

3D-SYSTEM integration

Francesco Guglielmino



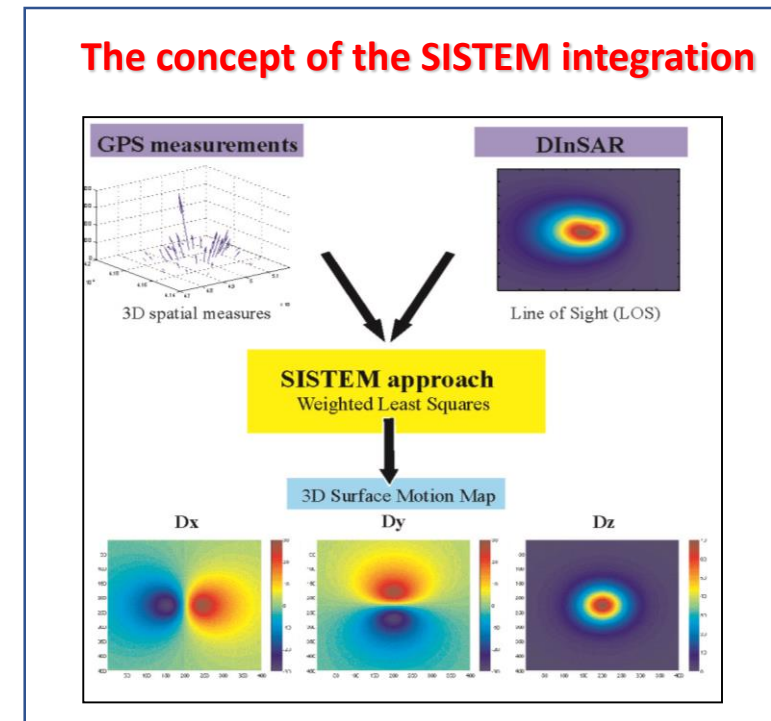
• SCIENTIFIC RATIONALE

Thematic area: **Earth Observation - Space Geodesy**

The main objectives of these activities are focused to **validate /integrate the EO-SAR data with the ground deformation data**, using the SISTEM algorithm.

The application fields of such products are the following:

- Volcanic eruptions, volcanoes inflation/deflation movements, volcano-tectonics.
- Seismic cycle investigation: coseismic, postseismic and interseismic phases
- Landslides
- Urban or coastal subsidence



• OBSERVATIONAL INFRASTRUCTURE

Observational infrastructure consists of:

EO and Ground SAR deformation products, generated with different techniques and using different SAR Sensor.

DInSAR classic products

- Ku-X-C-L band SAR 1D-LOS displacement maps

A-DInSAR products

- SAR displacements Time-series
- MAI and BOI products

Ground based and UAV SAR products

- Local GBRAR
- UAV SAR

Either from internal or external sources

Ground deformation data acquired with different instruments and techniques

- 3D position – GPS,GNSS
- EDM – distance
- 1D elevation - levelling
- Tilt data
- Etc.

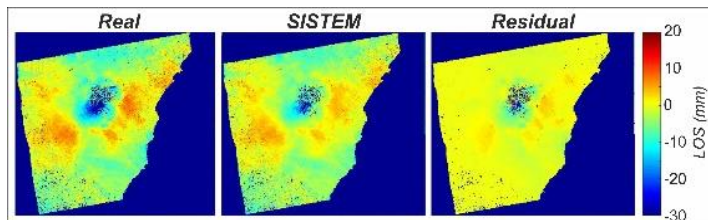
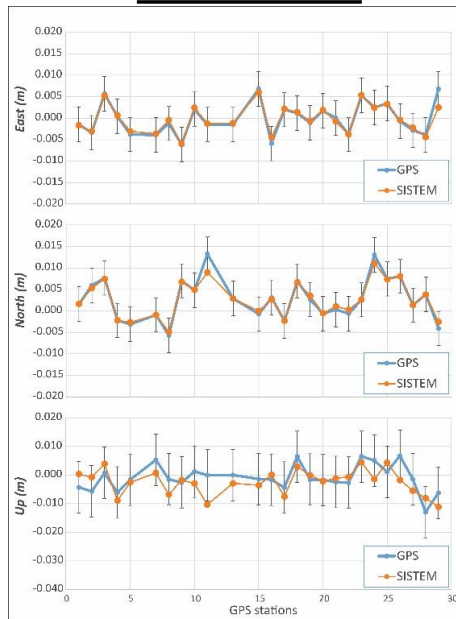
Either from internal or external sources

The COS integration module will provide both a «EO product validation» using the ground deformation data and simultaneously will provide the 3D-SISTEM integrated output (3D displacement maps, and the complete 3D strain components.

