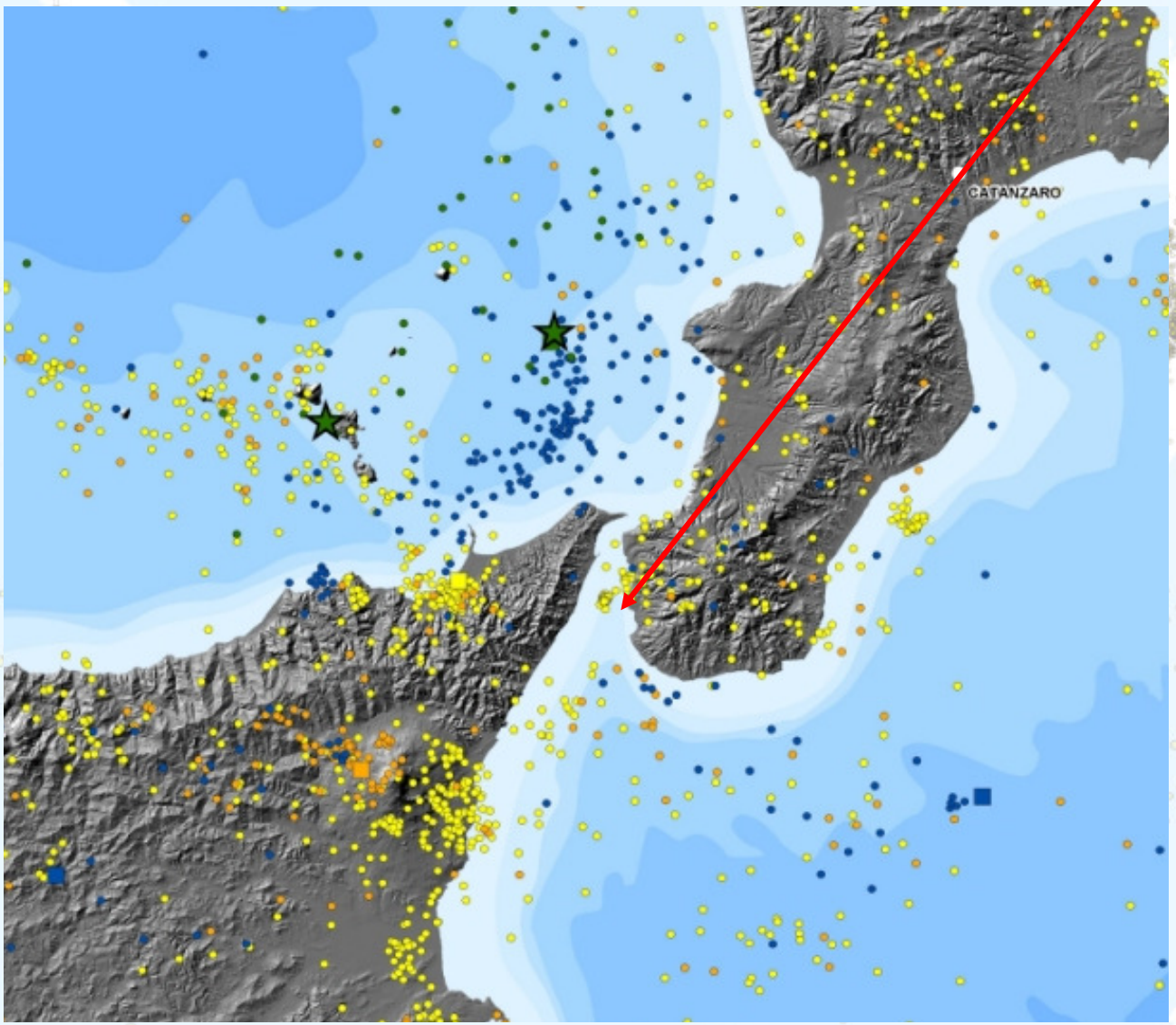
