Rheticus: Satellite-based Information Services for Utilities

by Vincenzo Massimi

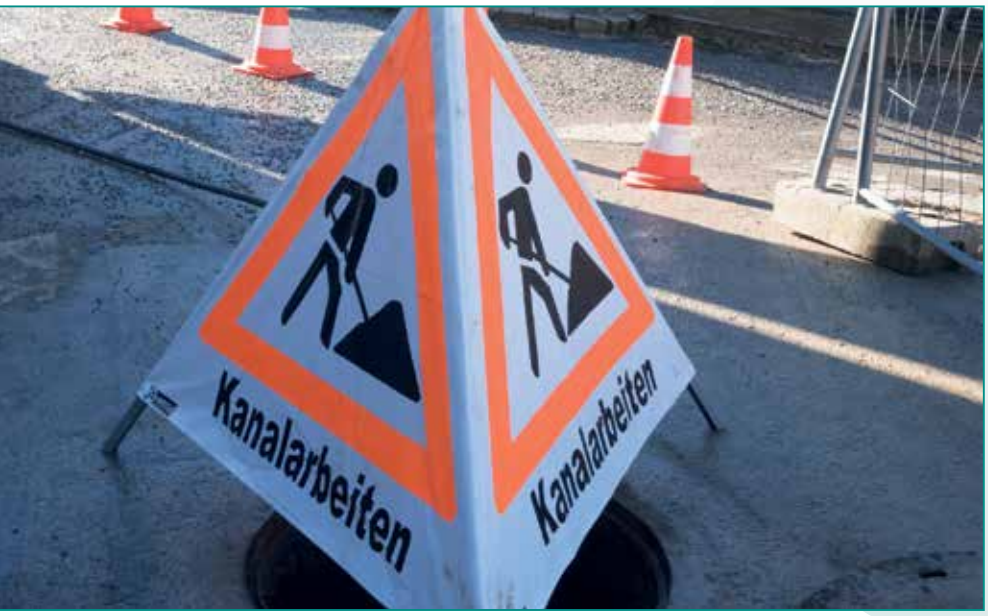

Fig. 1 - Satellite monitoring to prevent risks over water and sewer networks

Ground movements are common phenomena across Europe and worldwide. It is known that sometimes they can be quite severe, causing displacement of up to one meter over few years. Actually, movements of only few centimetres can cause damage around buried pipes and infrastructures.

Traditional campaigns for the regular monitoring of large and remote areas, however, employ considerable financial resources and time, and are often complex to implement. This is the case of utility companies, which need to manage large and distributed networks buried under the ground.
Even if pipes and underground networks are made with long-lasting materials, they are stressed and damaged by ground movements. This leads utility companies to face continually the complex and expensive task of the maintenance of underground pipelines, in order to avoid possible heavy stress conditions and, eventually, leaks in the pipes.
These leaks can then accelerate the erosion around the problem area, disrupting services and possibly creating larger problems, damage to surface facilities, properties and/or infrastructures, or exposing people to risks.
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.
The use of satellite data allows overcoming these limitations and obtaining frequent, accurate and accessible information thanks to the wide availability of spatial information, even in open data mode (e.g. Copernicus Sentinels data, INSPIRE data, etc.).
Satellite radar technology can give a good predictive indicator for where this may be occurring by measuring where the ground is subsiding around the pipelines. Radar data, when pushed through Interferometric Synthetic Aperture Radar (InSAR) analysis, can provide changes in the ground level with millimetre accuracy. The European Space Agency's Copernicus programme includes SAR data from the Sentinel-1 constellation. Thus, Sentinel-1 data can be exploited to identify with high precision where the ground starts subsiding, allowing maintenance

