inio

Ground monitoring from space

by world leaders in geotechnical engineering
and earth observation

NGI

KSAT
KONGSBERG
KONGSBERG SATELLITE SERVICES

A COMPREHENSIVE GLOBAL InSAR SERVICE PROVIDING RAPID GEOTECHNICAL ANALYSIS FROM SPACE

Inio is a comprehensive InSAR service offered by leading providers of earth observation and geotechnical engineering.

With office locations on several continents, KSAT and NGI provide satellite analytics to stakeholders globally through Inio.

Rooted in Scandinavia, Inio has a strong focus on the Nordics and specializes in the engineering and monitoring challenges of the north.

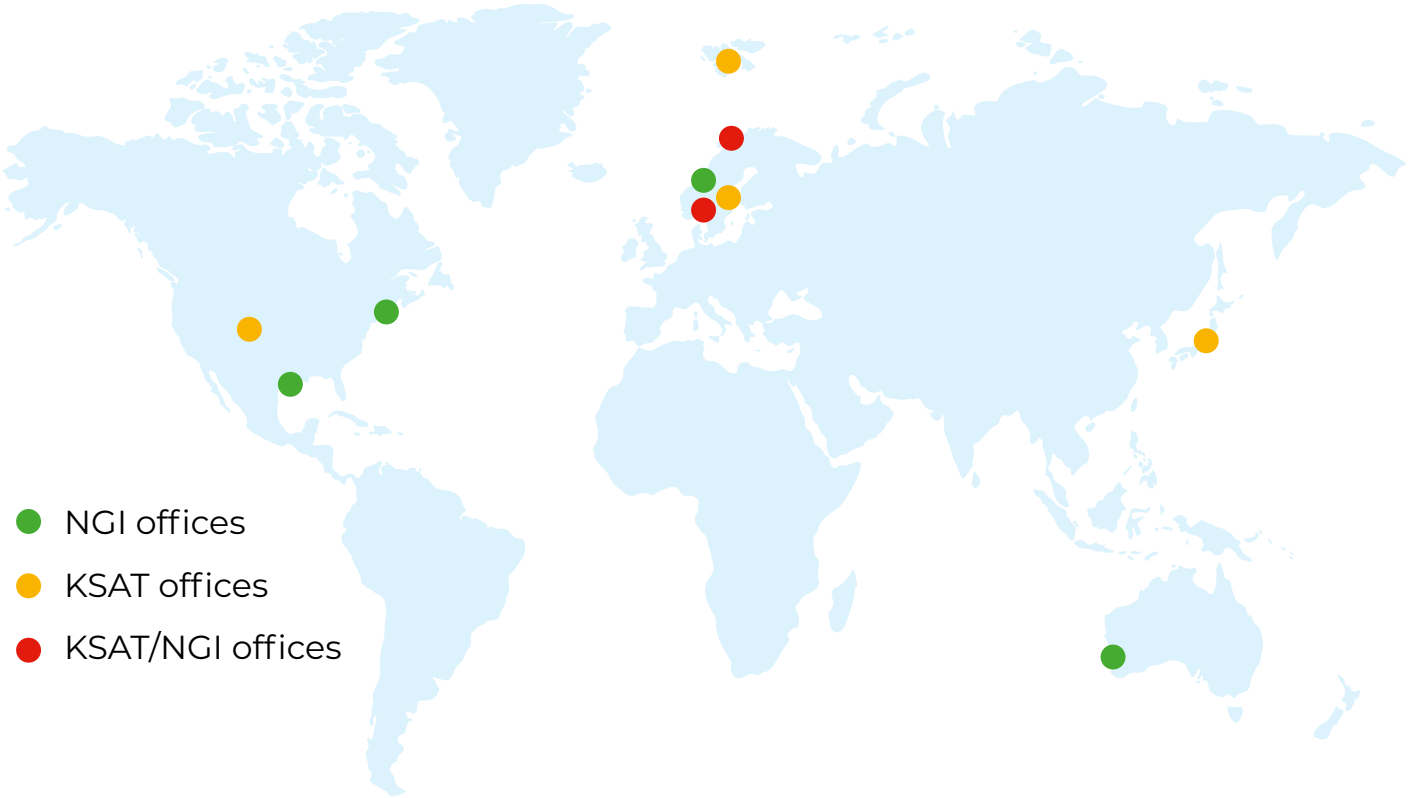
CONTENT

ABOUT INIO

Inio was established to meet the increasing demand for reliable space-based ground monitoring services and the need for a robust yet scalable service that can deliver tailored analysis to the global market.

Inio provides high quality, cost-effective and operational InSAR ground monitoring services both to public and private sectors. Stakeholders and applications are diverse, ranging from urban planning in the context of modern smart cities to the energy sector, which requires precise information for mining or oil and gas extraction activities. Governments also use this information to map critical areas prone to subsidence, erosion, or natural hazards.

Inio is a consortium of two world-renowned service providers in their respective domains: KSAT specializing in time-critical SAR imagery processing and delivery, and NGI specializing in InSAR data processing and interpretation as well as geotechnical consulting. This partnership offers full operational capability and scalability, from satellite data tasking and acquisition, to deformation tracking and mapping and geotechnical consulting.



THE COLLABORATION

Inio's vision is to gather strong complementary expertise in the Nordics to deliver unmatched InSAR service and value to partners and customers globally.

Inio is a comprehensive InSAR service based on a streamlined collaboration for optimal data integration and optimization. The result is an unmatched ground monitoring service enabling NGI and KSAT to deliver the entire value chain from data acquisition to geotechnical analysis and risk assessment.

Complementary expertise

Inio is made possible by harnessing complementary expertise from leading Nordic service providers that can deliver exceptional quality by focusing on their key expertise within their focused domains.

NGI

NGI provides expert consulting on geotechnical engineering, ground investigation, ground stability, and natural hazards around the globe.

The Norwegian Geotechnical Institute (NGI) is a private not-for-profit foundation with offices in Norway, USA, and Australia. NGI has provided cutting edge consulting and research to industry and government agencies for 70 years.

