



Rheticus[®] Network Alert

Dynamic Water and Sewage Networks Monitoring

Technical Specifications

► Document Info

Document Id.:	pkm106-152-1.2	16/04/2020
Approved by:	Vincenzo Barbieri	
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► Document History

List of reviews			
Version	Author	Date	Note
1.0	Antonello Aiello	04/12/2018	First version
1.2	Antonello Aiello	16/04/2020	Revised service update frequency, interface and functionalities

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Template: pkq001-30-2.3

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1. Rheticus®

Rheticus® is an automatic cloud-based geoinformation service platform (Figure 1), designed to deliver fresh and accurate data and information for monitoring the evolution of the Earth's surface. The platform includes services for dynamically monitoring the Earth's morphology, vegetation, infrastructure as well as coastal areas and seawater, covering both environmental and production aspects.

Access to Rheticus® is made available by subscription and allows users to have continually updated information.

Services update is guaranteed through the use of satellite images, mapping data and environmental information available online as open data. The service is updated with the availability of fresh incoming data, and the refresh rate can range from monthly to daily frequency depending on the service characteristics.

Rheticus® is available through the web portal on portable devices, such as tablets and smartphones. Information is displayed on a pre-set dashboard that simplifies the analysis of monitored phenomena, providing users with a comprehensive overview. Rheticus® provides information by means of graphic indicators, dynamic diagrams and pre-set reports. The provided information allows customers to immediately perform assessment operations over areas of interest.

Services are also available in Machine to Machine mode (M2M) via standard sharing protocols, making the platform an information hub that delivers content to other online systems. Export capabilities of data and information are also available, allowing users to download standard formats and facilitate their use in other external application environments.

