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## TAILINGS DAM MONITORING

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### PRODUCT DESCRIPTION

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#### Category

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| <input checked="" type="checkbox"/> Topographic information<br><input type="checkbox"/> Impact assessment<br><input checked="" type="checkbox"/> Change detection / continuous monitoring<br><input type="checkbox"/> Land cover / use<br><input type="checkbox"/> Near surface geology | <input checked="" type="checkbox"/> Surface deformation<br><input type="checkbox"/> Precision ortho-images<br><input type="checkbox"/> Terrain information<br><input type="checkbox"/> Water quantity & quality |
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#### Uses

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Monitoring the surface movements before, during and after underground operations.

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#### Challenges addressed

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Development and Operations – Ground Stability/Geotechnical  
 Closure and Aftercare – Affected Stakeholders

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#### Geo-information needs

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**DO-19:** Underground operations – surface subsidence

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#### Description

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This product provides information on the tailings dam during mining operations, based on the satellite-based InSAR (Interferometric Synthetic Aperture Radar) technique. It provides mm-precise measurements over large areas on a weekly-monthly basis and can serve as scanning tool for the complete area above the mine and the direct environment. Depending on the satellite, up to 100,000 measurements per km<sup>2</sup> can be obtained.

Typical mining applications of this product are monitoring of ground and slope motion and the effects of the mining operation on the environment. The advantages are that large areas can be monitored on a regular basis, in a fully automated manner and without human intervention, providing a spatially dense view of the effects of mining operations. Furthermore, by using satellites, a uniform data format and quality can be obtained over all mines in the portfolio.

InSAR is based on radar images, as acquired by various radar satellites. The products from these satellites differ in terms of number of measurements per km<sup>2</sup>, measurement frequency, price (free vs. commercial imagery) and availability. In most locations worldwide there is

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imagery available dating back to 2015 and for some locations even back to 1992. Therefore, it is easy to obtain a baseline for deformations around of tailings dam and thereby context of what is or has been happening. By using multiple satellites, vertical as well as horizontal (in the east-west direction) movements can be tracked.

Triggers can be implemented to warn mining operators in case of tailings dam movement is reaching pre-defined thresholds set by the regulator or when the above ground infrastructure is at risk. This allows for intervening before a potential accident happens and a more precise planning of backfilling/ground support strategies.

**Known restrictions / limitations**

The satellite’s ability to accurately measure surface motion is dependent on the reflectivity characteristics of the surface which is generally the case for tailings dam.

**Lifecycle stage and demand**

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

- Construction & Operations: Monitoring tailings dam in operational mines

**Geographic coverage**

Global coverage

**EARSC Thematic Domain**

Domain	Land
Sub-domain	Geology
Product description	Monitor Mineral Extraction

**PRODUCT SPECIFICATIONS**

**Input data sources**

Sampling of available products:

<b>Satellite</b>	<b>Sentinel-1</b>	<b>TerraSAR-X</b>	<b>RadarSat-2</b>	<b>COSMO-SkyMed</b>	<b>ICEYE-X2</b>
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<b>Status</b>	In operation	In operation	In operation	In operation	In operation
<b>Operator</b>	ESA	Airbus Defence & Space	MDA	e-Geos	ICEYE
<b>Data availability</b>	Public	Commercial, on demand	Commercial, on demand	Commercial, on demand	Commercial, on demand
<b>Resolution (m)</b>	20x4	3x3 or 1x1	25x7 or 5x5 or 3x3	3x3 or 1x1	< 1
<b>Coverage</b>	Global	Global	Global	Global	Global
<b>Frequency (days)</b>	6-12	11	24	4-16	< 1
<b>Launch year</b>	2014	2007	2007	2007	2019
<b>Website</b>	<a href="#">link</a>	<a href="#">link</a>	<a href="#">link</a>	<a href="#">link</a>	<a href="#">link</a>

### Minimum Mapping Unit (MMU)

The satellite can detect very small features (~decimeters), provided that objects and/or surfaces of interest reflect well enough. Generally, solid, stable, angular objects are the best reflectors.

### Accuracy / constraints

#### Thematic accuracy:

The technique works best on solid, angular objects like solid rock.

#### Spatial accuracy:

Dependent on the satellite resolution. The measurement can be located on sub-pixel level, typically in the order of 1-5 meters.

#### Measurement accuracy:

The deformation/movement of the tailings dam can be determined with a precision of around 1 mm/yr.

### Accuracy assessment approach & quality control measures

The quality is assessed by automated, thoroughly tested, quality control algorithms, delivering validated results. The quality of the product and the approach taken are described in an automatically generated report, ensuring high quality and reproducibility.

### Frequency / timeliness

#### Observation frequency:

*Depending on the satellite, varying from daily to 24 days.*

#### Timeliness of delivery:

*Depending on the satellite provider, the service provider and the type of application (within 1-*

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5 working days).

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### **Availability**

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- Global coverage with free imagery, lower resolution, including archive since 2015 and in some locations since 1992.
  - Global coverage on demand with paid imagery, higher resolution. Archive imagery available in some locations.
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### **Delivery / output format**

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- Data via API (Application Programming Interface), as GIS file format (geopackage, shapefile, .kml, .csv, etc.) or in a webviewer.
  - Triggers via API or email.
  - Automated reporting in pdf.
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### **Use case**

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This product is part of the project's service demonstration. Use case will be added soon.

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