, (c) and dimensionality reduction. Then, each image is characterized by the histogram of the coherency directions. As a result of the previous steps we obtain two sets **K** and **N** of the signatures vectors for images from sections containing karst cavity and non-karst subsurface, respectively.