The Earthquake Environmental Effects catalogue: "in situ" validation of seismic hazard assessment

Luca Guerrieri

Rome, Italy – April, 18-19, 2011

SEVENTH FRAMEWORK PROGRAMME

EGIDA

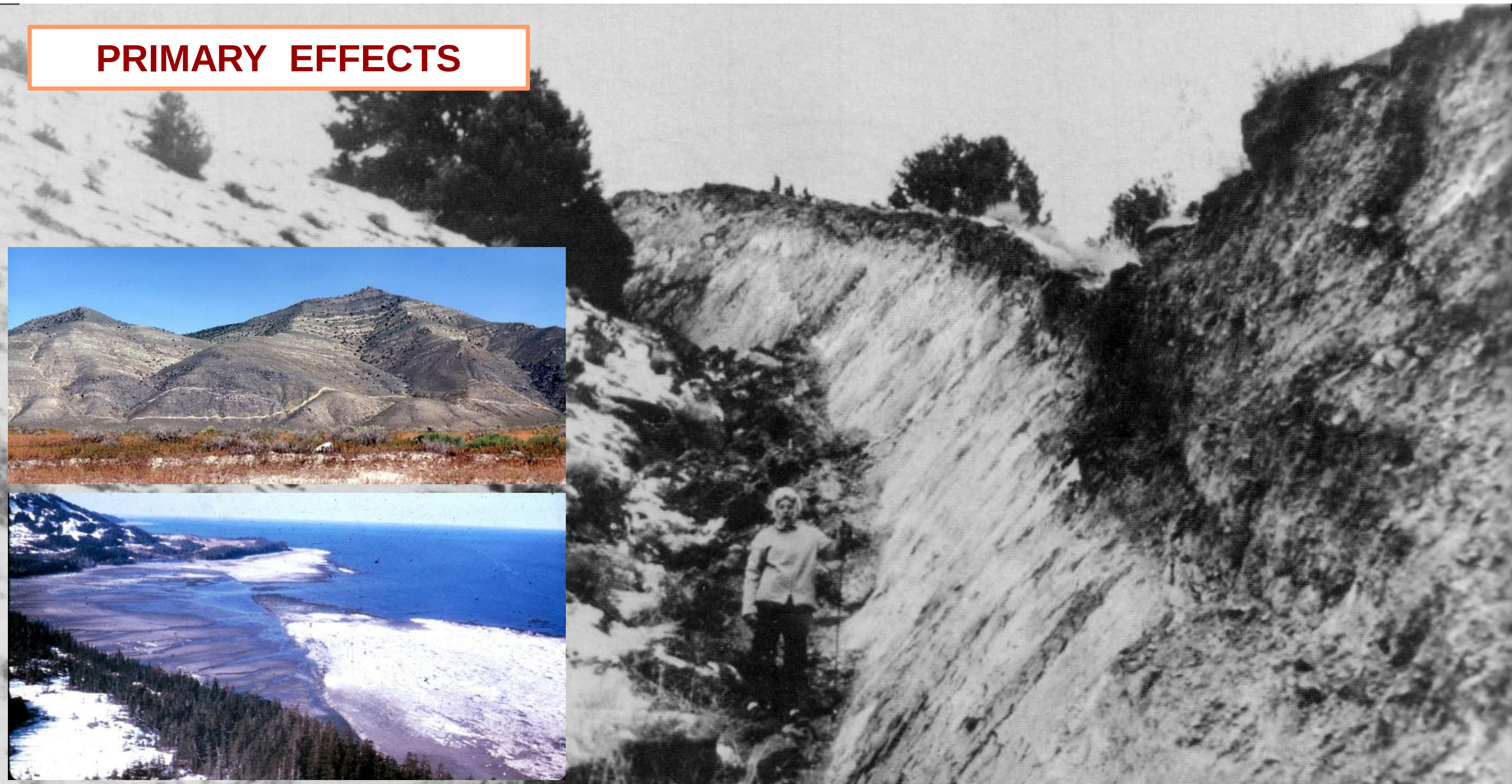
GEO

Earthquake Environmental Effects Catalogue

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

Earthquake Environmental Effects - EEEs

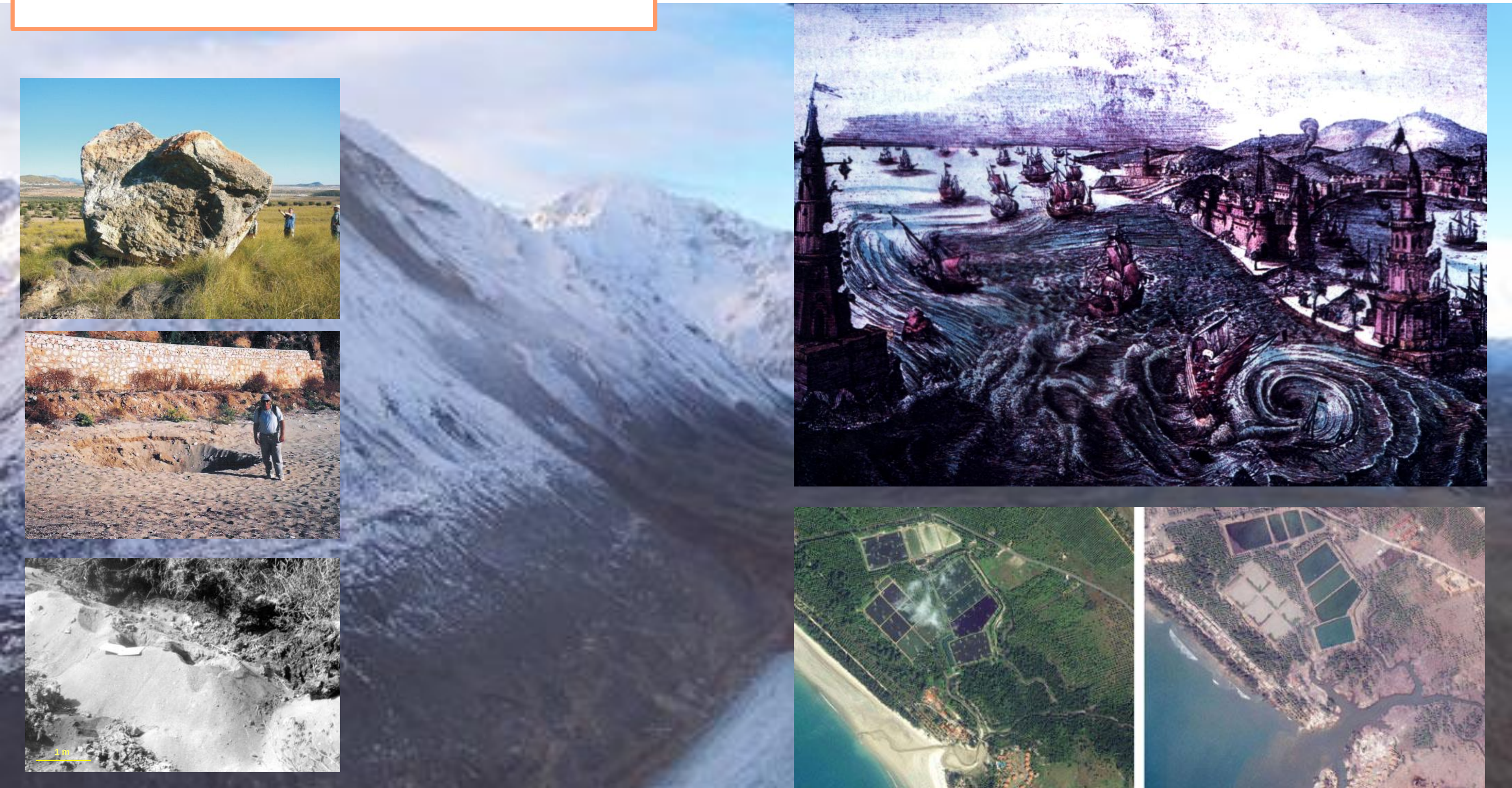
Earthquake Environmental Effects (EEEs) are any phenomena generated by a seismic event in the natural environment.



