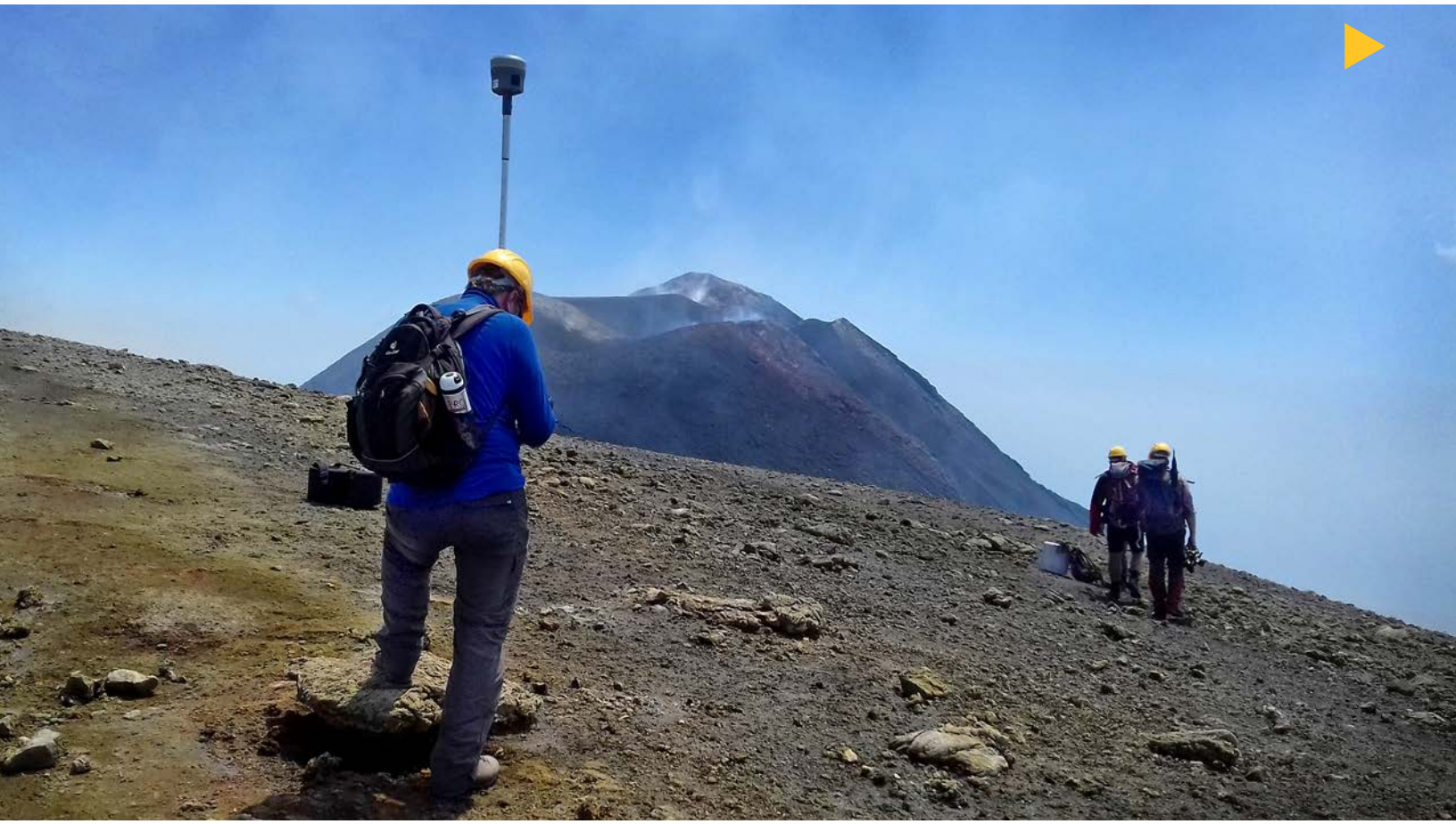
CASE STUDY | JANUARY 2019

Tracking Mount Etna's Magma



Precise GNSS helps researchers understand the behavior of active volcanoes.

