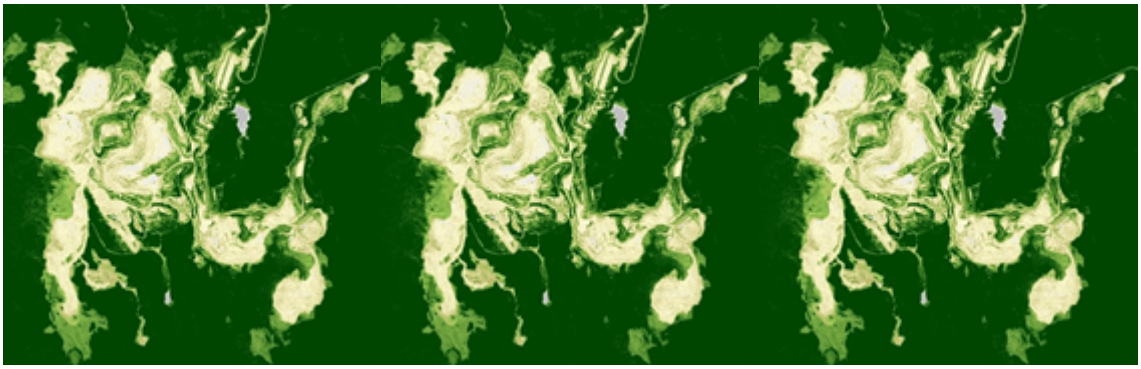
Product Sheet: Demonstration of Rehablitation /Revegetation

Demonstration of Rehabilitation/Revegetation	Download Product Sheet



Observation in time of the normalized difference vegetation index (NDVI, July 2016, 2017 and 2019) at the Carajas mine, Brazil (source: Sentinel Hub). Dark green and green values represent tropical rain forest, whereas yellow and white colors correspond to the land disturbed by mining activities.

PRODUCT DESCRIPTION

Category

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

Uses

Design, Construction & Operations / Mine Closure & Aftercare

- Continuous monitoring of rehabilitation steps and their resulting effects on the environment.
- Continuous comparison of baseline, current and agreed endpoint conditions.
- Crop health monitoring

Challenges addressed

- Closure and Aftercare – Environmental Mapping
- Closure and Aftercare – Geochemical Mapping
- Closure and Aftercare – Mapping of Infrastructure
- Closure and Aftercare – Affected Stakeholders

Geo-information needs

- **CA-2:** Characterisation of flora and fauna;
- **CA-3:** Soil structure and chemistry;
- **CA-4:** Demonstration of infrastructure removal;
- **CA-6:** Demonstrate no impact on special area of conservation;
- **CA-8:** Farming activities - confirm a return to baseline conditions for crops/animals

Description

During mine closure and aftercare, actors in the mining industry must demonstrate that the area of the mining site has been rehabilitated and returned to an agreed endpoint. The endpoint is based on the baseline data gathered during the permitting period and vegetation and variety of vegetation covers are key metrics. In order to conduct such analysis, several earth observation (EO) products can be made use of:

1. i) Optical imagery allows for a continuous monitoring of the rehabilitation steps and the consequent evolution of the revegetation around and on the mining site. Those changes in land usage can be manually digitalized with the help of Geographical Information System (GIS) software and shapefiles (vector objects). Such observations give the opportunity to both mining and mapping authorities to investigate the status of mine closure and aftercare steps, and to verify if those steps are conducted according to the agreed plan.
2. ii) Coupling of infrared and visible imagery products can be used to generate vegetation index map products, which allows for the identification of vegetated areas and their conditions.

iii) High-resolution digital terrain and surface models (DTMs and DSMs) derived from optical images (stereoscopy) and/or Lidar (LIght Detection and Ranging, laser measurements) can be used to find the heights of tree. Such analysis is useful in order to detect vegetated areas and estimate their volumes (biomass).

