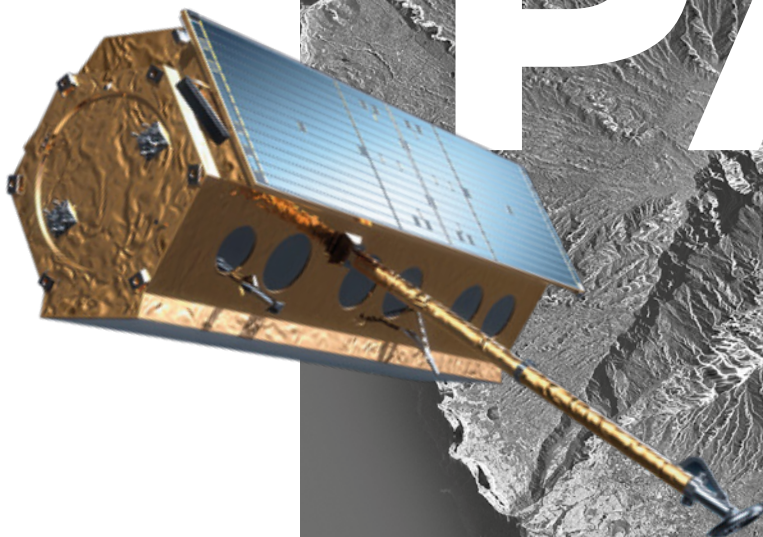


PAZ

SATELLITE

IMAGES AND SERVICES



Tajogaite volcanic eruption on La Palma island, Spain

Acquisition date and time: October 19, 2021, 07:06:50 UTC

Mission: PAZ-1 | Image mode: StripMap (3 m)

Polarization: VV | Incidence angle: 49.15°

PAZ satellite image © Hisdesat Servicios Estratégicos S.A. 2021

About Hisdesat

Hisdesat was founded in 2001 in Spain as an operator of government satellites. The company's mission is to provide satellite services in the fields of defense, security, intelligence, and other civil applications. Hisdesat offers communications services in the X, Mil-Ka and UHF bands, as well as Earth Observation in X band by means of a radar satellite.

Hisdesat is based on a public/private model of collaboration with the Ministry of Defense. Hisdesat's stakeholders include other key companies in the Spanish space sector, such as Hispasat, Airbus Defence & Space, Indra, and Sener, as well as public participation.

Unique satellite operator

Hisdesat is a unique operator offering services in several areas:

- Secure communications with its XTAR-EUR and SpainSat satellites, together with its new generation SpainSat NG satellites (I and II), which are soon to be launched
- Earth Observation, with its PAZ-1 satellite
- Satellite AIS services for maritime surveillance through agreements with Spire
- Monitoring of objects in orbit and Galileo navigation program



PAZ Mission

PAZ (Spanish word for “peace”) is the first Spanish Earth Observation radar imaging satellite with day and night and all-weather capability.

Hisdesat, the owner of PAZ satellite, is also responsible for its operation and the commercialization of services.

PAZ was launched on February 22, 2018 from the Vandenberg Space Force Base (California) on-board of a Falcon 9 rocket.

On September 6, 2018 it was commissioned and has delivered an average of 33 images a day to the Spanish Ministry of Defense since then. The rest of its capacity, up to 100 images, is commercialized to other Spanish and European institutional users. The Ministry of Transport, Mobility, and Urban Agenda, EMSA, SatCen, FRONTEX, ESA, and Copernicus are some of the clients of PAZ from 25 different countries.



