TERRA•EYE

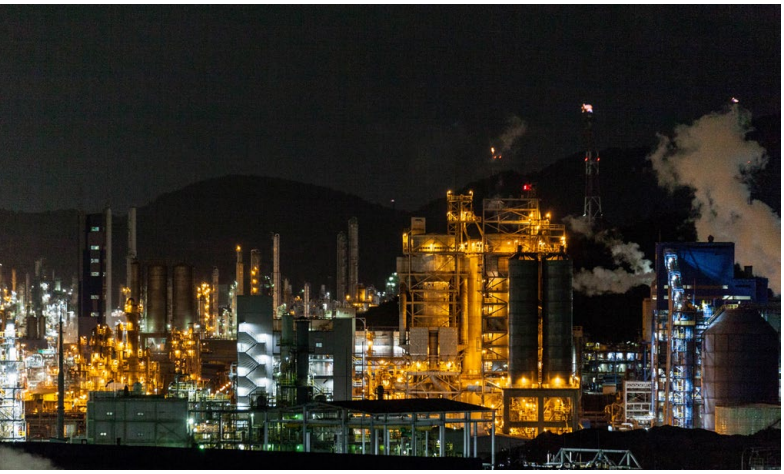
Capabilities of TerraEye System

Monitoring of Production Infrastructure with Remote Sensing Techniques

REMOTE SENSING
BUSINESS
SOLUTIONS

Maximizing efficiency and accuracy with AI-powered satellite data processing

The TerraEye system, that we are developing, is a tool for monitoring certain elements of the environment.



TERRA•EYE

The TerraEye system that we are developing is a tool for **monitoring selected elements of the environment based on the analysis of satellite remote sensing data supported by machine learning algorithms**.

In response to the existing need for continuous monitoring of areas around the routes of gas pipelines, oil pipelines, or power grids in near real-time, we have adapted selected functionalities of the TerraEye system for these purposes. Our system non-invasively and quickly provides data to support decision-making processes in exercising control over areas around network routes.

In our opinion, the use of new technology to monitor many aspects of the infrastructure of one of the largest oil and energy companies in Central and Eastern Europe can significantly contribute to increasing awareness and knowledge of the environmental impact of the entire Group. Given the ongoing consolidation of the activities of PKN Orlen, Lotos and PGNiG S.A., the automation of monitoring processes should bring the expected synergies resulting from the merger of several entities.

Critical infrastructure facilities such as refineries, oil and gas pits, and line infrastructure at the mine or medium-pressure gas pipelines may be covered by monitoring.

Fig. 1. A fragment of the gas pipeline network in the area of interest (based on: National Land Development Integration, 2022).

In addition to facilities located in Poland, onshore and offshore infrastructure located outside of our country, both located offshore (this applies to offshore platforms located in the North Sea) and mining infrastructure located in Pakistan, can be covered by monitoring (especially in terms of environmental protection).

In this article, we present selected functionalities of the TerraEye system relating to monitoring environmental changes relevant to infrastructure security. The area of interest chosen for the demonstration of our functionalities is the Siechnice municipality, located southeast of Wrocław.

A fragment of the gas pipeline network in the area of interest is shown on the left (Fig. 1).

Land deformations have an undesirable impact on existing linear infrastructure, creating a risk of failure.