NGI's focus is to develop and apply innovative solutions to solve critical societal needs and ensure safety of development and construction and securing sustainable energy solutions.

NGI has built up some of the most advanced geotechnical laboratories in the world and operates a large fleet of drilling rigs and instrumentation for field investigation and monitoring.

NGI has applied InSAR for geotechnics, ground settlement, and slope stability for two decades. This has resulted in the development of advanced analytics and InSAR interpretation methods for challenging projects and conditions.

Read more at www.ngi.no

KSAT

As a leading provider of Ground Network Services and Earth Observation Services for many years, KSAT knows what it takes to operate and deliver fast and reliable services – every day.

Kongsberg Satellite Services (KSAT) is the world's leading supplier of Ground Network Services connecting Space to Earth with offices in Norway, Sweden, Japan and USA. KSAT delivers Earth Observation services derived from an extensive portfolio of commercial satellites including both Synthetic Aperture Radar (SAR) and high-resolution optical satellite data.

Combined with the uniquely positioned global ground station network, KSAT offers an end-to-end solution on coverage, resolution, price and monitoring frequency, delivered in just minutes after acquisition.

Read more at www.ksat.no

A UNIQUE SERVICE

Inio was established to meet the increasing demand for reliable space-based ground monitoring services and the need for a robust yet scalable service that can deliver top quality analysis to the global market.

1 We are experts

We do not outsource customer communication. With our service, you speak directly with the experts and all your analysis is carried out by the same people, most of whom have advanced degrees in this field with many decades of combined experience.

We believe this is essential to ensure that the custom monitoring solution is optimal for your needs.

2 We have expertise in all methods of monitoring and instrumentation

We provide a wide selection of monitoring services, InSAR, in-ground sensors like inclinometers, ground-based radar and lidar, and total stations. You do not need to worry about which service to select.

Our experts will help you choose an optimal solution with the best solutions for your project.

3 All monitoring solutions are streamlined for geotechnical analysis

Because we deliver all possible forms of monitoring solutions, they can be streamlined. As we also offer geotechnical analysis based on InSAR data through NGI, we can ensure that the data is produced and presented in the most optimal way.

In our extensive experience, all of these things matter. This is why Inio exists - to provide a service with clear advantages for every customer.

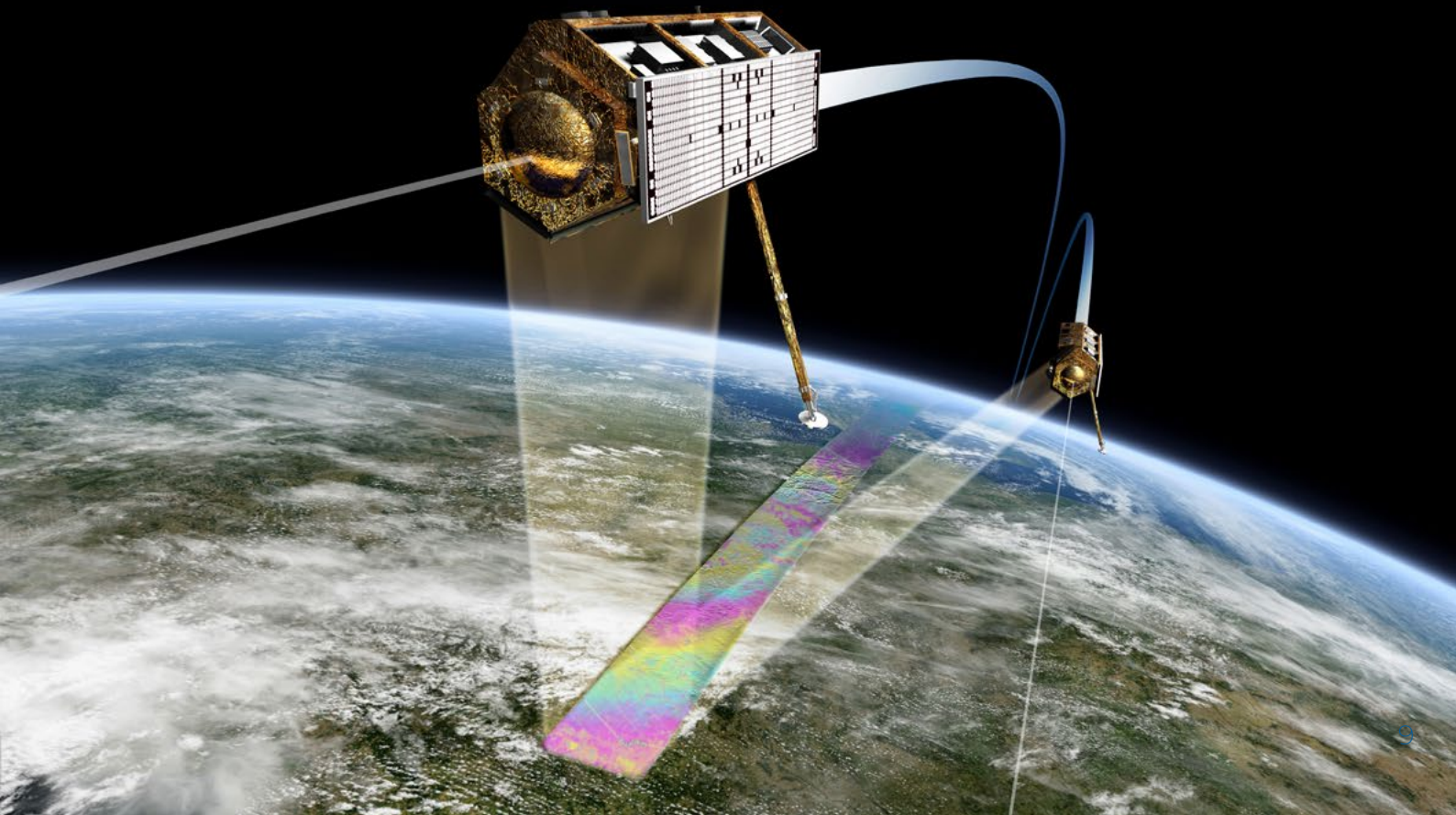
InSAR

InSAR is a technique that enables observations of ground motion from space with millimeter-scale precision and assessments of ground stability and risk.

