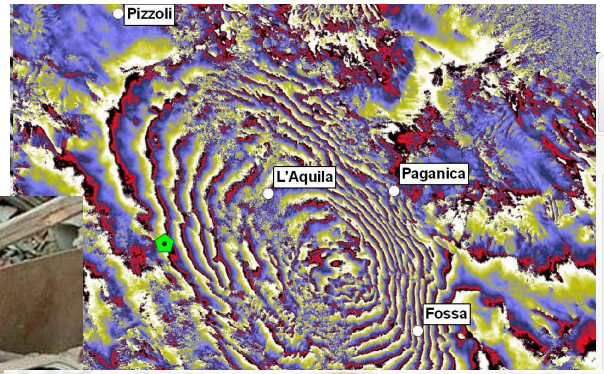

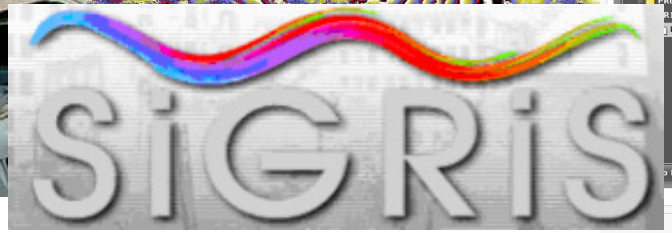

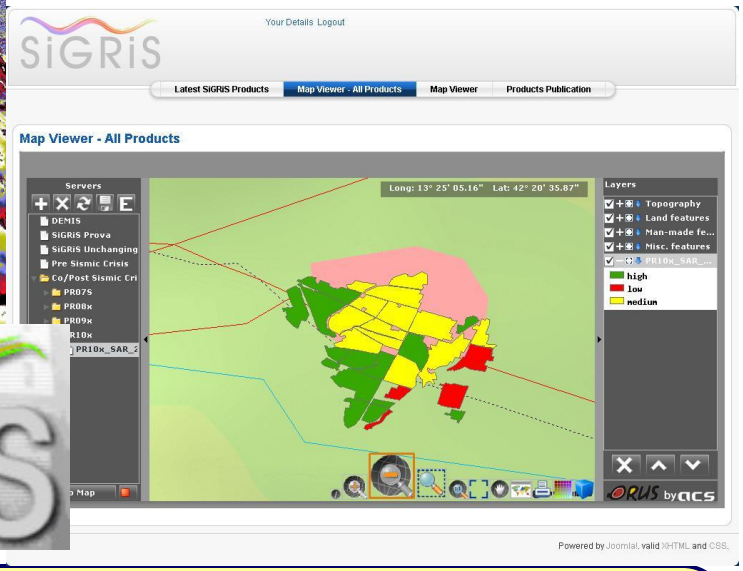

Use of space-based information for seismic risk management: an ASI project

S.Zoffoli[1], S. Salvi[2], S. Vignoli[3], V.Bosi[4] and the SiGRiS Team

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[4]Dipartimento della Protezione Civile – Rome, Italy

SiGRiS: a Space Observation System for Seismic Risk Management

Scope:

To demonstrate the operational use of EO data in the management of the Seismic Risk (emphasis is on **Cosmo-Skymed** data).

Main Task:

To generate operational, value-added products for the **Civil Protection Service**, integrating EO and ground data

SiGRiS is a pre-operative project

- funded by the Italian Space Agency
- designed and developed by an integrated team (scientific + industrial) on the Italian Civil Protection user requirements
- active in 2007-2010 timeframe
  SiGRiS system is operated by INGV

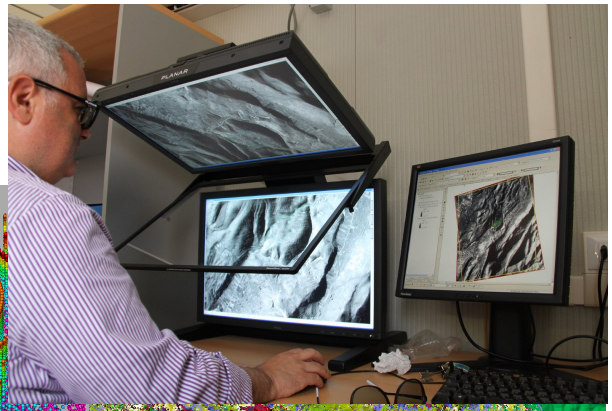
EO and ground data

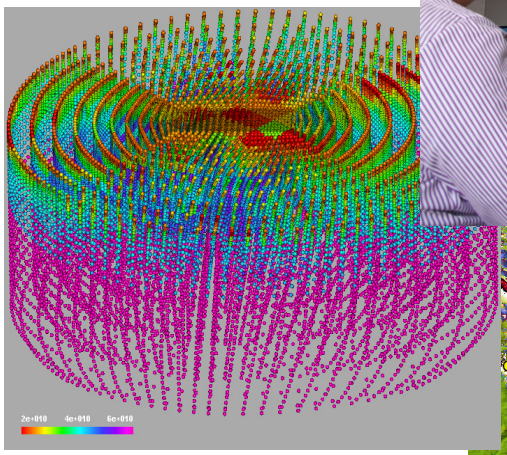
Algorithms & models

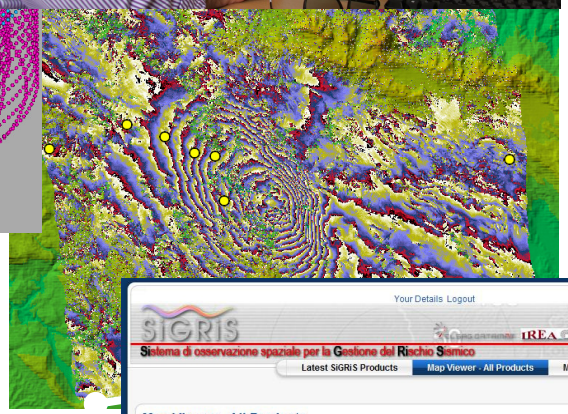
Value added products

Validation

Dissemination







Products in two risk management phases:

1. Knowledge & Prevention, i.e. support to the Seismic Hazard assessment

2. Warning & Crisis, i.e. support to the Emergency management

Products to support the Emergency management

Map of co-seismic ground deformation
Map of the seismic source
Map of induced surface effects
Damage map

get direction of search and rescue operations
define the area to evacuate
find the best locations for emergency shelters
estimate areal probability of large aftershocks
assess increments of induced risks (landslides, etc.)

The SiGRiS products for the April 6, 2009 Abruzzi Earthquake crisis, Central Italy

