Wrocław University of Science and Technology

Sharing Geoscience Online
May, 2020

EGU General Assembly 2020

Long-term Changes in the Surface Area in the Surroundings of the Open-cast Brown Coal Mine in Bełchatów (Poland)

Natalia Bugajska, Wojciech Milczarek, Anna Kopeć, and Dariusz Głąbicki

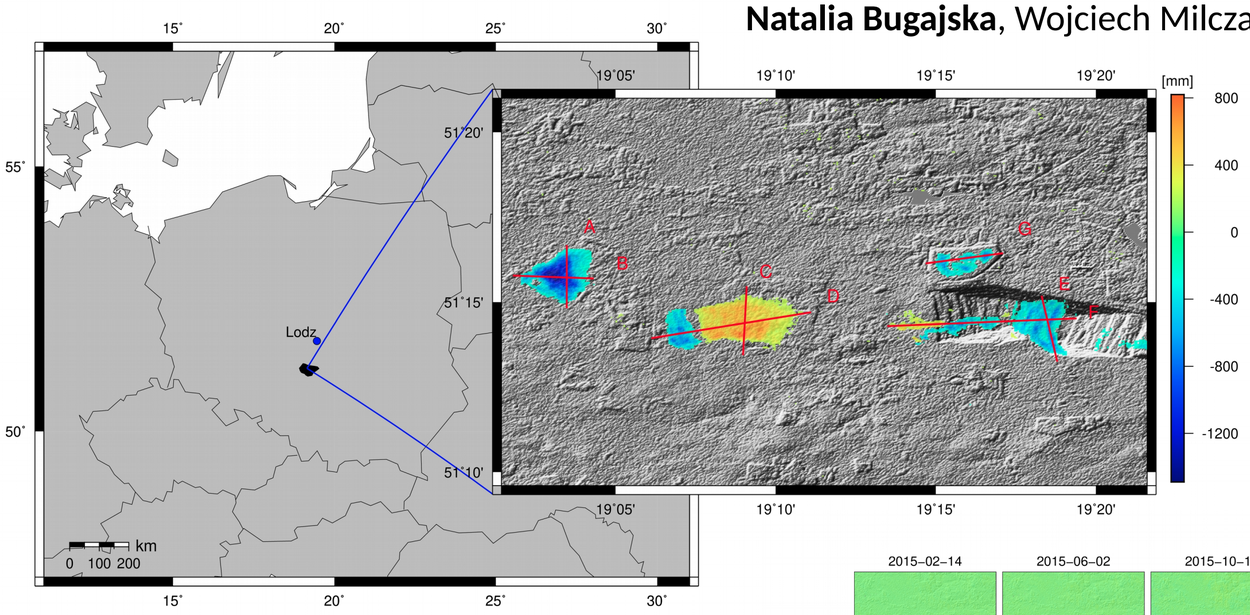

Fig. 1. Open-cast Brown Coal Mine in Bełchatów AOI. Total LOS displacements for analyzed period with the marking of cross-section locations

Area of Study

The Bełchatów Brown Coal Mine is located in central Poland, near the city of Lodz. The brown coal deposit exploited there dates back to around 20 million years. It is divided into three fields – Bełchatów Field, Szczerców Field and Kamieńsk Field. The existence of this division results from the occurrence of tectonic structures within the deposit, such as the Dębina salt dome (between the Szczerców and Bełchatów Field) and the Widawka Dam (separating the Kamieńsk Field from the Bełchatów Field). Due to the unfavorable ratio of the thickness of the deposit to the overburden, at present, mining is carried out only in the Bełchatów and Szczerców Fields (in the second of the aforementioned deposits it has a more complicated structure resulting from the presence of difficult-to-cut rocks in the overburden).

Method

To determine the long-term changes in the Bełchatów Brown Coal Mine surface we used Small Baseline Subset Time Series Method (SBAS). We acquired 216 Single Look Complex (SLC) satellite images from the Sentinel-1A and Sentinel-1B satellites (path 175) for the period from October 17, 2014 to June 11, 2019. Due to the fact that AOI was located on two stages, so they we combined them before calculations. We generated 839 interferograms (of which 463 have been ultimately selected) and determined LOS displacements for this period using GMTSAR software (Sandwell et al., 2011), removing topography with Shuttle Radar Topography Mission (SRTM) (https://topex.ucsd.edu/gmtsar/demgen/).