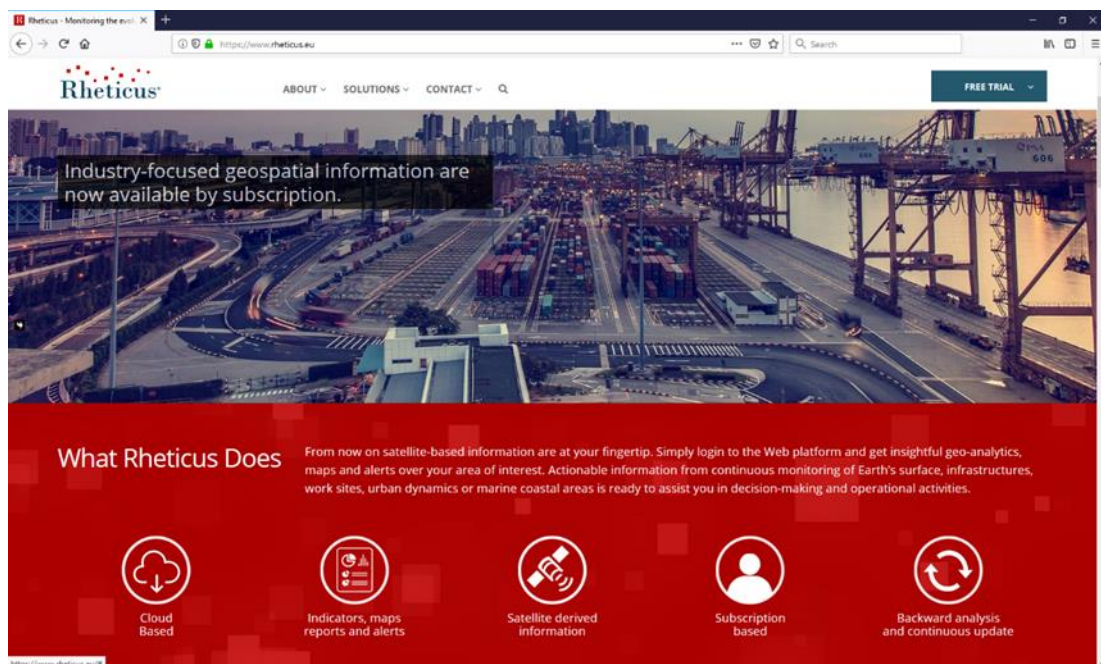


Figure 1 Rheticus® Website <https://www.rheticus.eu>

1.1. Rheticus® Key Features

The service	▶ Best cost/performance ratio thanks to the use of open data, automatic processing chains, and the adoption of a cloud architecture. ▶ Geo-information services designed to meet users' needs. ▶ Services available worldwide.
Data	▶ Use of geospatial information and open data available on the cloud. ▶ Direct online access to major satellite image providers using the best data available over the areas of interest.
Processing	▶ Automatic data processing throughout the entire production chain, ensuring timely and regular updating of geo-information services. ▶ Standardised processing procedures for high quality geo-information services.
Delivery	▶ Outputs following standard specifications and quality requirements, measurable through predefined metrics. ▶ Metadata are provided with geo-information services. ▶ Information and data are provided in standard formats for use with office automation, CAD and GIS applications. ▶ Accessible from desktop PCs, tablets and smartphones through web browsers or M2M mode.
Terms & Conditions	▶ Conditions of use and license for the data, information and services offered by the platform: https://www.rheticus.eu/wp-content/uploads/2018/05/terms_and_conditions.pdf

1.2. Rheticus® Services

Rheticus® Services	Servizi di monitoraggio satellitare e reporting periodico a supporto delle attività produttive, della salvaguardia dell'ambiente e del benessere dei cittadini
 Rheticus® DISPLACEMENT	Periodic monitoring of soil surface millimeter movements due to landslides and / or subsidence in urban and extra-urban areas with information on displacement and accelerations over time.
 Rheticus® SAFELAND	Periodic reporting service on the stability of the territory through the segmentation of wide areas and their classification based on the movement trends and anomalies detected from satellite.
 Rheticus® SAFEWAY	Periodic reporting service for monitoring and checking the stability of transportation infrastructures such as roads, railways and airports. The segmented infrastructures are classified on the basis of velocity and acceleration measured over time.
 Rheticus® NETWORKALERT	Periodic reporting service that informs about the stress level of water and sewage networks. The pipeline networks are classified on the basis of the stress level related to ground movements over time.
 Rheticus® BUILDING CHECK	Periodic reporting service on building stability, based on stress level related to ground movements over time.
 Rheticus® MARINE	Periodic monitoring of coastal seawater quality and marine resources through the measurement of parameters such as chlorophyll, turbidity, temperature and algae bloom.
 Rheticus® AQUACULTURE	Periodic monitoring and reporting of shellfish growth trends to support and optimize aquaculture activities and farm management. Insightful data are also provided to estimate the best harvesting time and the amount of production.
 Rheticus® URBAN DYNAMICS	Periodic reporting on urban dynamics for monitoring land use/cover changes caused by construction works and implementation of urban plans.
 Rheticus® WILDFIRES	High-performing geo-information service for burnt area detection, fire severity classification, vegetation regrowth monitoring and detection of illegal changes within past official burnt areas.
 Rheticus® OENOVUEW	Periodic reporting on the bio-physical parameters of vineyards to support winegrowers and/or winemaking cooperatives for the optimisation of their activities, the improvement of the productivity and quality of their vineyards through an accurate operational mapping of each plot.

2. Rheticus® Network Alert

Dynamic Water and Sewage Network Monitoring

2.1. Overview

The management of water and sewer networks is a complex and expensive task for multi-utility companies, which are in need of ensuring the correct and safe functionality of all their assets, from underground pipelines to wastewater treatment plants. Although pipes are made with long-lasting materials, often they are stressed and damaged by ground movements, alike ground stability is important for sedimentation tanks in order to guarantee efficient wastewater treatments.

Utilities spend a lot of money maintaining their networks and fighting against leakages and structural problems. Right now, companies' maintenance policies are strictly oriented to recovery their assets in case of disrupting service due to major problems. A great number of utility companies put in place activities for pipe replacement only in areas where severe subsidence phenomena reveals leaks in the pipes. Identifying ground movements before they become critical is a challenge.

Rheticus® Network Alert is a turnkey vertical web service for the continuous monitoring of instability phenomena affecting pipeline networks (water and sewage) in urban areas, caused by ground displacement (Figure 2).

Doing so, Rheticus® Network Alert indicates locations of concern and lets operators to act upon the information, simplify maintenance activities and prioritise inspection. Thus, the service allows an “a priori” approach, helping to highlight problems before they become critical. As a result, operators better manage their financial resources and reduce service disruptions and/or threats for people.

All those information are updated and delivered to utility companies with extremely intuitive Business Intelligence tools to add dynamic analysis and new features to their planning, management and maintenance activities.