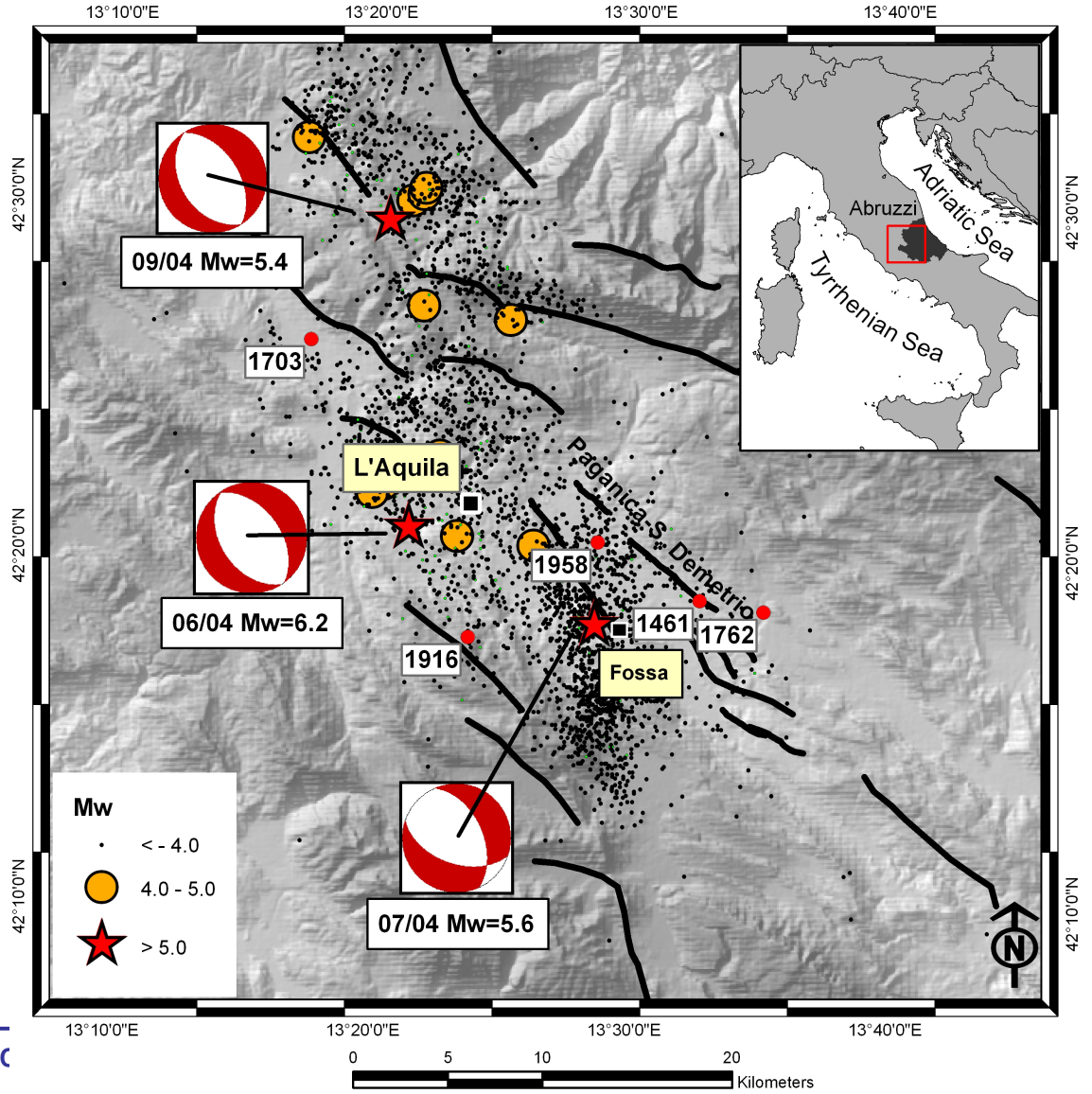
L'Aquila EQ context

Italy

L'Aquila Quake
6/04/2009
3:32 a.m.

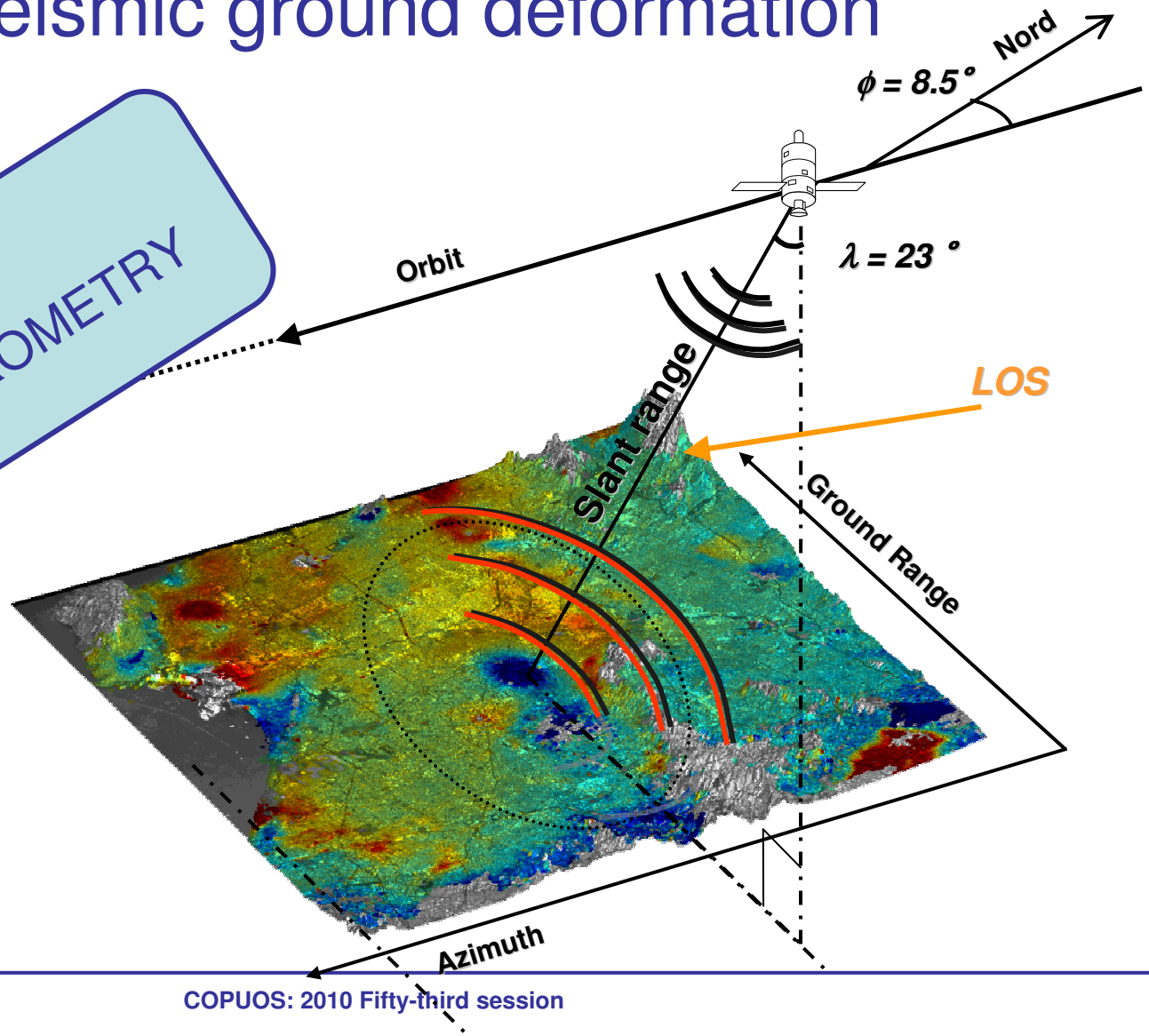
Mainshock M_w 6.3 located at 9.5 km, followed in the next week by 7 aftershocks
M > 5
300 casualties
1500 injured
65.000 displaced

5:34 SiGRiS System activation



Map of co-seismic ground deformation

Based on
SAR INTERFEROMETRY

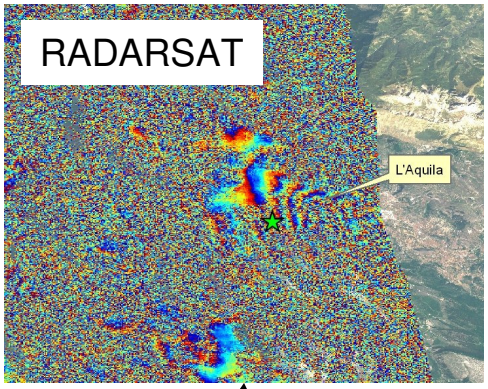


Post event SAR data 6 days after the quake:

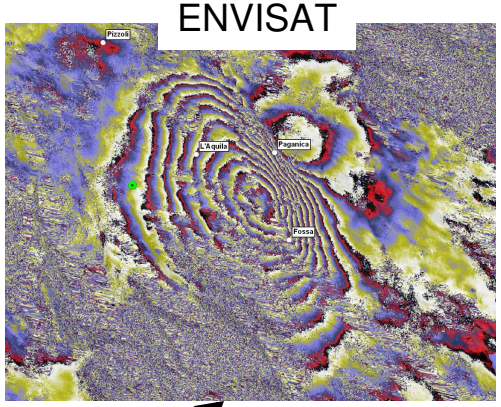
- 1 ENVISAT acquisition
- 1 RADARSAT acquisition
- 21 COSMO-SkyMed acquisition

