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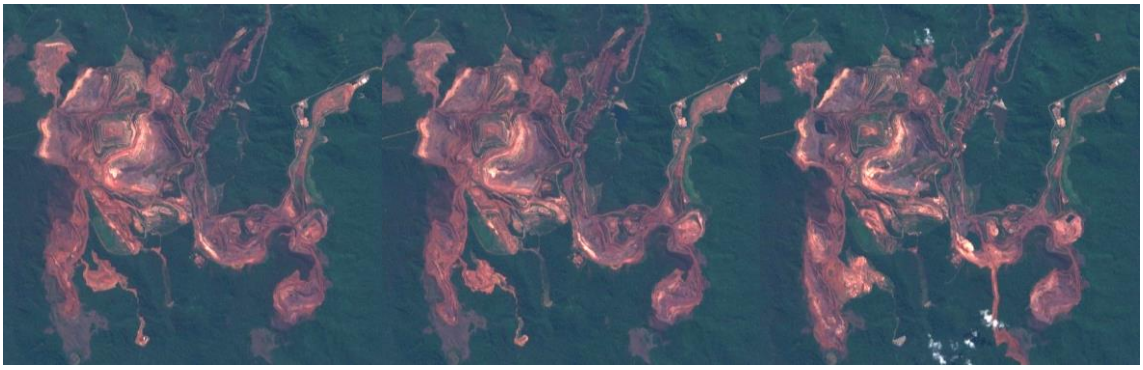
LAND DISTURBED BY MINING ACTIVITIES



Caption Observations (July 2016, 2017 and 2019) of mining activities at the Carajas mine, Brazil (source: Sentinel-2).

PRODUCT DESCRIPTION

Category

☐ Topographic information	☐ Surface deformation
☒ Impact assessment	☐ Precision ortho-images
☒ Change detection / continuous monitoring	☐ Terrain information
☒ Land cover / use	☐ Water quantity & quality
☐ Near surface geology	

Uses

Environmental Assessment & Permitting*:*

- *Baseline information to monitor land disturbed by mining activities*

Design, Construction & Operations*:*

- Continuous monitoring of mining activities, infrastructures and land cover changes
- Continuous monitoring of the vegetation close to the mining site
- *Can support in detecting illegal mining*

Mine Closure & Aftercare

- *Continuous monitoring of the rehabilitation of land disturbed by mining activities*

Challenges addressed

Development and Operations – Affected Land Status

Development and Operations – Illegal Mining

Closure and Aftercare – Environmental Monitoring

Closure and Aftercare – Mapping of Infrastructure

Closure and Aftercare – Affected Stakeholders

Geo-information needs

DO-4: Land disturbed by mining activities

DO-5: Land progressively rehabilitated;

DO-27 Mapping of illegal mining operations

CA-1: Demonstration of rehabilitation/revegetation;

CA-2: Characterisation of flora and fauna;

CA-4: Demonstration of infrastructure removal;

CA-6: Demonstrate no impact on a special area of conservation;

CA-8: Farming activities - confirm the return to baseline conditions for crops/animals

Description

The product reports (for a given area) the land disturbed by the mining operators during the construction and operational phases. By comparing two or multiple satellite images (optical imagery products) acquired at different times, both the mapping and mining authorities can control whether the conducted mining activities are nominal. By combining manual or automatic inspection of those images and the use of a Geographical Information System (GIS) program, vector layers can be generated to delimit the land disturbed by mining activities and investigate the evolution of the land cover throughout the construction and operation phases.

Moreover, infrared and optical imagery products can also be coupled (i.e., by making ratios of images taken at different wavelengths) to quantify how the vegetation within and around the mining site have been disturbed (via for example the generation of vegetation index map products).

Known restrictions / limitations

Cloud coverage might be an issue if a high-resolution land use/cover evolution (in time) is needed. The magnitude of such limitation is dependent on the geography and climate of the mining site as well as the season.

Lifecycle stage and demand

Exploration	Environmental Assessment & Permitting	Design, Construction & Operations	Mine Closure & Aftercare
	■■	■■■■	■■

Geographic coverage

Demand and coverage are global.

EARSC Thematic Domain

Domain – Land

Sub-domain – Land use

Product description – Monitor land cover and detection change

PRODUCT SPECIFICATIONS

Input data sources

Satellite	*Sentinel-2*	*Landsat-8*	*GeoEye-1*	Worldview-1, 2 and 3	SPOT 6, 7	Pleiades
Status	In operation	In operation	In operation	In operation	In operation	In operation
Operator	ESA	NASA	Digital Globe	Digital Globe	Airbus	
Data availability	Public	Public	Commercial	Commercial	Commercial	al
Resolution (m)	10 - 60	15 - 100	0.46	0.31 - 0.46	1.5	0.5
Coverage	Global	Global	Global	Global	Global	Global
Frequency (day)	5	16	< 3	< 2	< 1	< 1
Launch year	2015	2013	2008	2007/2009/ 2014	2012/2014	2011
Website	link	link	link	link	link	link

NOTE: Airborne and drone imagery products (optical and infrared) for local and regional analysis might also be used in order to obtain higher image resolution.

