

Task 2. Test site “Messina Strait” Margheriti L., CNT-INGV
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*An on-land, off-shore integrated seismic network for monitoring the region struck by the M 7, 1908 Messina earthquake and **understanding the relationship between present stress regime and earthquake activity.***

S5-Task 2 supports ongoing research on Messina strait test site where the INGV is developing advanced monitoring geophysical networks in the frame of Messina 1908-2008 project

<p>Task 2. Test site “Messina Strait” Margheriti L., CNT-INGV margheriti@ingv.it</p> <p><i>An on-land, off-shore integrated seismic network for monitoring the region struck by the M 7, 1908 Messina earthquake and understanding the relationship between present stress regime and earthquake activity.</i></p>	<p>WP2.1 D’Anna e Mangano CNT-INGV danna@ingv.it; mangano@ingv.it</p>	<p><i>Sea Bottom Seismograph installation and data transmission testing through acoustic link</i></p>
	<p>WP2.2 Moretti , CNT-INGV moretti@ingv.it</p>	<p><i>Integrated on-land and off-shore seismic data bank and refined earthquake location</i></p>
	<p>WP2.3 Piccinini RM1- INGV piccinini@ingv.it</p>	<p><i>Seismic anisotropy analysis aimed at defining the present crustal deformation regime</i></p>
	<p>WP2.4 Mattia, CT-INGV mattia@ct.ingv.it</p>	<p><i>Strain field of Calabria and Peloritano regions from GPS data acquisition and modeling</i></p>
	<p>WP2.5 Neri, Univ. Messina geoforum@unime.it</p>	<p><i>Fault mechanisms and stress regime orientations in the Messina strait.</i></p>

Messina 1908 – 2008 Project

- To mark the centennial anniversary of the 1908 earthquake that shook Messina, Italy, the Istituto Nazionale di Geofisica e Vulcanologia (**INGV**) began the “Messina 1908–2008” research project. The aim is to clarify the extension deformation processes that occur in the Strait of Messina and to **understand relationships between subduction and crustal deformation** there by merging existing data and studies, and by collecting new and more detailed seismological, geodetic, historical, and satellite observations.
- The Messina 1908–2008 project’s assemblage of a database and integration of innovative technologies could transform **our understanding of the crust and mantle structure of the active tectonics and seismic hazards of the Strait of Messina.**

Messina 1908 – 2008 Project

Messina 1908-2008 Team Members

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Giuseppe D'Anna, Giorgio Mangano, Antonino D'Alessandro, Roberto D'Anna, Giuseppe Passafiume, and Stefano Speciale, **CNT, INGV, Gibilmanna, Italy;**

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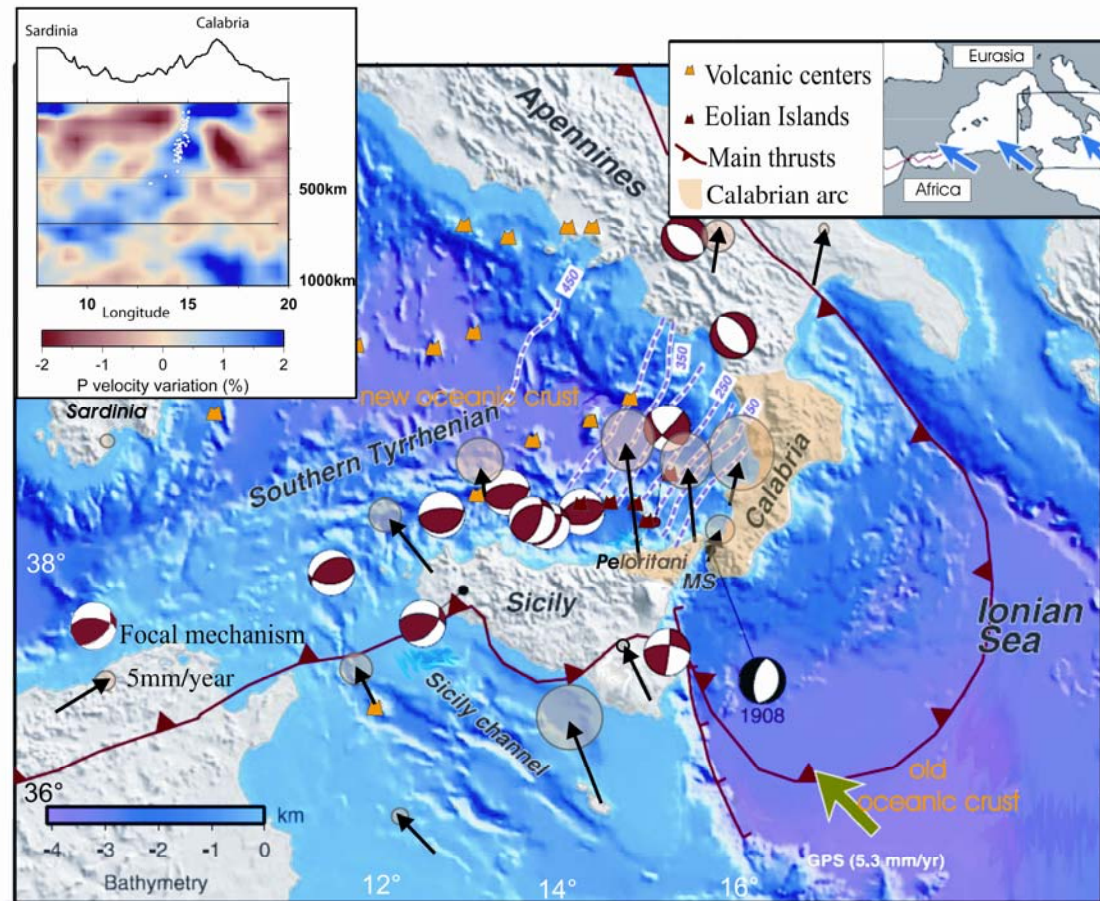
Enrico Serpelloni, **CNT, INGV, Bologna, Italy;**