Earthquake Environmental Effects - EEEs

Earthquake Environmental Effects (EEEs) are any phenomena generated by a seismic event in the natural environment.

SECONDARY EFFECTS



EEEs cause additional impacts: two recent examples

Christchurch, New Zealand, 11 March 2011 (Mw = 6.3): huge liquefactions

EEEs cause additional impacts: two recent examples

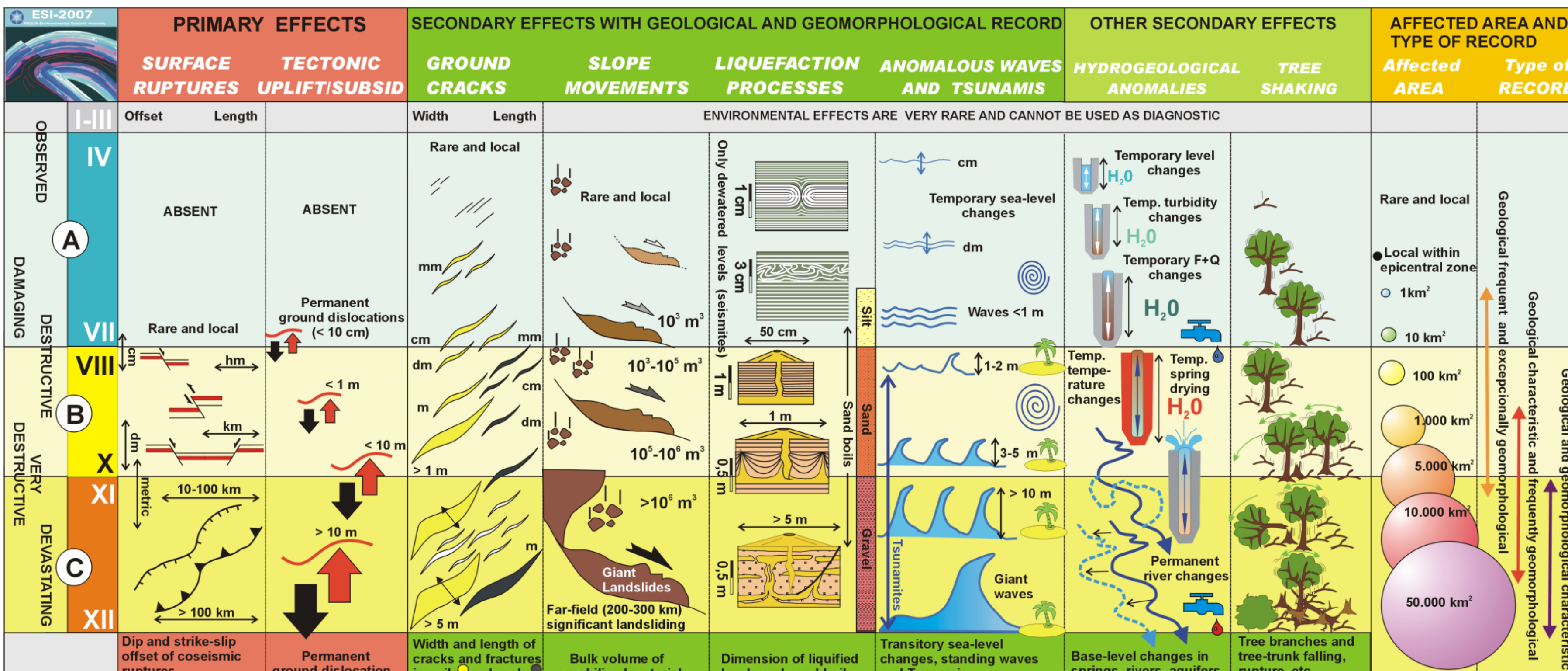
Eastern Japan, 11 March 2011 (Mw = 9.0): devastating tsunami

Sendai Coastal Plain: Rice Field Zone
AD 869 Jogan tsunami

EEEs for intensity assessment

Added value to traditional intensity evaluations:

- in not inhabited areas;
- not afflicted by saturation of all diagnostic effects events for the greatest earthquakes.



Michetti et al., 2007. Environmental Seismic Intensity scale - ESI 2007. Memorie Descrittive della Carta Geologica d'Italia, 74. Servizio Geologico d'Italia, APAT, Rome, Italy

Silva et al., 2008. Catalogue of the geological and environmental effects of earthquakes in Spain in the ESI-2007 Macroseismic scale., Geotemas, 6. Spain

