Genesis and course of anthropogenic and natural deformations of the terrain in post-mining areas of the former brown coal mine "Babina". Stage 2: The influence of hydrogeological conditions on the process of land deformations in post-mining areas.

Popular scientific summary

Motivation

Mining activity is usually associated with deformation of the surface above the mining operation or in the result of opencast exploitation. These deformations can have continuous (e.g. subsidence basins) or discontinues character (e.g. sinkholes). Occurrence of secondary deformations, i.e. deformations that develop even many years after the end of mining, is a growing problem worldwide. This is due to closure of an increasing number of underground mines, and reaching for deposits below older underground workings in difficult geological and mining conditions. Unexpected, secondary deformations can have a devastating effect on the surrounding environment, damage infrastructure and pose a risk to human safety.

The post-mining area under investigation is located in the Muskau Arch Geopark, which is characterized by a highly diversified system of geological layers due to glaciotectonic processes. The brown coal mining carried out here several decades ago resulted in deformations such as depressions and sinkholes, often filled with water, overlapped by natural deformations, e.g. related to weathering of the brown coal seams. As a result of mining activities, the already complex hydrogeological conditions have been transformed.

Aim of the research

The research hypothesis states that the basic mechanism of continuous and discontinuous secondary deformations of the terrain are the hydrogeological processes currently taking place in the environment of the Muskau Arch, which is unique in Europe. The main objective of the research is to reconstruct, understand and develop a model of natural and secondary deformations in the post-mining area of underground and opencast lignite mining, in the glacitectonic area of the Łuk Mużakowa Geopark in western Poland, taking into account the numerical model of hydrogeological conditions and the analysis of large data sets with the use of machine learning approach.

Scope of the project

The project comprises of three main research tasks. They are aimed at developing a comprehensive model of hydrogeological conditions, including field observations of hydrogeological parameters, e.g. the groundwater table and chemistry. The second aspect covers the observation of deformation processes in the research area with the use of the state of the art methods of geodetic, remote sensing and geophysical measurements. The last task is to demonstrate the cause and effect relationship between the observed secondary natural deformations and changes in hydrogeological conditions and to verify whether it is possible to precisely determine and predict the occurrence of surface deformations caused by former mining based on the analysis of large and diverse data sets representing hydrogeological, geological, mining, topographic and other parameters using machine learning methods.

Expected results

The research will allow to describe and understand the processes of natural and anthropogenic deformation processes of the past and presently in the area of the former shallow underground and opencast mining of lignite deposits in the complex glaciotectonic environment of the Muskau Arch. The results will show whether and to what extent changes in hydrogeological conditions affect the formation of discontinuous (sinkholes) and continuous deformations (subsidence, uplift), the safety of post-mining areas, and whether numerical methods based on machine learning will allow for a reliable prediction of areas susceptible to deformation. The universal effect will be the improvement of the methodology of integrated monitoring and predictive modelling of deformation in complex post-mining environments that can be used in other places subjected to the influence of the completed exploitation of minerals.