Nicola D'Agostino, Claudia Piromallo and Davide Piccinini, **Sismologia e Tettonofisica, INGV, Rome Italy;**

Silvia Pondrelli, sezione di Bologna, INGV, **Bologna, Italy.**

Messina 1908 – 2008 Project

State of the art

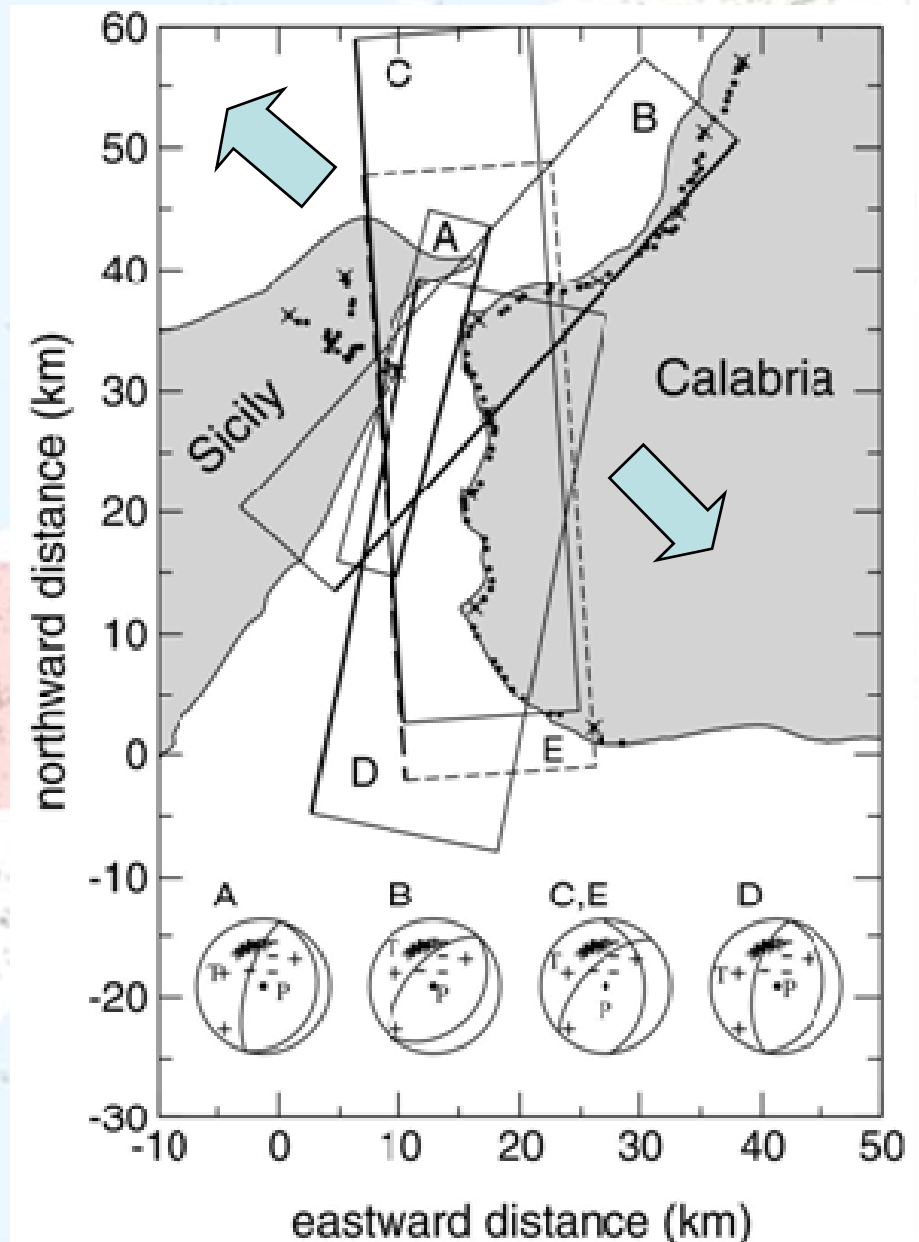


- Amiani A., Serpelloni E., and Bonazzi C. (2007) Pattern of deformation around the central Aeolian Island: evidence from multichannel seismics and GPS data. *Terra Nova* 19, 5 pp 317-323
- D'Agostino, N., and G. Selvaggi (2004), Crustal motion along the Eurasia-Nubia plate boundary in the Calabrian Arc and Sicily and active extension in the Messina Straits from GPS measurements, *J. Geophys. Res.*, 109, B11402, doi:10.1029/2004JB002998.
- Faccenna, C., T. W. Becker, F. P. Lucente, L. Jolivet, and F. Rossetti (2001), History of subduction and back-arc extension in the central Mediterranean, *Geophys. J. Int.*, 145, 809–820.
- Lucente F.P., Margheriti L., Piromallo C. and Barruol G. "Seismic anisotropy reveals the long route of the slab through the western-central Mediterranean mantle" *EPSL* 241 517-529.
- Nicolosi, I., F. Speranza and M. Chiappini, 2006, Ultrafast oceanic spreading of the Marsili Basin, southern Tyrrhenian Sea: Evidence from magnetic anomaly analysis, *Geology*, 34(9), 717-720.
- Neri G., Barberi G., Oliva G., Orecchio B. (2004). Tectonic stress and seismogenic faulting in the area of the 1908 Messina earthquake, South Italy. *Geophysical Research Letters*. vol. 31 (10), pp. L10602-1-L10602-5.
- Pino, N. A., D. Giardini, and E. Boschi, The December 28, 1908, Messina Straits, southern Italy, earthquake: Waveform modeling of regional seismograms, *J. Geophys. Res.*, 105, 25,473– 25,492, 2000.
- Pondrelli, S., C. Piromallo, and E. Serpelloni (2004), Convergence vs. retreat in Southern Tyrrhenian Sea: Insights from kinematics, *Geophys. Res. Lett.*, 31, L06611, doi:10.1029/2003GL019223.

Margheriti, L. and Messina 1908-2008 team –
[Understanding crust dynamics and subduction in southern Italy](#) ,
Eos Trans. AGU, 89(25), 225–226.