INQUA
International Union for Quaternary Research

Earthquake Environmental Effects Catalogue

Project 0811

"A global catalogue and mapping of earthquake environmental effects“

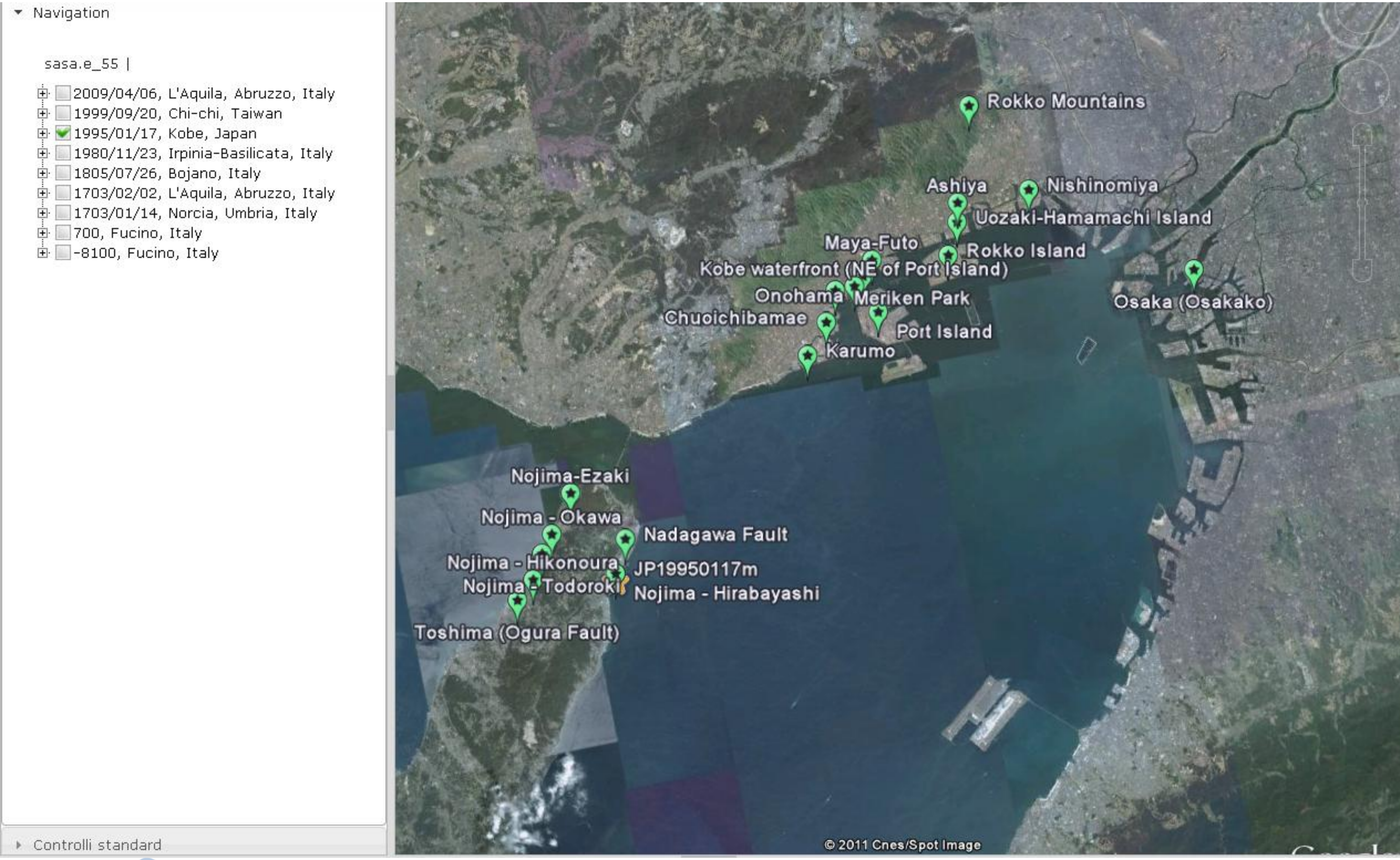
- The EEE Catalogue is an inventory of Earthquake Environmental Effects (EEE) compiled at global level.
- It is structured similarly to traditional seismic catalogues, in three different levels of detail (earthquake, locality, site).
- It is designed to collect data on recent, historical and paleo earthquakes.

http://www.eeecatalog.sinanet.apat.it/login.php

E

GROUP ON EARTH OBSERVATIONS

Year	Month	Day	Epicentral Area	Country	Magnitude	Magnitude Type	Damage Based Epicentral Intensity	Intensity Type	ESI Epicentral Intensity	Authors					
PALEOEARTHQUAKES															
-8100			Fucino	Italy	7.2	Me			11	Blumetti A.M. & Guerrieri L.				Locality	Map
-4700			Fucino	Italy	7.0	Me			11	Blumetti A.M. & Guerrieri L.				Locality	Map
-1500			Fucino	Italy	7.0	Me			11	Blumetti A.M. & Guerrieri L.				Locality	Map
700			Fucino	Italy	6.5	Me			10	Blumetti A.M. & Guerrieri L.				Locality	Map
HISTORICAL EARTHQUAKES															
1586	07	10	Callao	Peru	8.1	Mm	10	MM	11	Zamudio Y., Marin G. & Vilcapoma L.,				Locality	Map
1703	02	02	L'Aquila, Abruzzo	Italy	6.6	Mm	10	MCS	10	Blumetti A.M.				Locality	Map
1703	01	14	Norcia, Umbria	Italy	7.1	Mm	11	MCS	11	Blumetti A.M.				Locality	Map
1829	03	21	Torreveja, Alicante	Spain	6.6	Mm	10	EMS	9	Alfaro P., Silva P.G. & Bardají T.				Locality	Map
MODERN EARTHQUAKES															
1915	01	13	Fucino	Italy	7.0	Ms	10	MCS	11	Blumetti A.M. & Guerrieri L.				Locality	Map
1980	11	23	Irpinia-Basilicata	Italy	6.9	Mw	10	MCS	10	Esposito E. & Porfido S.				Locality	Map
1995	05	27	Neftegorsk, Sakhalin Island	Russia	7.4	Mw	9	MSK	11	Tatevossian R.E., Rogozhin E.A., Arefiev S.S., Ovsyuchenko A.N.				Locality	Map
1997	09	26	Colfiorito	Italy		Mw		MCS		Campagnolo D. & Sileo G.				Locality	Map
1999	01	25	Armenia	Colombia	6.1	Mw	7	MM		Lalinde Pulido C.P. & Franco L. E.				Locality	Map
1999	09	21	Chi-chi	Taiwan	7.7	Mw	6	JMA	11	Lin-Wong N. & Ota Y.				Locality	Map
2004	10	23	Chuetsu, Nijgata region	Japan	6.6	Mw	7	JMA		Ota Y. & Azuma T.				Locality	Map
2009	04	06	L'Aquila, Abruzzo	Italy	6.3	Mw	9	MCS	9	Lippmann L.				Locality	Map