• TECHNOLOGICAL LABORATORIES

STATE OF THE ART: The SAR Laboratory is an INGV-OE infrastructure specifically devoted to a) the analysis of SAR data, b) their Validation/Integration with available ground deformation data with SISTEM, and c) their interpretation and modelling of the 3D integrated data (SISTEM output).

Validation



Recent Mt. Etna Application

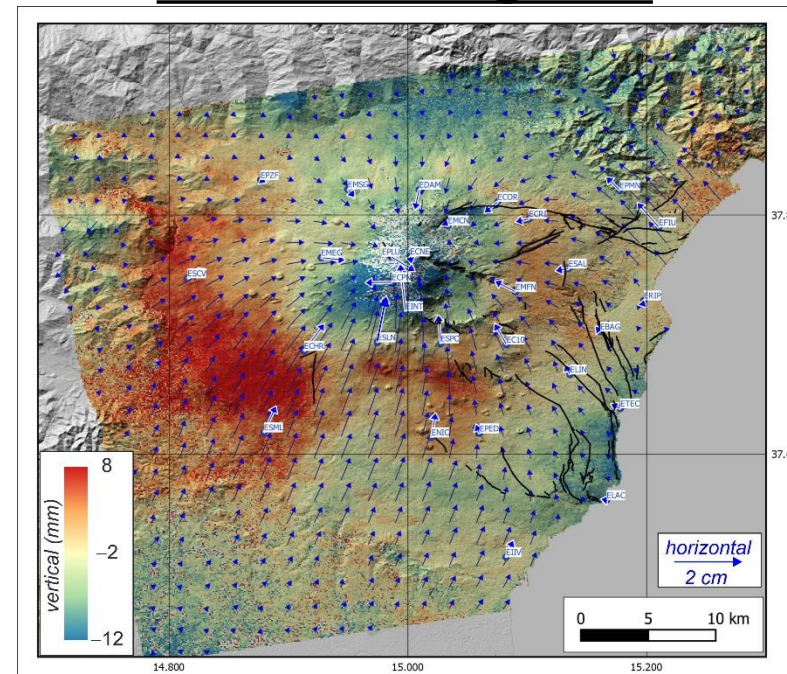


Article

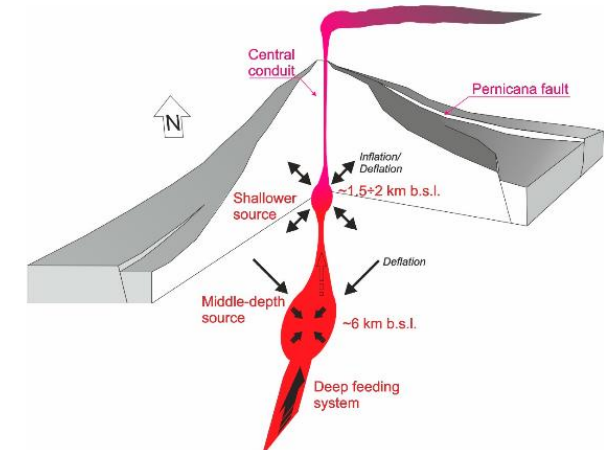
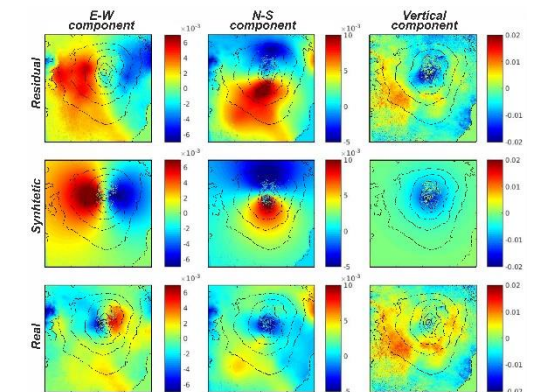
Combining High- and Low-Rate Geodetic Data Analysis for Unveiling Rapid Magma Transfer Feeding a Sequence of Violent Summit Paroxysms at Etna in Late 2015

Alessandro Bonforte , Flavio Cannavò , Salvatore Gambino and Francesco Guglielmino