Interferograms after the quake

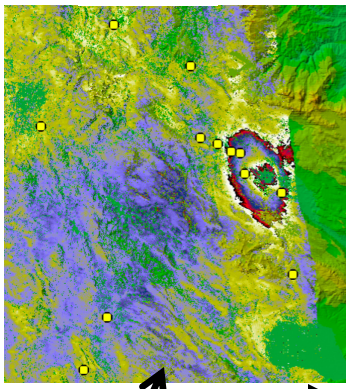
RADARSAT



ENVISAT



ALOS



L' Aquila Quake

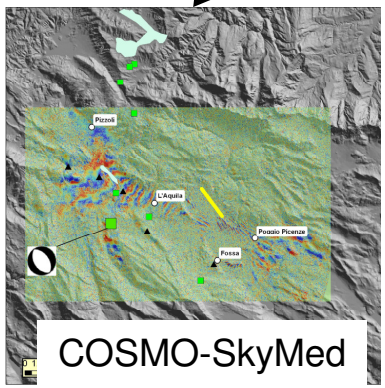
Mw = 6.3

06.04

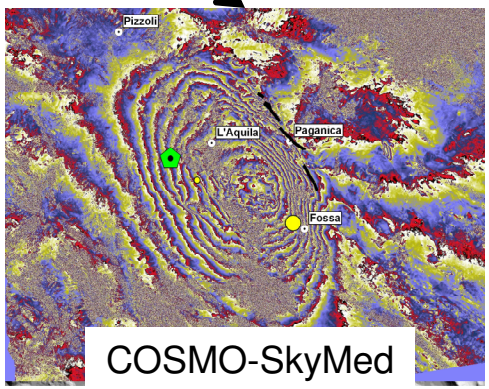
09.04

12.04

22.04

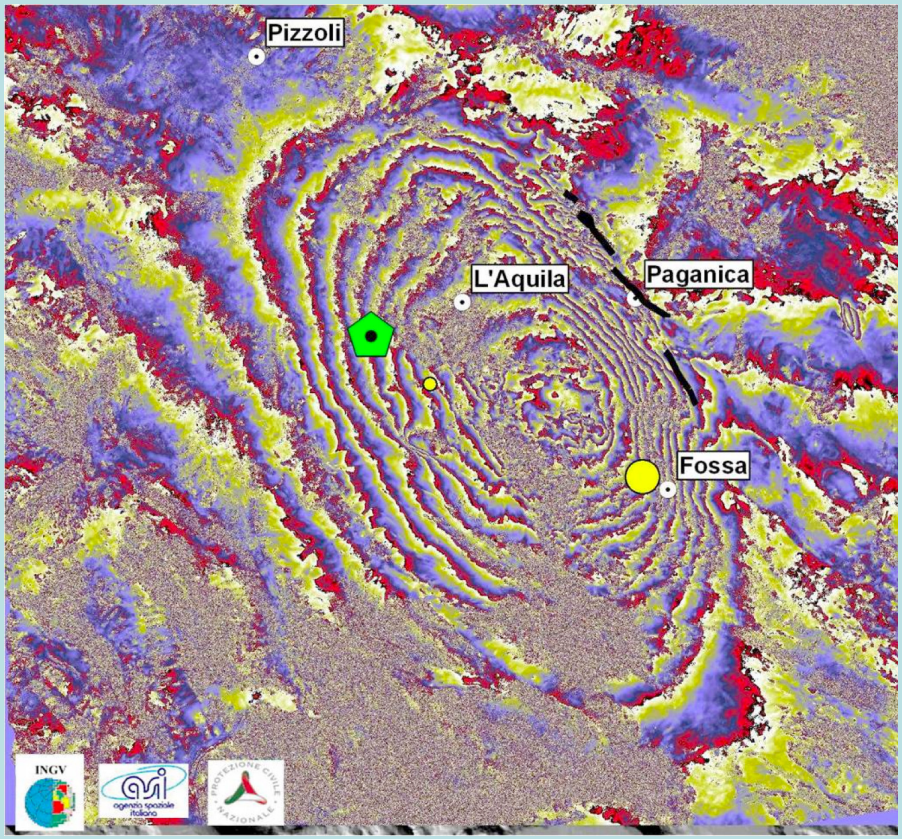


COSMO-SkyMed



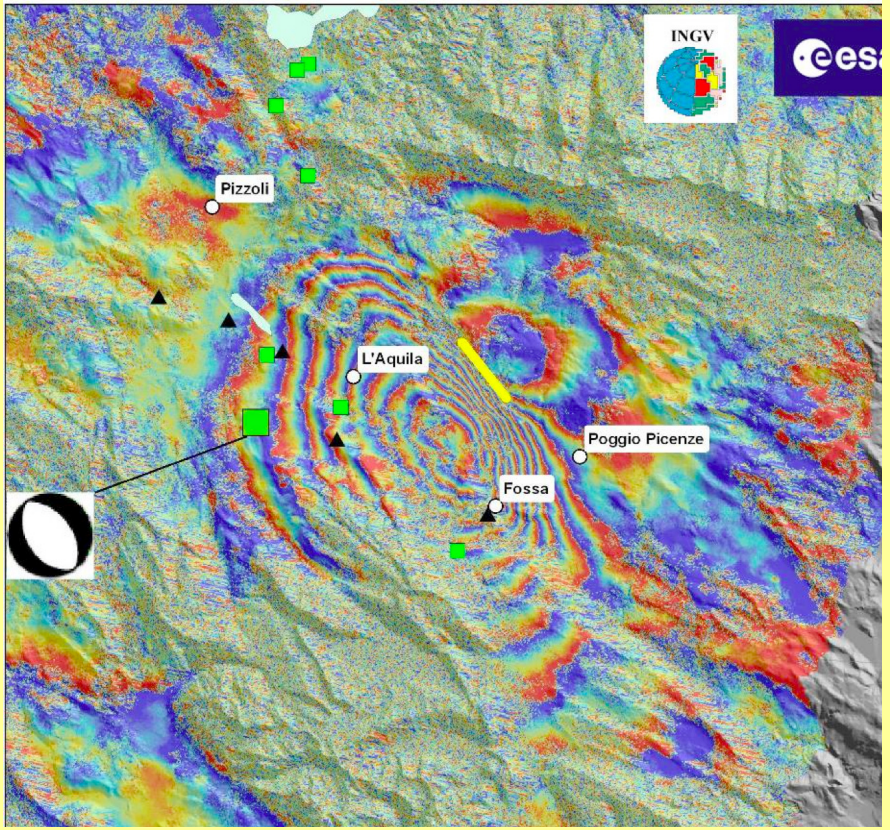
COSMO-SkyMed

COSMO-SkyMed Interferogram 12/4



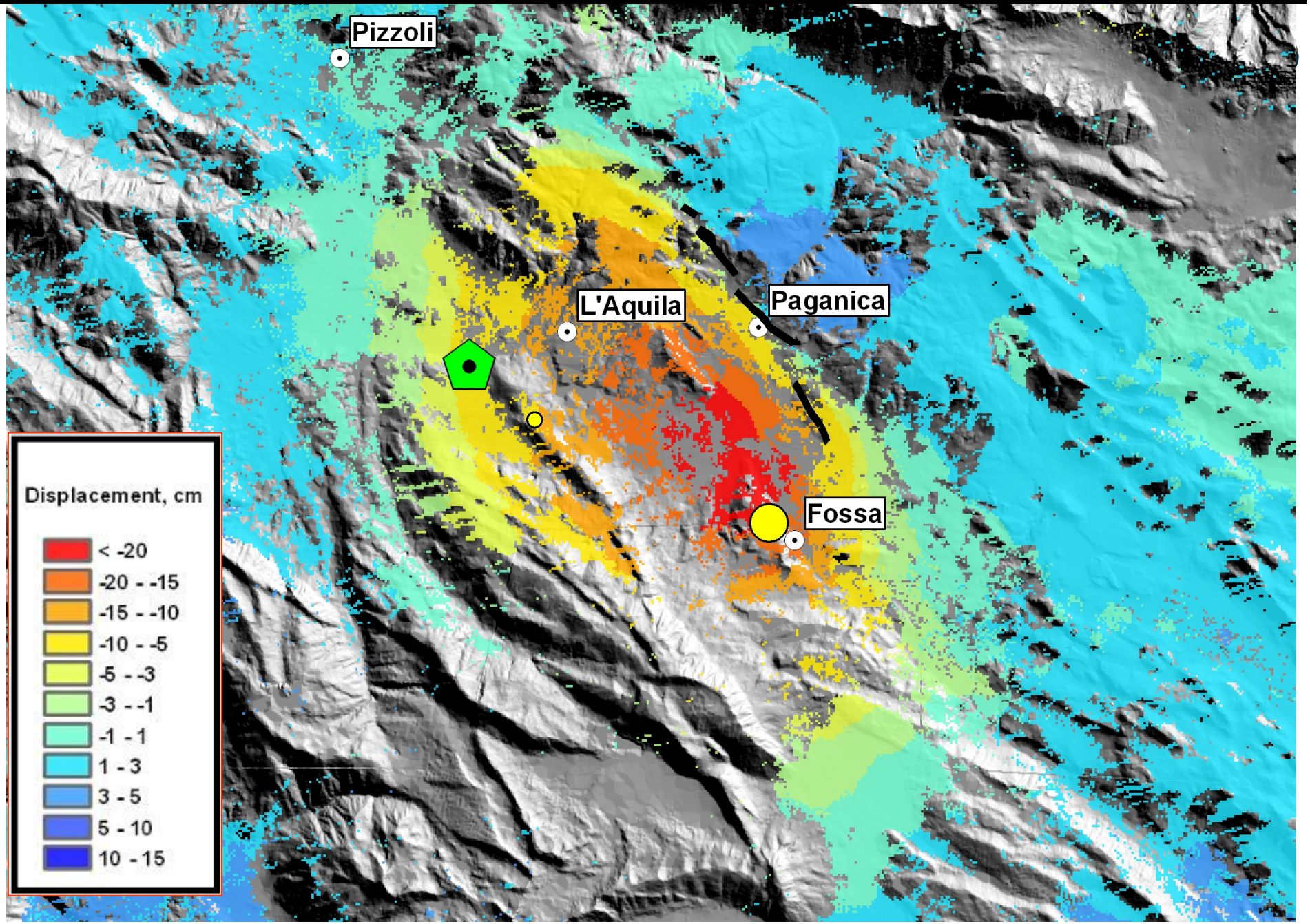
Each fringe corresponds to about 1.5 cm of displacement in the satellite direction (~36° from vertical)