Trimble positioning services provide accurate location data in challenging and remote locations.

Solution

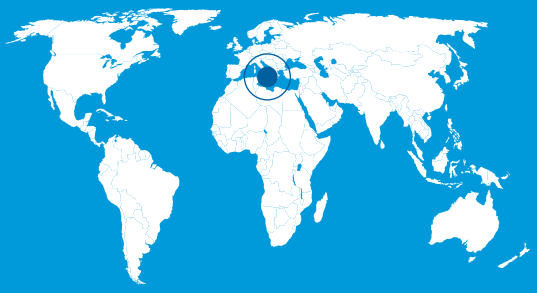
Trimble CenterPoint® RTX Correction Service

Trimble R10 GNSS Receiver

Trimble Business Center Software

overview

Italy's Mount Etna is one of the world's most active volcanoes. Located on the east coast of Sicily, the mountain's location and frequent eruptions make it a popular destination for tourists and scientists. By developing methods to understand the movement of magma within the mountain, researchers look to improve their ability to predict volcanic unrest or eruption. The work requires accurate GNSS positioning in difficult— and sometimes dangerous—environments.



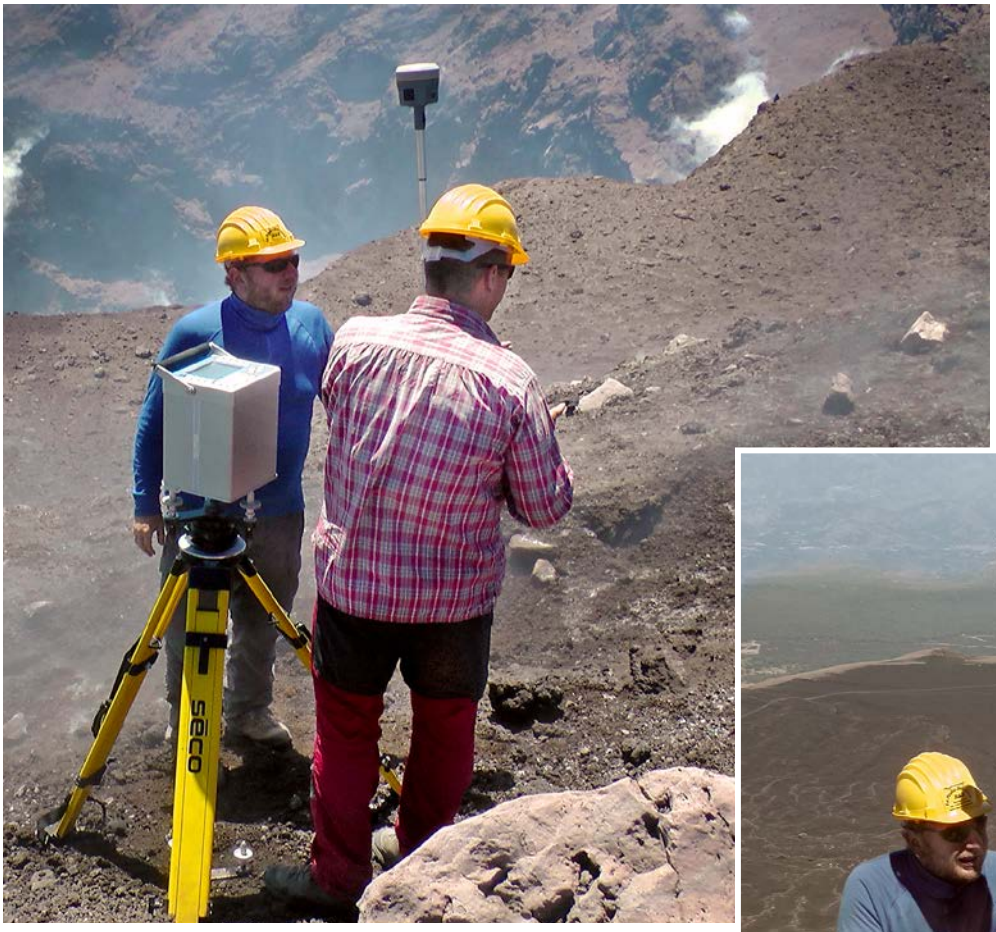
Location
ITALY

Studying Mount Etna is rugged work. In addition to high altitude and steep terrain, research teams face spewing smoke and gases, unstable ground and explosive eruptions of ash and lava. However, a team of researchers from Slovakia views Mount Etna as a laboratory to measure and analyze the movement of magma inside the mountain.

Geophysicists Peter Vajda and Pavol Zahorec of the Earth Science Institute of the Slovak Academy of Sciences teamed up with colleagues from the Osservatorio Etneo of the Italian National Institute for Geophysics and Volcanology (INGV) in Catania to set out for a field campaign measuring vertical gradients of gravity on the slopes of Etna and in the volcano's summit craters area. This work serves verification purposes for their devised improvements in the methodology of interpreting spatiotemporal gravity changes in volcanic areas, which are indicative of magma movements and magma state changes and thus help understanding the volcanoes better and contribute to forecasting volcanic hazards. For team member Juraj Papčo, a geodesist at the Slovak University of Technology in Bratislava, the gravimetry called for high-accuracy GNSS positioning. He was especially interested in achieving accurate height measurements. While Mount Etna is surrounded by geodetic control points, conducting real-time GNSS observations was challenging. Inconsistent cellular service made connection to Italy's real-time GNSS network difficult and constraints on radio licensing ruled out conventional RTK. To ensure reliable GNSS performance, Papčo turned to the Trimble CenterPoint® RTX correction service.

HIGH-ACCURACY ELEVATIONS IN REAL TIME