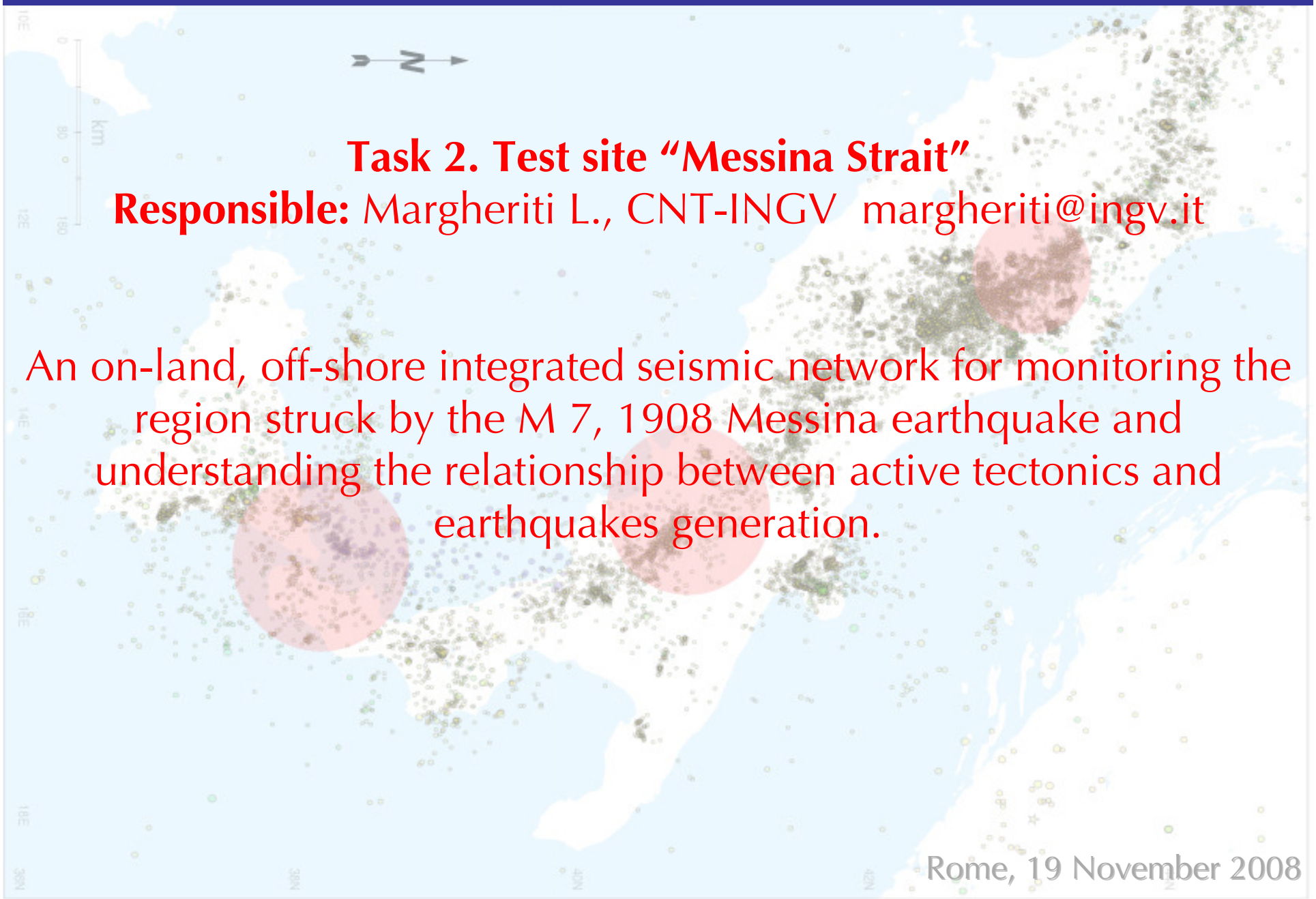
Task 2. Messina Strait