ENVISAT Interferogram 12/4

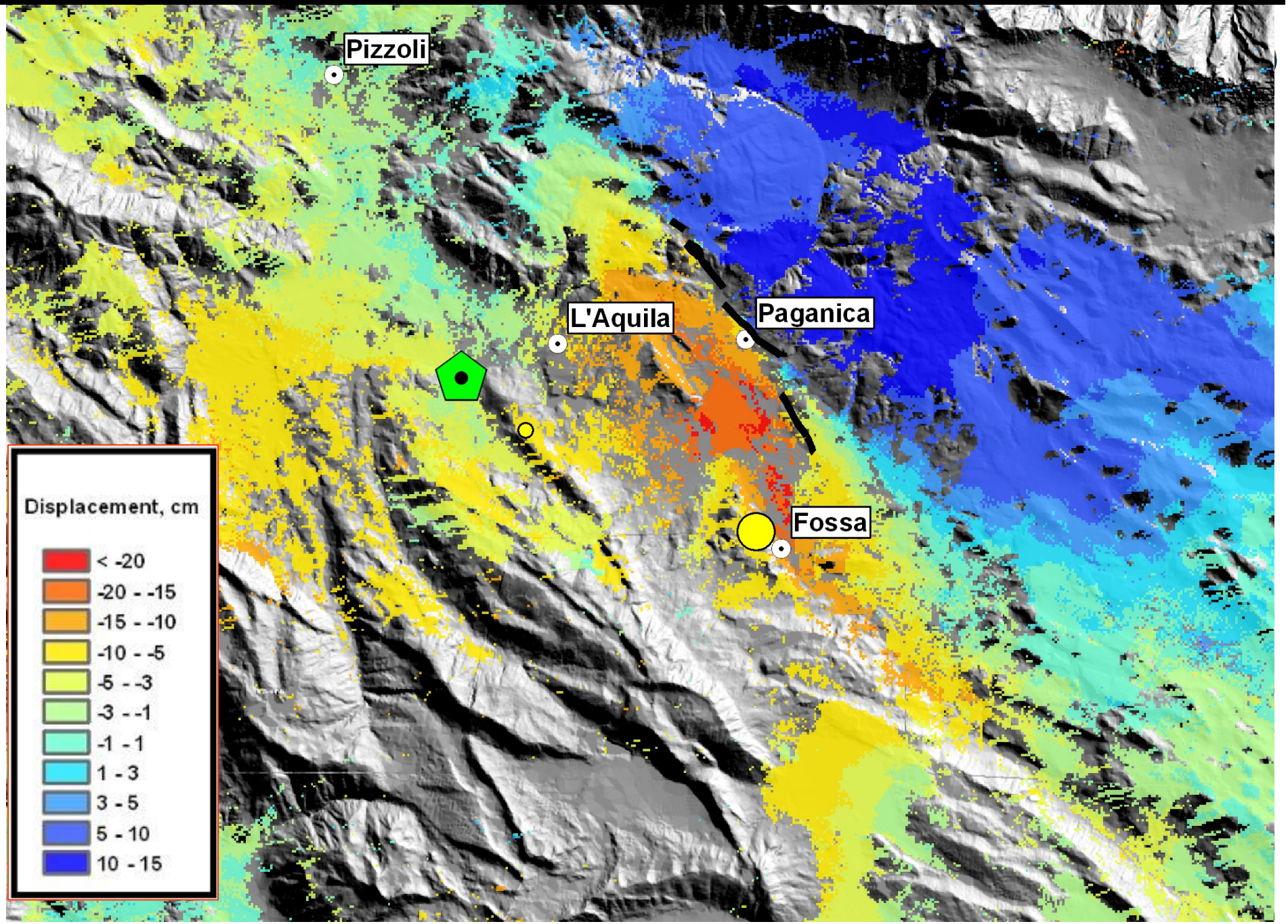


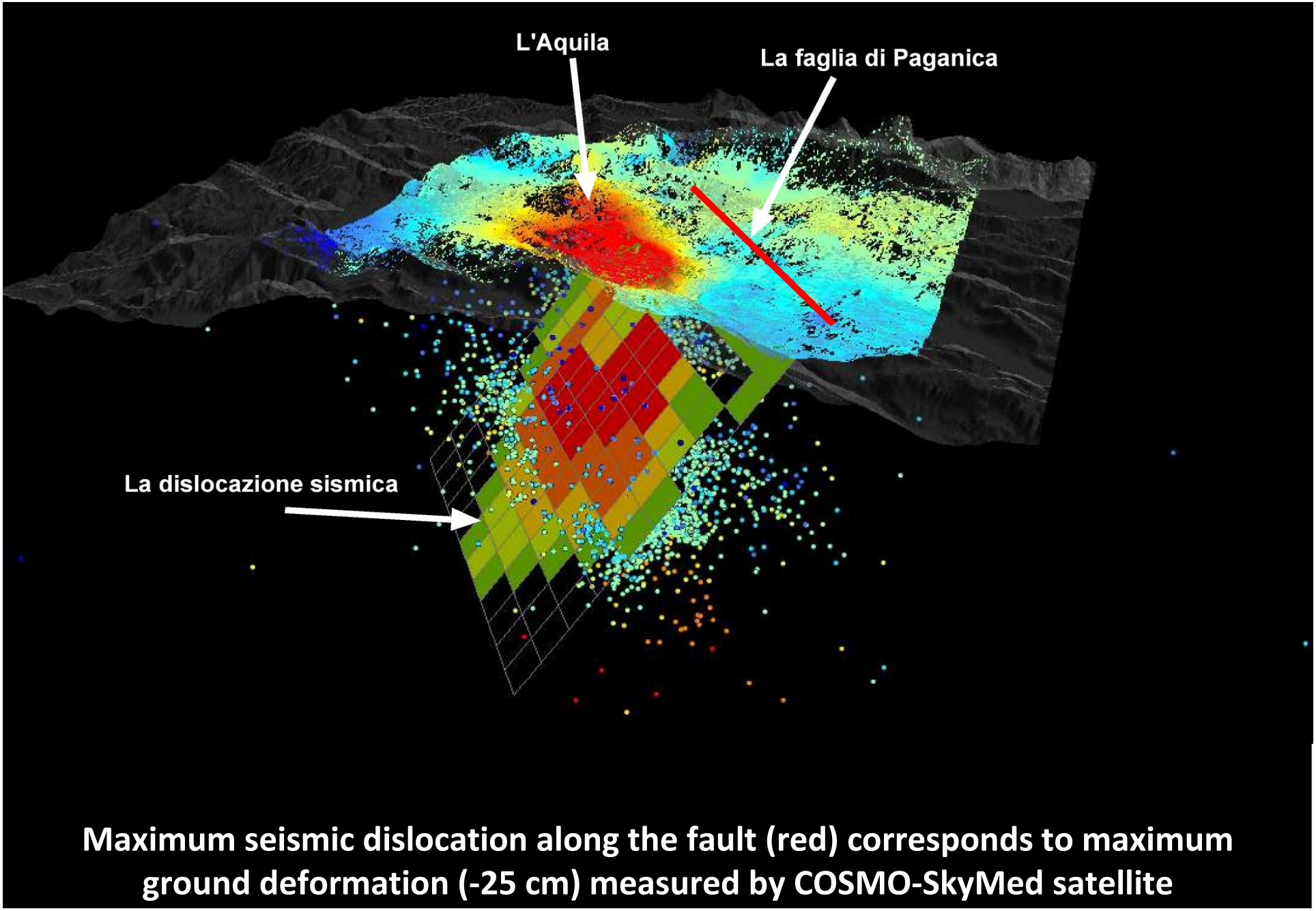
Each fringe corresponds to about 2.8 cm of displacement in the satellite direction (~23° from vertical)