Synthetic Aperture Radar Interferometry (InSAR) is the science of extracting the phase difference in the electromagnetic radar signals. This phase difference is directly related to the motion on the ground and due to the precise orbit of the SAR satellites enables continuous monitoring of ground displacements over several years. The large footprint of the SAR signal also enables the tracking of spatial variations in movement over kilometers.

InSAR has grown from a niche to a mainstream earth observation tool with widespread applicability to diverse industries on all continents. The use of InSAR is rapidly increasing along with elevated access to satellite data and stakeholder awareness of the technology.

The team behind Inio has been applying InSAR to monitoring needs of real projects for decades. We strive to elevate the use of the technology today to help ensure not only the stability of the ground, but also the stability of industry operations, while enhancing societal safety.



THE SERVICE

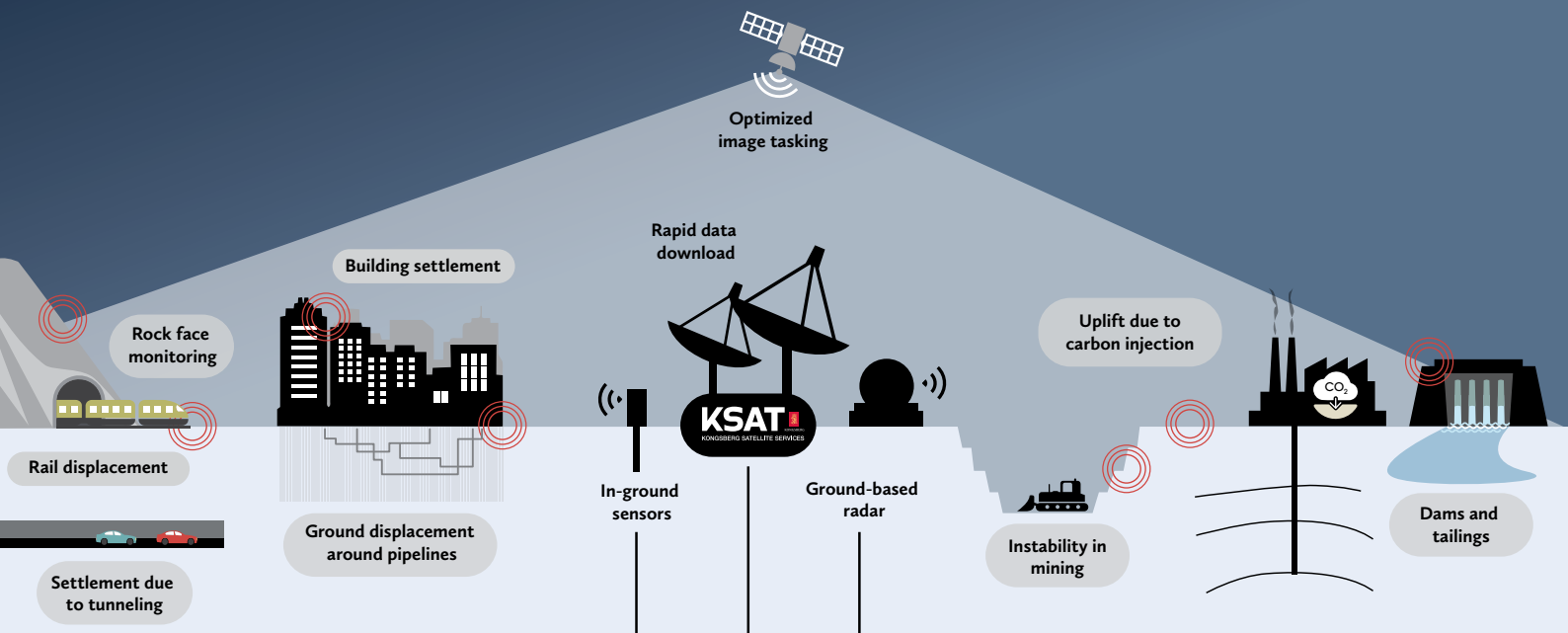
The InSAR service consists of several packages - the first two being the InSAR service, and the last two - valuable add-ons.

FAST DATA DELIVERY

KSAT provides down-link services derived from an extensive portfolio of commercial satellites resulting in seamless data download and processing and rapid updates of ground motion products.

DATA INTEGRATION

Ground motion monitoring with InSAR can be augmented by on-site instrumentation and ground-based remote sensing installations providing alerts or early warning.



ANALYSIS AND DELIVERY

KSAT provides down-link services derived from an extensive portfolio of commercial satellites resulting in seamless data download and processing and rapid updates of ground motion products.

NGI
Data integration
Processing
Interpretation

GEOTECHNICAL INTERPRETATION

NGI provides expert geotechnical consulting based on InSAR data
We help you understand the underlying causes and geological conditions responsible for the motion. We provide expert consulting on risk assessment and mitigation efforts.