Rome, 19 November 2008



Task 2. Test site "Messina Strait"

Responsible: Margheriti L., CNT-INGV margheriti@ingv.it

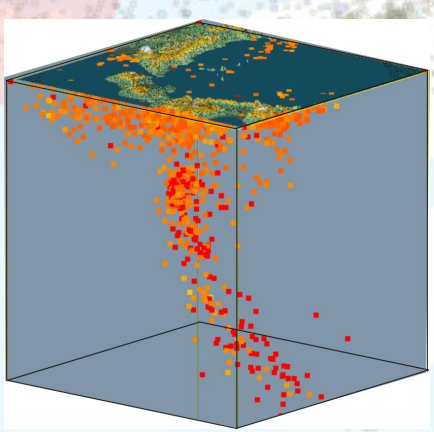
An on-land, off-shore integrated seismic network for monitoring the region struck by the M 7, 1908 Messina earthquake and understanding the relationship between active tectonics and earthquakes generation.

S5 project is aimed at supporting the ongoing research on selected Italian test sites where advanced monitoring geophysical networks are available or under construction.

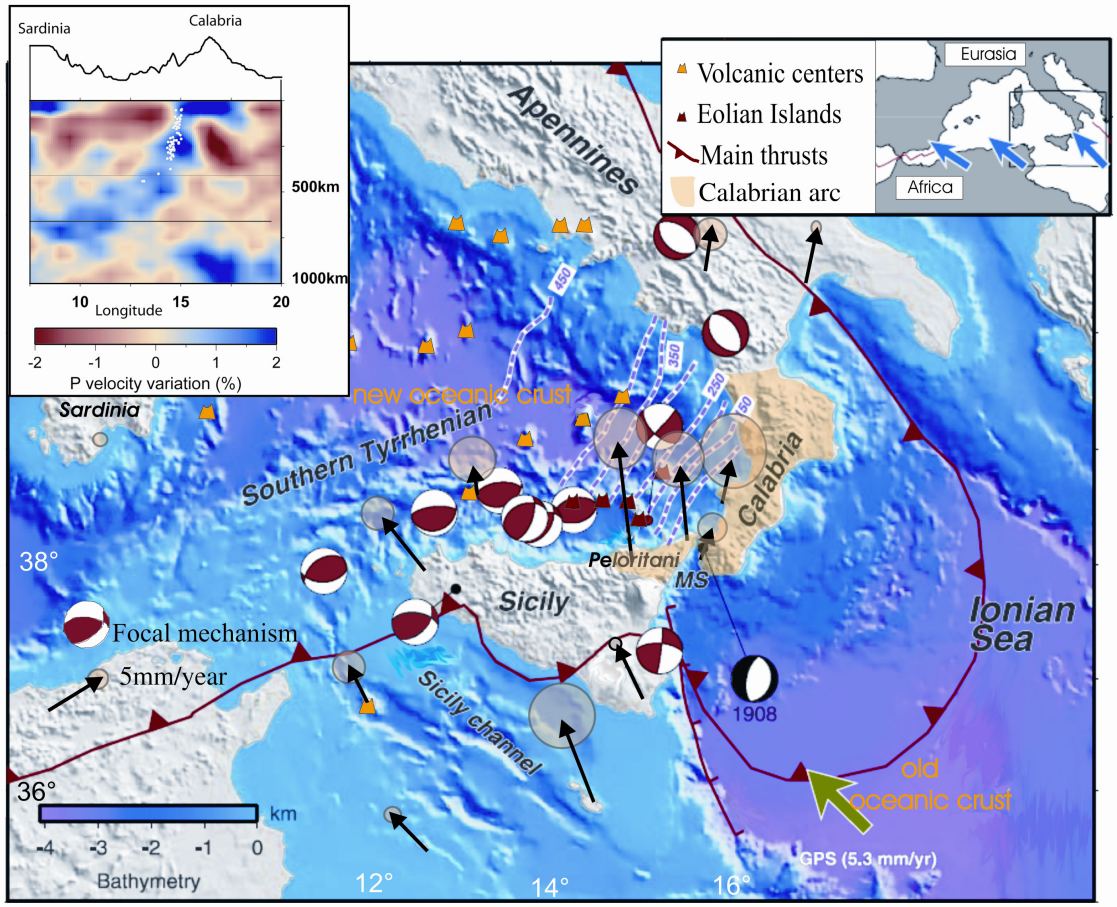
S5-Task 2 supports ongoing research on Messina strait test site where the INGV is developing advanced monitoring geophysical networks in the frame of Messina 1908-2008 project