Up ground displacement 8 days after, all data sets + GPS



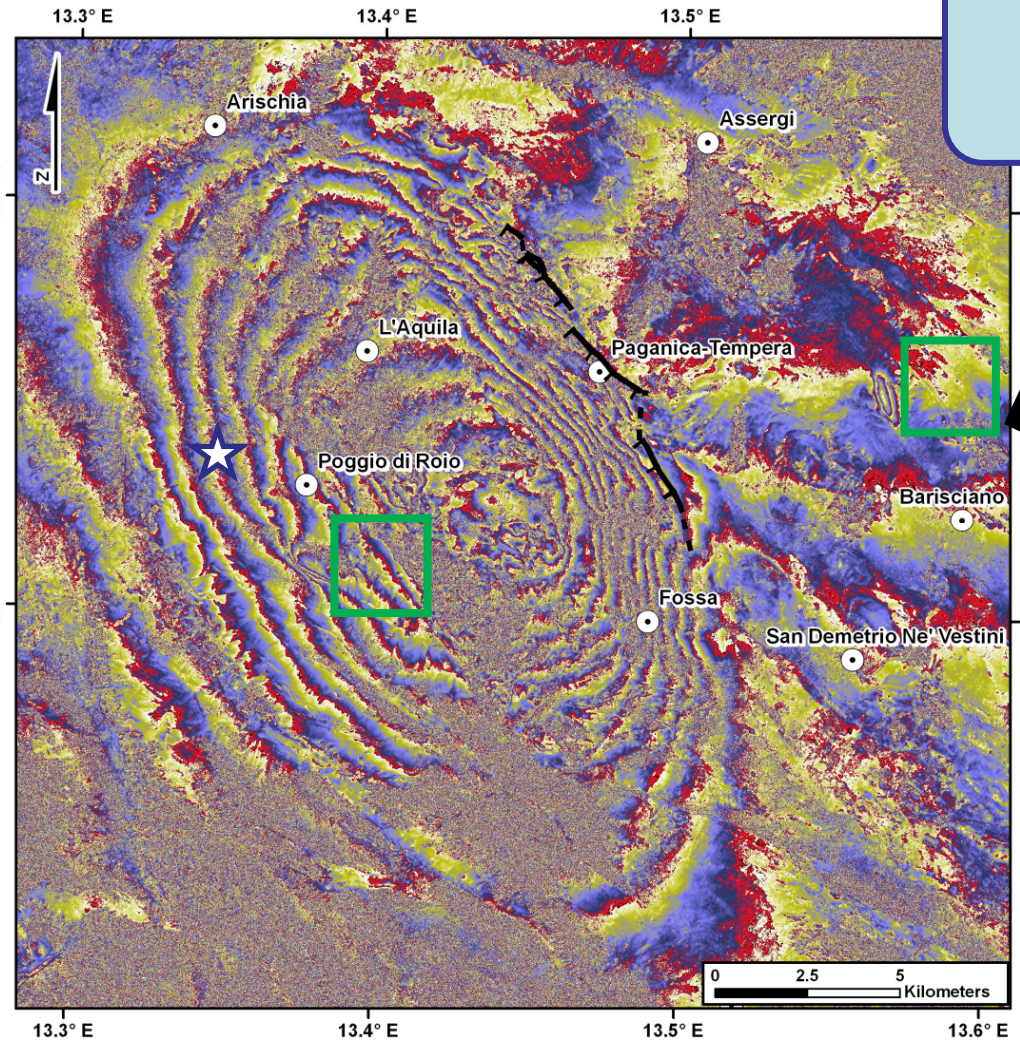
East ground displacement 8 days after, all data sets

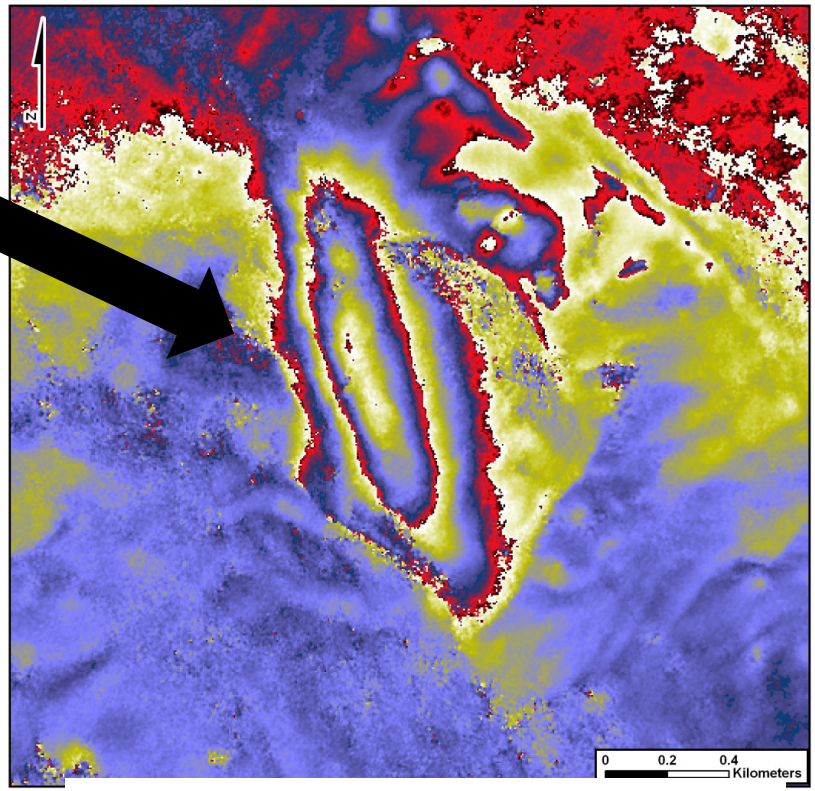




Maximum seismic dislocation along the fault (red) corresponds to maximum ground deformation (-25 cm) measured by COSMO-SkyMed satellite

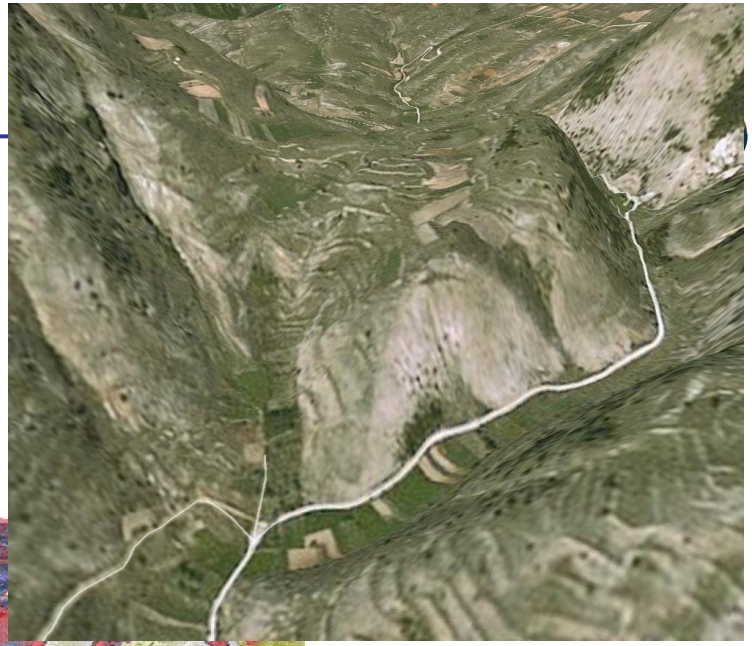
COSMO-SkyMed high resolution data permit to localize induced risks (like landslides)