http://10.158.102.214/terremoti/index.php

GROUP ON
EARTH OBSERVATIONS

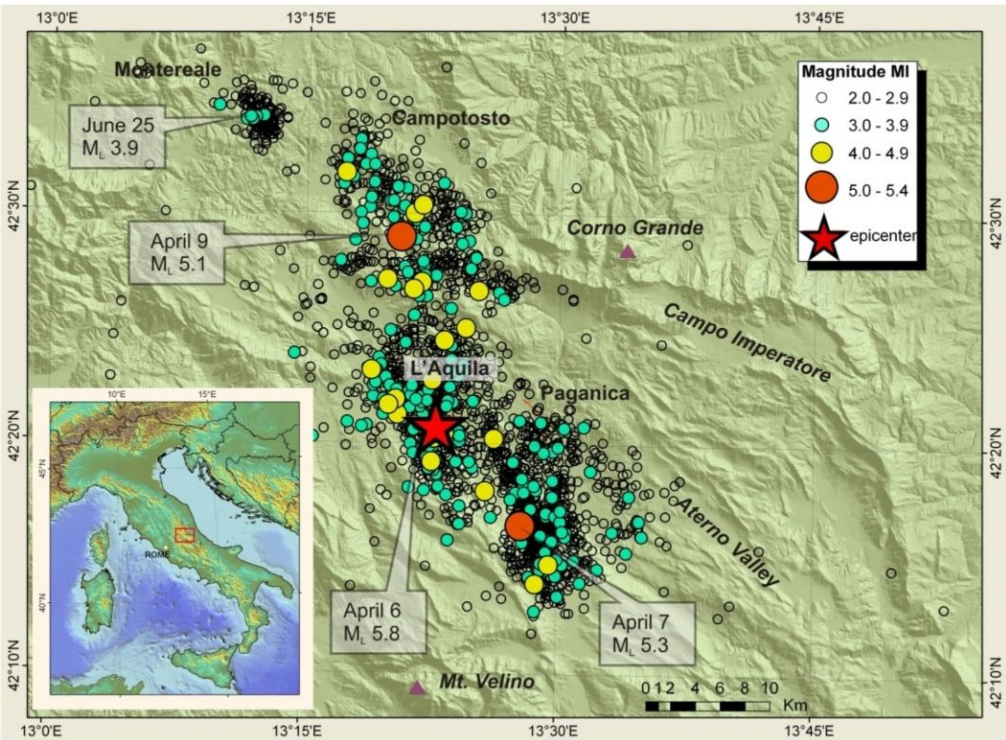
GEO Work Plan 2009 – 2011

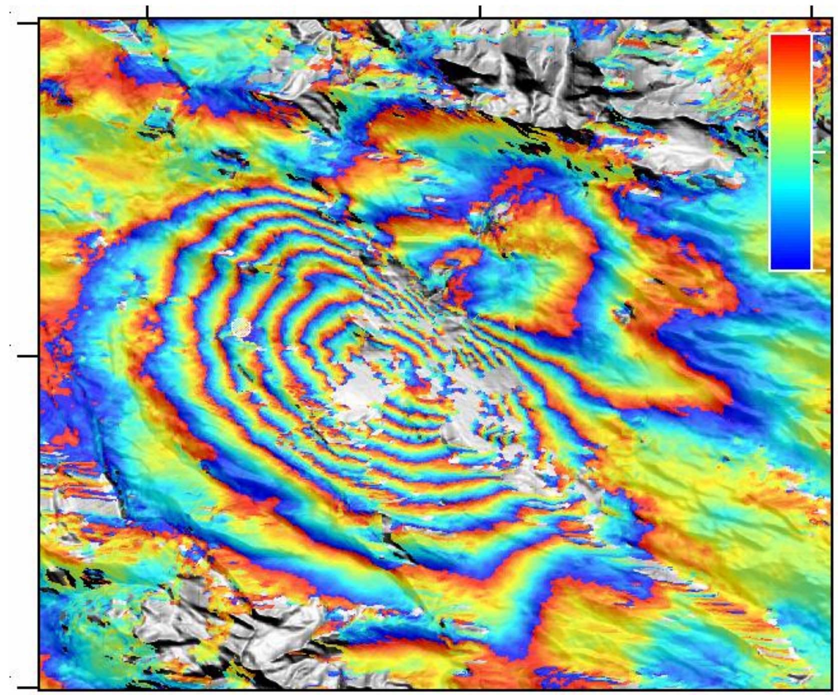
DI-09-01: Systematic Monitoring for Geohazards Risk Assessment

“Concerning seismic hazard assessment, in-situ data related to earthquakes environmental effects will be provided by a catalogue compiled at global level by several research and academic institutions worldwide in the frame of an international cooperation within INQUA (International Union for Quaternary Research)”.

GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

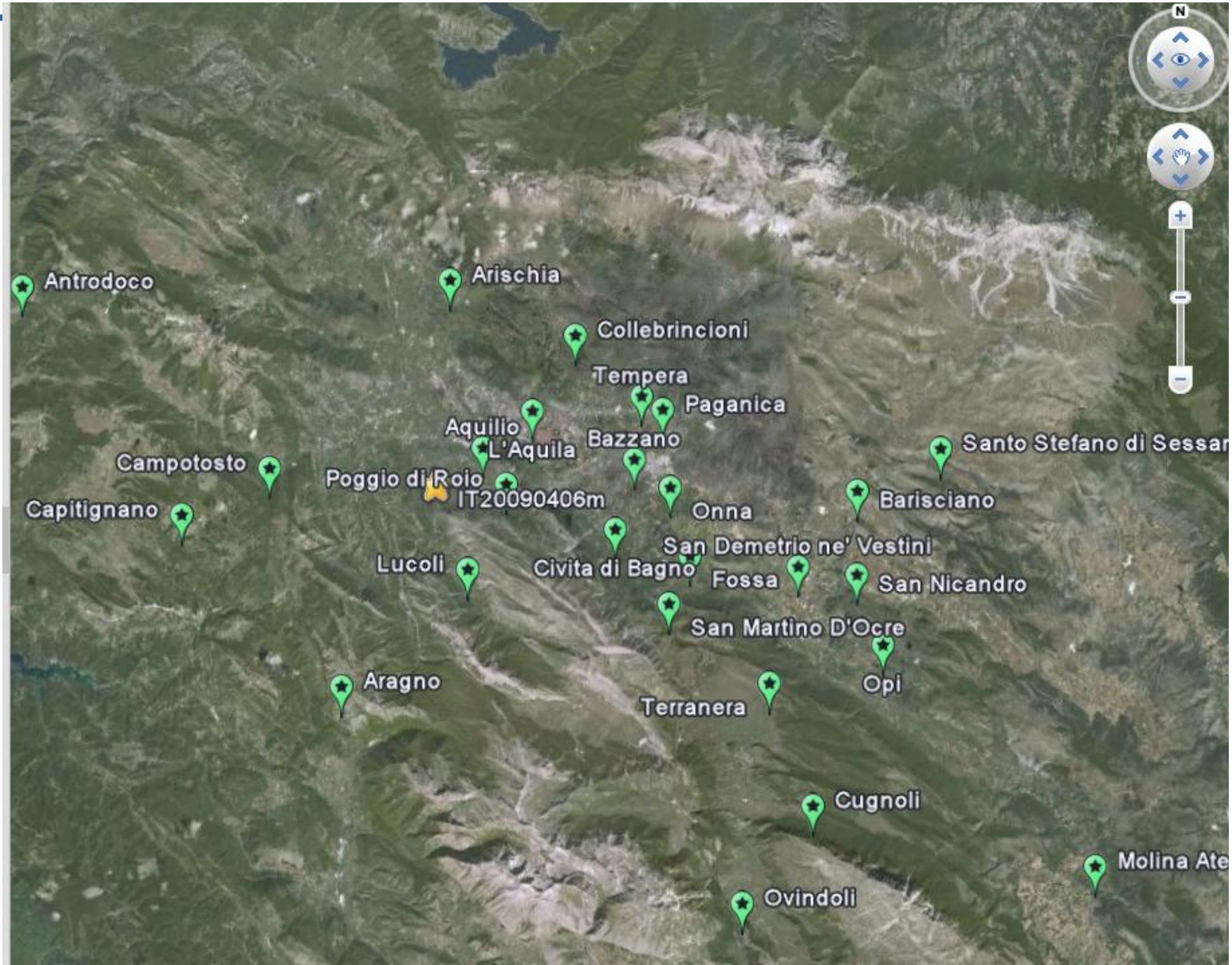
The geological effects of the 2009 L'Aquila earthquake (Central Italy)





GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

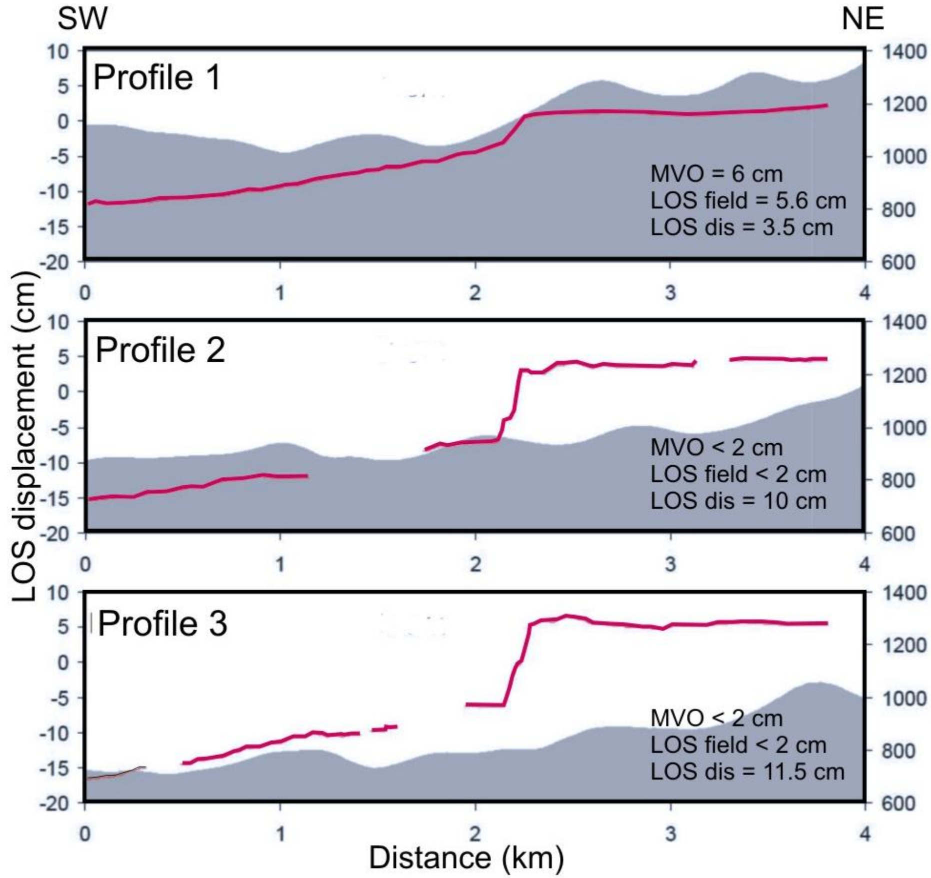
The geological effects of the 2009 L'Aquila earthquake (Central Italy)

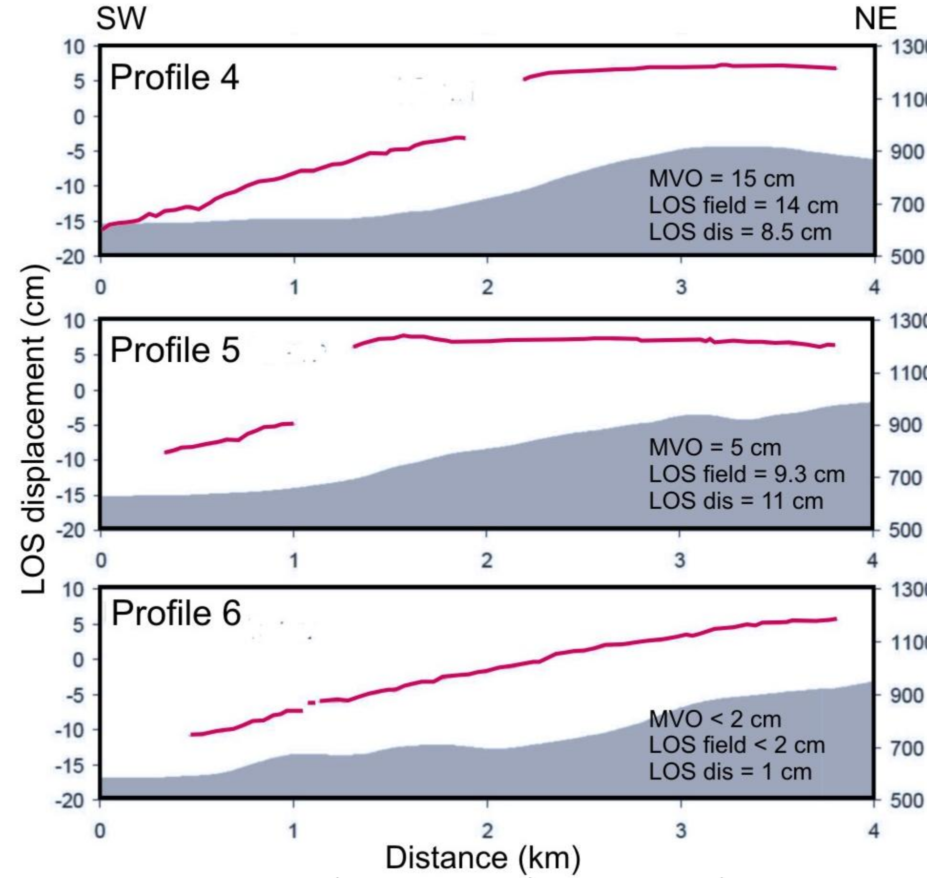


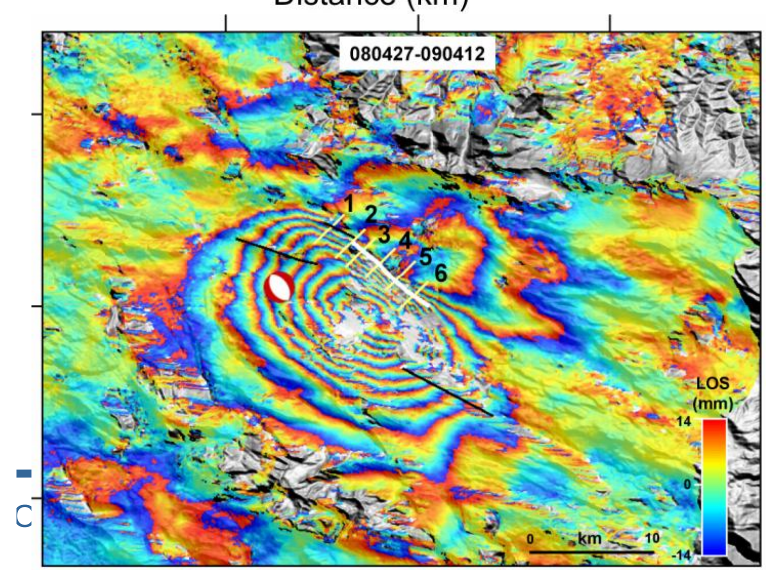
GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

The geological effects of the 2009 L'Aquila earthquake (Central Italy)

"from about 2,6 km up to 6-7 km, considering the discontinuous aligned ruptures toward northwest "