3D-SISTEM integration



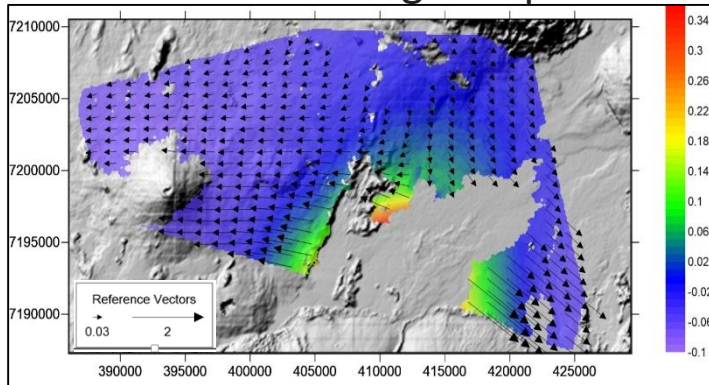
3D-SISTEM output Modelling & Interpretation



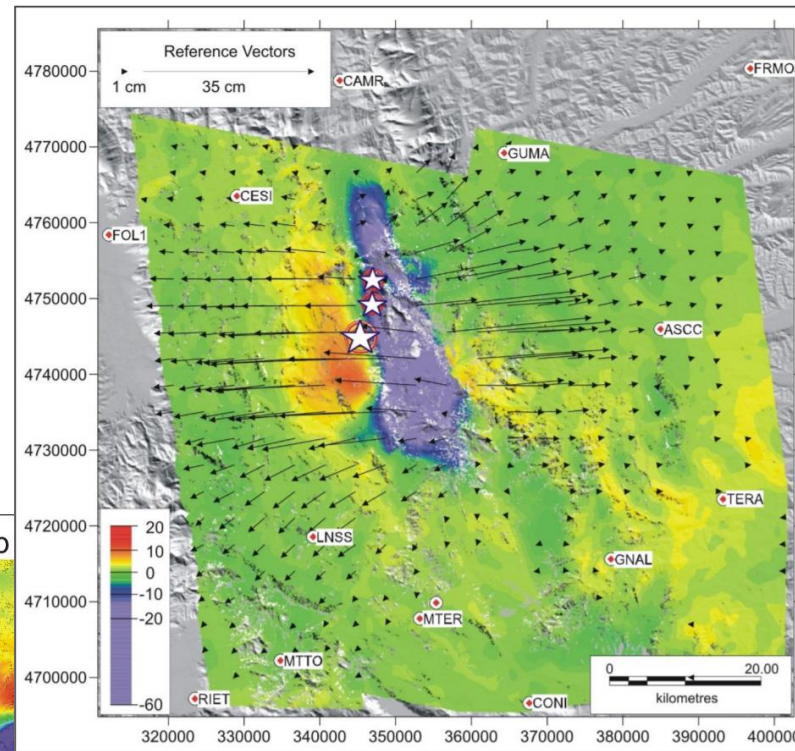
• TECHNOLOGICAL LABORATORIES

Currently, the activities are focused on Mt.Etna monitoring, but several application are performed on several event (volcanic and seismic) worldwide.