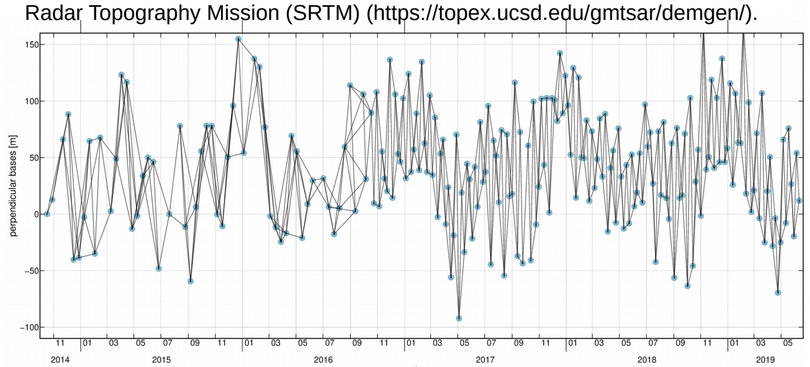

Fig. 2. Baseline plot for acquired SAR data

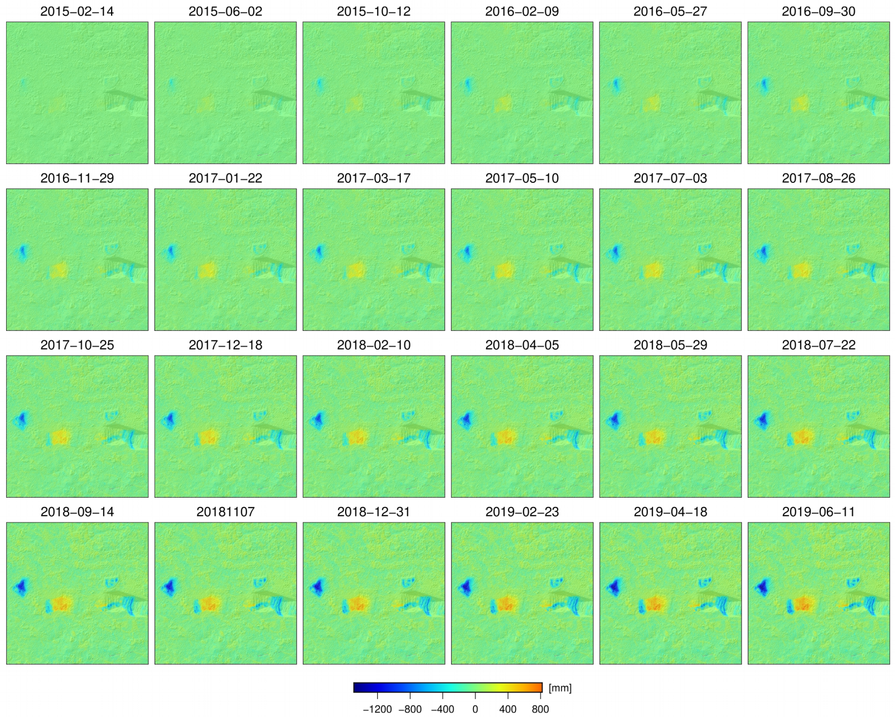

Fig. 3. Displacements in time-series for analyzed period. Successive figures correspond to 2-month (initially 4-months) increments of surface subsidence and uplift.