Characteristics

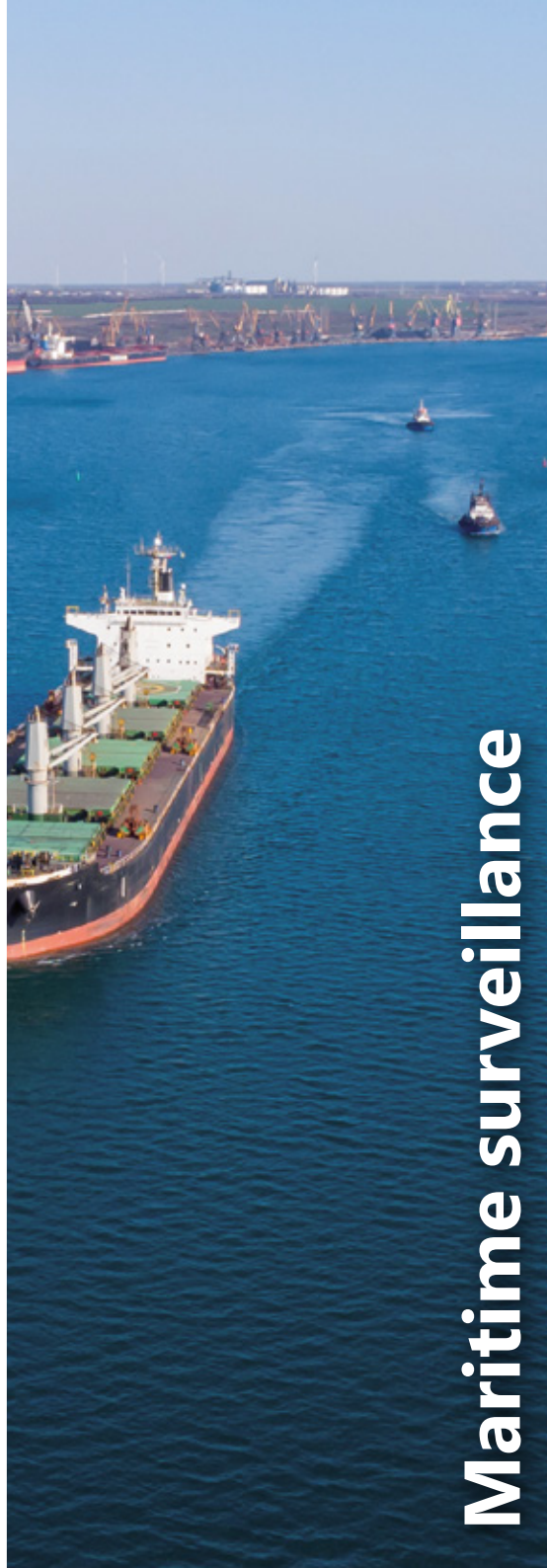
- PAZ is in a polar orbit at an altitude of 514 km, with a repeat cycle of 11 days (reduced to 4 or 7 days when working in Constellation).
- PAZ features very-high-performance X-band Synthetic Aperture Radar (SAR) with imagery resolution down to 25 cm, radiometry with a very low noise level (very low NESZ), and sub-metric geolocation error. In addition, it has a reliable interferometric capability for ground deformation measurements and change monitoring.
- Thanks to the versatility of its electronically steerable antenna, PAZ offers a great variety of image modes, allowing for everything from small and detailed images for intelligence applications, to very large images with lower spatial resolution for maritime surveillance.
- PAZ is the first Earth Observation satellite to include an AIS (Automatic Identification System) receiver on board, useful for maritime traffic monitoring applications.

	Staring SpotLight	SpotLight/HR SpotLight	StripMap	ScanSAR	WS ScanSAR	
	4 km x 4 km	10 km x 10 km/ 5-10 km x 5 km	30 km x 50 km	100 km x 150 km	270 km x 200 km	IMAGE SIZE
RESOLUTION	25 cm	1-2 m	3 m	18,5 m	40 m	

