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POTABLE WATER LEAK DETECTION BASED ON L-BAND SAR TECHNOLOGY

Abstract

In the US alone, an estimated 6 billion gallons of treated water is lost to leaks each day (2021 ASCE Report Card for America's Infrastructure). Water is an already limited resource, and its loss wastes both manpower and energy, two highly valuable resources. Today's methods of pipe replacement and leak mitigation are often times inefficient because leak detection teams will physically scan an entire network over years to find, on average, 1.3 leaks per day. This slow method leads to immense water loss over time. In order to diminish water loss there is a need for a more efficient, effective, and pinpointed leak detection method. This has been achieved by ASTERRA using L-Band polarimetric SAR (JAXA's ALOS-2 PALSAR-2 CONAE's SAOCOM-1A 1B) technology for leak detection. L-Band SAR has unique penetration capabilities and is highly sensitive to the dielectric constant, which is directly correlated with salinity levels. The penetration depth of SAR is affected by several properties, the principle of which is wave frequency, where the smaller the frequency the deeper the penetration. L-Band has a frequency of 1-2 GHz and can penetrate up to several meters in ideal conditions. The leak detection algorithm relies on this penetration to see below the surface and identify leaks that have not yet surfaced. The frequency of L-Band SAR is also able to discern between salinity levels, which allows for differentiation between types of water (potable, sewage, seawater, groundwater). ASTERRA's leak detection algorithm was built on the basis of this sensitivity and using empirical data collected in correlation with L-Band SAR satellite imagery. By analyzing the different backscatter patterns and values which correlate with the dielectric constant and salinity in the vicinity of a pipe system, the algorithm is able to pinpoint pipe segments that have leakages. Leak detection crews can then go directly to the leaks and repair, which saves water, money, and manpower. Between 2017 and 2021, the leak detection algorithm saved approximately 17 million m3 of water, with equates to 21,800 mwh of energy saves yearly.