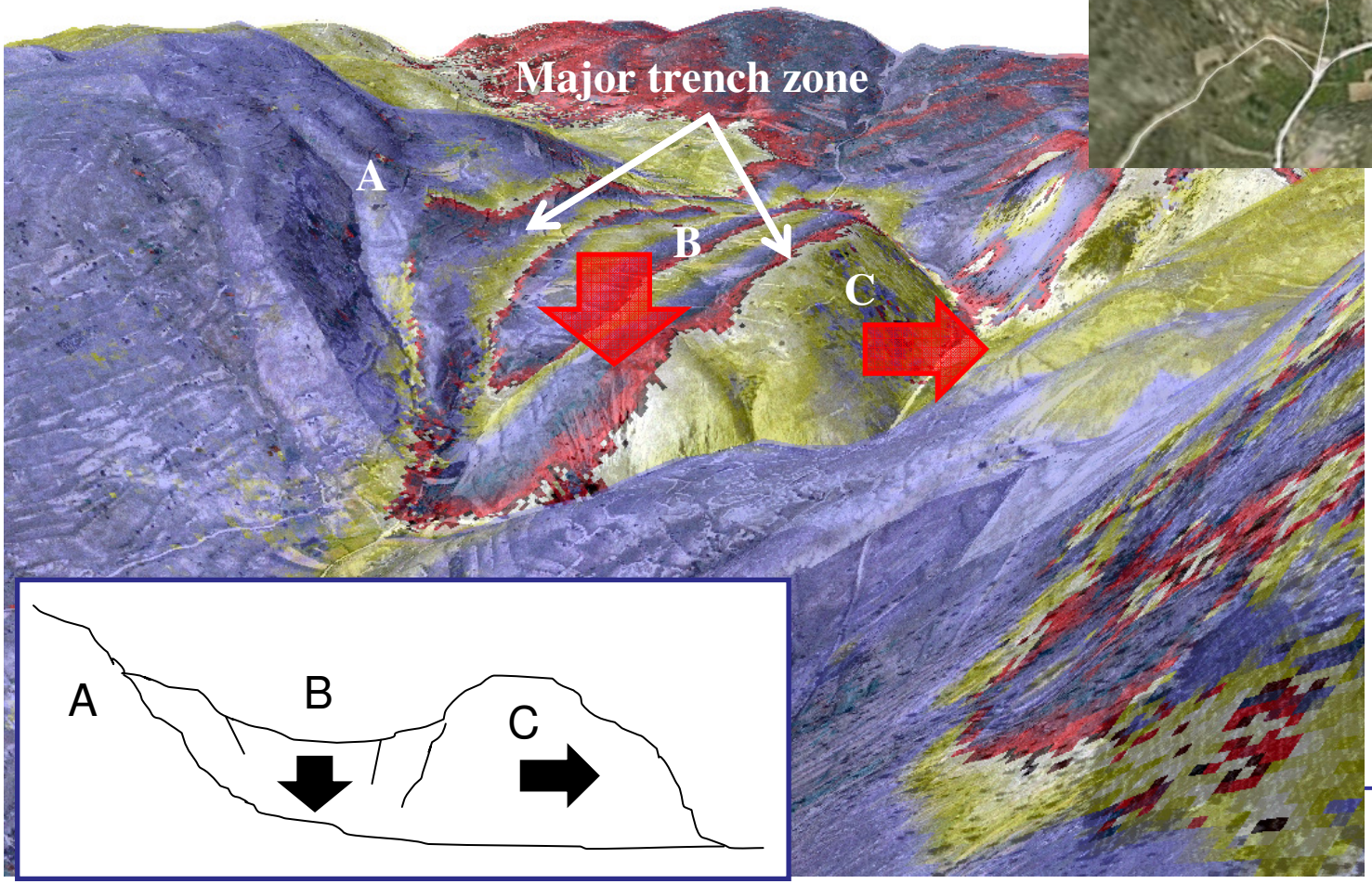




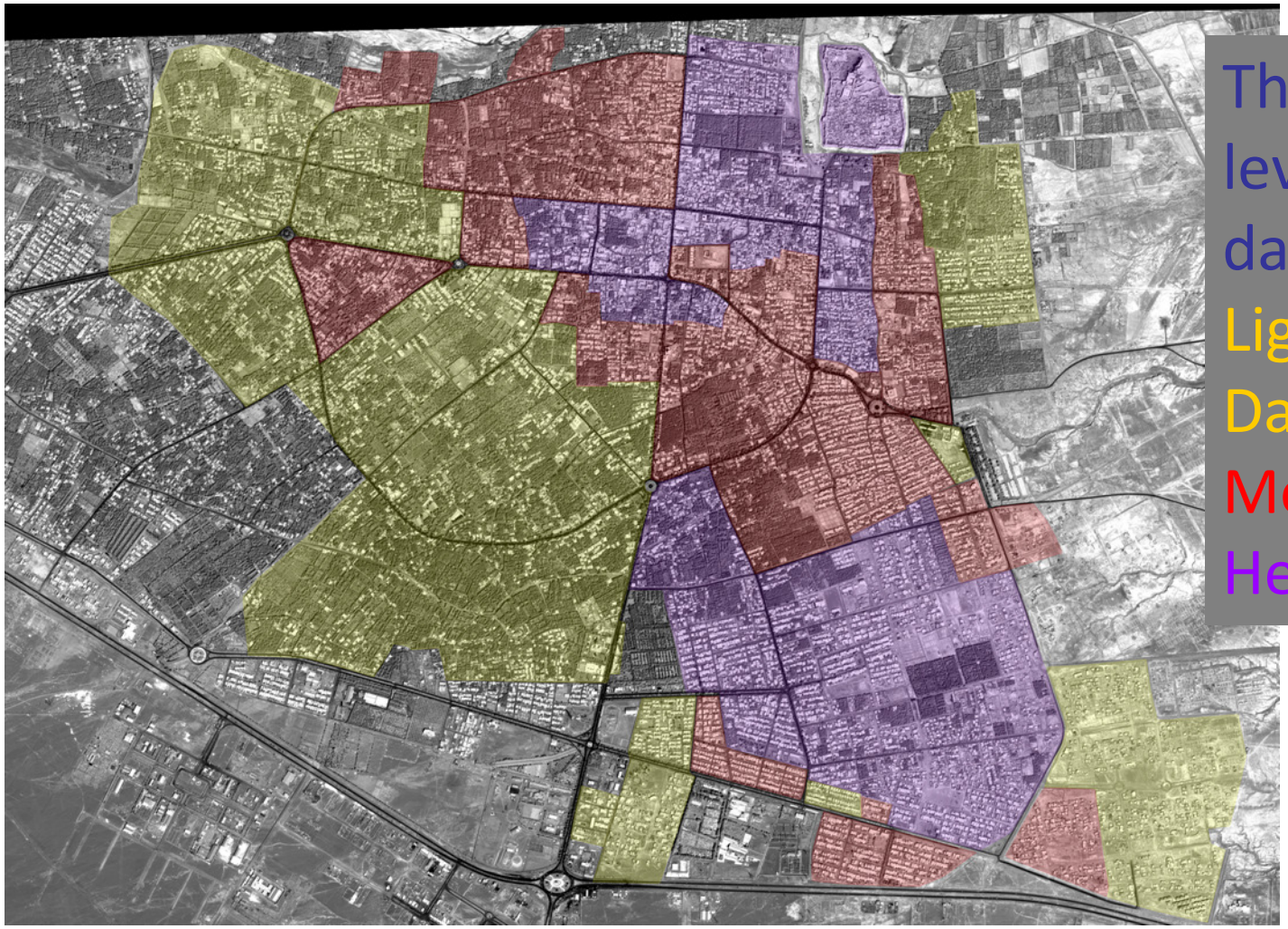
The entire deformation is about 3 cm

Map of induced surface effects
3D view of the sagging area





The 2003 Bam Earthquake – Damage Map



Three different levels of damage:
Light (or No Damage)
Medium
Heavy

Single Building Damage Level Map

Three different levels of damage:
Light (or No Damage)
Medium
Heavy

Pan 09/30/2003

Pan 01/04/2004

Products in two risk management phases:

1. Knowledge & Prevention, i.e. support to the Seismic Hazard assessment

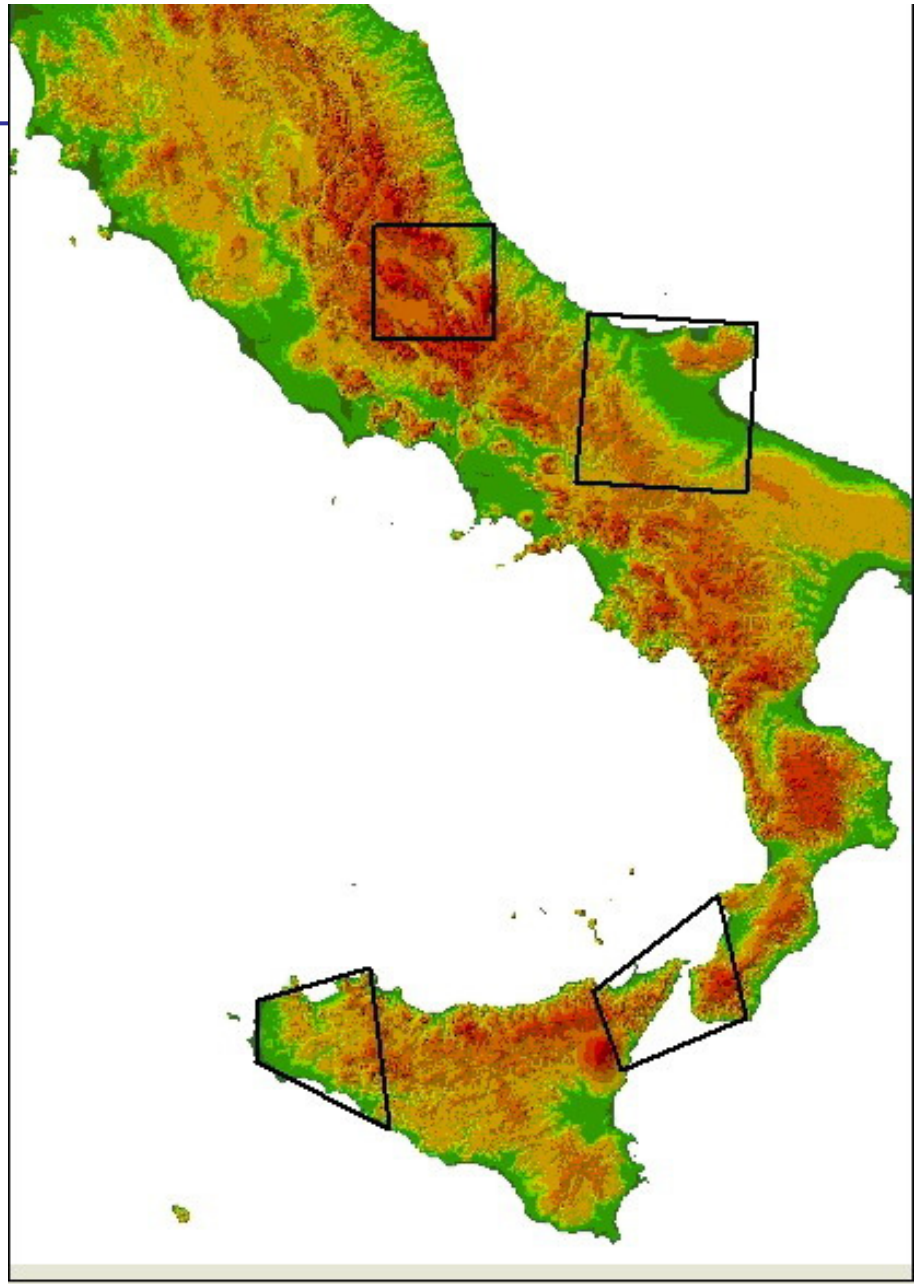
1. Warning & Crisis, i.e. support to the Emergency management