1908- FAULT GEOMETRY

Models of the 1908 earthquake source. The figure shows the surface projection of the causative fault according to: A – Schick (1977); B – Bottari et al. (1986); C – Capuano et al. (1988); D – Boschi et al. (1989); E – De Natale and Pingue (1991). Thick sides are the upper ones. From Amoruso et al. (2002).



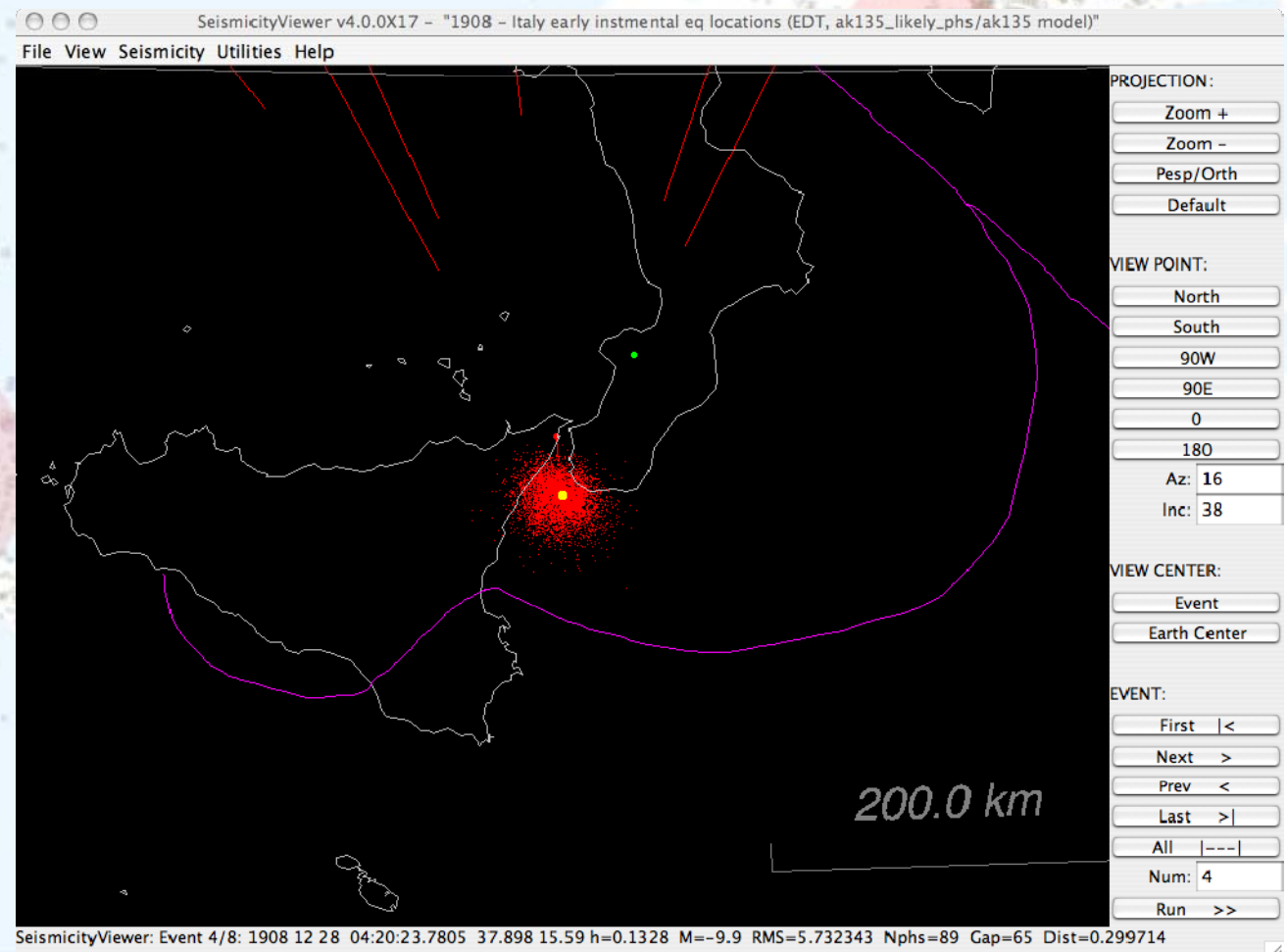
1908 – NUCLEATION POINT

Source directivity: $V_p=5$ km/s, $V_s= 2.7$ km/s, $V_r=2$ km/s
 → UNILATERAL rupture model from South to North

Pino et al., 2000

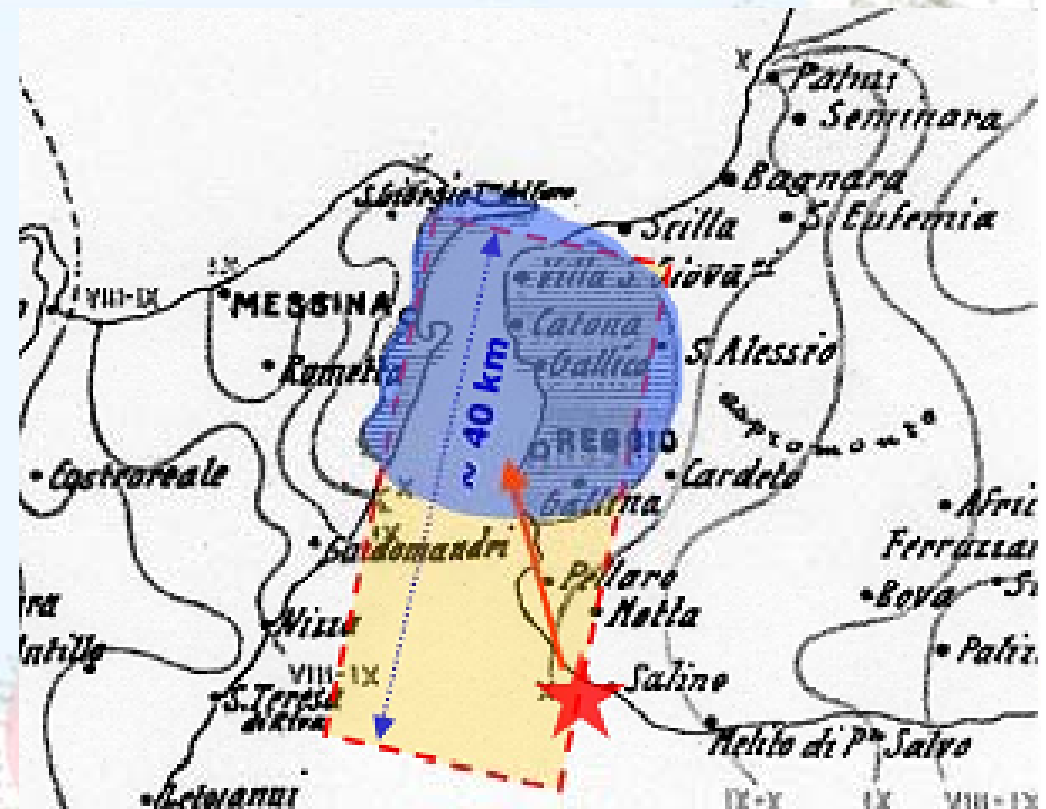
37.898N-
 15.59E
 h=0.13km (non
 vincolata)