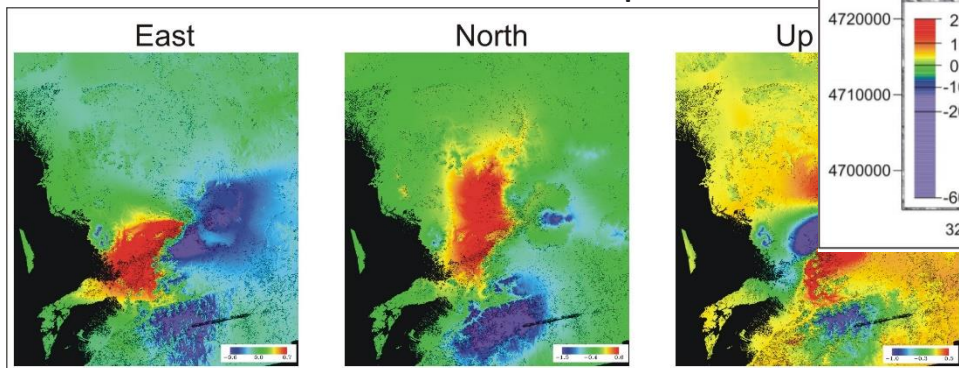
2014 Bardarbunga eruption



2016 “Visso-Norcia” earthquake sequence

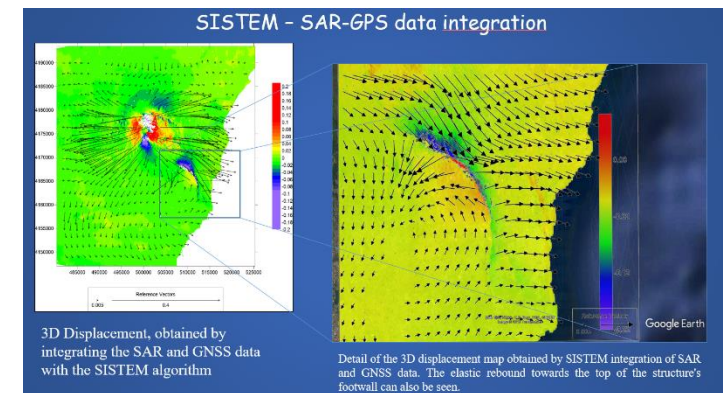


2016 Kumamoto earthquakes



2018

Mt. Etna eruption & Fiandaca earthquake



• INFRASTRUCTURE FOR DATA PROCESSING

INGV is equipped with the follow infrastructures specifically dedicated to the SISTEM integration

HARDWARE

Name	CPU	RAM	HD
INGV Workstations	1-2 CPU 2.4-3.4GHz	8GB	2TB
Virtual Machines on OE CED	1x Intel Xeon-Gold 2.3GHz/24-core	16 GB	1Tb

SOFTWARE

Matlab

• PRODUCTS AVAILABLE

3D SISTEM output products can be classified in three classes:

CLASS 1 - Validation:

Difference and Standard Deviation between SISTEM vs. EO /
Ground deformation data

CLASS 2 – 3D displacement:

SISTEM 3D-component maps with same original SAR pixel
resolution

CLASS 3 – 3D strain components:

Complete strain components for each pixel of original SAR data
+ estimation of the meaningful strain invariants in 3D

- PRODUCTS AVAILABLE

Product	Format	Spatial coverage	Temporal coverage	Provision
<u>Validation</u> difference and Standard deviation between Eo and Ground deformation data	ASCII txt	Values for each ground deformation benchmark	-	On demand
<u>Deformation</u> 3D-SISTEM displacement maps	GeoTIFF	Depending on sensor and users requirements	-	On demand
<u>STRAIN</u> Complete Strain Tensor values + 3D Strain invariants	GeoTIFF	Depending on sensor and users requirements	-	On demand

• CURRENT DISTRIBUTION OF PRODUCTS

3D SISTEM products are made available depending on the activities (*data* policy)

Services:

Such products are provided in the framework of a collaboration agreement between INGV and DPC

Projects

Such products are available as outcomes within the end of the project

Scientific purposes:

Such products are currently available on-demand inside and outside INGV.

• PROGRAMS/PROJECTS OF REFERENCE

- Progetto PON-GRINT (MUR)
- Progetto Allegato A (DPC)
- Progetto Eurovolc (UE)
Cooperation with Terradue to implement SISTEM on GEP platform
- Progetto Attempt (FOE)
- Progetto IMPACT (FOE)

• TEAM AND AFFILIATIONS

- Matteo Albano – Sezione ONT
- Andrea Antonioli – Sezione ONT
- Simone Atzori – Sezione ONT
- Lisa Beccaro – Sezione ONT
- Christian Bignami – Sezione ONT
- Alessandro Bonforte – Sezione OE
- Sven Borgstrom – Sezione OV
- Erica De Paolo – Sezione ONT
- Girolamo Dixit Dominus – Sezione ONT
- Fawzi Doumaz – Sezione ONT
- Nicola Famiglietti – Sezione ONT (Grottaminarda)
- Francesco Guglielmino – Sezione OE
- Marco Moro – Sezione ONT
- Giuseppe Pezzo – Sezione ONT
- Marco Polcari – Sezione ONT
- Giuseppe Puglisi – Sezione OE
- Stefano Salvi – Sezione ONT
- Michele Saroli – Sezione ONT
- Valeria Secreti – Sezione ONT
- Valeria Siniscalchi – Sezione OV
- Salvatore Stramondo – Sezione ONT
- Nikos Svigkas – Sezione ONT
- Cristiano Tolomei – Sezione ONT
- Elisa Trasatti – Sezione ONT