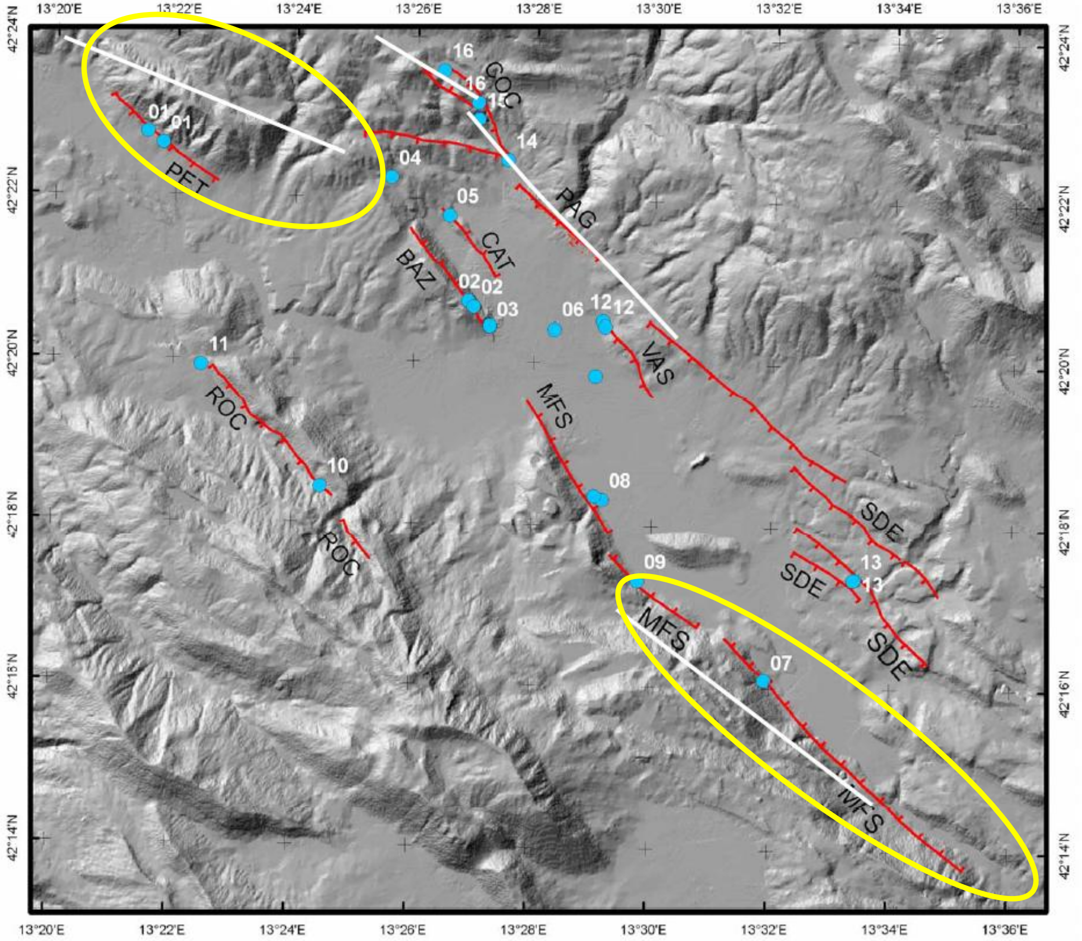




MVO = Measured vertical offset on the field.

LOS field = vertical offset projected on the satellite Line of sight.

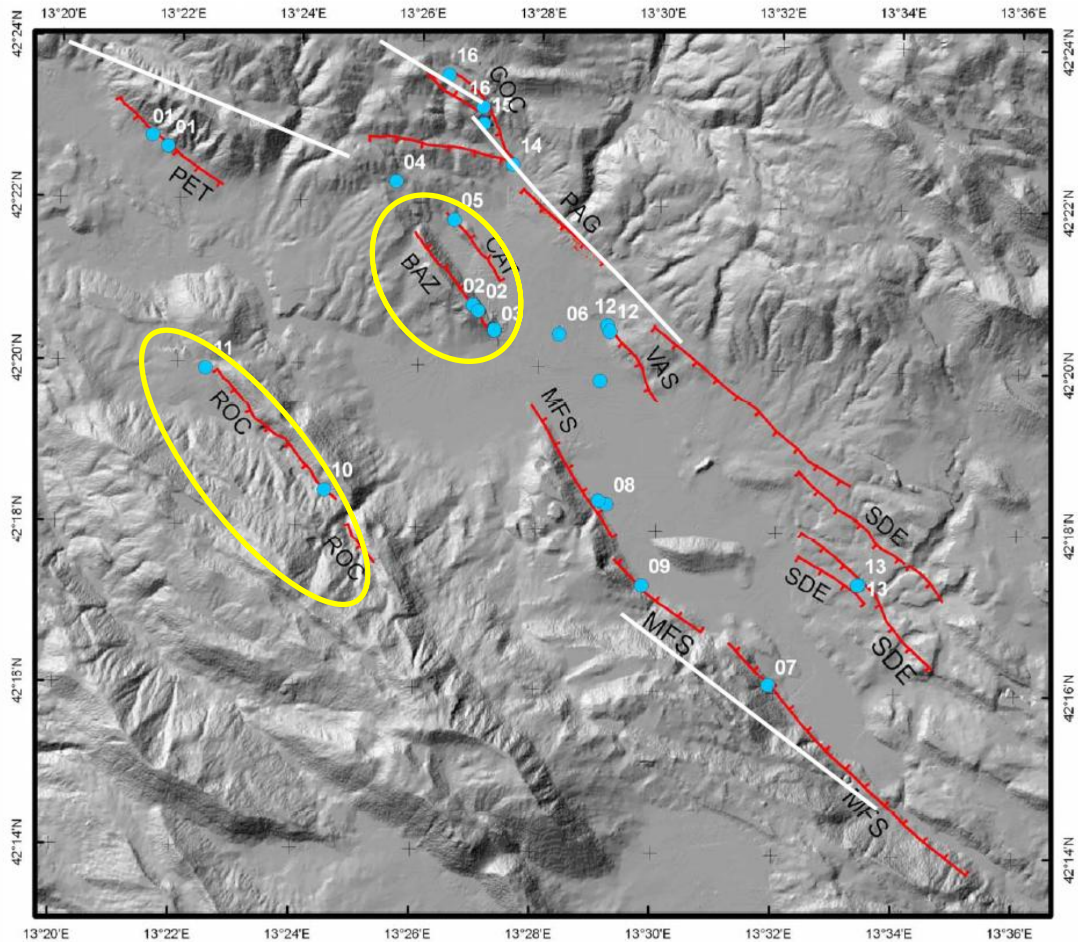
LOS dis = Radar Line of sight displacement.



Monticchio Fossa Stiffe fault

Pettino fault

Field and InSAR evidence along the Monticchio-Fossa-Stiffe Fault seems to be in a good agreement, although the InSAR results are contaminated by topographic contribution and de-correlation, and are thus somewhat questionable.



Along the Roio-Canetre fault, a fresh free face in rock, 1 cm high and more than 1 km long, associated with rock-debris and rock-to-rock tectonic contacts, suggests a primary origin. Unfortunately, such minor deformation cannot be seen by InSAR.

Along the Bazzano fault the maximum offsets was in places comparable to the maximum offsets of the Paganica ground ruptures. The lack of any LOS discontinuity does not support a primary origin.

Roio Canetre fault

Bazzano fault

The geological effects of the 2009 L’Aquila earthquake (Central Italy)

The scenario of minor surface ruptures triggered by the 2009 L’Aquila earthquake is typical for moderate (6.0 < M < 6.5) earthquakes in the Apennines.

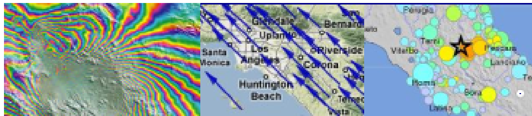
The combination of field observations and InSAR measurements was proven to be very helpful for detecting continuous surface ruptures, even for a moderate event such as the L’Aquila earthquake.