(Michelini et al.,
 personal com.
 2008)



Synoptic view of the 1908 earthquake rupture history and of the associated damage. The region of largest intensity is outlined in blue, the surface projection of the reference fault in yellow (from Baratta, 1910, modified).

Strike (degrees)	20°
Dip (degrees)	29°
Rake (degrees)	270°
Length (km)	40.0
Width (km)	20.0
Min depth (km)	3.0
Max depth (km)	12.7
Slip (m)	1.42
M_w	7.0
M_0 (Nm)	3.5×10^{19}
Longitude	15.378 N
Latitude	37.939 E



1908 - FAULT GEOMETRY - DISS

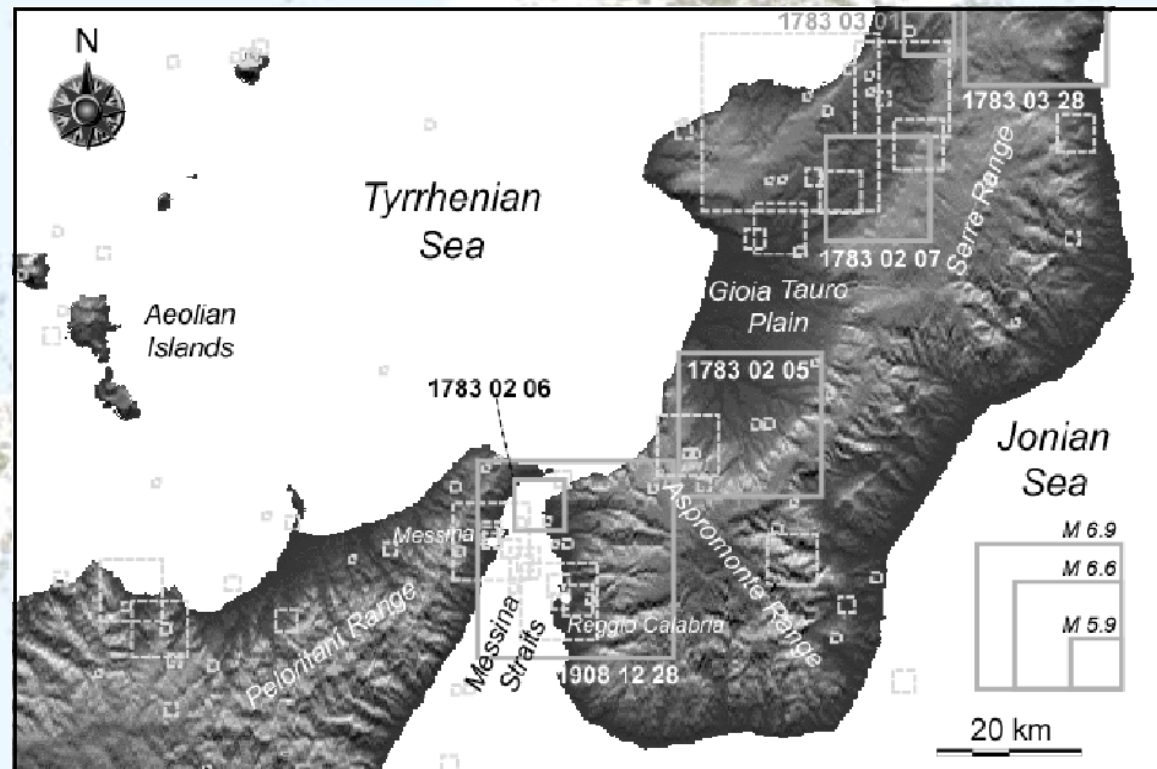
Coordinates of southernmost corner of fault projection onto the surface

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Historical seismicity

several large events ($M > 6$) have taken place in the past (91 B.C., August 31, 853; February 6, 1783; November 16, 1894 [Boschi et al., 1997; Guidoboni et al., ???])

Historical seismicity of the Messina Straits and surroundings (from Catalogue of Strong Earthquakes in Italy, Boschi et al., 2000).



Recent seismicity

Although the straits zone is one of the most seismically active regions in Italy and several large events ($M > 6$) have taken place in the past (91 B.C., August 31, 853; February 6, 1783; November 16, 1894 [Boschi et al., 1997]), only **four earthquakes with $ML > 4$ have been recorded here in the last decades**: March 10, 1952, $ML=4.5$; March 24, 1961, $ML=4.7$; **January 16, 1975, $ML=4.7$** ; and May 14, 1985, $ML=4.1$ [Bottari et al., 1989]. A fault, plane solution could only be computed for the 1975 event [Gasparini et al., 1982; Bottari et al., 1989].