DOMAINS



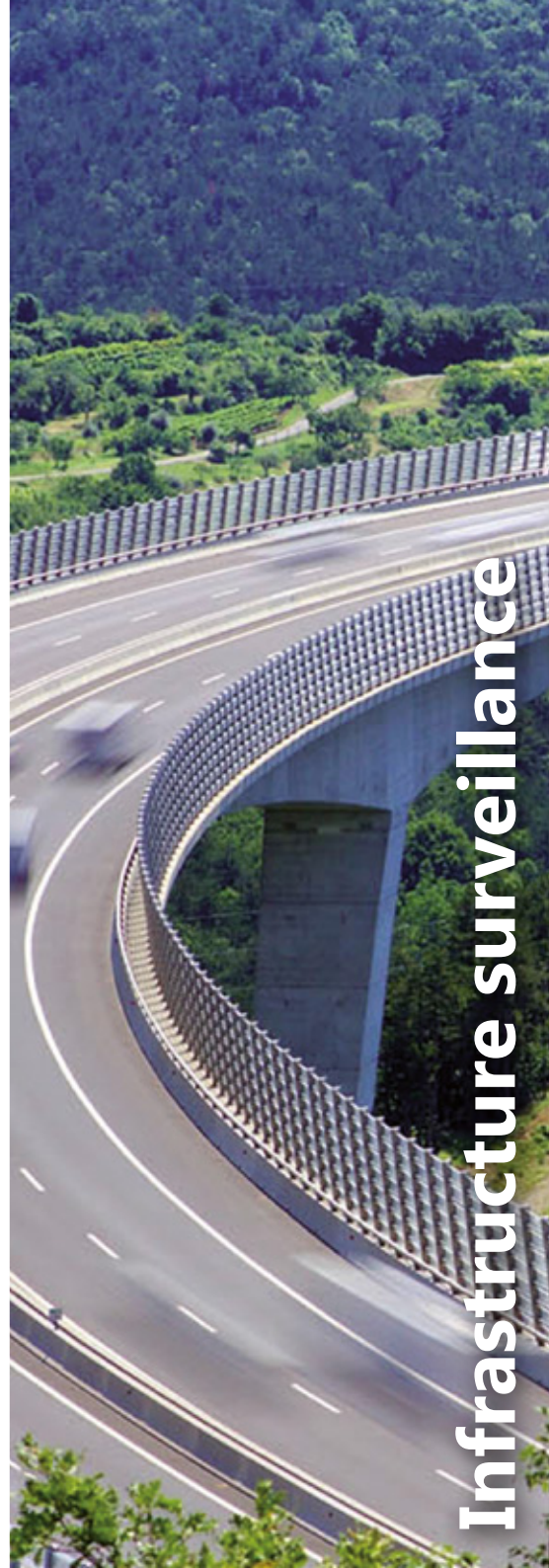
Defense and Security



Maritime surveillance



Risk and emergency management



Infrastructure surveillance



Environmental surveillance

Coherence image of Madama (Niger)

PAZ's interferometric ability allows coherence-based change detection from images taken on different dates.

Coherence is very sensitive to changes such as soil movement, accumulation of new materials, arrival or removal of vehicles, canopy, etc. In fact, it is so sensitive that it makes it possible to detect whether a vehicle has travelled over a track.



In this coherence image, tire marks can be seen in black that show the passage of vehicles on a track in the desert between two dates.

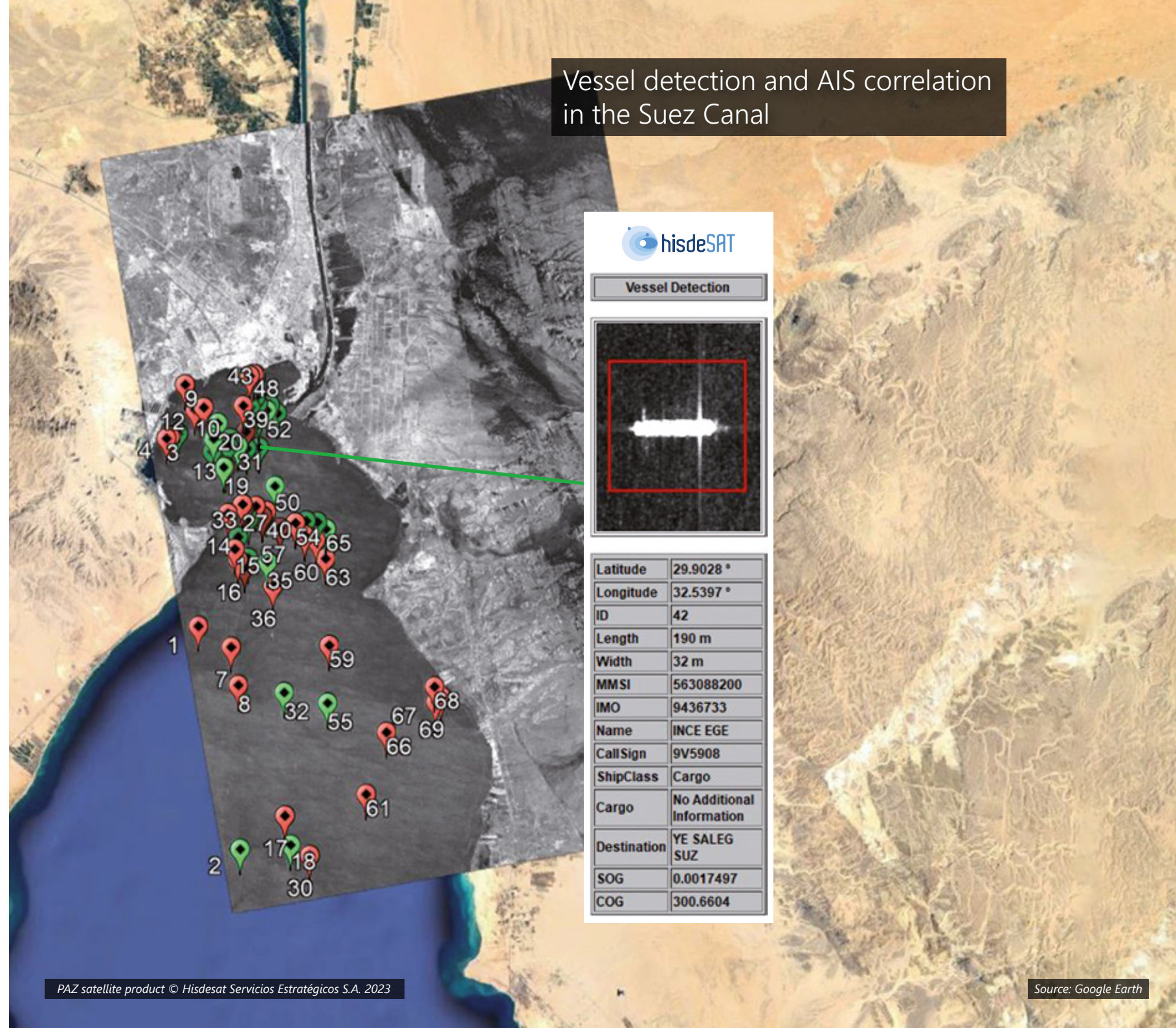
This is an active Flow Monitoring Point (FMP) from Niger to Libya. It is an alternative route for migration to cross to the Libyan border, located in the Agadez Region, passing through non-paved tracks that avoids border checkpoints.