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



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

State of the art

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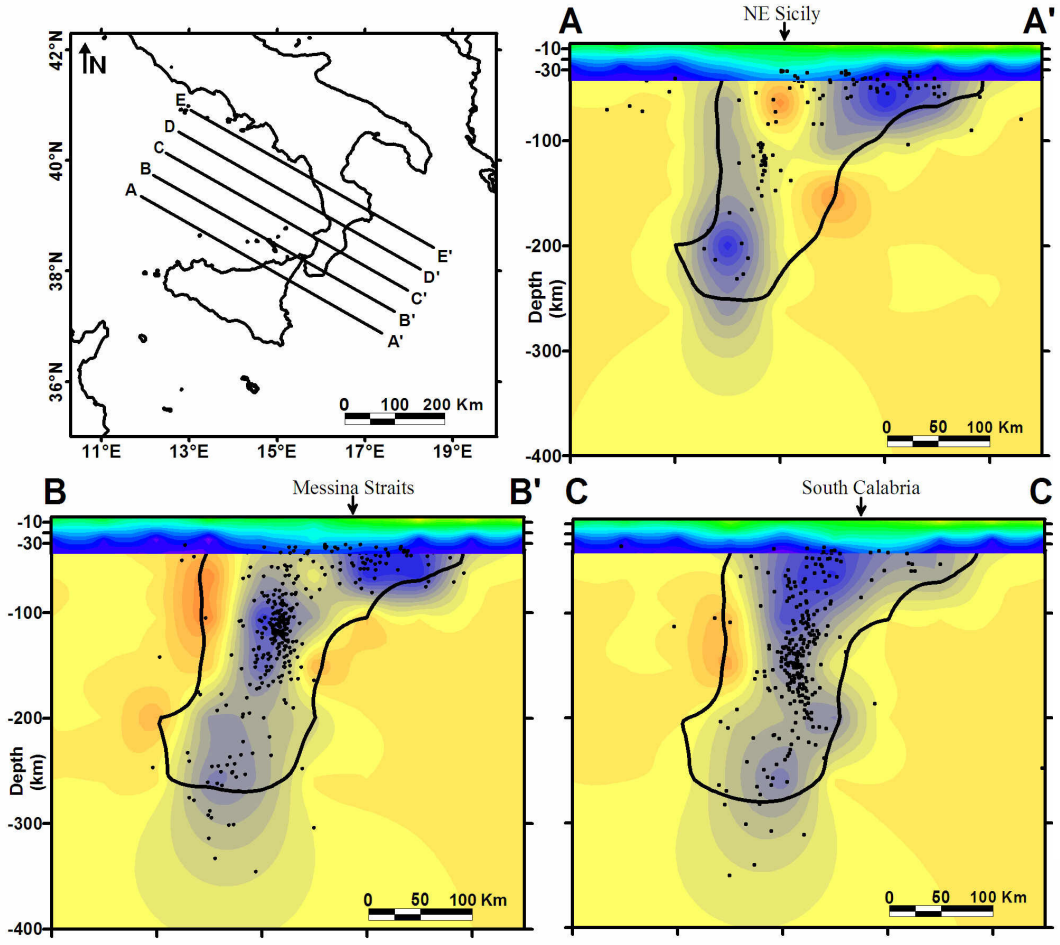
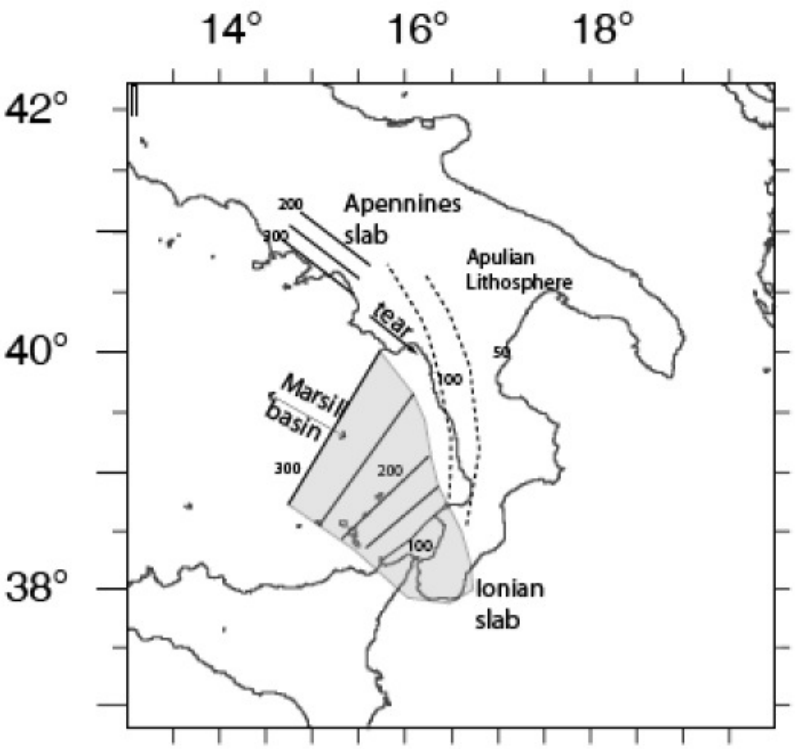
The Messina Straits seats on the SW edge of the slab