Consulting by geotechnical engineer

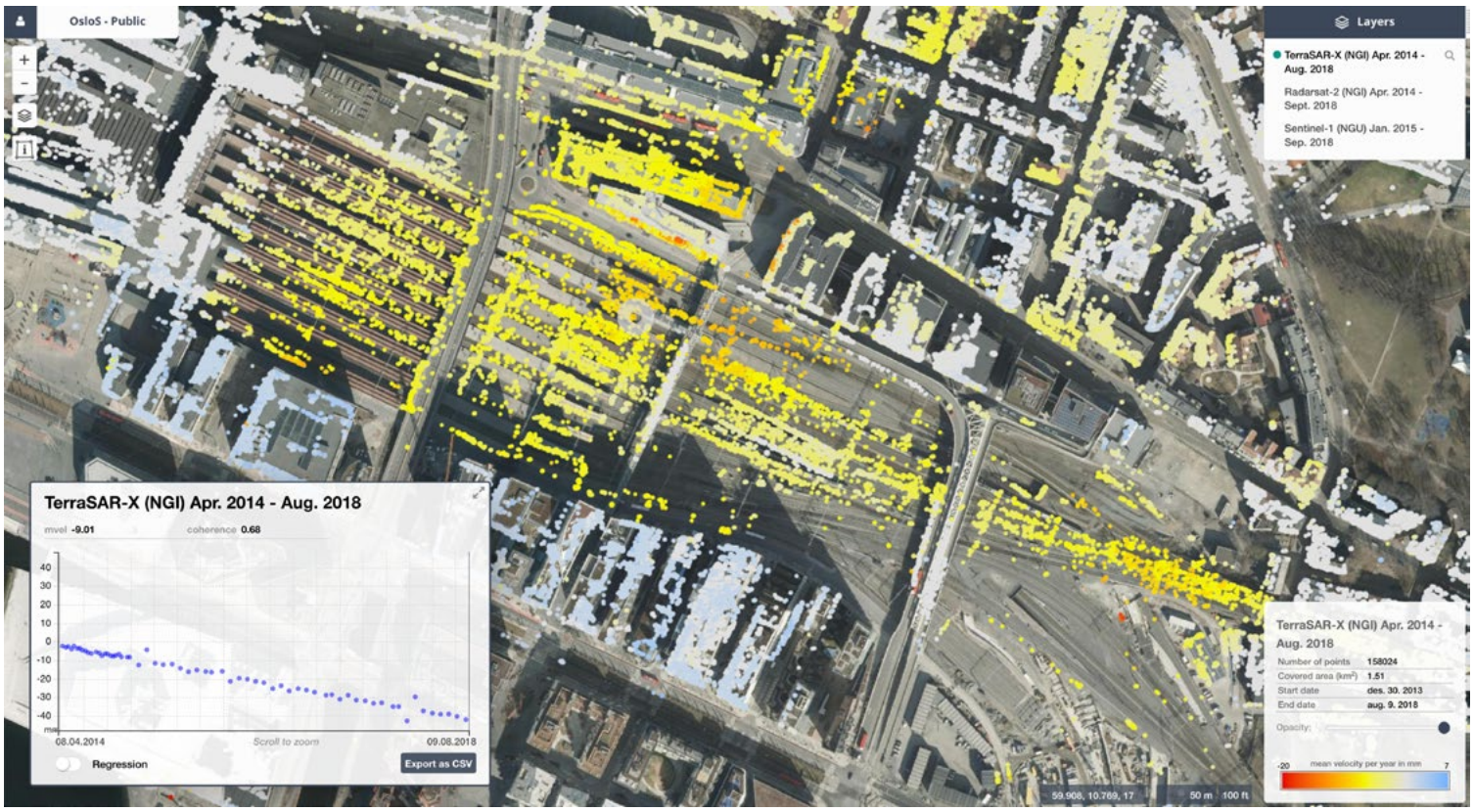
Live monitoring by installed sensors on-site

DEFORMATION MONITORING

Inio tailors each delivery to custom specifications to ensure the data can be optimally used and integrated into each customer's own system.

All InSAR deliverables include data access through a live - continuously updated monitoring portal. This gives every customer access to the most recent deformation values and trends for live monitoring of all company assets.

The portal enables instant filtering and grouping of data for on-the-fly analysis and data interpretation of deformation trends and data accuracy.



INSTRUMENTATION

Inio integrates on-site interferometric radars or custom sensor installations to augment large-scale InSAR-based monitoring with a localized and frequent data acquisition through a portal.

InSAR data provides cost-effective tracking of ground displacement over areas covering up to tens to hundreds of kilometers. An additional advantage is the potential ability to investigate deformation several years back using archived data.

The additional integration of on-site sensors has advantages as it enables more frequent observations, allowing for near real-time monitoring and alerting.

Sensors, such as inclinometers, are often placed in drilling holes, providing information about how surface displacement relates to deformation further down in the soil column.

Sensor monitoring data is provided through a live monitoring portal for instant access to view deformation and instability for all assets.

The NGI Live portal provides instant access to monitor environmental data or installed inclinometers or custom monitoring solutions. The platform has been developed to deliver stable data flow that can be integrated into customer solutions and used to supplement InSAR services and analysis.

NGI ON-SITE INSTRUMENTATION

Instrumentation can be used in combination with InSAR to enhance monitoring by providing acquisition control and elevated resolution.

DATA THROUGH A GLOBAL ANTENNA NETWORK

KSAT's global antenna network provides access to all relevant SAR satellite data and rapid data ordering, processing and delivery enabling speedy monitoring updates.

Kongsberg Satellite Services (KSAT) provides highly reliable communication services between space and ground based on an extensive global network of ground stations. KSAT is based in Tromsø, Norway, but with antennas and offices in several locations around the world, and is a truly global company.

The KSAT Global Ground Station Network sites have been carefully selected to provide an optimized connectivity for satellites in polar and inclined orbits. The KSAT Global Ground Station Network is continuously being developed to meet new customer demands. KSAT is always adding more capacity, more antennas, and new sites.

Our Global Ground Station Network

GEOTECHNICAL MODELLING AND CONSULTING

InSAR analysis gives customers insight into how the ground moves. As part of the service, NGI consultants can help customers map the underlying processes and evaluate risk, safety, and options for stabilization when critical.

NGI provides expert consulting on geotechnical engineering, ground investigation, ground stability, and natural hazards around the globe.

Inio delivers InSAR-based analysis of ground motion from space. The service is developed and provided in part by NGI with the deliverables needed for NGI to integrate the data into geotechnical and risk assessments.

NGI also provides expert industry consulting on the ground across the world and integrates data from InSAR, on-site instrumentation, inspections, ground investigations and geophysical surveys.