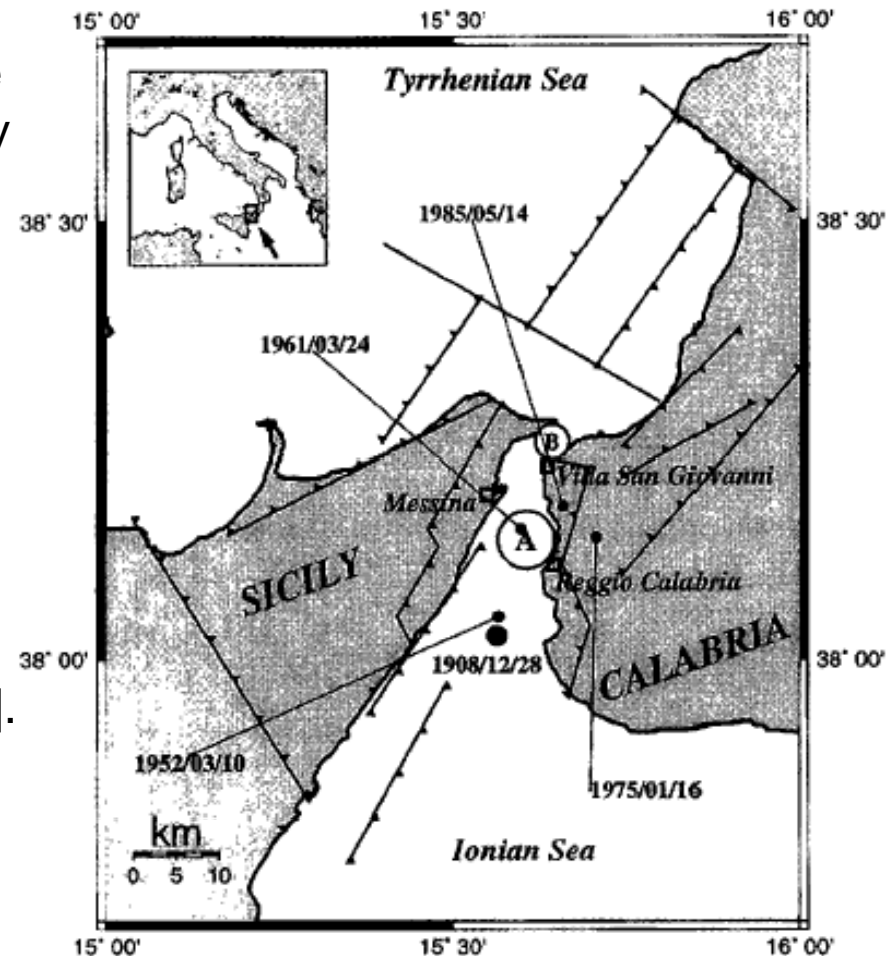


Figure 1. Structural map of the Messina Straits region, with the location of the major fault systems (see text for the references). The location of 1908 earthquake and the areas of maximum energy release according *Omori* [1909] (A) and *Baratta* [1910] (A,B) are also shown, along with the epicenters of the strongest events in the last 50 years.

Studies with data from permanent networks

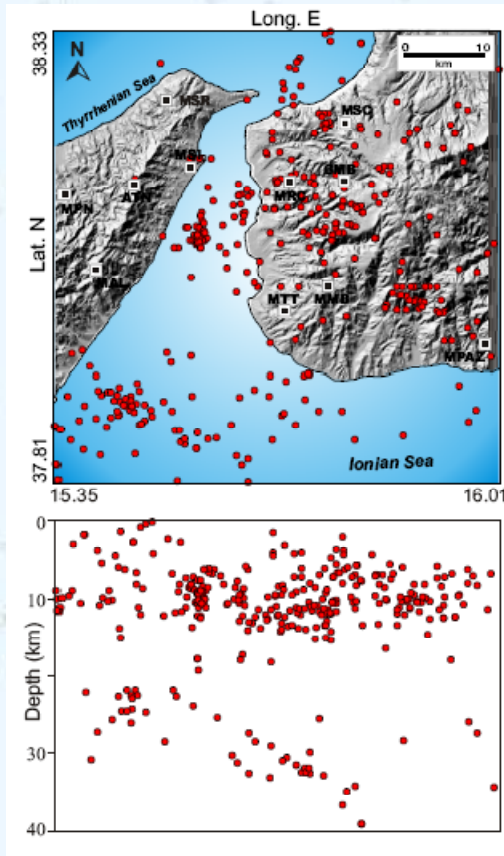
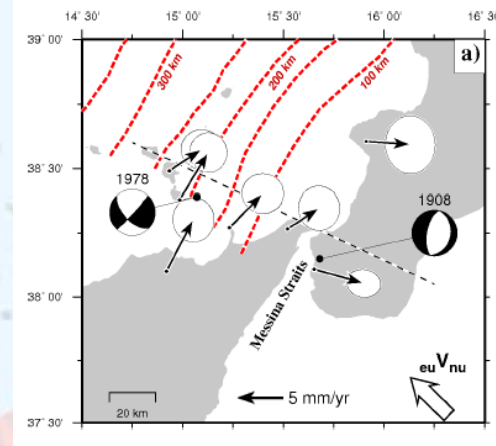
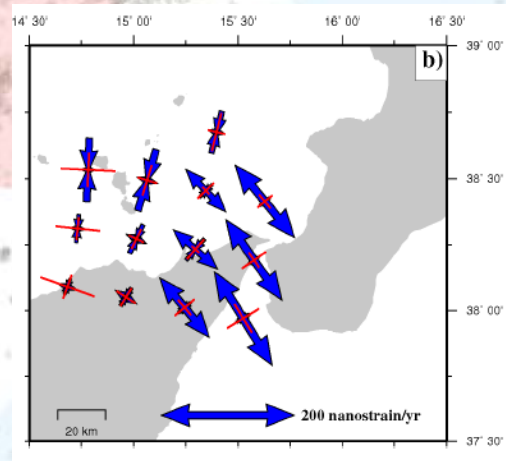


Fig. 2 - Map view, N-S and E-W cross sections of the studied area with earthquakes located from 1999 to 2007. Black/white boxes indicate seismic stations.

Scarfi et al in prep



Combined velocity solution in a Nubia reference frames.

