

Drought Resiliency: Securing Drinking Water Supply in Northern Italy with Satellite Leak Detection

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Background

Alfa S.r.l. is the water utility that regulates and manages the water distribution system of the Province of Varese (Lombardy, Italy). Alfa S.r.l. performs continuous analyses on the flow regimes in 103 municipal areas of the above-mentioned territory, covering up to 4.303 km of pipes and assuring the water service for 565.728 inhabitants. Pressure and flow are monitored remotely thanks to the smart meters, but also with direct measurements in the field, using manometers, carried out by operating teams.

The territory covered by the Alfa S.r.l. network is extremely heterogenous. The south is characterized mainly by flat lands, whereas the north is mainly mountainous. Consequently, sources of water supply in the territory vary respectively with its geography: in the south, water is supplied by 302 wells, while in the north, water comes from about 360 natural springs. These differences have direct implications on the availability of potable water in the network, depending on the weather conditions. While in the south, the water available in wells is basically constant throughout the year,

regardless of the rainfall regime, in the north of the territory, protracted drought conditions and the absence of snow have immediate effects on the water availability at the springs.

Most of water pipes in the Alfa S.r.l. distribution network were placed in the early 40s-50s, so they are now nearing their designed lifespans, and fragile. Damages to water pipes occur frequently in the network due to pipe age and a pressure regime beyond what was originally intended for due to the increase in end-users served by the network. This causes many leakages in the network that are often quiet or hidden.



Technology

ASTERRA uses remote earth observation L-Band Synthetic Aperture Radar (SAR) imagery to identify likely leak locations. The satellite image is taken by means of microwave illumination of the area of interest and collection of backscatter pulses for analysis. Once the satellite image is obtained, it is overlaid with the water pipe network GIS and the pipes where water leaks were detected are highlighted. Data from satellite images are provided to the customer as part of a subscription based service.

Drought

In 2022, Italy was affected by severe drought conditions that caused water scarcity problems in most of the national territory. In the Lombardy region, the emergency conditions related to water scarcity were officially declared by the President of the Region on the 24th of June 2022, via the official document O.P.G.R. n. 917, imposing restrictions in water supply to all the municipalities served by Alfa S.r.l. During the summer period, springs were emptied in the north of the territory, and water was transported from the southern towns with tankers.

Unfortunately, drought emergency conditions are still ongoing, and the situation foreseen for the 2023 summer period is not better than what occurred in 2022.

Considering that, saving potable water has become of utmost importance.

Therefore, the detection of quiet leaks in the water distribution network is one of the primary tasks for Alfa S.r.l. Besides the operational duties carried out by the operative teams of Alfa S.r.l., that go into the field with specific tools and instruments to detect quiet leakages following pipes tracks,

the collaboration with 2f Water Venture (ASTERRA's official partner in Italy) and ASTERRA represented a meaningful step for detecting such leaks by utilizing techniques based on remote sensing analysis.

Service

The 2f Water Venture and ASTERRA contract also includes leak detection services in the field to identify quiet leaks, in addition to the points of interest provided by the remote sensing analysis. Operational teams are specifically directed to the points of interest so they can focus the attention on narrow areas of the network and concentrate their leak detection efforts. Alfa S.r.l. can then deploy its operating teams in the other critical areas.

The collaboration of Alfa S.r.l. with 2f Water Venture and ASTERRA has accelerated the process of leak detection and repair, increasing the efficiency of the water distribution network and reducing water losses. Satellite leak detection in areas affected by drought is "of great benefit because it reduces

the amount of water required by the system to maintain the minimum pressure in the network to assure the proper service offered by the water utility."

The collaboration between Alfa S.r.l., 2f Water Venture, and ASTERRA began in 2022 with a first satellite analysis carried out on most of the territory of Alfa S.r.l., that covered 4.119,9 km of

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pipes, corresponding to approximately 95.7% of the entire network (Figure 1). 433 leaks were detected from the satellite imaging analysis,

Figure 1. (left) Territory of the Province of Varese covered in the first service of the project of leak detection via satellite analysis in collaboration with 2f Water Venture, ASTERRA, and Alfa S.r.l.

the vast majority of these being non-surfacing leaks. The collaboration continued in 2023 with a second service to analyse the territories not included in the first service, namely the municipalities of Caronno and Saronno, as well as to re-analyze the most critical areas in the north of the territory served by Alfa S.r.l., where the largest number of leaks were detected within the first service. The new service covered up to 1,000 km of pipe, resulting in 250 new points of interest.

Figure 2 shows three examples of quiet leaks detected in the water distribution network managed by Alfa S.r.l. using the satellite and raster analysis in collaboration with 2f Water Venture and ASTERRA. The amount of water loss in these leaks can be considerable, highlighting even more the utility of this collaboration in response to the drought conditions affecting the territory.

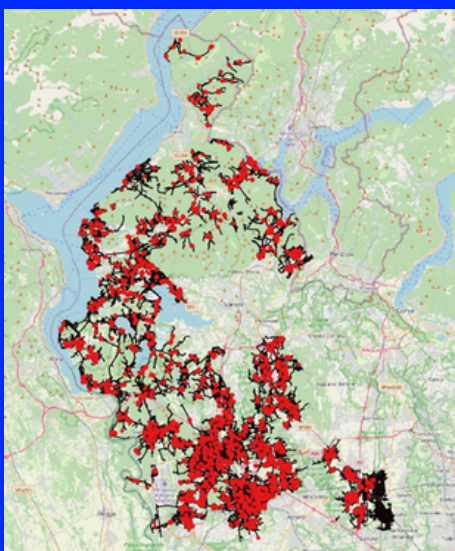




Figure 2 (above). Examples of quiet leaks in the water distribution network in the territory managed by Alfa S.r.l. detected via satellite analysis in collaboration with 2f Water Venture and ASTERRA.



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