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Long-term analysis of the environmental impact of mining in the Upper Silesia Coal Basin area based on historical and the latest remote sensing data

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The paper presents the results of long-term terrain subsidence monitoring in the mining area of the Upper Silesian Coal Basin (USCB) in Poland using Interferometry Synthetic Aperture Radar (InSAR), supplemented with differential analysis of digital elevation models. The work included analysis of mining-induced subsidence based on three archival surface models: historical terrain model obtained from the digitization of Messtischblatt topographic maps, representing the surface in 1919-1944; numerical terrain model DTED, derived from the vectorization of diapositives of topographic maps from the 90s of the twentieth century; LIDAR digital terrain model from 2013. Archival analyses were complemented by the newest PSInSAR database of Sentinel-1 data, processed for the entire area of USCB. The data covered a period of 6 years (October 26, 2014 - June 26, 2020), in which a total of 260 scenes from 124 descending paths were used. In the time domain, data were recorded at intervals of 12 days (for one Sentinel-1 satellite) or every 6 days for the full Sentinel-1 A / B constellation. The entire collection includes 8,139,901 PS points over 6,620 km2, giving an average density of about 1230 PS /sq km. The dataset enabled the analysis of contemporary vertical land movements. This huge set of various data was used to analyze the long-term influence of mining in the area broken down into time intervals, collectively covering the period from the mid-twentieth century to 2020. As a result of the analyzes, zones of mining-induced subsidence were developed, where the terrain surface was systematically changed in individual years. The data allowed for over 600 sq km identification under the influence of exploitation. Subsidence areas were matched with topographic data such as buildings and roads to estimate the effect of subsidence on urban areas. The work shows the great advantage of remote monitoring methods, which is the possibility of showing the long-term environmental impact to a large extent. The use of both historical and the latest data allowed for a comprehensive analysis of changes on the surface of the area now and in the past.