State of the art



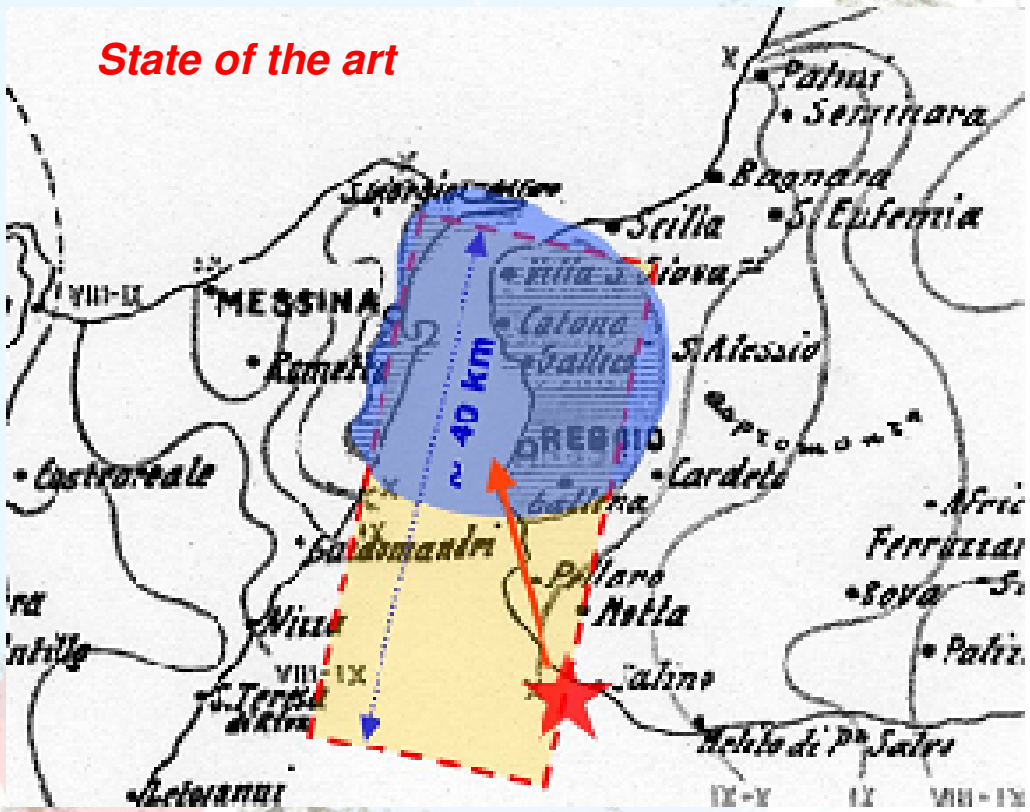
Neri et al. SRL In press



Chiarabba et al.EPSL

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 refence 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