NGI also offers geotechnical modeling, offering theoretical insights into subsurface material behavior, coupled with InSAR analysis, which delivers real-world, high-resolution data, enhancing the precision of monitoring ground deformations.

This synergy facilitates early warning systems and proactive risk mitigation, as geotechnical models predict potential subsidence or deformation patterns while InSAR analysis provides timely data on actual ground movements.

APPLICATIONS

InSAR is indispensable for real-time insights and risk management across a range of dynamic environments and projects.

Inio delivers integral information for diverse sectors:

- **Transportation**
- **Construction**
- **Mining**
- **Natural Hazards**
- **Energy**

Explore the power of InSAR yourself by exploring our interactive data product

By scanning the QR-code:

TRANSPORTATION

InSAR applications for infrastructure monitoring, including roads and railroads, provide crucial insights for ensuring the stability, safety, and resilience of transportation networks. Continuous monitoring allows for proactive maintenance and timely responses to potential challenges, contributing to the overall reliability of critical infrastructure.

Stability Assessment

The technology assesses the stability of roads and railroads, offering insights into ground movements and potential subsidence, ensuring the safety and integrity of transportation networks.

Construction Impact Analysis

Before, during and after construction projects, InSAR can be valuable for monitoring ground stability and deformation, assessing the impact on existing infrastructure such as roads and railroads.

Maintenance Planning

By providing continuous monitoring, InSAR aids in planning maintenance activities for roads and railroads, ensuring timely interventions to address potential issues.

Tunneling

InSAR applications for tunneling play a crucial role in monitoring ground stability, ensuring construction quality, and supporting risk mitigation efforts.

CONSTRUCTION

InSAR applications for urban settlements provide essential tools for subsidence monitoring, construction impact analysis, and urban planning. The technology contributes significantly to ensuring the safety, sustainability, and resilience of urban environments.

Subsidence Monitoring

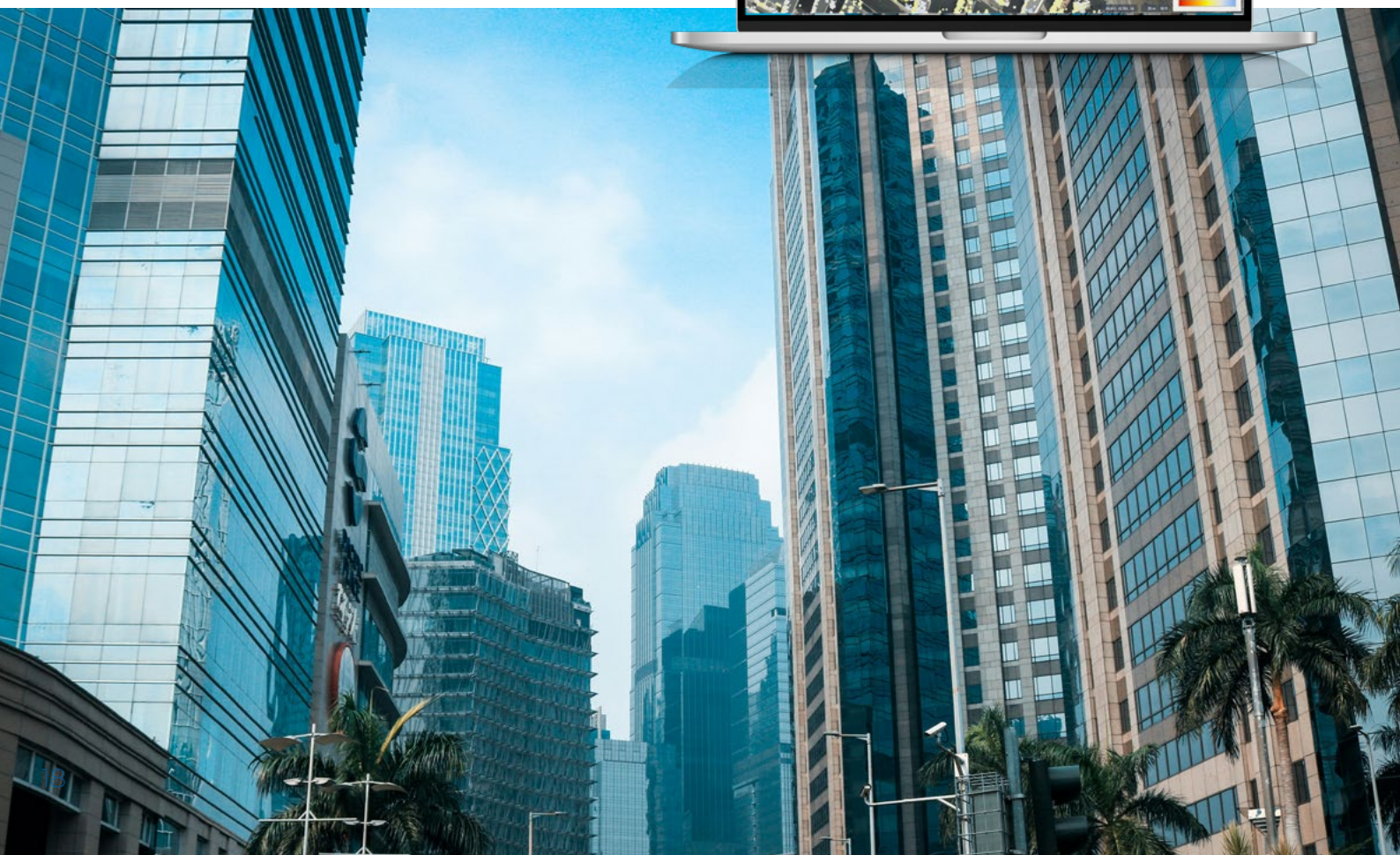
Real-time monitoring of ground subsidence in urban areas, offering early detection to mitigate risks to infrastructure, such as buildings, roads, and utilities. In addition, archived data can aid in the forensic assessment of settlement several years in the past.

Construction Impact Assessment

Monitoring ground stability and deformation, assessing the impact on existing urban infrastructure and facilitating proactive measures to avoid damage.