Figure 2 Rheticus® Network Alert User Interface¹. Example of monitoring of buried pipelines with summary report, trend of instabilities, and filtering tools.

¹ User interface is continuously enhanced to offer a better user experience and new features.

2.2. Who is it for?

Rheticus® Network Alert is for multi-utility companies, including water and sewage, energy supply, oil&gas, in charge of the management and/or maintenance of pipeline networks: the service helps keeping up with network management, maintenance, and rehabilitation needs over time with regularly updated data and powered by BI analytics capabilities.

3. Technical Specifications

Rheticus® Network Alert provides updated levels of concern on each segment of an underground pipeline network (water and sewage, including energy supply, oil&gas), based on measurements of displacement of the network itself as well as of the nearby areas.

3.1. Activation

Once the client performs the subscription to the service and provides the extent of the Area of Interest (Aoi) together with a georeferenced vector file of the pipeline network (ESRI shapefile, KML, DWG/DXF), the service is activated over the customer's Aoi.

At service activation, the client gains access to the web platform throughout the subscription duration.

The service is available at <https://services.rheticus.eu> with the credentials provided at activation.

3.2. Operation

Once the client logs into the web platform and launches the web application, the pipeline network together with relevant analytics are loaded within a Business Intelligence (BI) dashboard.

Each segment of the network is classified accordingly to the measurements of displacement of the segment itself as well as of the nearby areas measured through satellite radar data^{2, 3, 4, 5}.

The status of each segment of the network is represented with 3 classes/colours⁶ that correspond to increasing levels of concern and inspection priority: Figure 3

- ▶ stable segments in green,
- ▶ segments to assess in yellow,
- ▶ segments to inspect in red.

² The network is classified accordingly to the measurements of velocity, acceleration and coherence of Persistent Scatterers (PS). Persistent Scatterers are highly stable points on the ground. PS are identified and their velocity/acceleration are measured through a fully automatic Multi-Temporal SAR Interferometry (MT-InSAR) processing chain based on the extensively tested SPINUA® algorithm applied on satellite radar data. Additional information on the SPINUA® algorithm is available at the following link: https://www.rheticus.eu/wp-content/uploads/2018/12/SPINUA_a_flexible_processing_chain_for_ERSENVISAT.pdf

³ Coherence is a parameter directly connected to Persistent Scatterers (PS) quality: the higher the coherence, the lower the uncertainty.

⁴ Measurements of displacement of the network and of the nearby areas are provided with a precision of ± 1.5 mm/year along the satellite's Line of Sight (LoS). The direction of measured displacement is defined by the satellite's LoS. Horizontal localization of PS is provided with a precision of ± 10 m. Data are supplied in geographic coordinate system.

⁵ The standard service exploits satellite open data provided by the Sentinel-1 constellation of the European Copernicus programme. Additional information on the Sentinel-1 constellation are available at the following link: <https://sentinel.esa.int/web/sentinel/user-guides/sentinel-1-sar/overview>

⁶ If it is not possible to classify any segment of the network, the N/A class is attributed.

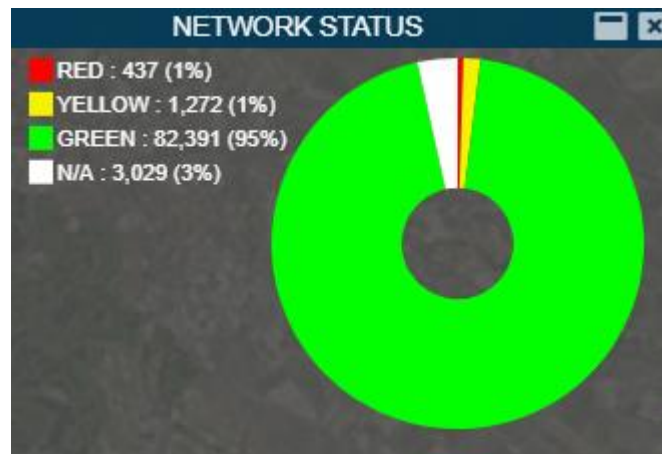


Figure 3 Number of segments by status

Each segment of the network has an Inspection Priority Score, ranging between 0 and 1. The greater Inspection Priority Score, the greater level of concern. Through a dynamic window it is possible to select a particular range of Inspection Priority Score e, as a consequence, the related segments having a score belonging to the selected range (Figure 4).

