

Ground deformation mapping and monitoring of salt mines using insar technology

Abstract

InSAR technology can be used for monitoring surface deformation caused by mining operations, both open pit and underground mines, worldwide. This technology allows the systematic mapping of all ranges of motion (millimetric, centimetric and metric magnitudes) over extremely large areas with a high density of measurement points.

Mining assets can be monitored regularly and precisely to record possible deformation patterns, assess the site's deformation regime and issue alerts upon initiation of new movements in terms of magnitude and spatial characteristics. In addition, this technology is especially useful in abandoned mining areas, where continuous and in-situ monitoring is not carried out anymore while information about the ground motion is still required.

To illustrate the capabilities of this technology, a recent case will be presented, referring to the elaboration of ground deformation maps for the Soltvyno salt mine area in Ukraine. The aim of the study was to delineate subsiding areas and unstable slopes, and to identify risk-sectors prone to landslides and other ground failure phenomena, such as major ground collapses that have created giant sinkholes very close to populated areas in Soltvyno.

Persistent Scatterer Interferometry analysis was conducted for Soltvyno mines area, in the context of two monitoring modes: (1) Historical Analysis from 1998 to 2016 with the C-band satellites ERS, ENVISAT and Sentinel and (2) 2016 - 2017 Monitoring using the high-resolution X-band satellites Cosmo-SkyMed. Additional information was properly integrated into this analysis, such as geographical and geological data, and assets extracted from very high resolution optical satellite imagery. As a result, subsidence and landslide risk areas for each study period were adequately classified. The thematic maps and geospatial databases that were produced, outline several critical zones in the mining area requiring immediate attention of decision makers and showcase the value of consistent and seamless monitoring of abandoned mines.

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Key words: Soltvyno salt mine, InSAR technology, abandoned mines, risk maps