Products to support the the Seismic Hazard Assessment

High resolution ground velocity maps
Interseismic fault models

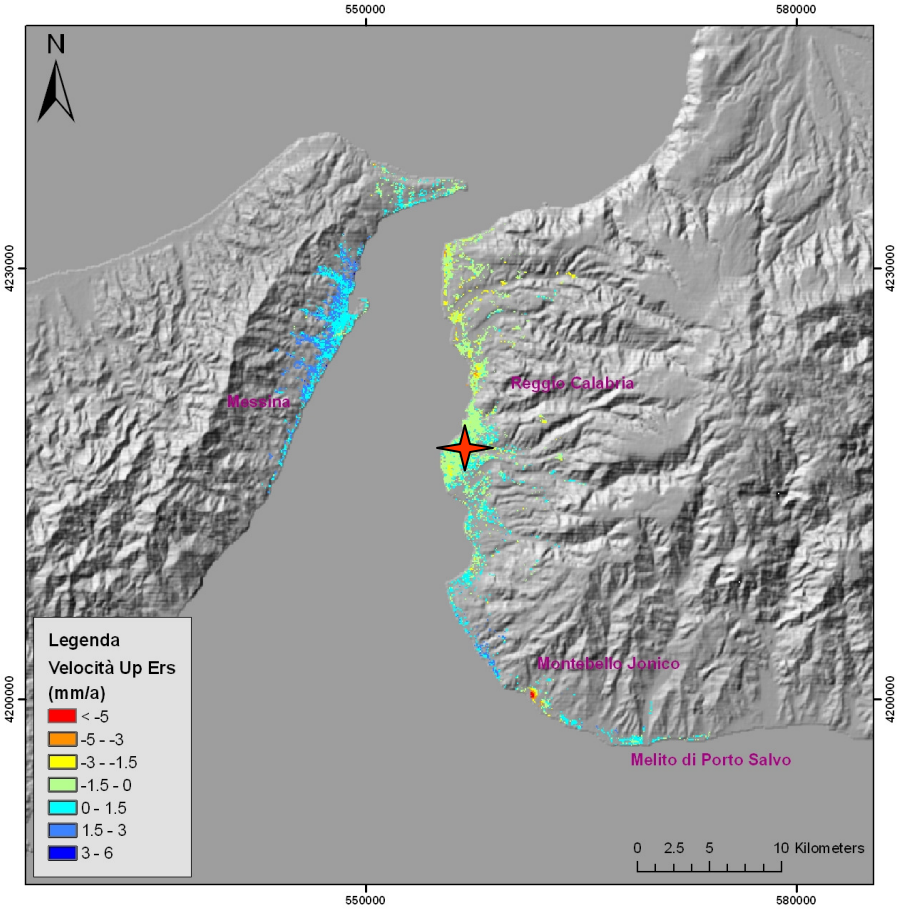
Identification of high strain patterns
Mapping and dimensioning active faults

High resolution ground velocity map based on analysis of Differential SAR Interferometry tecnique

