SAFED-POL

Synthetic aperture radar interferometry for Sub-regional Analysis of Fluctuance post-Exploitation Deformation in POLand

The issue of the impact of abandoned mining on the ground is currently one of the key problems facing European countries, including Poland. This is because now we are in the process of transformation related to ways of producing energy, which leads to large-scale closure of mines. Significantly, post-mining areas are primarily located in urban regions. In the vast majority of documented cases, numerical assessments of the impact of revitalizing post-mining rock masses on the surface have focused on individual mining areas, with whole mining basins rarely being considered. This was mainly due to the constraints imposed by classical surveying, which is time-consuming and spatially limited to specific survey points.

What if it will be possible to conduct the ground displacement surveys every few days and for the entire post-mining area?

The answer is yes. Have you ever heard of satellite radar interferometry (InSAR)? It is a powerful way of monitoring the Earth's surface to detect and track changes in altitude caused by phenomena such as volcanic, seismic, mining, post-mining and glacier displacement. The potential of InSAR methods is in spatial coverage (up to approx. 48,000 square kilometers) and temporal resolution (several days) of measurement for each scene. You can monitor the displacements that have occurred now, but you can go back in time, even to the 90s of the twentieth century and check the ground surface activity at any part of the Earth. This is the power of satellite radar data.

The main goal of the project is to develop a space-time monitoring system of residual ground surface displacement in post-mining areas caused by aquifer restoration. This scientific objective will be achieved in three stages. Firstly, by detection of patterns and trends of InSAR time series ground surface displacements using machine learning algorithms. Secondly, by determining the deformation decay coefficient in post-mining areas in a new way as a function of time based on InSAR time series. Ultimately, a description of the processes occurring in the post-mining rock mass as a result of aquifer reconstruction, based on numerical analysis, will be conducted. The innovative of the proposal arises from the scale and quasi permanent nature of InSAR measurements (time series) and the novel approach of using them and their derivatives (trends, patterns, time domain decay coefficient) in numerical analyses related to describing the impact of aquifer restoration on the ground surface.

What will be the measurable results of the project contribution to science?

The project will develop a quantitative and qualitative description of the impact of groundwater table restoration on the ground surface on post-mining areas. The results will provide new knowledge in the field of mining areas protection and rock mass mechanics. It will also be a valuable source of information in such fields as environmental protection and engineering, civil engineering, and transport. The developed scenarios will help to improve safety and reduce the risk of ground surface deformation hazards in practice.

As part of the project, in the national-wide scale, a time series of ground surface displacements and their classification by source will be regularly provided. The information about ground surface movement can be an important factor in studies on inter alia: natural phenomena related to endogenous factors and processes, the impact of human activity on the ground surface, and monitoring of environmental hazards. The results available to a wider audience will enable further, targeted research to be carried out by other researchers.

We invite you to visit the project website/portal, where we will successively present the results of our work.