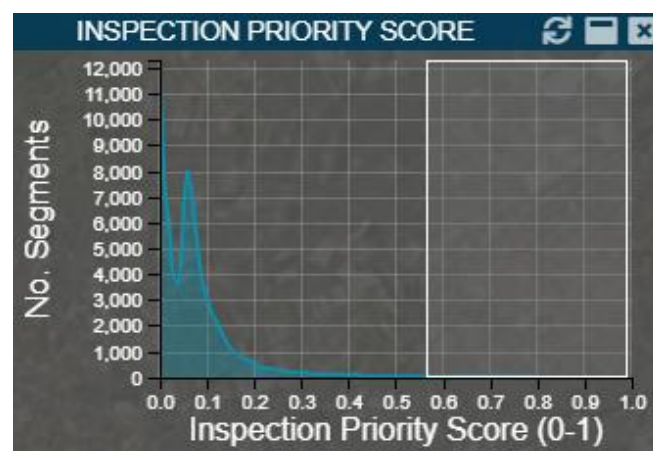


Figure 4 Inspection Priority Score associated to each and every segment of the network

Moreover, frequency of occurrence of velocity values measured over the segments are provided (Figure 5):

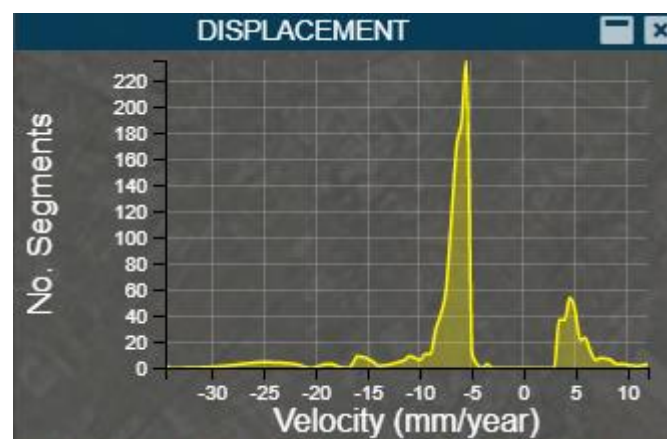


Figure 5 Frequency of occurrence of velocity values of over the segments of the network

Clicking over each segment a pop-up window shows all information related to the selected segment (Figure 6):

- ▶ Segment ID;
- ▶ Address and geographic coordinates (latitude, longitude);
- ▶ Segment Status;
- ▶ Velocity (mm/year);
- ▶ Acceleration (mm/year²);
- ▶ Distance of the critical PS from the segment (m);
- ▶ Inspection Priority Score;
- ▶ Link to analyse displacement trends of all PS in the nearby of the segment in Rheticus® Displacement (Figure 7).

