Determination of long-term post-seismic ground movements in L'Aquila (Italy) after the earthquake of 2009

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ID: 1c1798

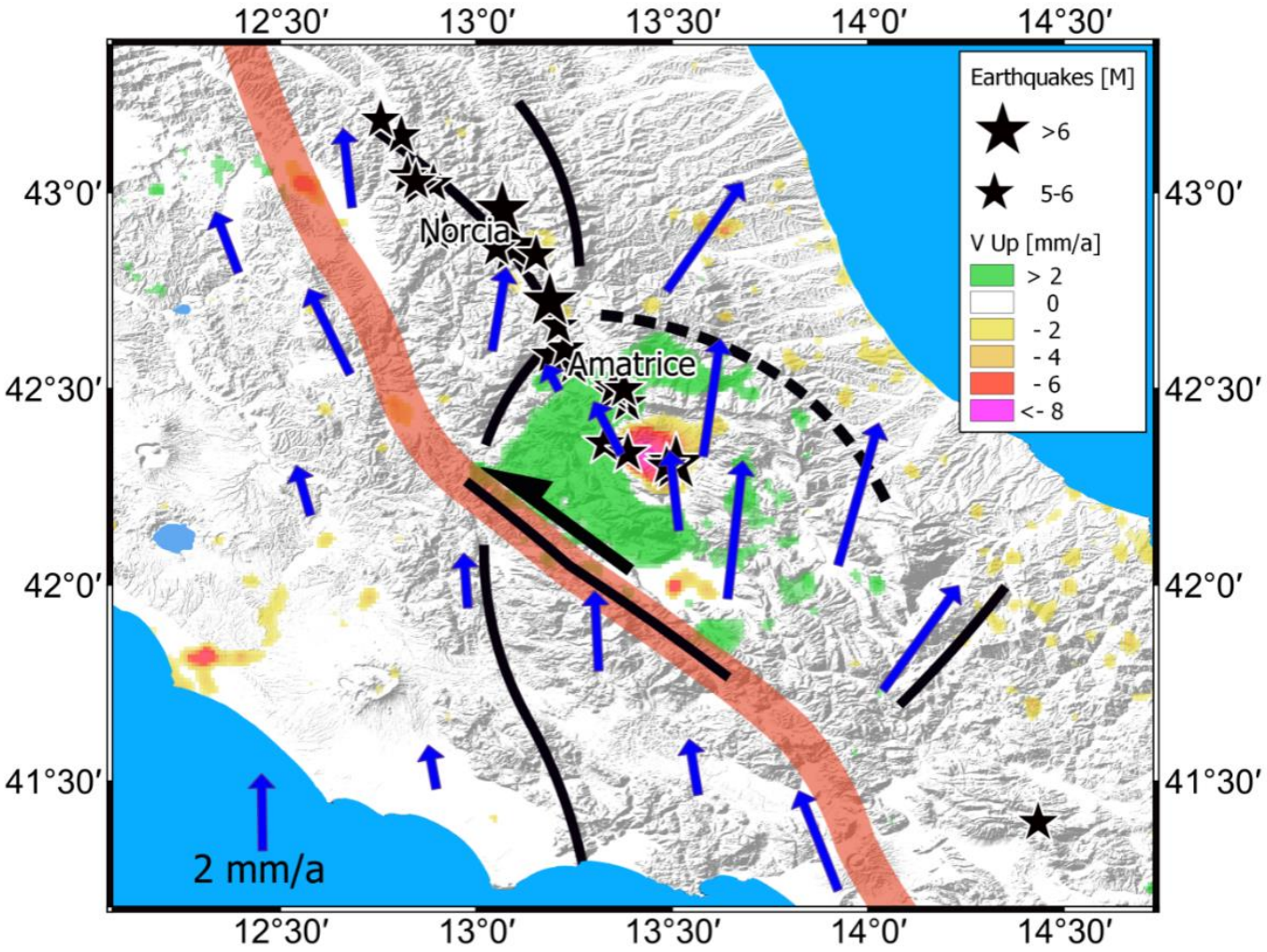
Objectives: The aim of our project is to investigate post-earthquake movements to understand the evolution of the fault system.