InSAR data as a field guide for mapping minor earthquake surface ruptures: Ground displacements along the Paganica Fault during the 6 April 2009 L’Aquila earthquake

L. Guerrieri,[1] G. Baer,[2] Y. Hamiel,[2] R. Amit,[2] A. M. Blumetti,[1] V. Comerci,[1] P. Di Manna,[1] A. M. Michetti,[3] A. Salamon,[2] A. Mushkin,[2] G. Sileo,[3] and E. Vittori[1]

GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

The geological effects of the 2009 L'Aquila earthquake (Central Italy)



SUPERSITES L'AQUILA

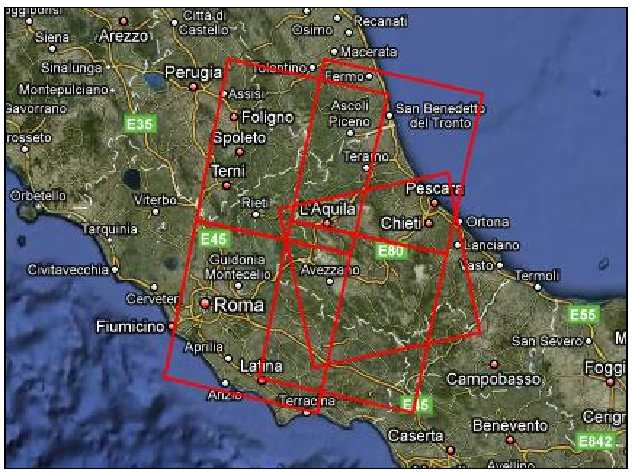
- main
- documents
- apply for access
- collaborators
- links
- publications and news
- contact mailing list

- Hawaii
- Los Angeles
- Seattle-Vancouver
- Vesuvius
- Etna
- Istanbul
- Tokyo
- Tohoku-oki

The GEO Geohazards Supersite website pages include preliminary results contributed by researchers. The copyright of these results remains with the contributors. Any reuse of the material posted requires permission from the copyright holders, unless otherwise specified.

Supersite L'Aquila

SAR Footprints

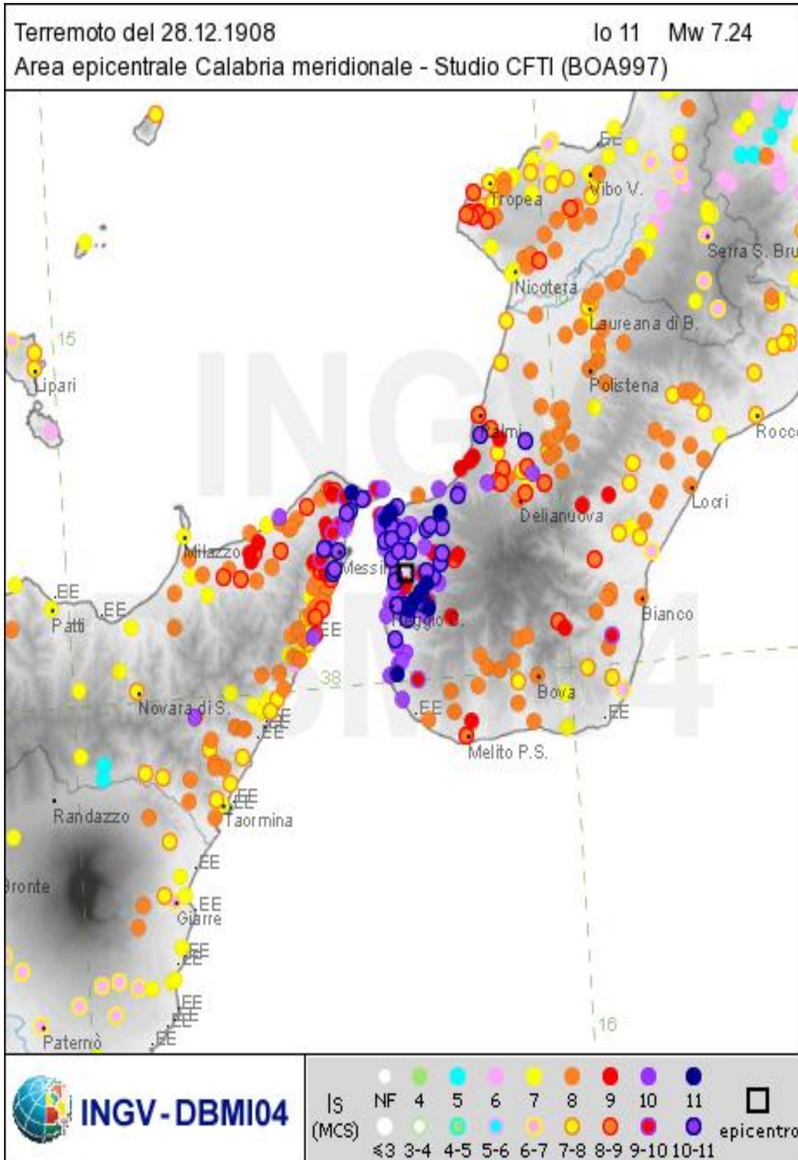


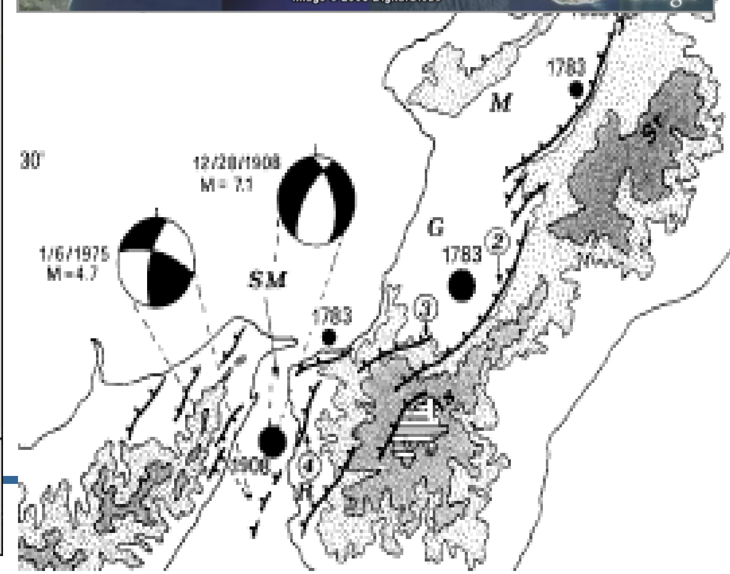
Data Source	availability
SAR	
Envisat	most recent Oct 7 2009
ERS	most recent Oct 4 2009
ALOS	No data available
TerraSAR-X	No data available
Radarsat-1	No data available
Radarsat-2	No data available
Cosmo	No data available
Seismic	
Short-period	IRIS lAquila Station Map
Long-period	No data available
Broad-band	No data available
Geodetic	
Continuous GPS	No data available
Campaign GPS	UNAVCO's DAI
Strainmeter	No data available
Tilt	No data available
Others	
Gas	No data available
gravity	No data available
High-res	No data available
Lidar	No data available

SAR Data

GEO Task DI-09-01a “Vulnerability Mapping and Risk Assessment”

The geological effects of the 1908 Southern Calabria – Messina earthquake (Southern Italy)

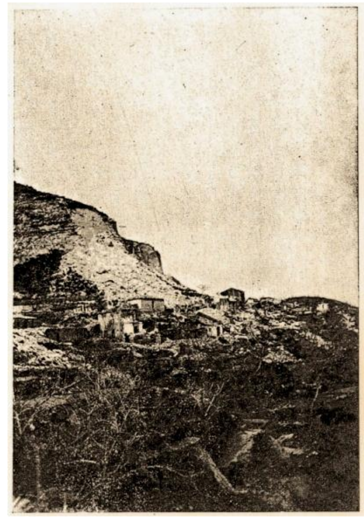




GEO Task DI-09-01a “Vulnerability Mapping and Risk Assessment”