Known restrictions / limitations

The rate of growth for vegetation cover will vary depending on geography and climate. Where the rate of growth is relatively slow, an extended period of monitoring (years to decades) might be required to demonstrate a fully recovered habitat in the mining area.

The recovery growth rate of the vegetation might be dependent on the evolution in time of a large number of factors such as infrastructure removal, air and water quality, water management and location of stockpiles. A continuous monitoring of each of those parameters over a long time period and the response of vegetation to their changes is therefore vital.
In period of intense rehabilitation, a more frequent monitoring and a shorter period between reports might be required. Depending on the geography, climate and season, cloud coverage might be an issue in the investigation of the evolution of the rehabilitation and revegetation steps.

Lifecycle stage and demand

Exploration	Environmental Assessment and Permitting	Design, Construction and Operations	Mine Closure and Aftercare

Environmental Assessment & Permitting:

- *Detailed input baseline information about the flora and fauna is required to conduct a thorough analysis of how the rehabilitation/revegetation steps are planned to be managed during mine operations and after mine closure*

Design, Construction & Operations / Mine Closure & Aftercare:

- *Continuous monitoring of rehabilitation steps and their resulting effects on the environment*
- *Continuous comparison of baseline, current and agreed endpoint conditions*

Geographic coverage

Demand and coverage is 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	Airbus
Data availability	Public	Public	Commercial	Commercial	Commercial	Commercial
Resolution (m)	10 - 60	15 - 100	0.46	0.31 - 0.46	1.5	0.5
Coverage	Global	Global	Global	Global	Global	Global
Frequency (days)	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 for local and regional analysis might also be used in order to obtain higher image resolution.

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 ongoing rehabilitation steps and revegetation from imagery products can be completed within a few days of work, dependent on how large the rehabilitated area is and the number of activities.

Rehabilitation/revegetation changes likely to be reported on a weekly to yearly basis.

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

Rehabilitation steps

Map showing conducted and planned rehabilitation steps

Output: vector formats - shapefile, reports of specified and/or requested key indicators, client-specified spatial formats

Land cover

Map showing the land cover in the region of interest (evolution in time)

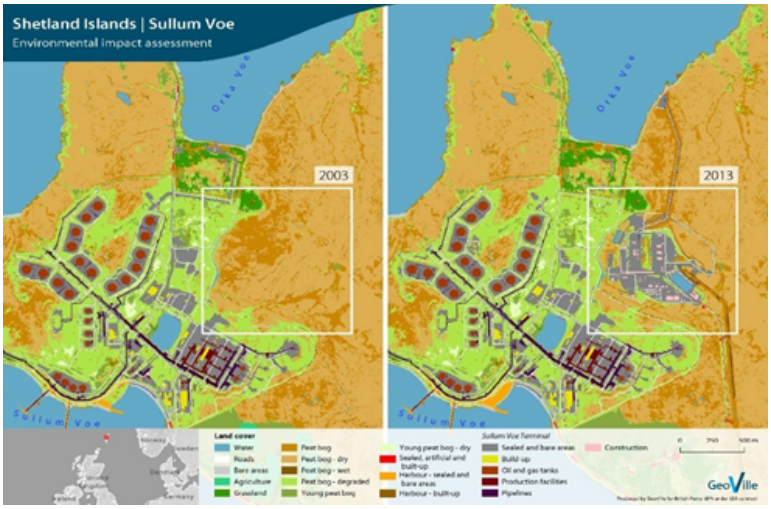
Output: - raster formats - GeoTiff, reports of specified and/or requested key indicators, client-specified spatial formats

Vegetation index

Map showing the vegetated areas and their conditions (evolution in time)

Output: - raster formats - GeoTiff, reports of specified and/or requested key indicators, client-specified spatial formats

USE CASE



Source: GeoVille

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. In terms of vegetation and rehabilitation mapping for the mining sector, this method may also be applied to map the baseline conditions as well as monitor changes.