Methodology: We used SLC (Level-1) Sentinel-1A and B images processed by P-SBAS (Parallel Small BAseline Subset) approach to detect terrain movements calibrated and integrated to the displacements detected by GNSS permanent stations.

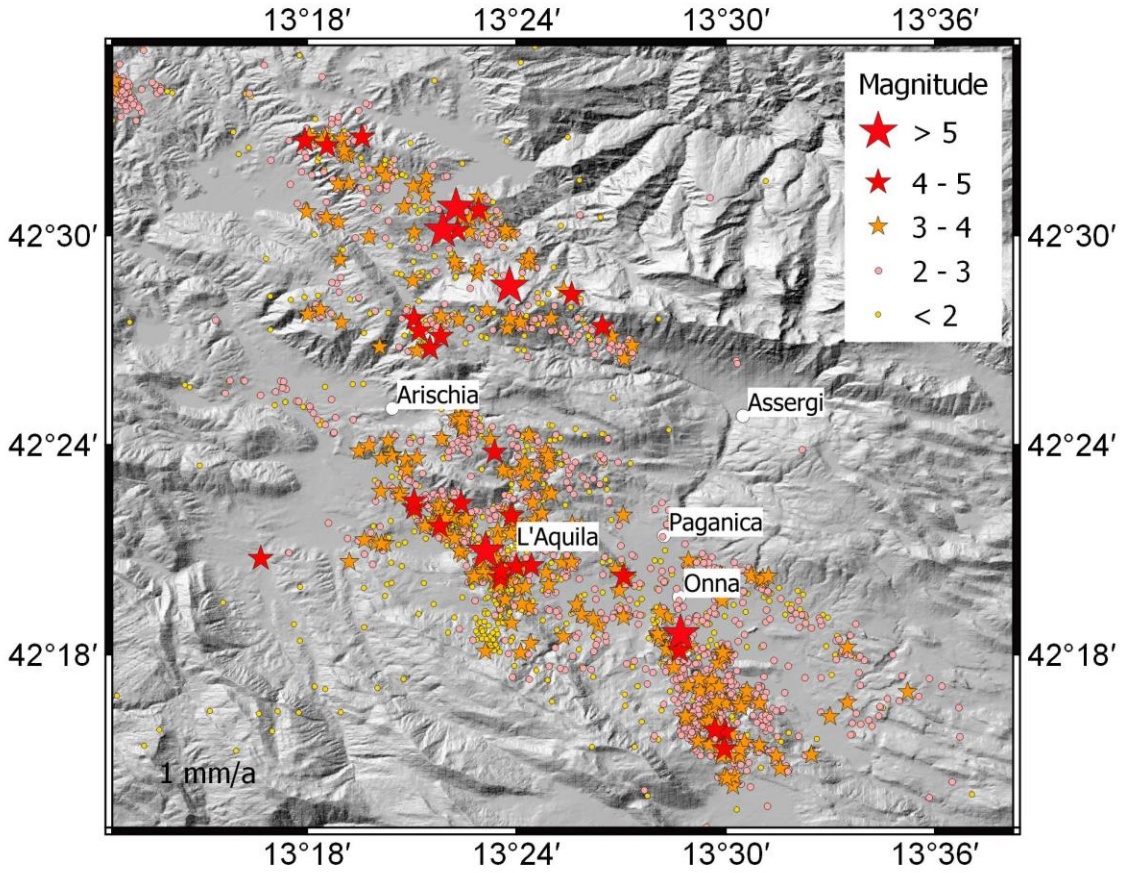
Study area: The study area is characterized by vertical movements in both lowering and lifting that go from -2 mm/a up to 5 mm/a. The research will provide unique and important geophysical information concerning the dynamic of the fault system after the earthquake of 2009.