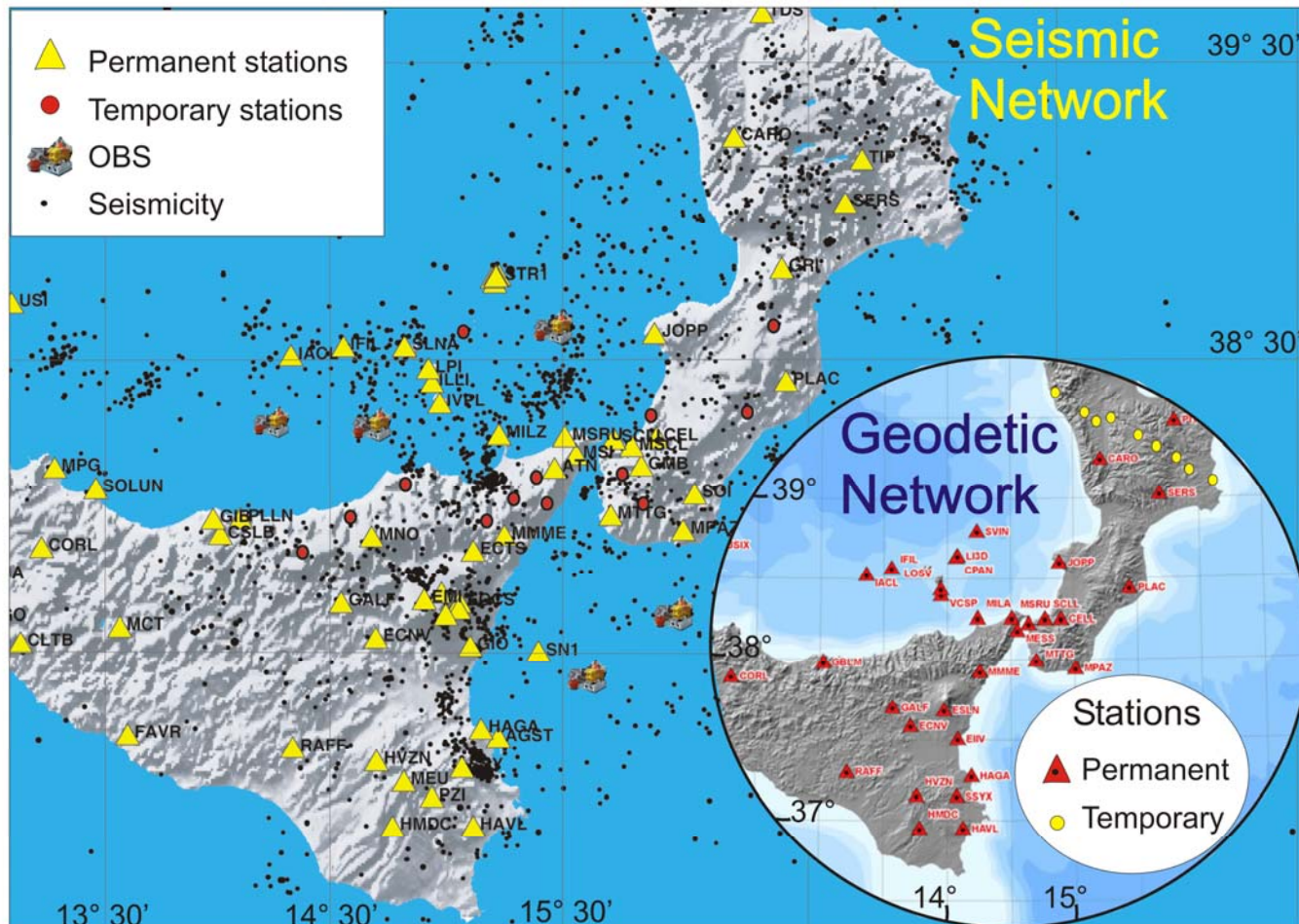


Principal axes of the horizontal strain rate tensor (in blue) and associated 1 sigma errors (red bars).