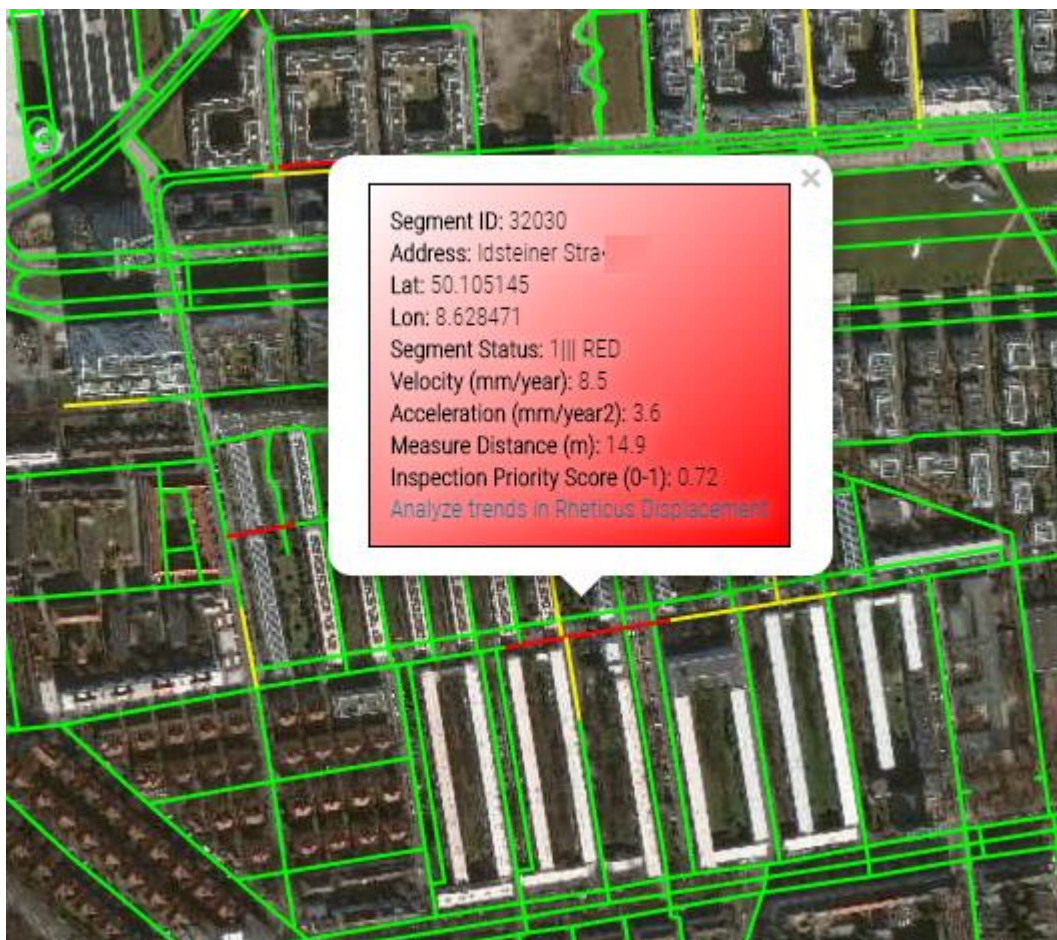


Figure 6 Details of information available in the pop-up window by clicking on each segment