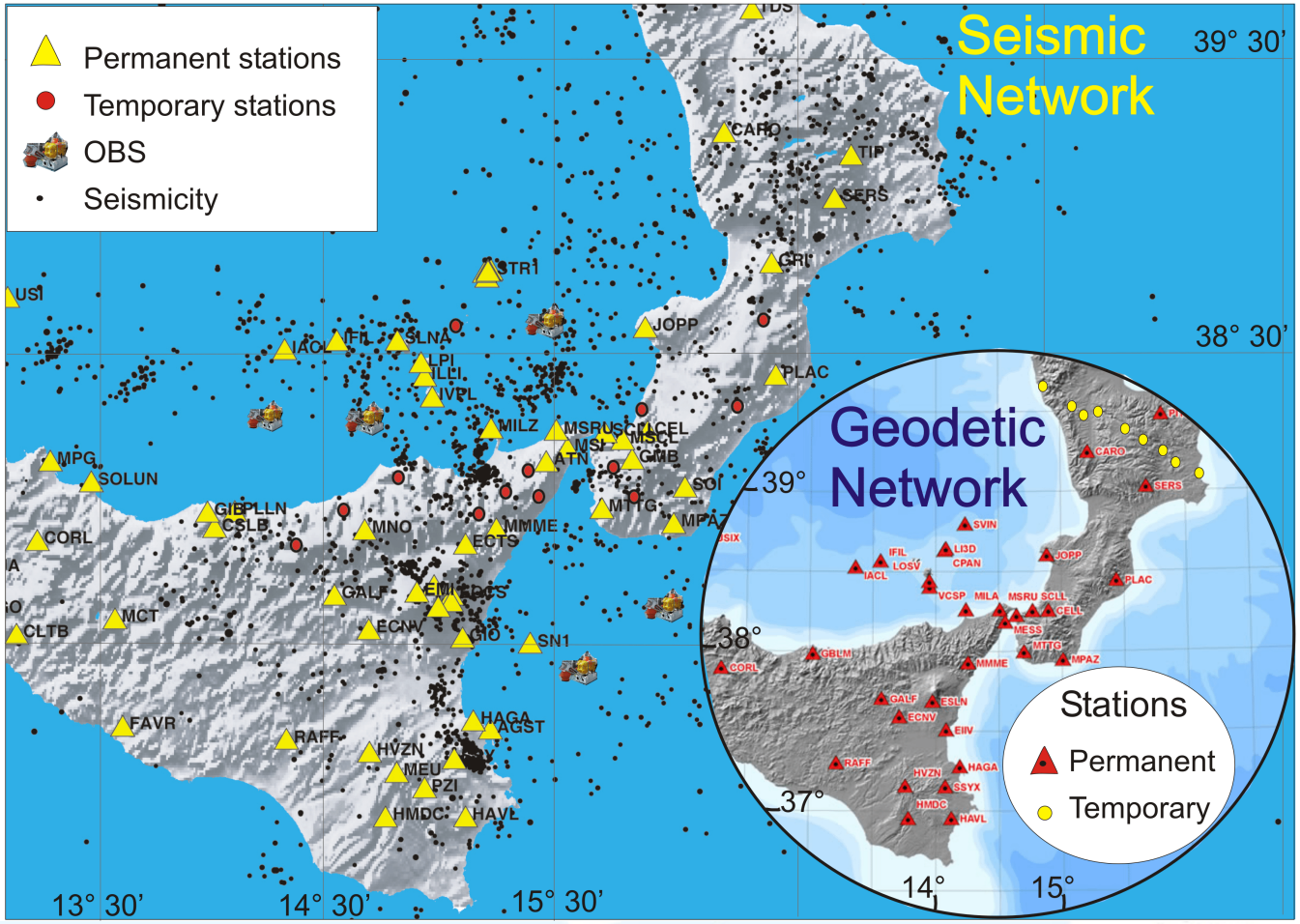


1908 - FAULT GEOMETRY - DISS

Coordinates of southernmost corner of fault projection onto the surface

Messina 1908 – 2008 Project

Today monitoring networks



Task 2. Test site "Messina Strait"

Task 2. Test site "Messina Strait" Margheriti L., CNT-INGV margheriti@ingv.it *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.*	**WP2.1** D'Anna e Mangano CNT-INGV danna@ingv.it;mangano@ingv.it	*Sea Bottom Seismograph installation and data transmission testing through acoustic link*
	WP2.2 Moretti , CNT-INGV moretti@ingv.it	*Integrated on-land and off-shore seismic data bank and refined earthquake location*
	WP2.3 Piccinini RM1- INGV piccinini@ingv.it	*Seismic anisotropy analysis aimed at defining the present crustal deformation regime*
	WP2.4 Mattia, CT-INGV mattia@ct.ingv.it	*Strain field of Calabria and Peloritano regions from GPS data acquisition and modeling*
	WP2.5 Neri, Univ. Messina geoforum@unime.it	*Fault mechanisms and stress regime orientations in the Messina strait.*

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

- WP2.1, 2.2 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.

- WP 2.2 2.5 Refined earthquakes locations in the Tyrrhenian and Ionian regions around Messina Strait to define seismogenic structures

- WP2.3 2.4 2.5 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

S5

DPC 2007-2009

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

Task 2. Test site "Messina Strait" Margheriti L., CNT-INGV lucia.margheriti@ingv.it

