

THE PRELIMINARY TEMPORAL ANALYSIS OF GROUND DEFORMATIONS IN THE AREA OF DABROWSKI COAL BASIN (SOUTH POLAND)

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1. INTRODUCTION

Ground deformations can be caused by many different factors. One of these factors is underground exploitation that has great impact on surface stability. In order to enlarge safety the permanent monitoring of mining areas has to be performed. The development of remote sensing gives us possibility to monitor deformations for larges areas with high precision. One of the satellites methods that can be used to detect ground deformations is the PSInSAR (Permanent Scatterer Interferometry SAR) technique. PSInSAR technique is a dynamically developed branch of satellite radar interferometry. It exploits a set of dozens of satellite SAR images in order to detect small ground deformations for large areas (Ferretti at al. 2001). PSInSAR technique derives information only about ground movements for stable radar targets, so called PS points. They correspond with man-made features on the Earth surface like buildings, bridges, viaducts and etc. For processing of radar images in PSInSAR technique the values of relative ground deformations occurred during the time between acquisitions of exploited SAR images can be calculated (Kampes, 2006). Using PSInSAR data we can study the values of ground deformations not only in space but also in time. Properly chosen methods of analysis of these data can give us possibility to study the trend of deformations, predict values of deformations that can occur in the future and find changes in the rates of deformations during the studied period of time. Detected changes can be analyzed in relation to e.g. coal exploitation or water pumping from excavated places.

2. ANALYSIS

In this work the PSInSAR data were used to study small, long lasting ground deformations which occurred in the Dabrowski Coal Basin (south Poland) in the years 1992-2003. In this region the intensive coal exploitation has been conducted. Additionally this area has complicated geological structure. These factors make studied region particularly threatened with terrain deformations. In this region 6106 PS points were identified. Previous research (Leśniak at al. 2007, Leśniak eta al. 2009) showed that values of average annual motion rates are correlated with locations of the main faults. In this work the preliminary temporal analysis of PSInSAR data was performed to study the probable impact of coal exploitation on the values of ground deformations.

For all PS points the relative values of ground deformations between years 1992-2003 were studied. For most cases the deformations measured at PS points are linear but for about 900 PS points the changes in the rates of subsidence in studied period of time were detected. As an example in the Fig.1 and Fig.2 the values of deformations for two selected PS points located in the mining area of “Sosnowiec” coal mine were shown. It is readily noticeable that for these PS points after the year 1997 the values of ground deformations were changing slower than before 1997. For both presented PS points the values of ground deformations can be approximate using two trend lines. The lines that represent the motion rates after 1997 have very small slope coefficient. These situations occur for most of PS points for which the changes in the rates of subsidence were detected.

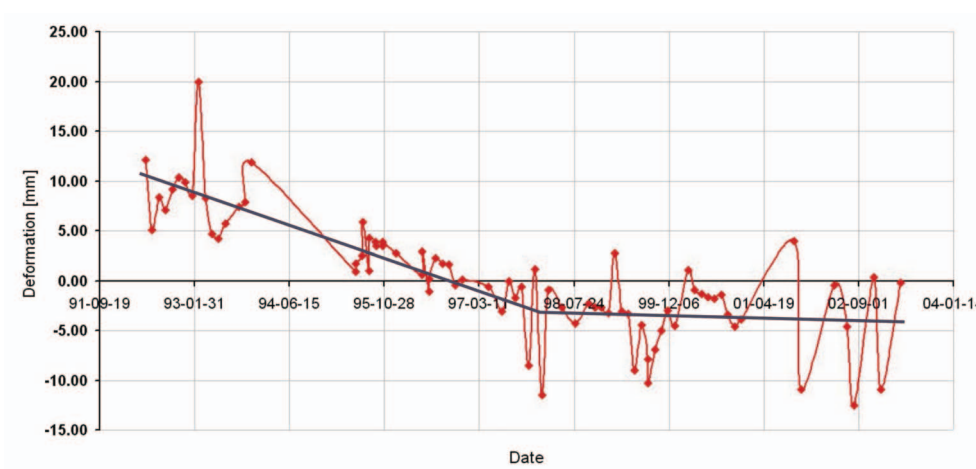


Fig. 1 Relative ground deformations for selected PS point

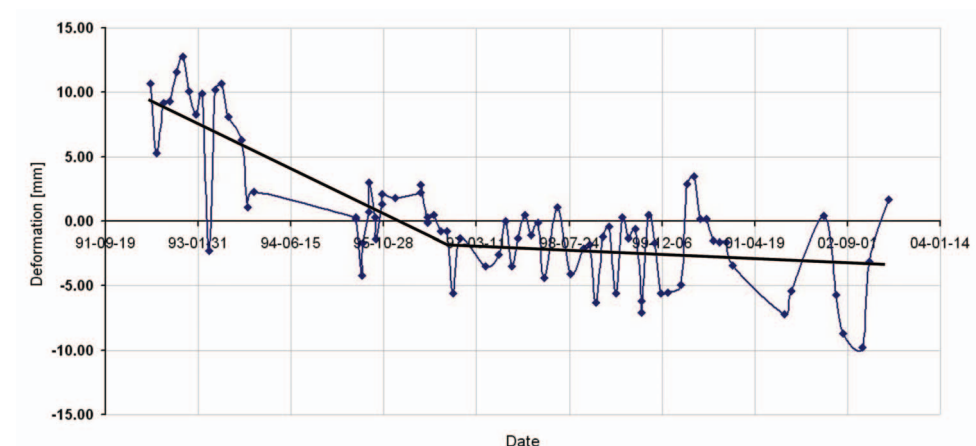


Fig. 2 Relative ground deformations for selected PS point

3. CONCLUSIONS

The performed preliminary analysis showed that for subset of PS points the values of ground deformations rates change during the studied period of time. In most cases these changes occur near the year 1997. After this year the values of rates of ground deformations decrease. It has to be emphasizing that

between years 1995-1997 two coal mines (“Sosnowiec” and “Paryz”) located in the central part of studied region finished coal exploitation. It can be presumed that the decrease of motions rate can be caused by termination of mining activity. In order to explain a phenomenon of ground deformations in this region the results of spatio- and temporal analysis of PSInSAR data have to be combined with information about geological structure of this region and with detailed data describing a mining activity in this area.

4. REFERENCES

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