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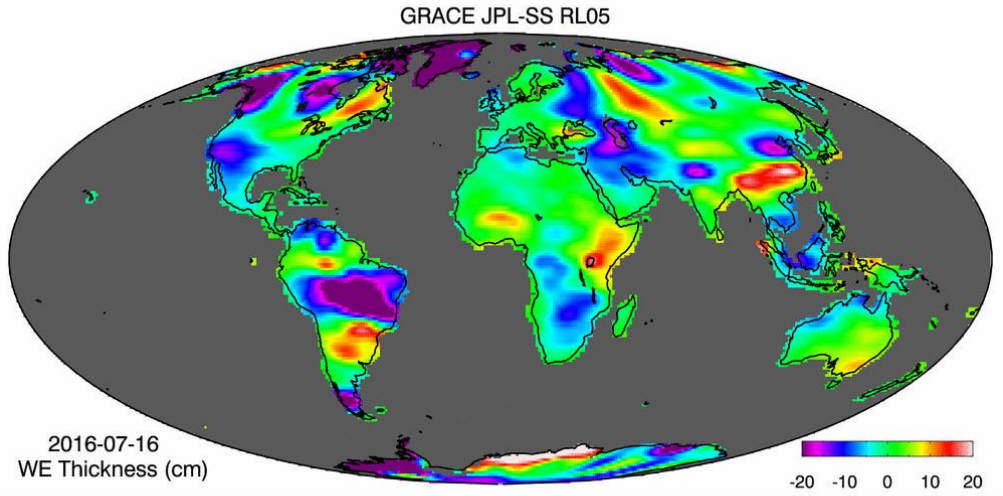
GROUND WATER MONITORING



Land water storage anomalies, July 2017 (Source: NASA)

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

Monitoring of ground water levels

Impact assessment

Environmental monitoring – Baseline historic mapping of environment and ecosystems

Environmental monitoring – Continuous monitoring of changes throughout the lifecycle

Challenges addressed

Permitting Process – Water catchment

Development and Operations – Environmental Monitoring

Geo-information needs

P-2: Groundwater

DO-22: Ground water monitoring

Description

Ground water monitoring in respect of water level as well as chemistry is an important task in terms of impact assessment of the mining activities on the environment. It is quite challenging to meet these needs with remote sensing data. Remote sensing may indirectly address those issues by providing several indicators. This product provides several indicators that are addressed with gravimetry as well as interferometry techniques.

Changes in the Earth's gravitational field are detected with satellite imagery and furthermore indicate movement and changes within ground water. These changes indicate variations in water storage and further make it possible to calculate variations in volume.

Interferometric Synthetic Aperture Radar (InSAR) imagery is used to detect changes in land surface and altitude. Satellite images from several points in time make it possible to observe changes. As the depletion of ground water leads to ground subsidence, the derived information indicate this. The product shows the ground water level and indicate changes and anomalies when examining time series.

As groundwater levels are linked to soil moisture, in the future this might be a good indicator and an opportunity in future times.

Known restrictions / limitations

As mentioned above, monitoring of ground water level as well as chemistry is a challenging task that can only be addressed indirectly by remote sensing at the moment.

NASA's GRACE missions provide data on Earth's gravitational field and could thus be a measure of volumetric ground water. However, resolution is not as high as desirable. The first GRACE mission (2002–2017) provided a resolution of 300 km, the follow-up mission, GRACE-FO, launched in 2018, now provides a resolution of 100 km.

Resolution is better using radar satellite imagery. Depending on satellite, a resolution of 1 m is possible.

Lifecycle stage and demand

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

Environmental Assessment & Permitting:

- Information to minimise the impact of mining activities on the environment

Design, Construction & Operations:

- Information to monitor impacts on the environment

- Information on ground water level

Mine Closure & Aftercare:

- Information to monitor impacts on the environment after mine closure

Geographic coverage

Globally available.