Urban Planning and Development

Providing insights into ground stability, helping city planners make informed decisions regarding development projects and infrastructure improvements.



EXAMPLE:

The development of the iconic Bjørvika waterfront district in Oslo is a great example of how our InSAR monitoring is integrated with a suite of other services.

Over several years, NGI participated in the development of the Oslo harbor applying ground drilling, instrumentation, geo-physics and other methods.

Extraction of soil cores by NGI to evaluate ground conditions before excavation and construction.

During and after construction, NGI thoroughly monitored the harbor and surrounding area with InSAR, helping to track the associated deformation of the Oslo Central Station.

MINING

InSAR for mining and tailings management provides critical information for optimizing operations, ensuring safety, and meeting environmental standards. Continuous monitoring of ground movements is essential for mitigating risks and maintaining the overall stability of mining sites and associated infrastructure.

Ground Subsidence Monitoring

InSAR provides real-time monitoring of ground subsidence in mining areas, helping to identify potential risks and mitigate the impact on infrastructure.

Pit Deformation Analysis

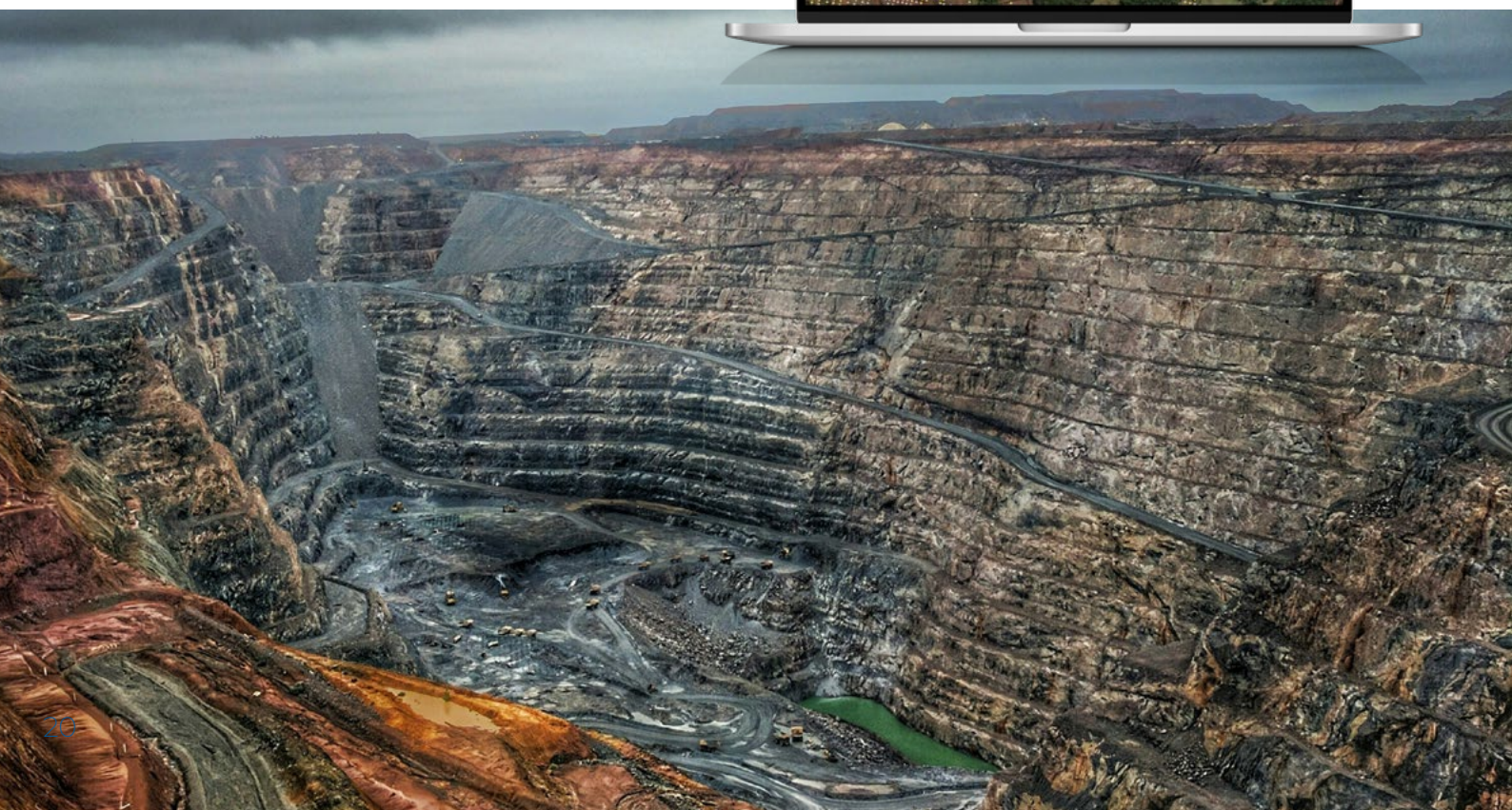
The technology can analyze pit deformations over time, offering insights into the stability of mining excavations and help optimize mining operations.

Infrastructure Integrity

InSAR is utilized to assess the impact of mining activities on infrastructure, such as roads, buildings, and pipelines, ensuring their integrity and safety.

Stability of Tailings Storage Facilities

For tailings storage facilities, InSAR plays a crucial role in monitoring stability. It detects ground deformations around tailings ponds, providing early warnings for potential issues.