Product generated from two PAZ SpotLight (SL) images acquired on January 5 and 16, 2020.

Radar images make it possible to detect the presence of vessels at sea. By adding satellite AIS information, it is also possible to detect which vessels have AIS turned off ("dark vessels"), which can be an indicator of potential illegal activities such as smuggling, human trafficking, illegal fishing, underwater pillaging, etc.

Hisdesat offers an operational service for the detection of vessels through radar images combined with AIS data. The service allows for recurring monitoring of large areas, such as an EEZ (Exclusive Economic Zone) or areas on demand with short notice. This service allows one to strengthen sovereignty over jurisdictional waters and improve the efficiency of traditional resources such as planes and patrol boats.

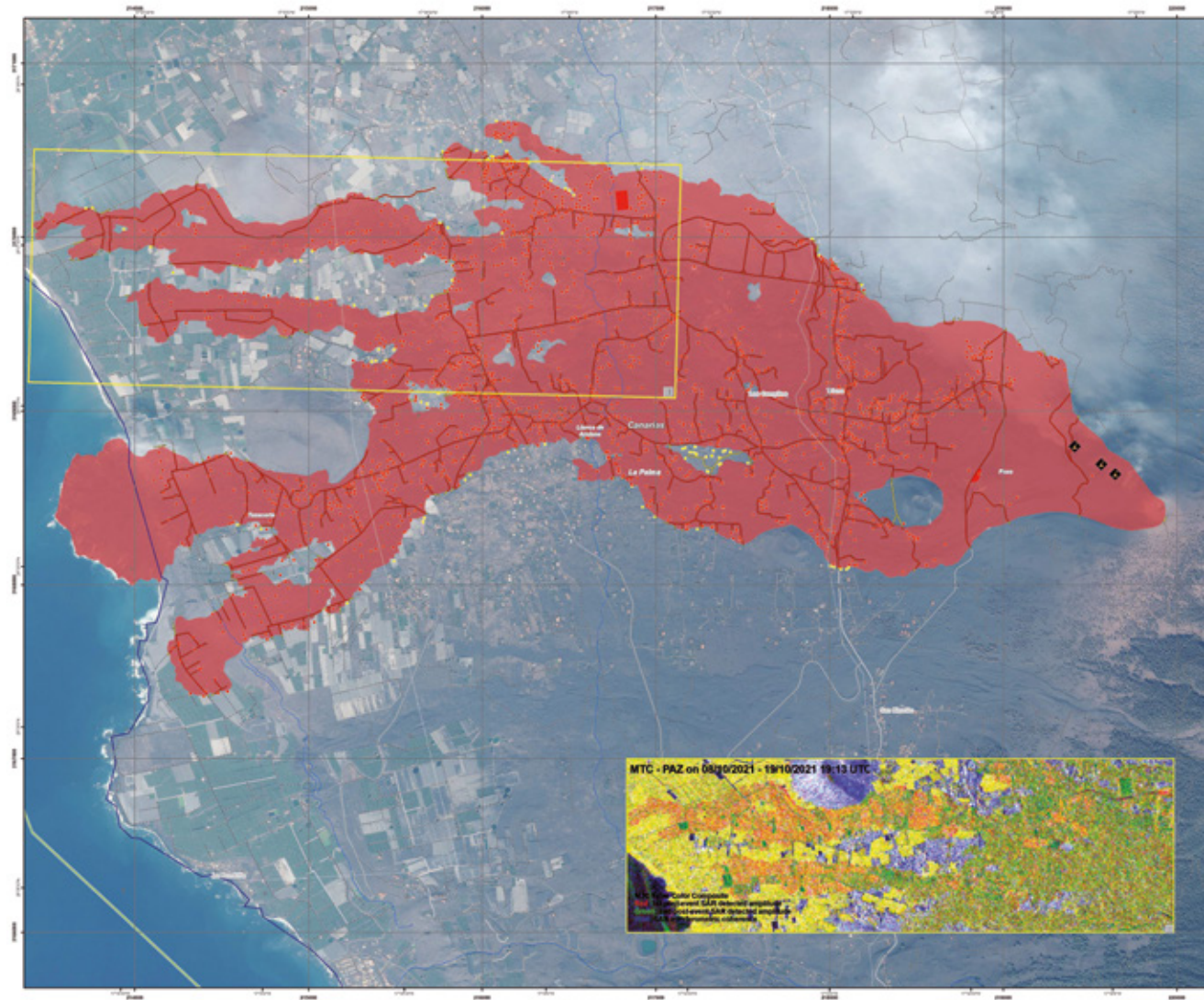
Vessel detection and AIS correlation in the Suez Canal