Working with colleagues from INGV, Papčo conducted inital measurements on 10 existing profile points using a Trimble R10 GNSS receiver and CenterPoint RTX and then measured a number of sites on the mountain, including a trip to the summit. "There was a lot of gas, dust and loose rock," he said. "In many places it was quite dangerous and scary"



Researchers use Trimble GNSS to locate aerial photo targets and gravimetry points.

Papčo used CenterPoint RTX to capture data at 17 locations where gravity data was collected. At each gravity point, he measured additional ground points to provide check data for the elevation models. "Using RTX corrections was very exciting," Papčo said. "On many points, especially the higher part of the volcano, Internet signals were poor or none at all. Only by using RTX were we able to collect real-time data."

For each profile and gravity point, Papčo collected real-time positions as well as roughly 25 minutes of static observation. He processed the static data using Trimble Business Center software (TBC) and compared the results with Trimble RTX and previous measurements by INGV. Data collected using CenterPoint RTX produced vertical accuracy of four to five cm." The accuracy was very good," Papčo said. He also imported and processed aerial imagery using the UASMaster module in TBC. The ability to process all the aerial and ground data in one software provided an added benefit and Papčo said making transformations and classification of points was smooth.

DEEPER KNOWLEDGE

The project teams used existing aerial imagery to identify the areas where they wanted to measure VGG. They then used Trimble RTX to navigate to the locations before collecting real-time and static data on the points. "Without RTX, it would have been very difficult

and complicated to navigate to the desired points," Papčo said.

The work on Mount Etna is helping scientists understand how surface deformations and gravity changes indicate the magma redistribution. It is providing tools to better predict and characterize volcanic unrest or eruption activity.

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"We had a very good experience with Trimble CenterPoint RTX. It performed well in higher elevations and in difficult conditions."

— Dr. Juraj Papčo, Department of Theoretical Geodesy, Slovak Technical University, Bratislavia

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