Example:

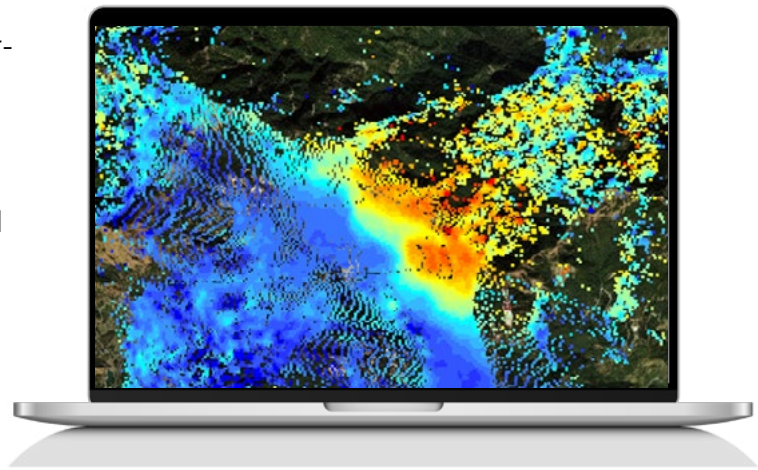
Cadia gold mine is located near Orange in the New South Wales Central West that collapsed in 2018 and the leak sparked fears of broadscale groundwater contamination in the surrounding farmland.

NATURAL HAZARDS

InSAR can be used to monitor landslides and other ground and rock movement associated with natural hazards.

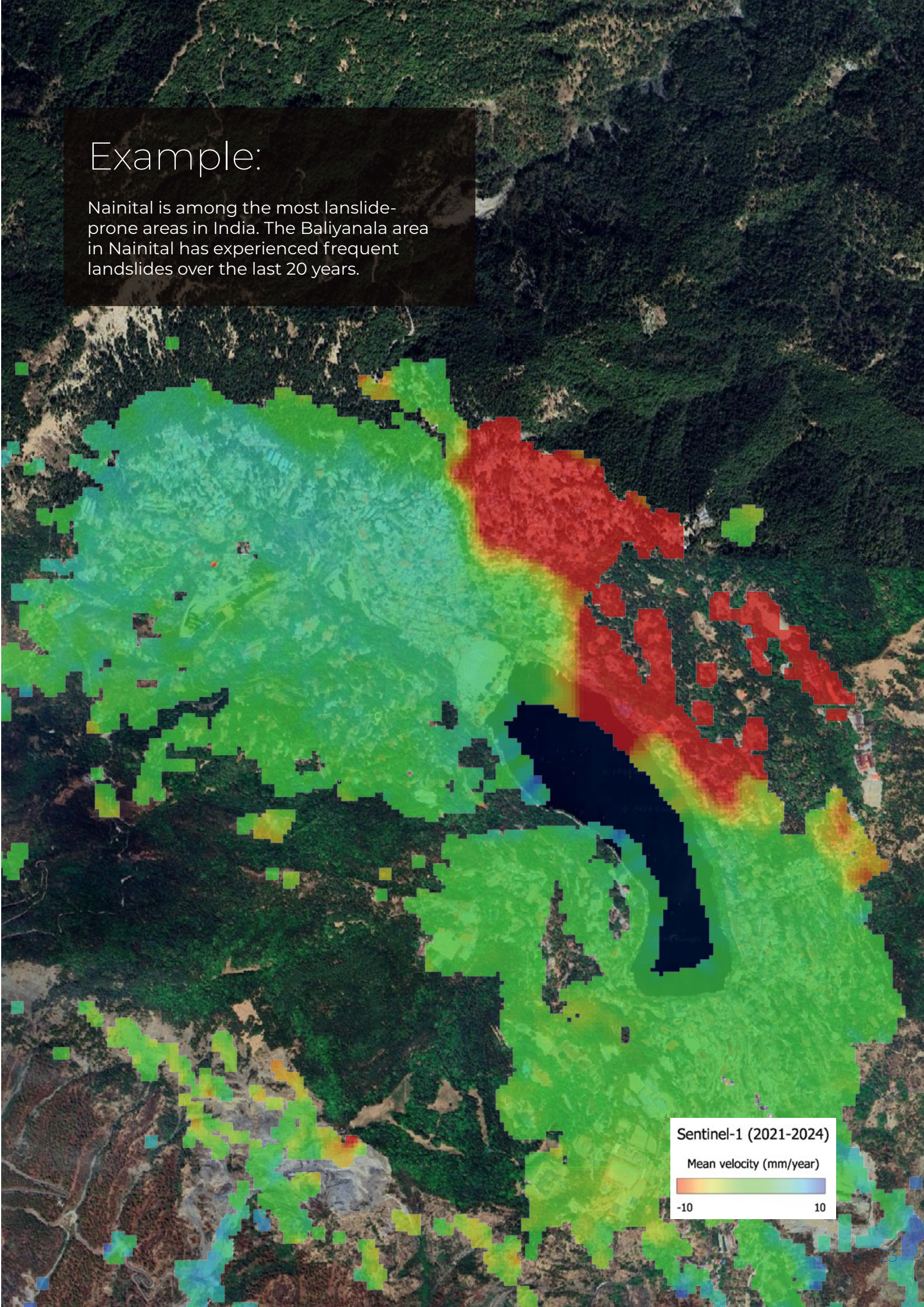
InSAR can be used to detect and monitor ground movements in the Earth's crust such as earthquakes and volcanic activity.

InSAR can also be used to evaluate deformation within near-surface layers such as landslides, subsidence due to natural processes, or ground movement due to flooding. Tracking such ground movements using InSAR can help understand impacts and prioritize mitigation measures in vulnerable areas.



Example:

Nainital is among the most lanslide-prone areas in India. The Baliyanala area in Nainital has experienced frequent landslides over the last 20 years.



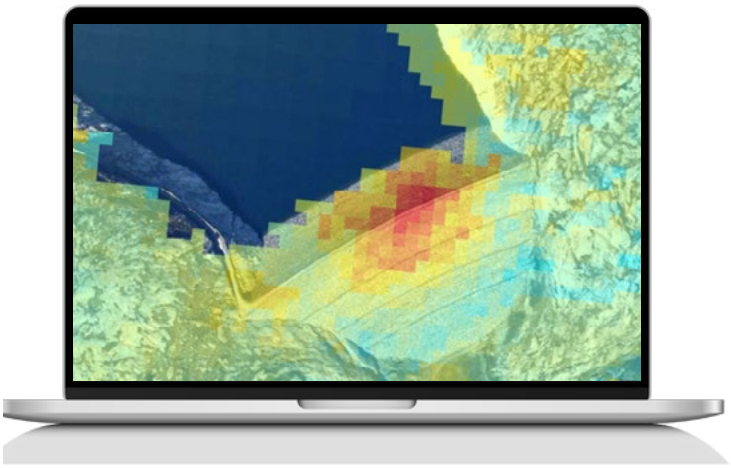
ENERGY

InSAR is used to support energy sectors in closely monitored operations.