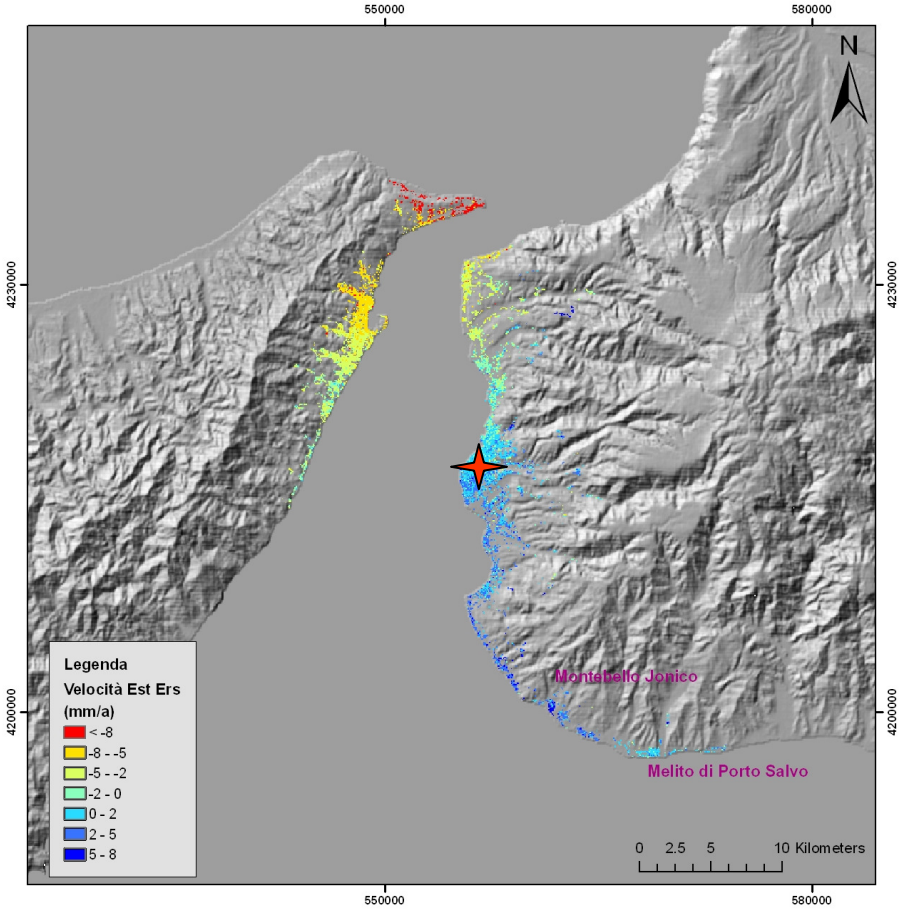


4 seismogenic test areas in the SiGRiS Project

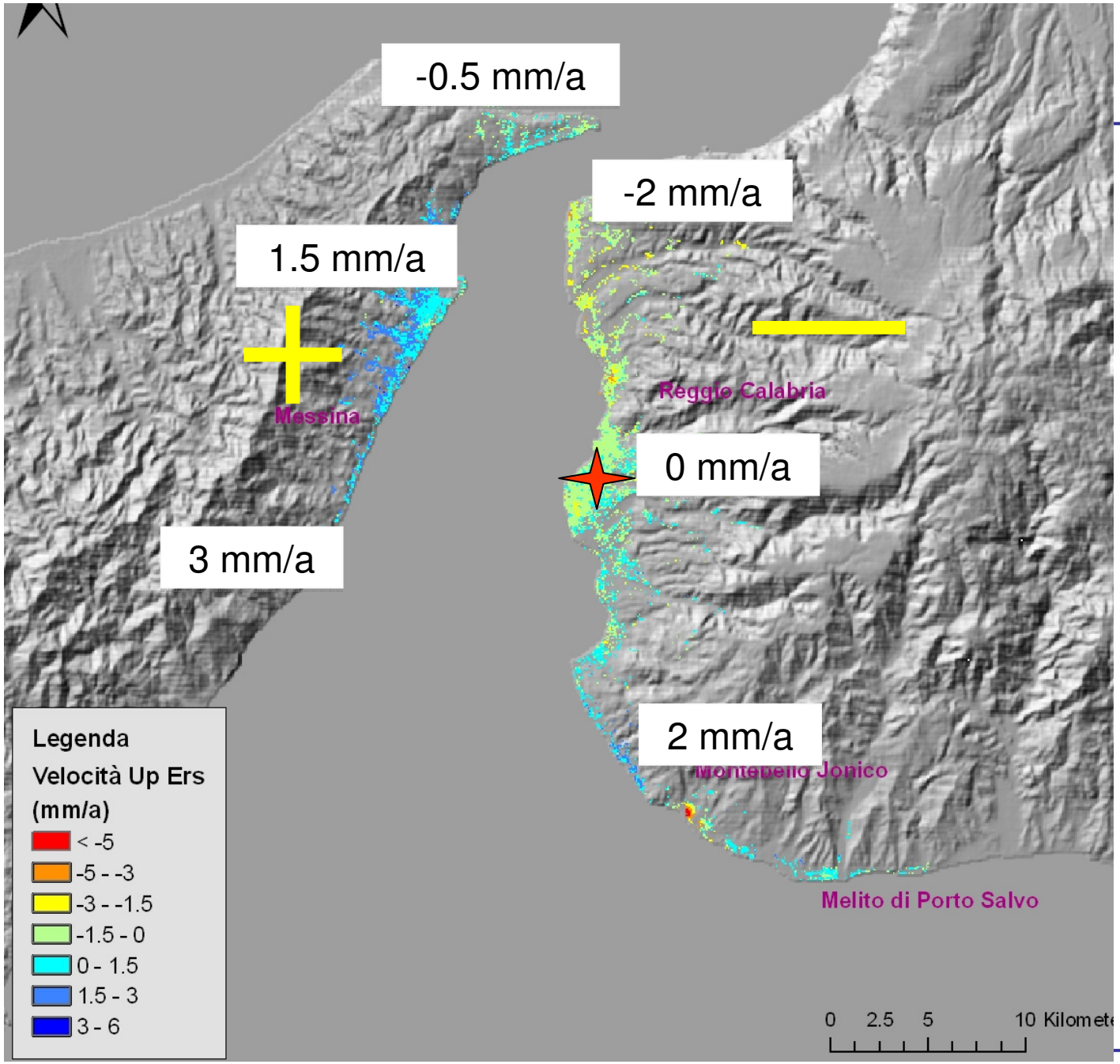
Strait of Sicily : ground velocity maps



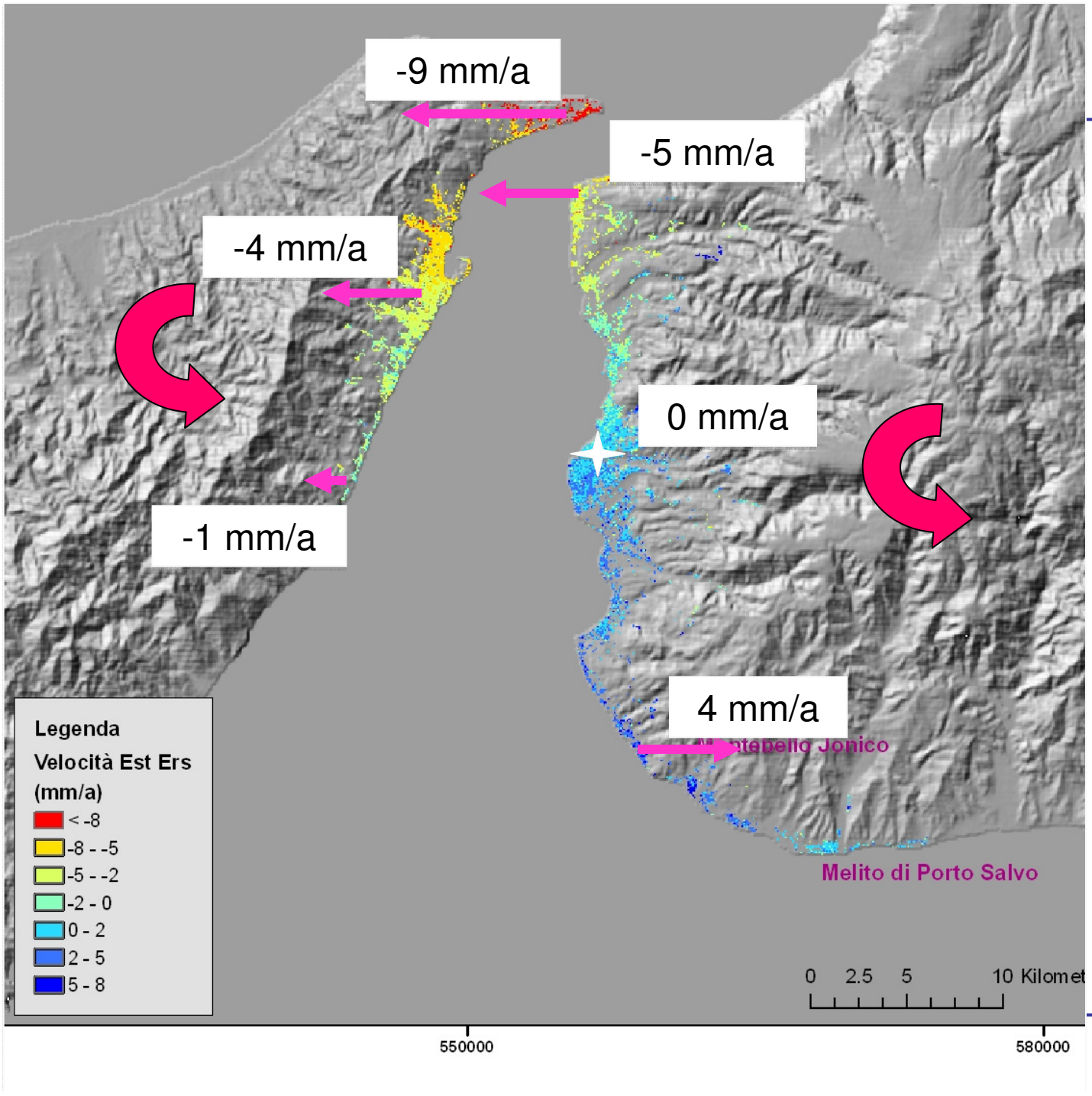
Up component



East component

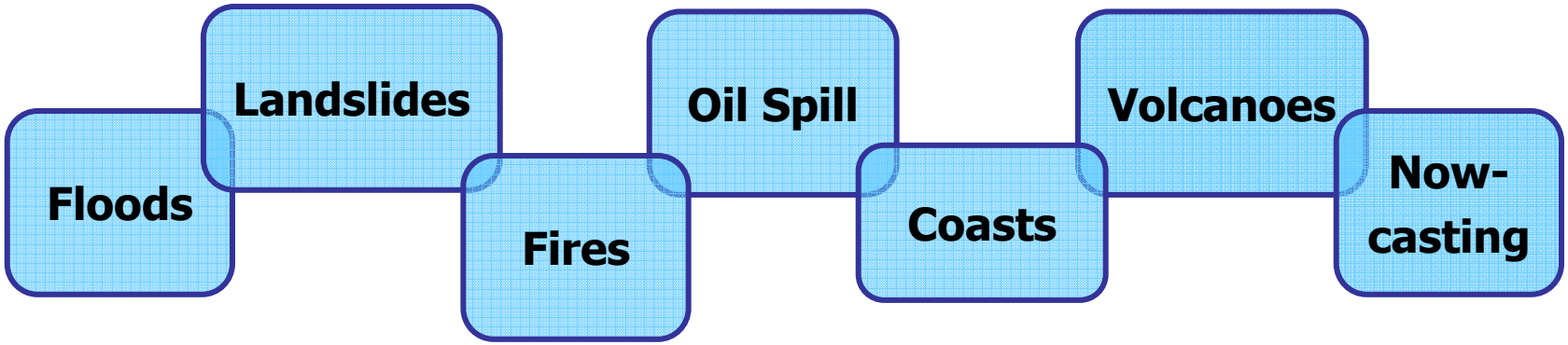


Up component



East component

Italian Space Agency is developing with the same strategy (deep cooperation with the final user) other demo services for environmental risk management on: floods, landslides, fires, oil spill, coasts, volcanoes, now-casting.



Thanks for your attention

and to the

SIGRIS TEAM

S. Salvi, S. Aztori, C. Tolomei, S. Stramondo, F. Doumaz, S. Vinci, A. Antonioli, M. Moro, E. Trasatti, M. Chini, A.R. Pisani, A. Megna, I. Unstad, F. Balestra, L. Conti, C. Kyriakopoulos, G. Pezzo, E. Mantovani, V. Marcello, S. Vignoli, S. Perelli, G. Pace, V. Santacesaria, P. Castracane, P. Belardino, D. Pannucci, C. Giannico, R. Carpentiero, M. Serra, V. Bosi, R. Giuliani

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