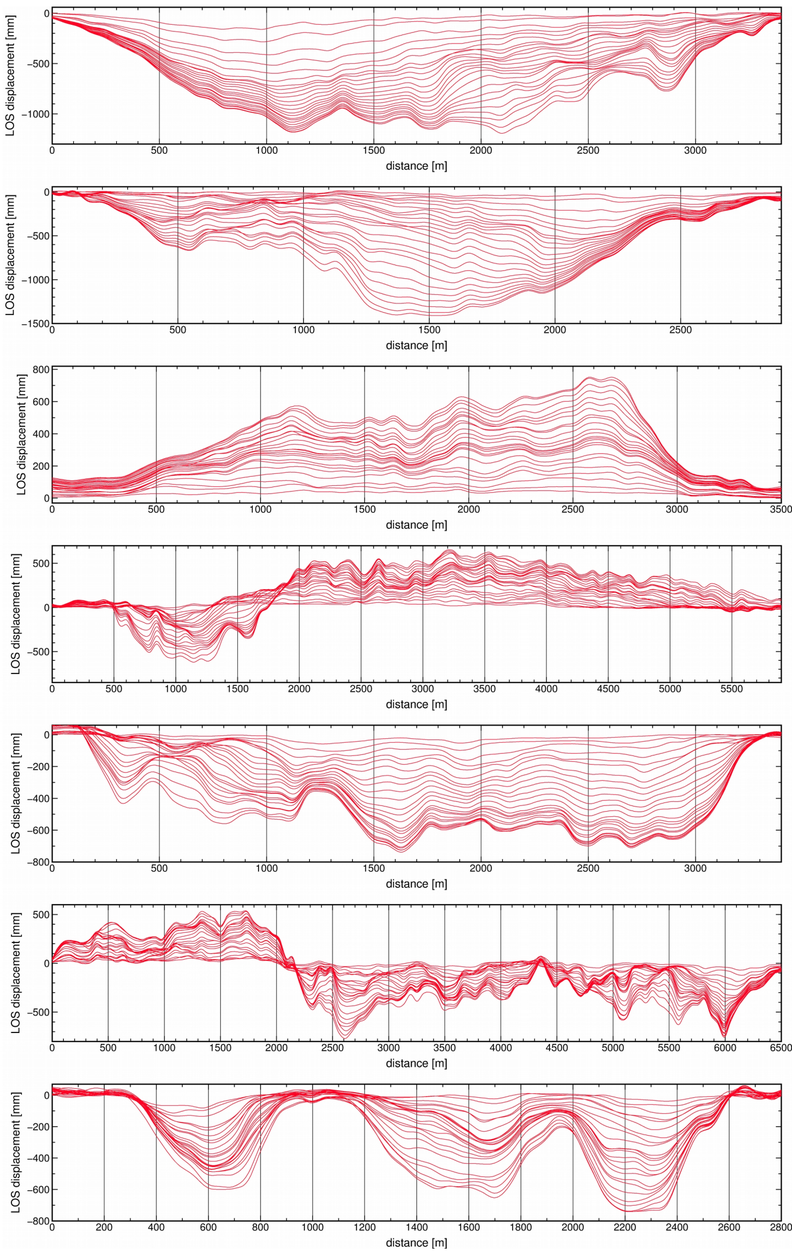

Fig. 4. Ground subsidence and uplift determined for selected parts of the mining area. Successive curves correspond to 2-month increments of surface subsidence and uplift. Locations of selected cross-sections are shown in Fig. 1.

Results

In the mining area of the Bełchatów Brown Coal Mine four main areas, which are significantly affected by deformation, can be distinguished. In the area of the Szczerców Field external dump, on the borders of the Bełchatów Field internal dump and in the Lubień ash landfill, subsidence of the area with maximum values of up to -150 cm during the observation survey was recorded (blue on Fig. 3). However, the elevation of the area is noticeable in the area of the current exploitation of the deposit in the Szczerców Field, whose maximum values oscillate within 80 cm (red color on Fig. 3). A clear relationship can be seen between the mining work currently underway and the place where the deformation occurs. Surface subsidence is associated with the phenomenon of automatic reduction of the volume of soil under the influence of its own weight (consolidation). The speed of consolidation largely depends on the type of soil (in this case stacked overburden). The presence of clay, sands, humus soil and mineral resources in the overburden generates relatively slow and steady subsidence of the area. The elevation of the bottom of excavations in the Bełchatów and Szczerców Fields is the result of the soil relaxation process (increase in volume due to the reduction of the load acting on the soil by removing subsequent layers of overburden and mineral).