The geological effects of the 1908 Southern Calabria – Messina earthquake (Southern Italy)

432 contemporary testimonies relating to **290** earthquake environmental effects



Sources:

- Newspapers,
- Contemporary Reports


L'ORA

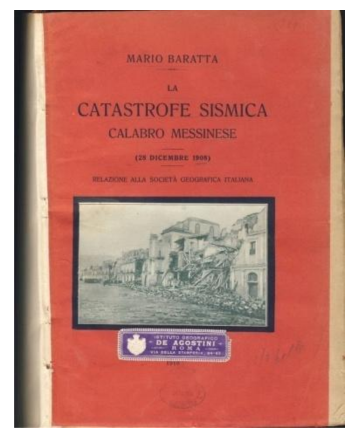
Gli avanzi di Messina s'estinguono in un rogo immenso

Non sono scampati alla morte che poche migliaia d'abitanti


GIORNALE DI SICILIA

Messina distrutta da un violento terremoto

Un terribile maremoto allaga la città sommergendola


MARIO BARATTA

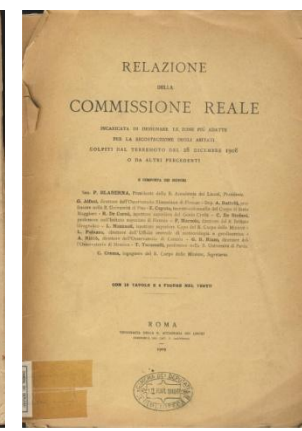
LA

CATASTROFE SISMICA

CALABRO MESSINESE

(28 DICEMBRE 1908)

RELAZIONE ALLA SOCIETÀ GEOGRAFICA ITALIANA


RELAZIONE

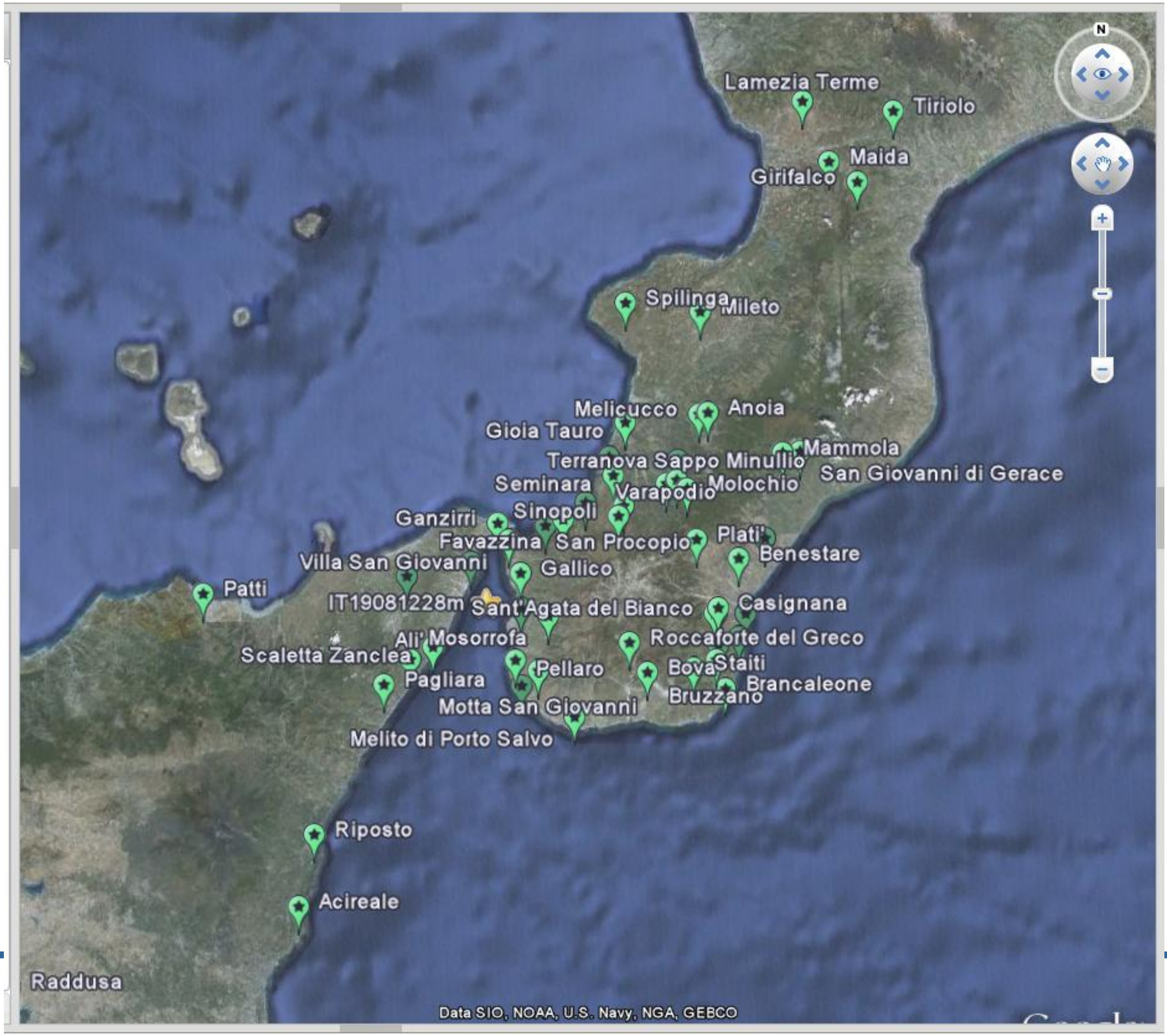
DELLA

COMMISSIONE REALE

ROMA

GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

The geological effects of the 1908 Southern Calabria – Messina earthquake (Southern Italy)



GEO Task DI-09-01a “Vulnerability Mapping and Risk Assessment”

The geological effects of the 1908 Southern Calabria – Messina earthquake (Southern Italy)

Implications for seismic risk of the Messina area

• The dataset clearly points out the vulnerability of the physical environment to the occurrence of 1908 Messina like-earthquakes (and associated tsunami). The identification and characterization of the most vulnerable sites nowadays exposed to the occurrence of earthquake environmental effects is essential in the seismic risk assessment of the Messina area.

• The analysis of the “in situ observations” reported in the contemporary sources allowed us to map the spatial distribution of ground coseismic environmental effects of the 1908 earthquake. This information is essential to better estimate the future impact of a similar event on a town like Messina that has experienced a strong urban and infrastructural growth since then.

GEO Task DI-09-01a "Vulnerability Mapping and Risk Assessment"

The geological effects of the 1908 Southern Calabria – Messina earthquake (Southern Italy)

EUCENTRE

University of Pavia

Remote Sensing Group

GROUP ON EARTH OBSERVATIONS

GEO Task DI-09-01a

Activity on "satellite-based global mapping of seismic vulnerability"

Fabio Dell'Acqua, Paolo Gamba

EUCENTRE – Telecommunication & Remote Sensing Section

University of Pavia – Remote Sensing Group

(fabio.dellacqua@unipv.it)