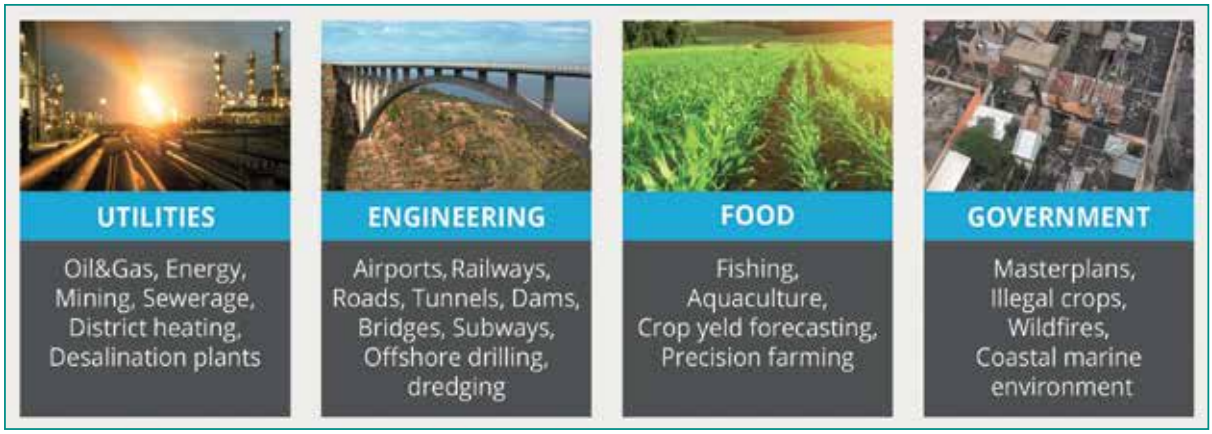

Fig. 2 - List of applications by industry of the satellite-based Rheticus services.

strategies focused on those areas under high risk, and before structural problems occur.

Copernicus Sentinels + Cloud infrastructures: the shift to Information as-a-Service

The Sentinel open data together with the power of cloud infrastructures provide players in the EO sector with the unprecedented opportunity to design operational Earth monitoring services. Shifting from the provision of data to the provision of continuous monitoring services (i.e., continuous access to information) is the key point upon which addressing real users' needs in the new Era of Big Data. Moreover, shifting from monitoring services on request to long time information services available under subscription is the real disruptive innovation in the field of EO: end-users pay for the information not for the processing.

At the forefront of this new innovative model there is Rheticus, a cloud-based hub that processes satellite imagery and geospatial data automatically, and delivers geo-information services ready-to-use by end-users. Designed and developed by Planetek Italia, Rheticus moves beyond mapping visualisation, thanks to a broad range of advanced geo-analytics. It allows end-users to gain insight into patterns not easily identified through traditional approaches to better understand the whole story that lives within data related to their assets (e.g. roads, railways, buildings, dams, mines, water supply networks and utilities), combining historical and daily/weekly satellite imagery acquisitions. Actionable information are provided by means of thematic maps, geo-analytics, pre-set reports, and alerts. Contents are dynamically displayed through an intuitive and user-friendly web dashboard, available 24/7 on any device or in Machine-to-Machine (M2M) mode directly within users' systems.

By integrating contents generated by Rheticus Platform with Hexagon Geospatial's Smart M.App technology, Planetek Italia succeeded in creating several monitoring services that provide timely solutions to address users' needs in various industries and vertical markets. Planetek released four Smart M.Apps: Rheticus Network Alert, Rheticus Bridge Alert, Rheticus Railways Alert and Rheticus Infrastructure Alert, all designed around Rheticus Displacement fuelled by radar data. These vertical services transform data into actionable knowledge thanks to our business intelligence tools, overcoming the concept of static maps.

Rheticus Network Alert: using satellite Radar data to identify ground instabilities.

Rheticus Network Alert is a turnkey web service that helps utility companies in the management of inspections and

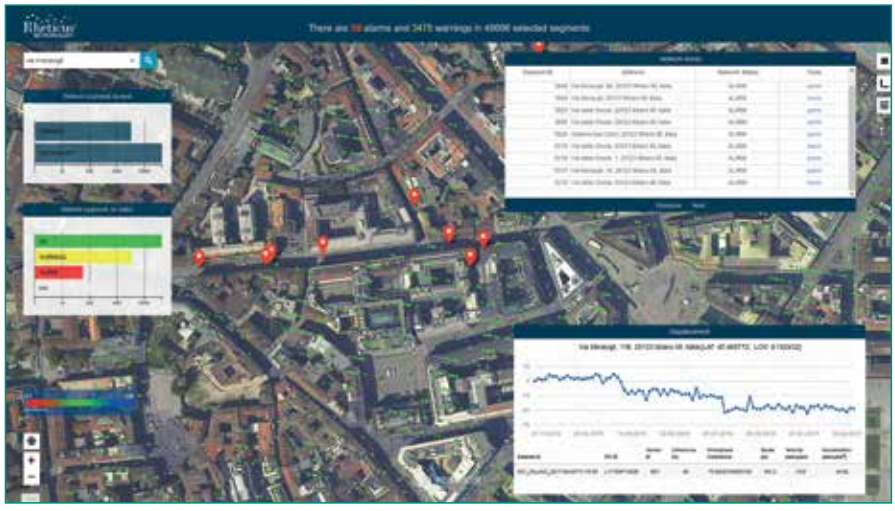

Fig. 3 - Screenshot of the Rheticus platform showing displacement monitoring over the city of Milan, Italy.