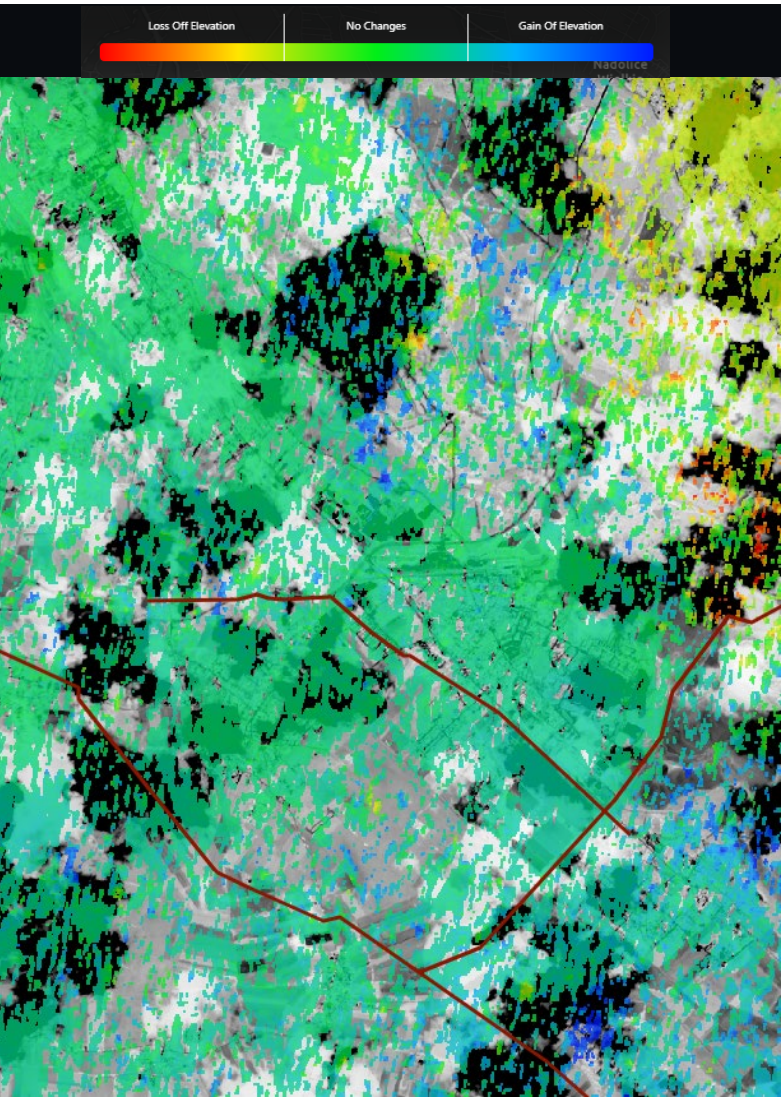


Fig. 2. Land deformations in the area of interest from 21-08-2022 to 02-09-2022

Damage to oil and gas pipelines pose a risk to both people and the environment. One of the causes of these failures is land subsidence, which can be caused by, among other things, underground exploitation of deposits, or large-scale changes in soil-water relations. For user-designated areas, based on the technique of satellite radar interferometry (InSAR), supported by machine learning algorithms, we can provide information on land subsidence in near real-time. By analyzing time series of data, we can pinpoint the exact locations of subsidence.

We are working on a notification system so that the user will receive an alert when the magnitude of land subsidence for the current time series exceeds acceptable values, allowing us to react as quickly as possible.

Below, the results of soil deformation analysis for the area of interest are presented (Fig. 2).

The results we generated are in the form of so-called **differential interferograms**, which are a composite of two radar scenes and represent the phase differences of the reflected signal. These differences reflect displacements on the ground surface. For the area of interest in the period from 21-08-2022 to 02-09- 2022, slight land subsidence of the order of 1 cm dominates.

We are working on a notification system so that the user will receive a notification when the magnitude of land subsidence in the vicinity of gas pipelines for the current time series exceeds the permissible values, which will allow us to respond as soon as possible.

The developed greenery detection functionality is used to inventory the vegetation cover in a given area.

Fig. 3. Machine learning model prediction results for land cover in the area of interest.

Our machine learning models can automatically distinguish **12 land cover classes**, including several classes of green areas, built-up areas, or bodies of water. In addition, for the time series of images, we can identify changes in land cover in the vicinity of gas pipelines, oil pipelines, or power grids.

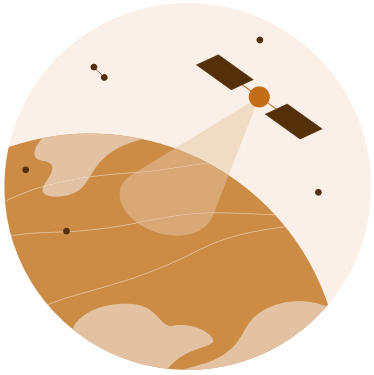
Below, the predictions of our machine learning model in the area of interest are shown broken down into 11 classes (Figure 3).

In addition, for areas covered with vegetation, we can calculate **indicators describing the condition of the greenery**. Leaks or leaks from gas or oil pipeline networks can cause the degradation of the surrounding vegetation.

As part of our research and development work, we are working on a solution where a sudden deterioration of indicators describing the condition of vegetation near a pipeline will be able to indicate the presence of leaks at a given location.

Our concept for critical sites monitoring

With a wide range of customers we understand the need for data in different ranges and different detail. To provide those types of information we aim to integrate with all types of technologies for data gathering.



THE BIG PICTURE

Satellite imagery provides the most diverse and up to date information:

- Every 2-3 days new multispectral images are available;
- Every 12 days new radar data is acquired for ground displacement information;
- Access to hyperspectral imagery data allows for more complex analysis.

A CLOSER LOOK

Drones (UAV) can be deployed to further supplement satellite data and to get more specific information about a region or a site:

- When better resolution is needed;
- When clouds obscure specific location;
- In case validation of sat data is needed.

IN-SITU DETAILS

Accessing granular information via additional sensors and physical sample gathering.

- Used to create and confirm analysis results.
- Gathering samples in specific locations in case of specific events or to acquire more insight for a planned future project.

POTENTIAL

In addition to the land deformation monitoring and vegetation inventory presented earlier, AI algorithms are being developed in TerraEye to:

- Noise detection and noise mapping for a given site (e.g. mine, refinery, denitrification plant, compressor station);
- Detection of oil spills and pollution of reservoirs/watercourses;
- Detection and identification of explosives in a given area (the tool can be used to monitor critical infrastructure).

