

Monitoring Open-Pit Mining

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Introduction

Open-pit mining is the most common form of mining in the industry and one of the most harmful to the environment. This method often causes uncontrolled alterations to the terrain, resulting in long-term landscape transformation and environmental degradation. The project aims to monitor open-pit mining sites using Earth observation techniques. The research focuses on tracking changes in extraction area boundaries and land transformation from year to year, and ultimately on assessing environmental impacts.



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Legend:

- Legal extraction area
- Illegal extraction area
- Mining site boundary
- Infrastructure
- Water



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Case Study

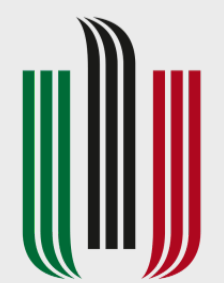
For the case study, the Niedźwiedzia Góra mine in Poland was selected, an active site of crushed stone extraction. The results reveal an illegal extraction area located in the north-eastern part of the mine.

Methodology

The project is based on optical data acquired by Sentinel-2 satellites; the boundaries of mining sites are defined using official information from the Polish Geological Institute. The automated workflow is as follows. First, the Normalized Difference Vegetation Index was calculated to identify areas of exposed soil. Land cover classes – buildings, residential and industrial areas, parking lots, other mining sites, and water bodies – were filtered out using layers derived from OpenStreetMap. Then, the bare soil layer was segmented into clusters. Particular attention was given to clusters that originated within the mining polygon but extended beyond the legal extraction boundaries, indicating potential unauthorized expansion. Areas of bare soil located far from the mine were excluded, as they are likely associated with agricultural practices. Finally, a time-series analysis of satellite imagery was conducted to demonstrate the increase in the illegal extraction area over time.



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