All the vessels detected in this PAZ StripMap image from April 12, 2023 have been marked. In green are those vessels that correlate with AIS data and in red are those without AIS data. For the vessels in green, detailed information is available such as length, MMSI, IMO number, name, type, destination, etc. – all based on AIS data. The beam and length of the vessels in red are available (based on the radar image only).

On September 19, 2021, the Tajogaite volcano erupted on La Palma island in Spain (initially known as the “Cumbre Vieja” volcano). From the beginning of that eruption, Hisdesat made all the PAZ images of the area available to the Spanish National Geographic Institute and the Copernicus Programme.

These images contributed throughout the emergency to measuring the ground deformation and monitoring the extent of the successive lava flows and their impact.



Monitoring of lava flow

Map prepared by the Copernicus Emergency Management Service (EMS) to assess the damage that occurred in the area. In red, we can see the lava flow status as of October 19 at 19:13 UTC, when many roads and buildings had already been buried by the lava. The PAZ satellite helped assess the damage in the area.

This product is the first official use of PAZ in the Copernicus Programme of the European Union. Since that time, and through a contract with the European Space Agency (ESA), the PAZ satellite has been used regularly in said program for emergencies, polar ice monitoring, and security applications.

Map courtesy of Copernicus

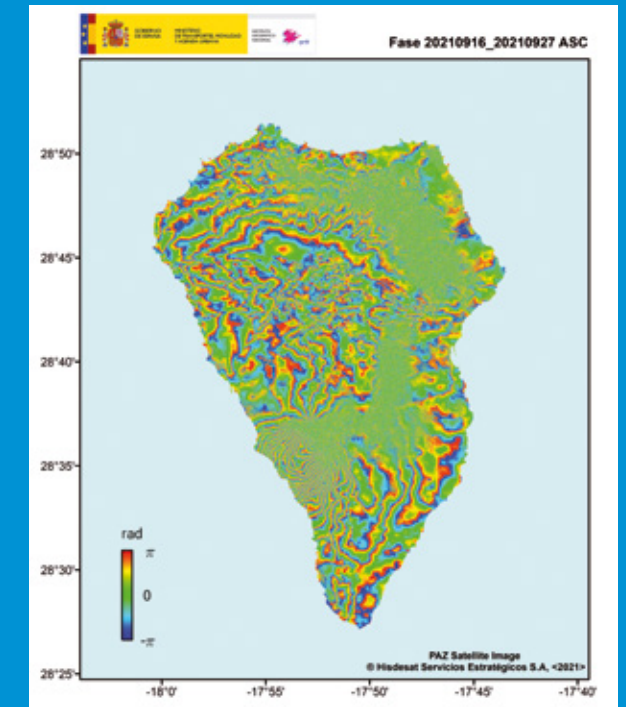


Ground deformation monitoring

Interferogram of La Palma island generated by the Spanish National Geographic Institute (IGN), using phase information from two PAZ StripMap images from 16 and 27 September 2021.