NOTE 2: Most of the satellite operator provide images under raster type of formats such as ".tif" files. Satellite products are often gathered into a single product containing several bands (i.e., images obtained at different wavelengths).

Minimum Mapping Unit (MMU)

Minimum detectable feature size (d*ependent on the input pixel resolution, ~1 - 3* px)

Accuracy / constraints

Thematic accuracy:

>85% threshold for overall accuracy / class accuracy.

Spatial accuracy:

Dependent on the input pixel resolution; typically, *~0.5 - 1* pixel.

Accuracy assessment approach & quality control measures

Dependent on the input pixel resolution; typically, *~0.5 - 1* pixel.

Timeliness

Digitization of land disturbed by mining activities from imagery products can be completed within a few hours/days of work, dependent on how large the area disturbed by mining activities is.

To tie in with corporate reporting, monthly assessment and reporting would be required.

Availability

Data from Sentinel satellites are freely available through the open data policy of the European Space Agency. Data is made available typically within 6-12 hours of satellite fly-over (similar for Landsat through NASA open data policy).

GeoEye-1, Worldview, SPOT and Pleiades data are commercially licensed and must be purchased through operator/vendor. Usually available within hour(s) of satellite fly-over.

Airborne and drone imagery products can be purchased through operator/vendor. Usually available within hours or days after acquisition.

Delivery / output format

Mining activities

Overview map of mining activities (and evolution in time)

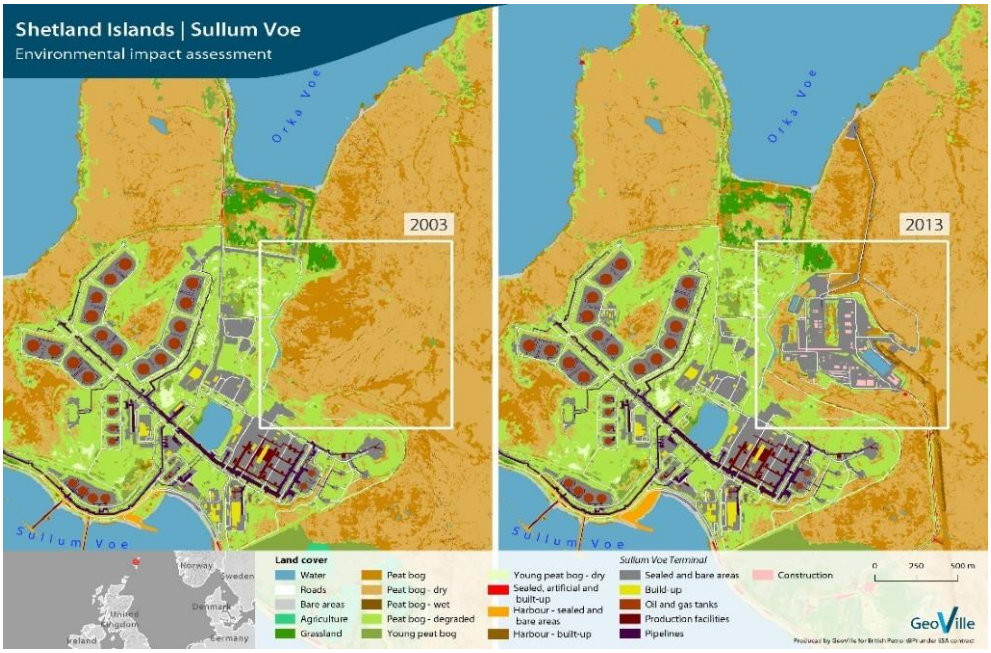
Output: vector formats - shapefile, report on key indicators, client-specified spatial formats

Land cover (land disturbed)

Overview map of land disturbed by mining activities

Output: raster formats - GeoTiff, report on key indicators, client-specified spatial formats

USE CASE



Shetland Islands – Environmental impact assessment

The aim of this project was to support environmental impact assessment and to provide guidance to minimize ecological impacts and to value ecosystem services in the region. A detailed very high-resolution land cover and land use classification was provided. The examples were used to identify valuable ecosystem services, to recognize ecosystem services dependencies and the impact caused by the operations. This method may also be applied to monitor mining activities and the land disturbed by them.