maintenance activities over their integrated water and sewerage networks. By using satellite radar data to identify ground instabilities, Rheticus Network Alert provides operators with an always updated log of hot spots within their network that can reveal leaking pipes.
Thus, network's operators can act on the information they have. The service provides all the information by means of geo-analytics, maps and reports, released on a monthly basis. Instead of replacing pipes and connectors after major leakage evidence, Rheticus Network Alert allows an '*a priori*' approach, replacing those pipes classified as possibly at risk and before larger problems occur. As a matter of fact, companies better manage their financial resources and reduce service disruptions and/or threats for people.
Among our Rheticus active users, there are some of the largest European utility companies, which generally face costs per repair ranging between 2.500,00-5.000,00 €/km. Benefits of subscribing our Rheticus services ensure a high return on investment thanks to the chance of prevent severe damages, perform focused maintenances, and avoid costs for major repairs. Those impacts on companies' financial statements were remarked also by EARSC in "*Copernicus Sentinels' Products Economic Value: A Case Study*". Benefits are even larger in areas exposed to landslides, subsidence and earthquakes.

Hera Group: exploiting satellite data to enable the preventive maintenance of pipelines

Hera, the second largest operator in Italy by volumes of water supplied (300 million cubic meters per year), has always looked with enthusiasm towards innovation, the development of new technologies and their testing. For this reason, in 2016 it was the first company in Italy to adopt a system to search of water via satellite to address the problem of hidden leaks from water networks.
Subsequently, HERA decided to start a test using Rheticus system, with the aim of providing an automatic system to exploit satellite data in order to perform complex analyses, and simplify inspection planning.
In 2017, HERA first subscribed to our Rheticus Displacement service, activated over the Province of Modena. In 2018, HERA has adopted Rheticus Network Alert and extended the area of interest, now including also the Province of Bologna, reaching more than 6,200 km of pipelines monitored from Space over an area of about 3,500 square kilometres.
Furthermore, HERA Group incorporates sophisticated equipment (e.g., smart meters, traffic-monitoring systems) together with information from citizens (e.g., distribution of relevant emergency calls) into its management processes, collecting a great amount of data related to its assets. It is not feasible to exploit all those data through traditional approaches. Artificial Intelligence is the only reasonable way to exploit them. Machine learning algorithms integrated in Rheticus Network Alert will enable to better exploit historical and real-time data, thus supporting decision-making about all relevant aspects of HERA assets, from demand forecasting to workforce capacity management, emergency planning, predictive maintenance, optimized scheduling, more accurate travel times, seasonal service patterns, and so forth.
Since HERA is in charge of a wide network covering a broad area that requires great management effort, following a proposal from HERA, Rheticus Network Alert will be increased with a specific add-on functionality: the ingestion of various information layers to achieve a predictive operational level alongside the current support on daily inspection planning and mid-term network management.
In 2017, Planetek won the "EARSC European Earth Observation Company of the Year Award", and recently received the "2018 Best Go-to Market Strategy 2018 Award" from Hexagon Geospatial, announced at the HxGN Live 2018 Conference in Las Vegas – Nevada.
Rheticus will be showcased at INTERGEO 2018 (stand: D.051 Hall: 12.1) in cooperation with the global network of Hexagon's partners. By visiting https://www.rheticus.eu, it is possible to read further information and case histories, or to start using a Free Trial DEMO.

KEYWORDS
Rheticus; network alert; satellite data; radar; copernicus sentinels; cloud infrastructures; ground instabilities

ABSTRACT
Ground movements can cause damage around buried pipes and infrastructures. Satellite radar technology can give a good predictive indicator for where this may be occurring, helping utility companies face the complex and expensive task of the maintenance of underground pipelines. Rheticus Network Alert is a turnkey cloud-based service that processes satellite imagery and geospatial data automatically to deliver geo-information services, helping utility companies in the management of inspections and maintenance activities over their integrated water and sewerage networks. Hera Group decided to start using Rheticus system over the Provinces of Modena and Bologna, Italy, with the aim of providing an automatic system to exploit satellite data in order to perform complex analyses, and simplify inspection planning.

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