Geological setting

- Map of the dynamics of Central Italy and the main earthquakes that have occurred in recent years [1990-2017]. The red line identifies the Moho deep discontinuities, the black lines mark the discontinuities, and the blue arrows represent the main horizontal velocity trends derived by GNSS stations and represented with respect to the Eurasian reference frame(ETRS89). The background colours represent the vertical displacements.
- *Source: Farolfi G. et al," Fusion of GNSS and satellite radar interferometry: Determination of 3D fine-scale map of present-day surface displacements in Italy as expressions of geodynamic processes." Remote Sensing 11.4 (2019).*

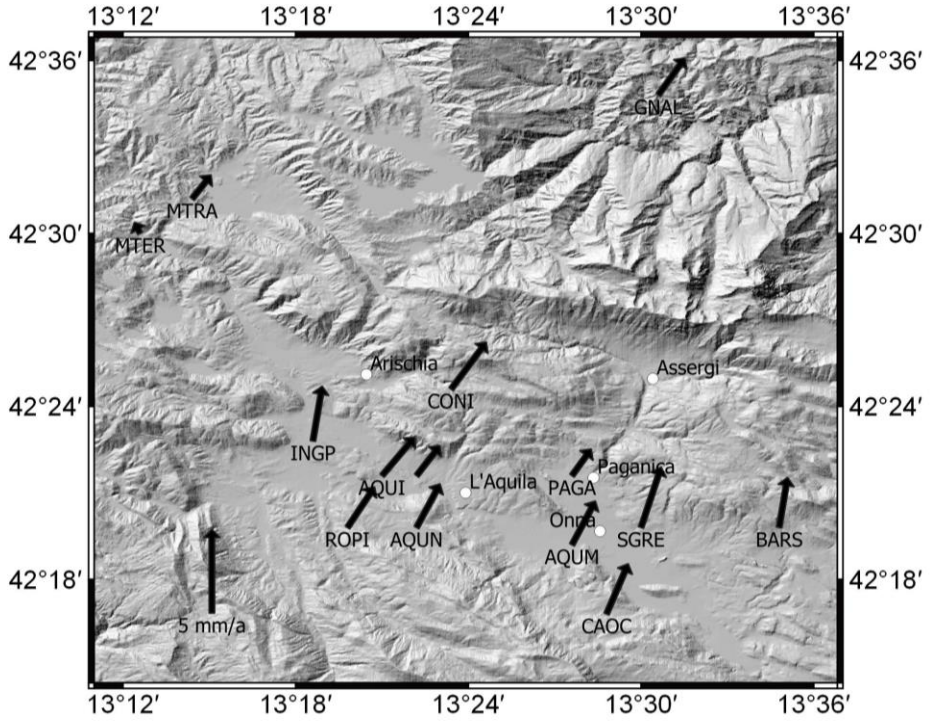


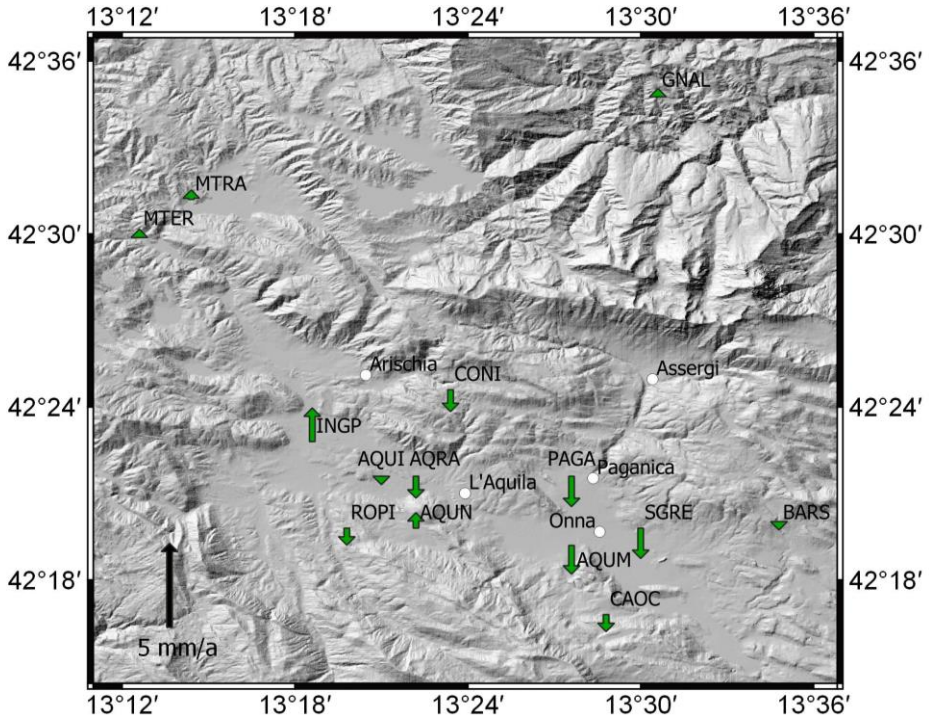
2009 L’Aquila seismic sequence
1 January 2009 – 31 December 2009