Through this interferogram, ground deformation of more than 20 cm was measured in the area close to the eruptive centers. These results allow determining characteristics such as the depth or the orientation of the dike that gave rise to the eruption – very important parameters for the characterization of the volcanic system.

Interferogram courtesy of IGN



Turkey and Syria earthquake

Based on PAZ images, it is possible to generate change detection maps between two dates. These are multi-temporal maps, which are widely used in defense and security applications and in emergencies – both during the disaster and recovery phases.

Multi-temporal product (MT)
■ Date 1: PAZ ST 2023-02-11
■ Date 2: PAZ ST 2023-03-16
□ No changes



This multi-temporal product shows the area of Antakya (Hatay Province, Turkey) affected by the earthquake that occurred on February 6, 2023. Changes can be observed associated with the establishment of emergency camps in the city.

This map is based on two PAZ Staring SpotLight (ST) images acquired on February 11 and March 16. In cyan blue temporary accommodation buildings for those affected by the earthquake are shown, while in white appear the buildings that remain unchanged.

Flood in Sicily

Based on PAZ images, it is possible to delineate the areas affected during a flood. This is due to the radar's ability to see-through the clouds during the emergency itself and detect areas covered by water. PAZ images are frequently used by the Copernicus Emergency Management Service (EMS) for this purpose.

In this example, based on a PAZ StripMap (SM) image, the area affected by the flooding that happened in Cuccumella (Sicily) on February 9, 2023 has been delineated. Thanks to this product, it is possible to quickly assess damages.

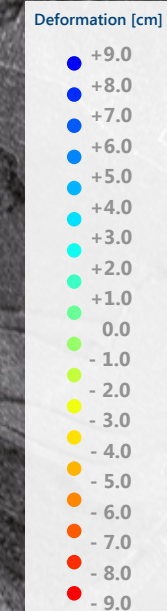
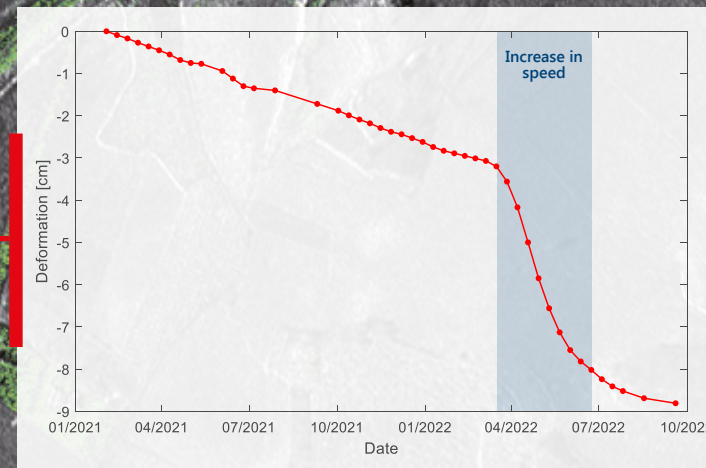
Flooded area based on Copernicus EMS

Ground deformation measurement

PAZ satellite images are widely used to monitor ground deformation processes in the mining, oil & gas, construction, and infrastructure maintenance sectors.

The monitoring of these processes, carried out using InSAR (Interferometric Synthetic Aperture Radar) technology, is key to ensuring the safety of people and infrastructures.

PAZ's interferometric ability, together with the very high quality of its images, allows high-resolution studies to be carried out, which are highly valued by infrastructure operators.



Study of ground movements in a section of the A-33 motorway in Valencia, carried out by Hisdesat for the Spanish National Public Works Research Centre (CEDEX), an organization that is affiliated with the Ministry of Transport, Mobility, and Urban Agenda. The project falls within the framework of an agreement that the Directorate-General for Roads has with CEDEX.

For the study, a series of very high-resolution PAZ images (pixels measuring 1 m²) were used, which made it possible to measure the ground deformation movements and facilitate an accurate diagnosis in order to take the appropriate measures for the road's maintenance.

An extract of the deformations detected is shown on this PAZ product.

Sanlúcar la Mayor Solar Plant (Seville), Spain

Acquisition date and time: March 7, 2023, 18:15:03 UTC

Mission: PAZ-1 | Image mode: Staring SpotLight (25 cm)

Polarization: HH | Angle of incidence: 30.26°

PAZ satellite image © Hisdesat Servicios Estratégicos S.A. 2023



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