D'Agostino e Selvaggi

Messina 1908 – 2008 Project

Monitoring networks



S5

DPC 2007-2009

High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

Temporary deployment of Messina 1908-2008



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S5

DPC 2007-2009

High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

Messina 1908 – 2008 Project

Furthermore the surface deformation is going to be imaged by SAR analysis



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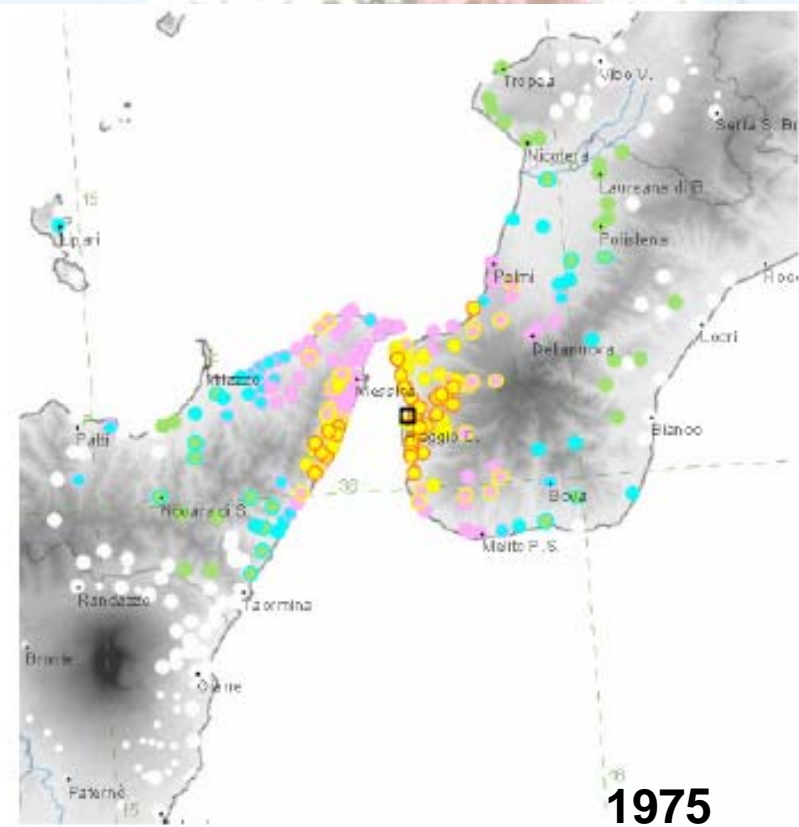
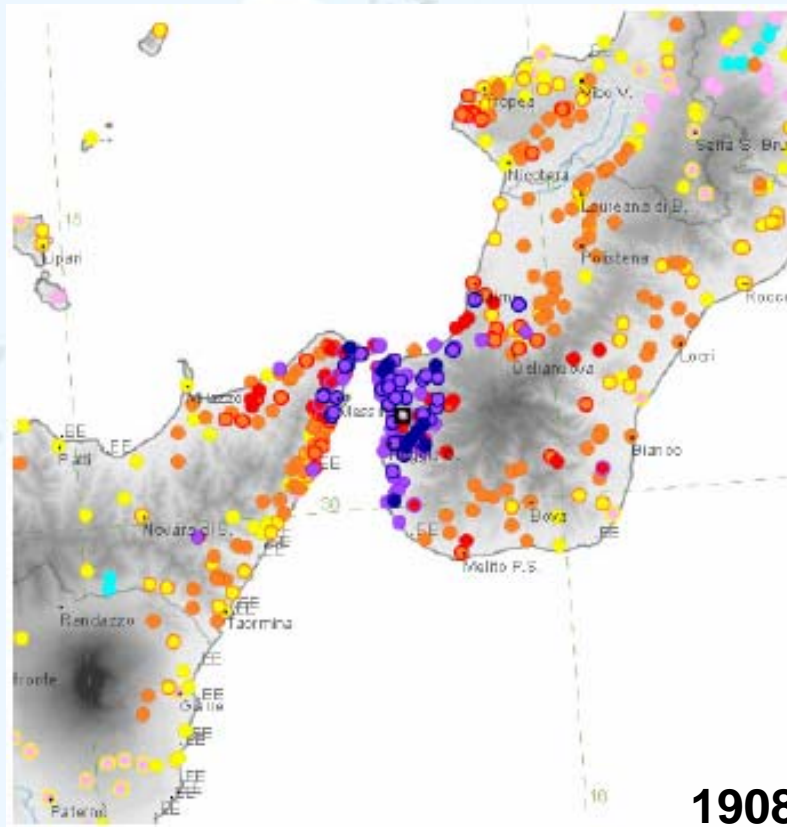
S5

DPC 2007-2009

High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

Messina 1908 – 2008 Project

And historical earthquakes are under studies at SISMOS (INGV)



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Table of deliverables

- Wp2.1 D9 Test of marine seismic deployment and integration of OBS data with on land data.
- Wp 2.1 D10 Test of the acoustic link to get quasi-real time data from OBS stations
- Wp 2.2 D11 Integrated data bank of continuous recordings for the period October 2007-October 2009 at the Messina strait test-site
- Wp 2.2 D12 Refined earthquakes locations in the Tyrrhenian and Ionian regions around Messina Strait to define seismogenic structures
- Wp 2.3 D13 An automatic code for the evaluation of shear wave splitting parameters; orientation and strength of the fracture field in the Messina strait area and its relation with the active stress field study of possible temporal variation in the anisotropy parameters
- Wp 2.4 D14 Processing of all available GPS data for the Messina strait area, map of the horizontal strain-rate field and computation of the inter-seismic strain loading and deep geometry of the 1908 Messina fault
- Wp 2.4 D15 Modelling of the source responsible for the December 28, 1908 earthquake, by using a numeric approach (i.e. finite element) 2.4
- Wp 2.5 D16 Database of focal mechanisms of earthquakes in the Messina Straits over the time period between 1988 and the end of the S5 Project
- Wp 2.5 D17 Map of the stress tensor orientations and simulation of potential damaging earthquakes in the Messina Straits area

Deliverables of Test site "Messina Strait" which have immediate impact and relevance for the Civil Protection Department (DPC)

- The integration of ocean bottom seismographs (OBS) inside the Italian National Seismic Network is one of the expected future development/improvement.
- The test of an acoustic link to transmit OBS data in near real-time is important for the seismic monitoring and for an eventual tsunami warning system to be installed in the region.(see S3 project).
- Refined earthquakes locations in the Tyrrhenian and Ionian regions around Messina Strait to define seismogenic structures
- The study of the deformation of the Calabro-peloritani arc using a multi-disciplinary approach (geodetic deformation, fracture field defined through seismic anisotropy, seismic strain evaluated by focal mechanisms) will furnish an interesting and detailed picture for the ongoing scientific debate (see state of the art).
- Computation of the inter-seismic strain loading and possible deep geometry of the 1908 Messina fault from GPS and leveling data.

Personale

Nominativo (Cognome e Nome)	Qualifica	Ente/Istituzione	Giorni/Persona (personale non a carico del progetto)	
			I fase	II fase
Margheriti Lucia	Prima Ricercatrice	INGV-CNT	1	3
D'Anna Giuseppe	Primo Tecnologo	INGV-CNT	2	2
Mangano Giorgio	CTER IV liv	INGV-CNT	0	0
Passafiume	CTER VI liv	INGV-CNT	1	1
Speciale	CTER VI liv	INGV-CNT	1	1
D'Anna Roberto	CTER VI liv	INGV-CNT	1	1
D'Alessandro Antonino	Borsista	INGV-CNT	1	3
Amato Alessandro	Dirigente di ricerca	INGV-CNT	0	0