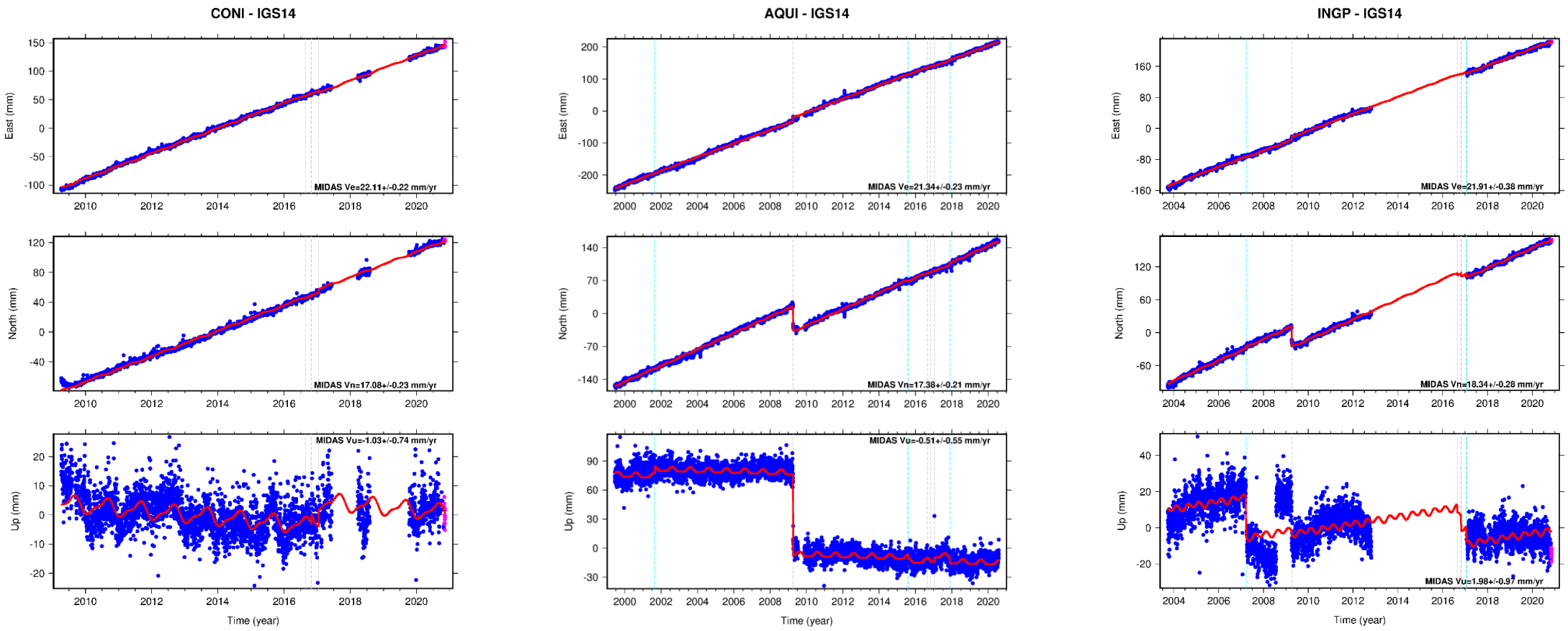
GNSS Stations

Determination of horizontal (left) and vertical ground velocities (right) of GNSS permanent stations in the ETRS89 reference frame.