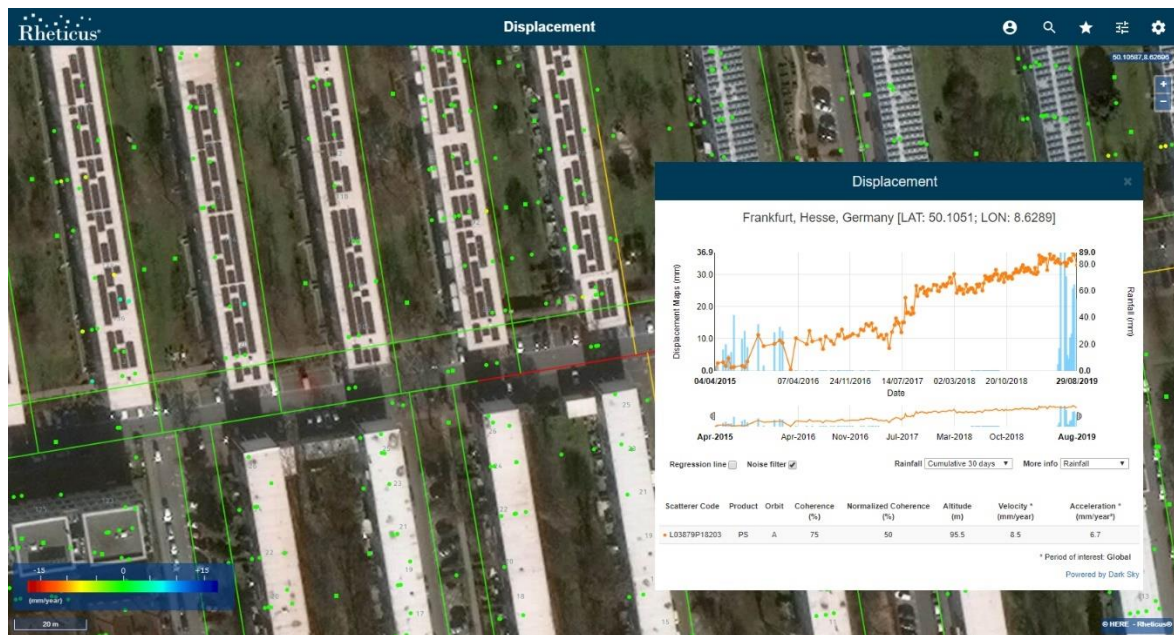


Figure 7 Integration with Rheticus® Displacement

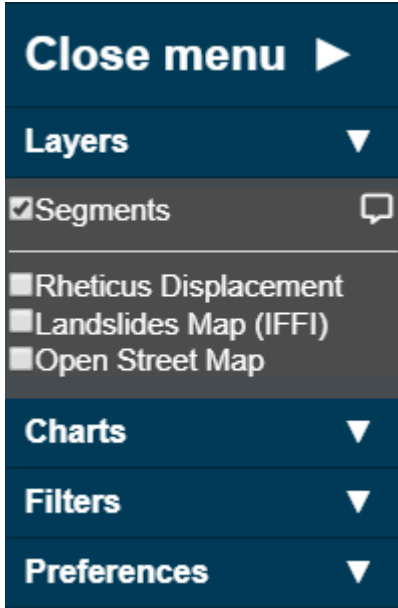
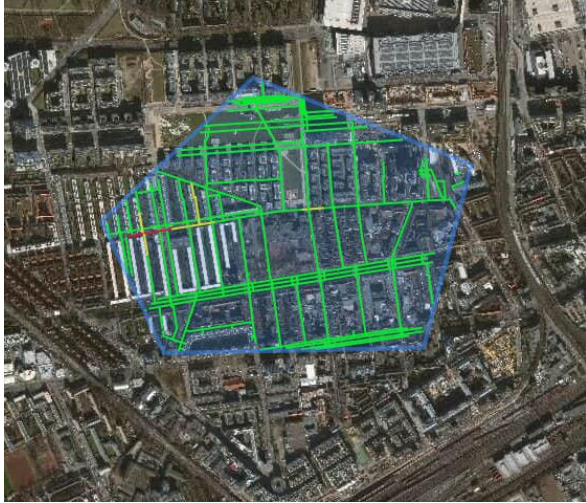
A detailed report is available on the table at the bottom left-side of the web interface, providing users with the following information: Segment ID, Address, Segment Status, Velocity (mm/year), Acceleration (mm/year²), Inspection Priority Score, Zoom-to-Feature tool, sorted by Network Status (Figure 8).

NETWORK ALERT					
Segment ID	Address	Segment Status	Velocity (mm/year)	Acceleration (mm/year ²)	Inspection Priority Score (0-1)
37696		RED	4.5	12.9	0.76
229	Weismüllerstraße	RED	-9	7.3	0.80
807	Gutleutstraße	RED	-8	3.5	0.75
808	Gutleutstraße	RED	-8	3.5	0.74
894	Am Salusbach	RED	-6.5	3.3	0.77

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Figure 8 Detailed report on the pipeline network

Through a right-side menu, it is possible to have access to a number of functionalities, described here below:

	Access to layers, analytics, filters, switch- on/off functionalities 
	Selection of a subset of the network by drawing a polygon, square, or circle on the map. 
	Swipe between layers, if any 
	Zoom- in/out, zoom extent, and scale bars

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Measurements are continuously updated. The standard service provides an update every three months. At each update, all new acquired measurements are made available. The standard service, based on the Sentinel-1 data, provides 4-year historical measurements stating from the activation date, with at least one measurements every 12 days, and with all available measurements within 2 years backwards the activation date.

For client's specific-purposes, exploitation of different satellite data (i.e. COSMO-SkyMed, TerraSAR-X, etc.) is possible.

The service is accessible as cloud service and as web service following OGC standards. It is available in Machine-to-Machine mode (M2M) via standard sharing protocols.

The service is available worldwide, and is accessible via web, 24/7, with any portable device.

4. Key Benefits

- ▶ **Regular Monitoring of Your Network Assets:** Keep up with underground pipeline network management, maintenance, and rehabilitation needs over time with regularly-updated satellite radar data powering your BI analytics capabilities.
- ▶ **Reveal Not-Yet-Visible Failures:** Quickly detect ground surface movements caused by structural defect/leaks of your collector that could affect the area above the primary network and adjacent areas.
- ▶ **Unparalleled Network Insight:** Gain reliable level of warning on each pipeline segment, simplifying maintenance activity and inspection priority.
- ▶ **No Required Expertise with GIS or Earth Observation Data:** Complex, multi-source data is geoprocessed by the application platform, which presents you with a simple and dynamic interface to easily perform analytics and derive project-specific insight.