Inio provides InSAR services for carbon capture, use and storage (CCUS) to detect and monitor large-scale surface upheave in response to CO_2 injection.

We also provide monitoring of hydropower dams to help correlate dam movements with water levels and identify unusual displacement and deformation.

Inio also provides stability assessments and active monitoring of offshore installations and movements related to external loads.



Example:

Beneath Barrow Island is a depleted oil and gas field, located around 60 km off the northwest coast of Western Australia, about 88 kilometres north of Onslow in the Carnarvon Basin. It is the largest oil field discovered in Western Australia.

Sentinel-1 (2021)

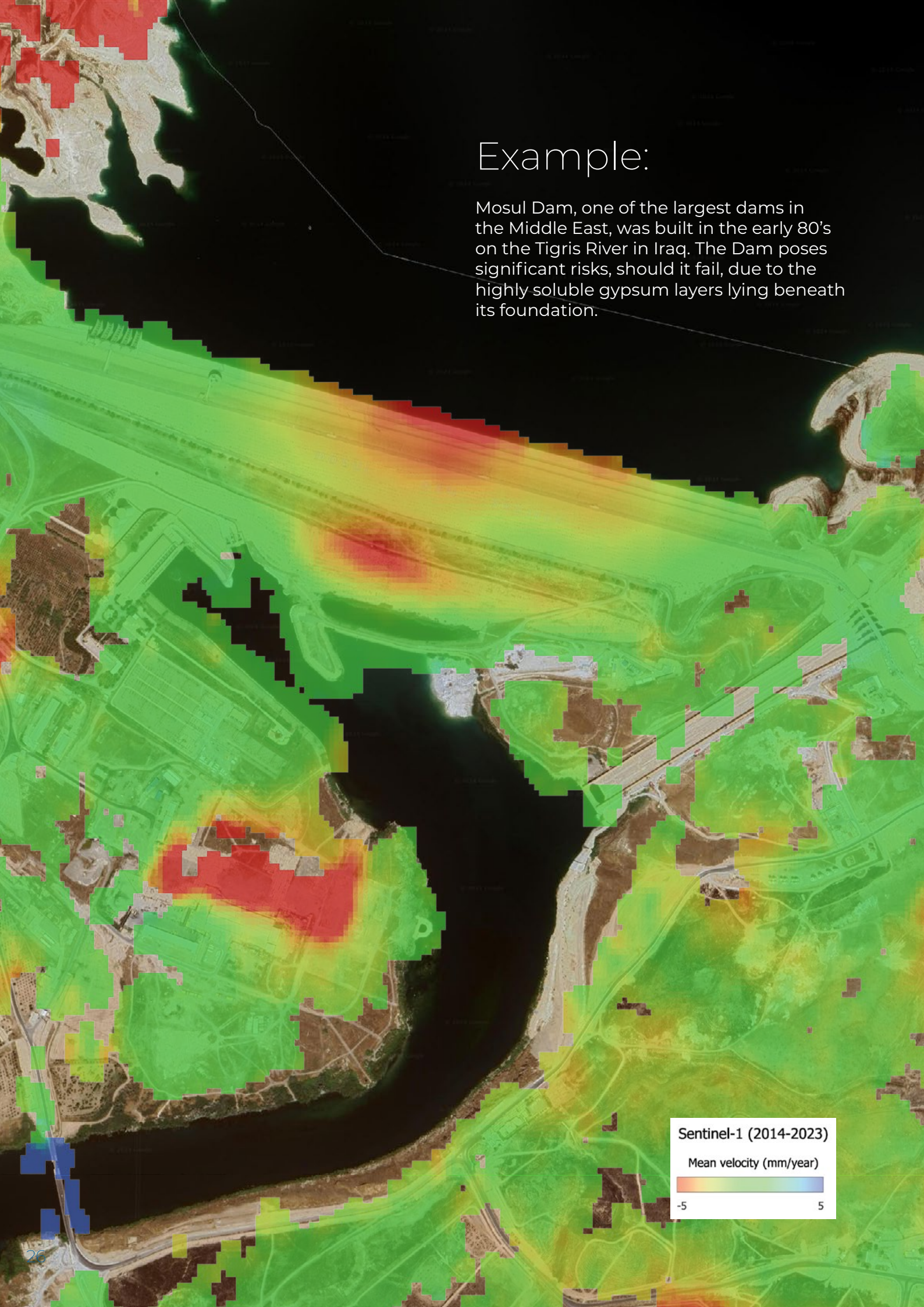
Mean velocity (mm/year)

-30 30

Monitoring ground movement on Barrow Island, WA, in response to CO_2 injection.

Example:

Mosul Dam, one of the largest dams in the Middle East, was built in the early 80's on the Tigris River in Iraq. The Dam poses significant risks, should it fail, due to the highly soluble gypsum layers lying beneath its foundation.



ENHANCING YOUR PROJECTS, FROM SPACE AND ON THE GROUND

OPTIMIZING PROCESSING AND DELIVERIES

Inio delivers tailor-made services to end users in the mining industry and transportation sectors. In addition we are innovating in new markets which require efficient low-cost InSAR solutions spurring our efforts to enhance efficiency and automation.

PROVIDING HIGH EXPERTISE

InSAR processing needs to be carried out carefully, with attention to detail and requiring manual expert interpretation. During these steps, we do not compromise and this is only done by InSAR experts with advanced knowledge and experience within radar remote sensing and signal processing.

www.inio.ai

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