

Monitoring of land deformation induced by underground coal mining activity around Zonguldak, Turkey

T. Deguchi ^a, H. Akcin ^b, H. S. Kutoglu ^b

^a Earth Remote Sensing Data Analysis Center (ERSDAC), Japan - deguchi@ersdac.or.jp

^b Zonguldak Karaelmas University, Turkey - (hakanakcin, kutogluh)@hotmail.com

Abstract

InSAR technique using JERS-1/SAR, RADARSAT and PALSAR data was applied to Zonguldak Hardcoal Basin in Republic of Turkey in order to detect mining induced surface displacement. Zonguldak coalfield is located along the Black Sea coast about 240 kilometers away from Istanbul. This area is at altitude between 0 and 1,000 meters above sea level, having steep topography and being covered by vegetation. Zonguldak coalfield has three coal mines, Kozlu, Uzulmez and Karadon. The activity of underground coal mining has been conducted by Turkish Coal Enterprises and several private companies since 1848. These coal mines annually produce 3 million tons of coal, and the production has been accumulated over 400 million tons since the development began. In the surrounding area, many illegal coal mining activities with no authorized exploration rights are seen.

Recently, several ground deformations caused by underground exploration have come to the surface, and these ground deformations have been destroying road and buildings. Aiming at understanding the entire situation, Bank of Provinces, Istanbul Technical University and Zonguldak Karaelmas University (ZKU) conducted GPS measurement in more than 150 points in 1996. However, effective measurement results were not obtained because most measurement points were lost when the second campaign was conducted in 2003. Information on ground deformation in this district has not been organized yet and an efficient method to measure the ground deformation is desired.

From the analysis using JERS-1/SAR data obtained in May and September 1995, small phase anomalies at the spatial scale of several hundred-meter were identified around three coalfields. In the vicinity of Kozlu coalmine, the largest surface deformation was extracted whose amount of deformation was 204 mm during 132 days. In Uzulmez and Karadon coal mines, some deformations were detected in several places, and the amount of deformation was more than 130 mm in both districts. The analysis using RADARSAT data obtained during the period between July 2005 and October 2006 showed two local surface displacements in the vicinity of Kozlu mine. The amount of deformation was approximately 44 mm/year in slant range direction. The location of the detected ground deformation was at extension of the mining tunnels, and it corresponded to the area where underground exploration is active. Furthermore, local ground deformations, more than 20 centimeters between May and September 2007, were detected clearly around Karadon and Uzulmez mines using PALSAR data. In the future, we will try to verify the accuracy of ground deformation using GPS data and continue to monitor the situation by InSAR using PALSAR data.

References

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