EARSC Thematic Domain

DOMAIN	LAND
Sub-domain	Inland water
Product description	Assess ground water and run-off

PRODUCT SPECIFICATIONS

Input data sources

Sampling of available products:

Satellite	***GRACE***	***GRACE-FO***	***Sentinel 1***	***TerraSAR-X***
Status	Archive	In operation	In operation	In operation
Operator	NASA	NASA	ESA	DLR/Astrium
Data availability	Commercial, on demand	Commercial, on demand	Public	Commercial, on demand
Resolution (m)	300 km	100 km	5 – 100	1 – 16
Coverage	Global	Global	Global	Global
Frequency (days)			< 3	< 5
Launch year	2002 – 2017	2018	2014	2007
Website	link	link	link	link

Minimum Mapping Unit (MMU)

Variable, depending on source data resolution.

Accuracy / constraints

Thematic accuracy:

N/A

Spatial accuracy:

Dependent on input pixel resolution

Accuracy assessment approach & quality control measures

N/A

Frequency / timeliness

Observation frequency:

Every one or more days, depending on satellite.

Timeliness of delivery:

Within five (working) days of sensing.

Availability

Data from all Sentinel satellites are freely available through the open data policy of the operator ESA (Sentinel-1A since 2014, Sentinel-1B since 2016).

GRACE (2002–2017) and GRACE-FO (since 2018) data can be accessed through the operator/vendor. TerraSAR-X satellite imagery is commercially available through EADS Astrium GmbH.

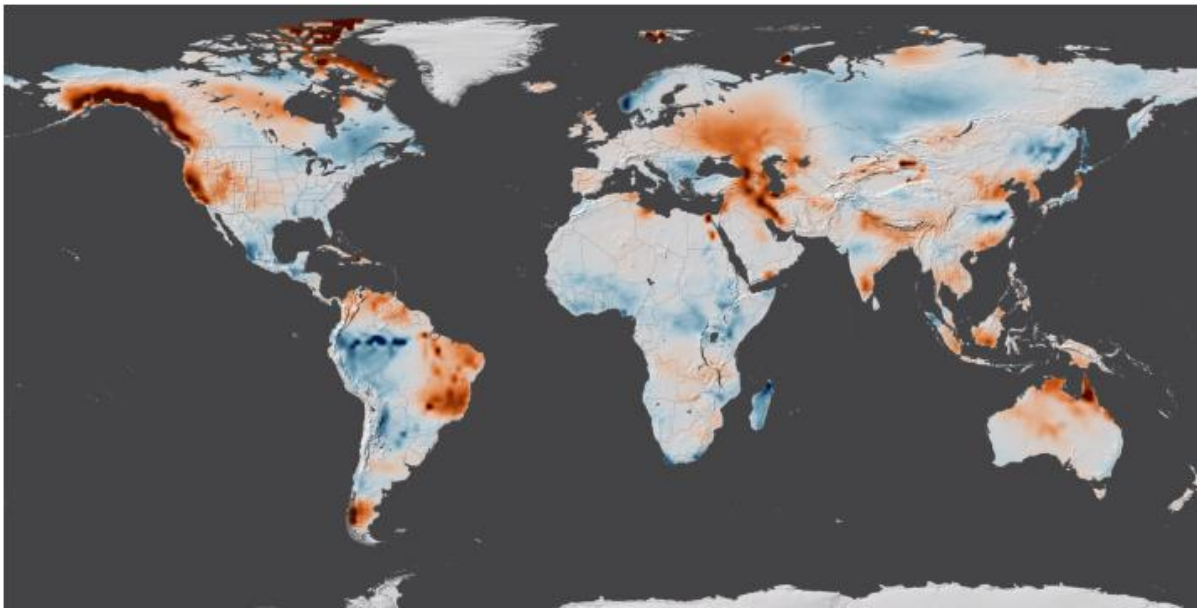
Delivery / output format

Data type: Raster formats

File format: Geotiff

Further delivery formats: Paper maps, Statistical change report

USE CASE



NASA GRACE gravity variations are used to determine ground water storage. (Source: NASA; https://gracefo.jpl.nasa.gov/science/water-storage/)

Groundwater is an indicator on impacts on the environment. From gravity variations over time, anomalies in ground water storage can be calculated and show, where the ground water storage has changed.