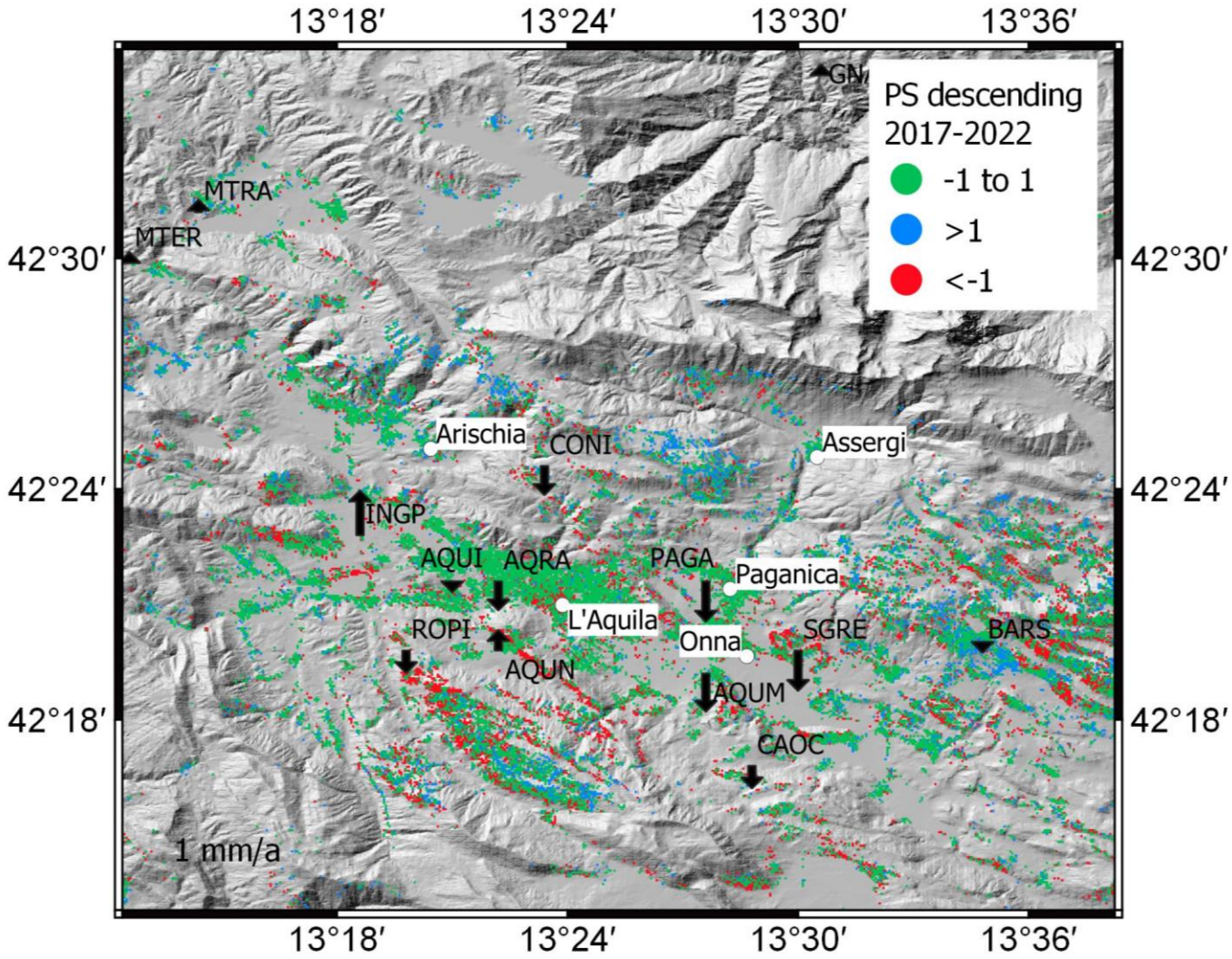




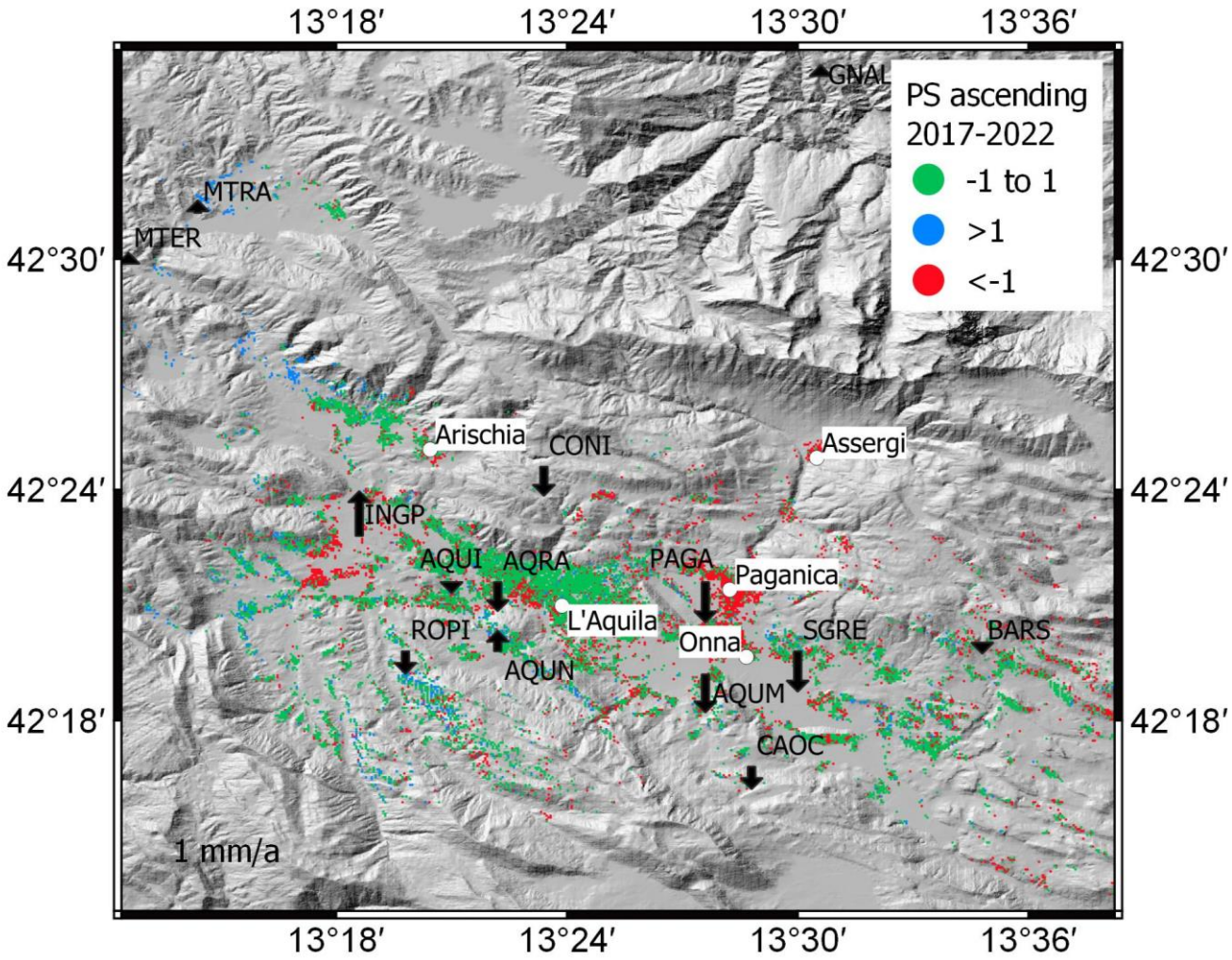
GNSS time series of CONI, AQUI and INGP



InSAR P-SBAS for Sentinel-1 descending orbits



InSAR P-SBAS for Sentinel-1 ascending orbits

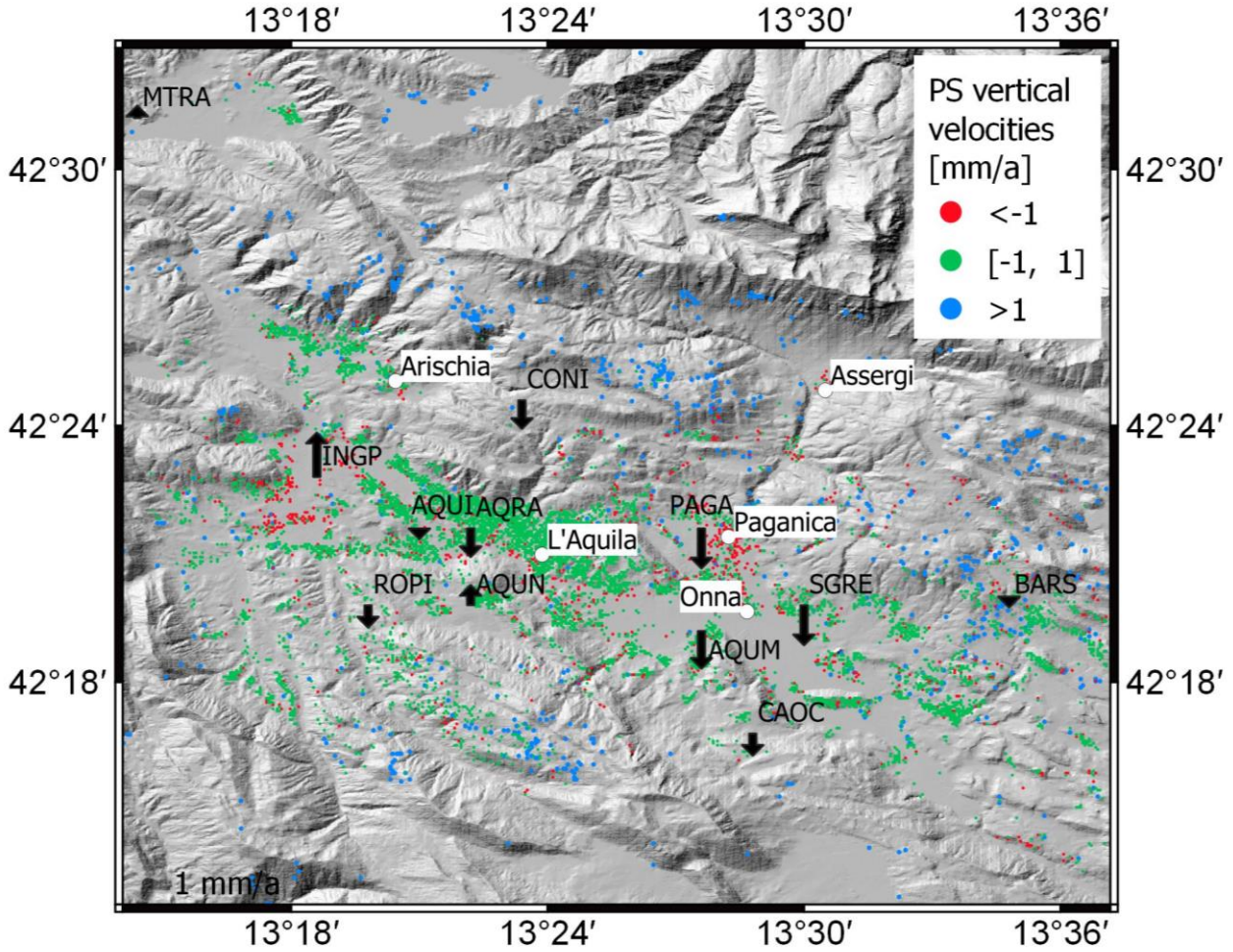


PS calibration

The calibration is based on the comparison of ground point velocities determined using both techniques. The easiest way is to compare each of the GNSS sites' velocities with PS velocities located around each of them. Because the probability that a PS point overlaps a GNSS station is low, an exponential inverse distance weighting interpolation was applied for the velocity determination involving the PS displaced around 1000 m from each of the GNSS sites.

Results

The ground movements detect by the integration of GNSS with InSAR show that the area around the town of L'Aquila is stable, downward movements around the town and Paganica, and a huge area around those towns, present an uplift of higher than mm/a.



Credits

European Space Agency
Agence spatiale européenne

The project was founded by ESA Network of Resources (NoR) ID: 1c1798 and the InSAR processing performed by TerraDue Platform (www.terradue.com)