Caprino Giovanni	dottorando	POLI BA	1	1
Guerra Ignazio	Professore ordinario	UNICAL	1	1
Gervasi Anna	Assegnista	UNICAL-INGV	0	0
Pastori Marina	Dottoranda	UNIPG	3	3
Monaco Carmelo	Prof. Ordinario	UNI CT	1	1
De Guidi Giorgio	Ricercatore	UNI CT	1	1
Neri Giancarlo	Prof. Ordinario	Università di Messina	3	3
Orecchio Barbara	Assegnista di Ricerca	Università di Messina	2	
Presti Debora	Assegnista di Ricerca	Università di Messina	4	4
da individuare mediante selezione	Co.co.co.	Università di Messina		
D'Amico Sebastiano	Borsista	Università di St. Louis (USA)	1	1
Guerra Ignazio	Prof. Ordinario	Università della Calabria	1	1
Totaro Cristina	Borsista	Università di Messina	2	2
Pondrelli Silvia	Primo Ricercatore	INGV-Bologna	1	1
Calò Marco	Dottorando di Ricerca	Centro Nazionale Terremoti-Gibilmanna	1	1
Luzio Darlo	Prof. Ordinario	Università di Palermo	1	1

Mcretti Milena	Ricercatrice	INGV-CNT	2	2
Govoni Aladino	Ricercatore	INGV-CNT	1	1
Mendiello Alfonso	Tecnologo	INGV-CNT	1	1
Di Stefano Raffaele	Ricercatore	INGV-CNT	0	0
De Gori Pasquale	Ricercatore	INGV-CNT	1	1
Baccheschi Paola	Borsista	INGV-CNT	0	0
Angela Chesi	CTER	INGV-CNT	1	1
Corrado Castellano	CTER VI liv	INGV-CNT	0	0
Arcoraci Luca	CTER VI liv	INGV-CNT	0	0
Piccinini Davide	Ricercatore	INGV-RM1	1	1
Pondrelli Silvia	Prima Ricercatrice	INGV-BO	1	1
Salimbeni Simone	Borsista	INGV-BO	1	1
Bianco Francesca	Prima Ricercatrice	INGV-OV-NA	1	1
Zaccarelli Lucia	Assegnista	INGV-OV-NA	1	1
Mattia Mario	Tecnologo	INGV CT	1	1
Aloisi Marco	Ricercatore	INGV CT	1	1
Bruno Valentina	Borsista	INGV CT	0	0
Palano Mimmo	Ricercatore	INGV CT	0	0
Pulvirenti Fabio	Borsista	INGV CT	1	1
Cannavò Flavio	Tecnologo	INGV CT	0	0
Cantarero Massimo	Tecnico	INGV CT	0	0
Bonforte Alessandro	Ricercatore	INGV CT	1	1
Puglisi Biagio	Tecnico	INGV CT	0	0
Cheloni Daniele	Borsista	INGV-CNT	0	0
D'Agostino Nicola	Primo ricercatore	INGV RM1	1	1
Sevaggi Giulio	Dirigente di ricerca	INGV CNI	0	0
Hunstad Ingrid	Ricercatrice	INGV CNT	0	0
Serpelloni Enrico	Ricercatore	INGV CNT	1	1
Anzidei Marco	Primo Ricercatore	INGV CNT	2	2
Avallone Antonio	Ricercatore	INGV CNT	1	1
Massucci	Tecnico	INGV CNT	0	0
Del Mese	Tecnico	INGV CNT	0	0
Costantino Domenica	Ricercatrice	PCI I RA	1	1
Angelici Maria Giuseppa	Dottoranda	PCL I BA	1	1

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7. Piano finanziario (in Euro) Task2 UR INGV

Categoria di spesa I fase	Wp1	Wp2	Wp3	Wp4	Tot
1) Spese di personale				6000	6000
2) Spese per missioni	1500	1000	1500	2000	6000
3) Costi amministrativi (solo per Coordinatori di Progetto)					
4) Spese per studi e ricerche ed altre prestazioni professionali		6333			6333
5) Spese per servizi	16000				16000
6) Materiale tecnico durevole e di consumo				5100	5100
7) Spese indirette (spese generali)	500		1000	1300	2800
Totale	18000	7333	2500	14400	42233
Categoria di spesa II fase	Wp1	Wp2	Wp3	Wp4	Tot
1) Spese di personale					
2) Spese per missioni	1500		1500	3500	6500
3) Costi amministrativi (solo per Coordinatori di Progetto)					
4) Spese per studi e ricerche ed altre prestazioni professionali		12667			12667
5) Spese per servizi					
6) Materiale tecnico durevole e di consumo				1700	1700
7) Spese indirette (spese generali)	500		1000	400	1900
Totale	2000	12667	2500	5600	22767,00
Categoria di spesa TOTALE	Wp1	Wp2	Wp3	Wp4	Tot
1) Spese di personale				6000	6000
2) Spese per missioni	3000	1000	3000	5.500	12500
3) Costi amministrativi (solo per Coordinatori di Progetto)					
4) Spese per studi e ricerche ed altre prestazioni professionali		19000			19000
5) Spese per servizi	16000				16000
6) Materiale tecnico durevole e di consumo				6.800	6800
7) Spese indirette (spese generali)	1000		2000	1700	4700
Totale	20000	20000	5000	20000	65000

Categoria di spesa	Wp5
1) Spese di personale	19000,00*
2) Spese per missioni	2000,00
3) Costi amministrativi (solo per Coordinatori di Progetto)	
4) Spese per studi e ricerche ed altre prestazioni professionali	
5) Spese per servizi	
6) Materiale tecnico durevole e di consumo	
7) Spese indirette (spese generali)	
Totale	21000,00

Categoria di spesa	Wp5
1) Spese di personale	19000,00
2) Spese per missioni	6000,00
3) Costi amministrativi (solo per Coordinatori di Progetto)	
4) Spese per studi e ricerche ed altre prestazioni professionali	
5) Spese per servizi	
6) Materiale tecnico durevole e di consumo	
7) Spese indirette (spese generali)	
Totale	25000,00

Categoria di spesa	Wp5
1) Spese di personale	
2) Spese per missioni	4000,00
3) Costi amministrativi (solo per Coordinatori di Progetto)	
4) Spese per studi e ricerche ed altre prestazioni professionali	
5) Spese per servizi	
6) Materiale tecnico durevole e di consumo	
7) Spese indirette (spese generali)	
Totale	4000,00