Assessment Of Rosia Jiu Mining Area Through TerraSAR-X New Imaging Modes

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The goal of this study is to evaluate new Staring Spotlight mode capabilities to monitor the mining activities impacts on the environment in order to ensure an effective management and to prevent possible natural and technological hazards. The societal and environmental impacts are huge such as: the topographic alteration, changes in the soil structure and vegetation coverage, influence on the underground water resources and on the rain water draining regime and air pollution. Rosia Jiu opencast test site is part of Motru-Rovinari coal basin (Figure 1) which is located in southwest of Romania, in the Getic Piedmont, stretches between Jiu Valley (est) to Motru Valley (west). The area is affected by subsidence phenomena caused by the closing of the hollows remained from the underground exploitation of lignite and by altering of the hidro-geological conditions, due to the applying of a forced and high intensity dewatering of the aquifer system within the area (Braghina, 2011). In this view, the test site Rosia Jiu opencast has a particular specification: underground rock excavation equipment, human settlements located on two sided at distances of 100-150 m and configuration and negative rates of three limits of the opencast. The area is surrounded by small hills covered with vegetation. The settlements act like corner reflectors and it is hoped that double bounce effects will maintain coherence in some areas.

Figure 1. Coal exploitation in the Oltenia region: black - coal exploitation perimeters, red - protected natural areas, dark green - hardwood forests, light green - selvedges and scrubs, yellow - pastures and agricultural lands with significant vegetation.
In the study, a methodology based on deformation maps will be designed for monitoring of the elastic deformation, early warning stage and detection of the risk occurrence. Very high resolution SAR data are used for continuous monitoring of mining activities and assessment of land degradation. The selected data consists of TerraSAR-X high resolution spotlight (HS) images which allow for the computation of a Digital Elevation Model which will be employed as reference model for the deformation analysis. This DEM will be compared with leveling measurements acquired in 1970, 1990, 2000 and 2010 in order to evaluate the excavations in the rock strata (Fig. 2). Differential Interferometric techniques are employed to determine changes occurring on the land surface due to mining activities in open pits and underground (fig. 3 and fig. 4). For the computation of the deformation model we employ a stack of TerraSAR-X images acquired in the Staring Spotlight (ST) mode, which allows for very precise coregistration and high detail deformation information extraction. The ST image series consist of images acquired in ascending mode during July to December 2014. Atmospheric induced errors are evaluated and mitigated through stacking techniques. Apart from the coherent analysis, a non-coherent multi-temporal processing can be performed in order to delineate landcover changes and complement the deformation model. The non-coherent analysis is based on the radiometric information and is performed stack-wise. It will be obtained more precise deformation models of rock strata that could improve mining operations.

**Figure 2.** Leveling measurements in the Rosia Jiu open pit including excavations in the rock strata with inclinations ranging between $10^0$ - $90^0$. 
Figure 3. Coherence map (slant range) and Filtered Interferogram from TerraSAR-X ST data.
Figure 4. Coherence map and Filtered Interferogram from TerraSAR-X HS data