PARTNERSHIP

To achieve the highest quality of presented information and constantly improve our machine learning algorithms, we cooperate with the experts:

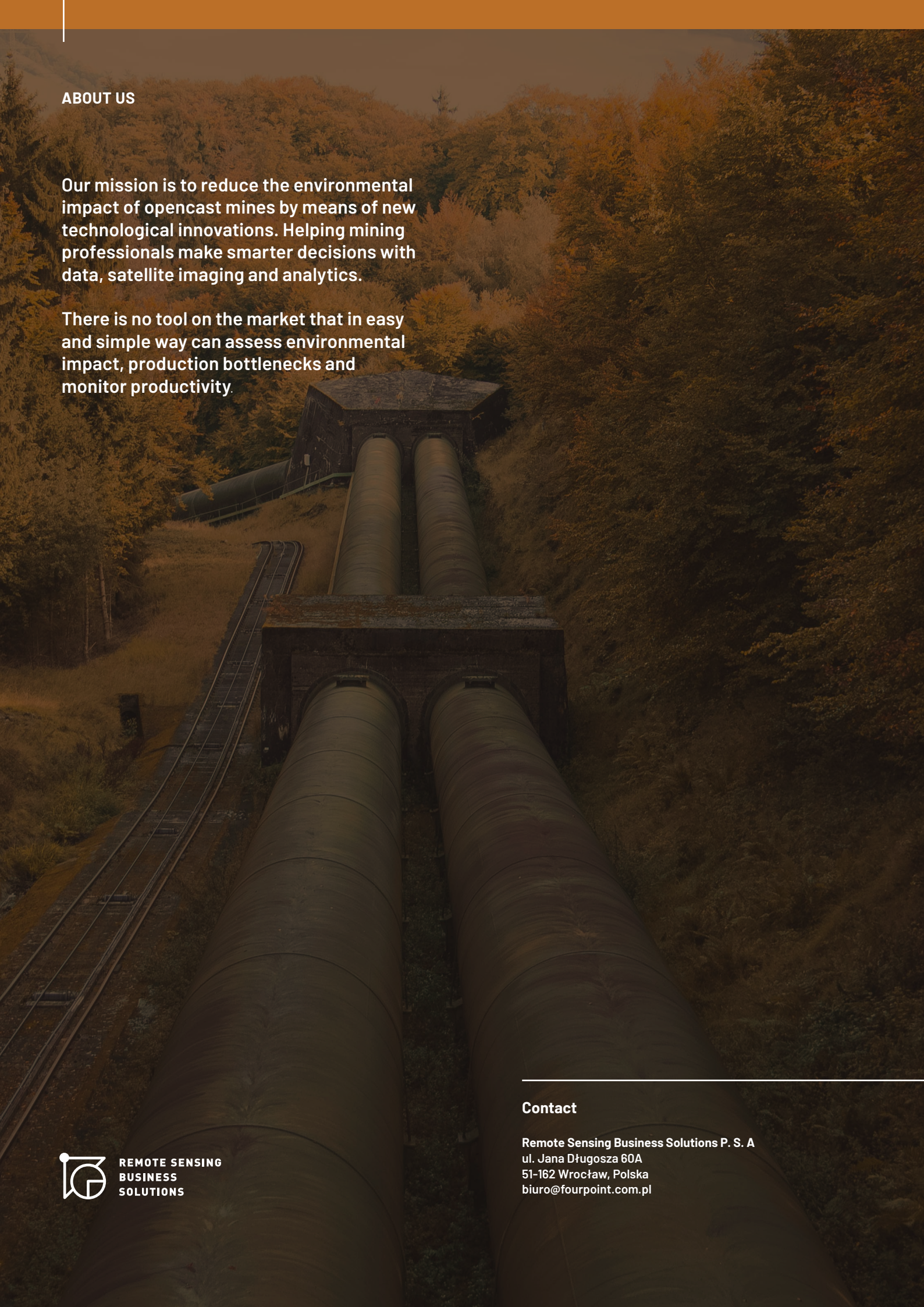
- Working on data from optical constellations (including Pléiades Neo, Pléiades, SPOT DMC Constellation, Vision-1) through cooperation with Airbus, SentinelHub, ESRIC, Maxar, SatRev, Pixxel and SkyWatch.
- Cooperating with Prometheus S.A. as part of the implementation of drone flights and data acquisition.
- Cooperating with the Faculty of Geology of the University of Warsaw and the Wrocław University of Science and Technology to improve our algorithms.
- Supporting by Microsoft, PWC and ESA in developing our system.
- Receiving funding from the National Centre for Research and Development.

AIRBUS MAXAR esric
sentinelhub pixxel SATREV
Microsoft PROMETHEUS pwc
esa UNIWERSYTET WARSZAWSKI Politechnika Wrocławska
SKYWATCH NCBR Narodowe Centrum Badań i Rozwoju

ABOUT US

Our mission is to reduce the environmental impact of opencast mines by means of new technological innovations. Helping mining professionals make smarter decisions with data, satellite imaging and analytics.

There is no tool on the market that in easy and simple way can assess environmental impact, production bottlenecks and monitor productivity.



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