GANT

First 6 months

PHASE		I		II	
SEMESTER		1	2	3	4
2/3	2.1	First OBS deployment	OBS recovery Integration of OBS data into the archive	Second OBS deployment and test of the acoustic link	OBS recovery Integration of OBS data into the archive
2/3	2.2	Development of procedures to have all data in the same format	Integrated archive	Earthquake refined locations	Integrated archive Earthquake refined locations Correlation of seismicity and active faults
2/3	2.3	Comparison of different available codes	Implementation of a preferred code to evaluate seismic anisotropy parameters automatically	Events selection and parameters estimation	Interpretation of the results in terms of fracture field and of possible temporal variations of the stress field
2/3	2.4	Geodetic survey	Evaluation of the velocity field from all the available data	Computation of the horizontal strain-rate field and of the inter-seismic strain loading and deep geometry of the 1908 Messina fault.	Interaction with other WP and interpretation of the results
2/4	2.5	Preparation of the datasets needed for analyses of earthquakes occurring during 1988-2007	Prosecution and conclusion of FM computations for 1988-2007 earthquakes	Hypocentral locations and FM computations with the additional contribution by the INGV experiment data (first phase)	Hypocentral locations and FM computations with the additional contribution by the INGV experiment data (second and last phase)
2/4	2.5	Hypocentral locations and start of focal mechanism computations with the different techniques	Integration of the computed FMs with the FMs available in the existing catalogs and in the major literature	Start of computations of stress and strain fields	Preparation of the final integrated database and last phase of stress/strain computations. Comparison of the results with the findings of the other RUs for final evaluations

Rome, 19 November 2008

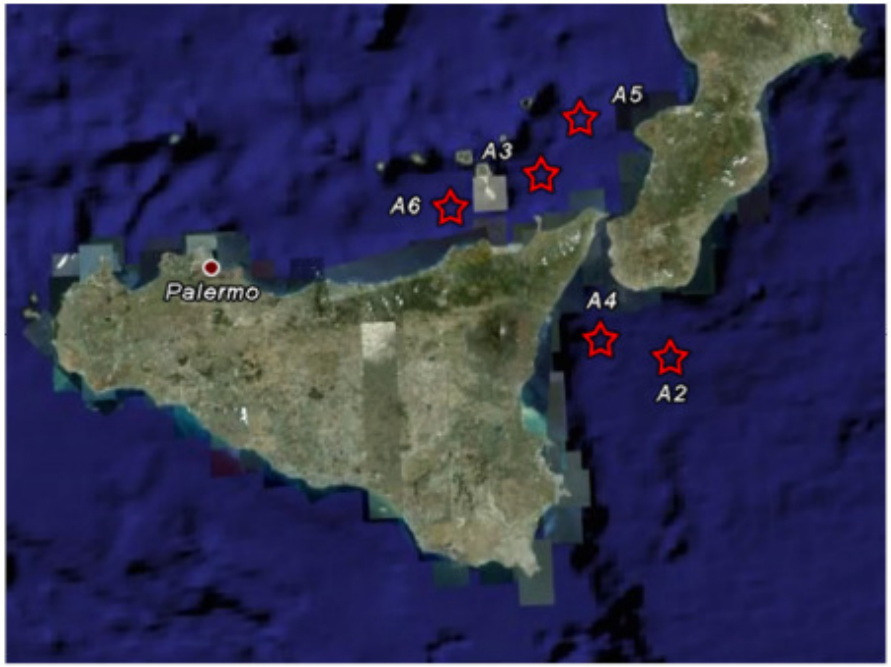
WP2.1 Ocean Bottom Seismographs deployment and test

Responsible: Giuseppe D'Anna – Giorgio Mangano, INGV- CNT

Objectives

- Deployment of 5 Ocean Bottom seismometers to integrate the on land seismic network.
- Test an acoustic link to recover data without recovering the instruments from the sea floor.

WP2.1 Six months activity



OBS deployment 14 July
OBS recovery 8 November

OBS are equipped with sensors Trillium 120 sec., and hydrophone (DPG band pass 160 s -2Hz), power supply, double recovery system and acquisition system on compact flash of 24 GB.

An ad Hoc levelling base (Gimbal) was projected and realized

OBS	Lat.	Long.	Prof. (m)
A4	37° 42' 32.1" N	15° 33' 26.4" E	1615
A6	38° 20' 38.7" N	14° 44' 50.8" E	1420
A5	38° 42' 53.2" N	15° 31' 10.1" E	1360
A2	37° 36' 28.2" N	15° 56' 51.6" E	1950
A3	38° 28' 10.2" N	15° 16' 37.8" E	1165

GPS tracking of an emerged OBS

It was installed again on August the 2nd

WP2.2 Integrated seismic data bank and refined earthquake location to define seismogenetic structures

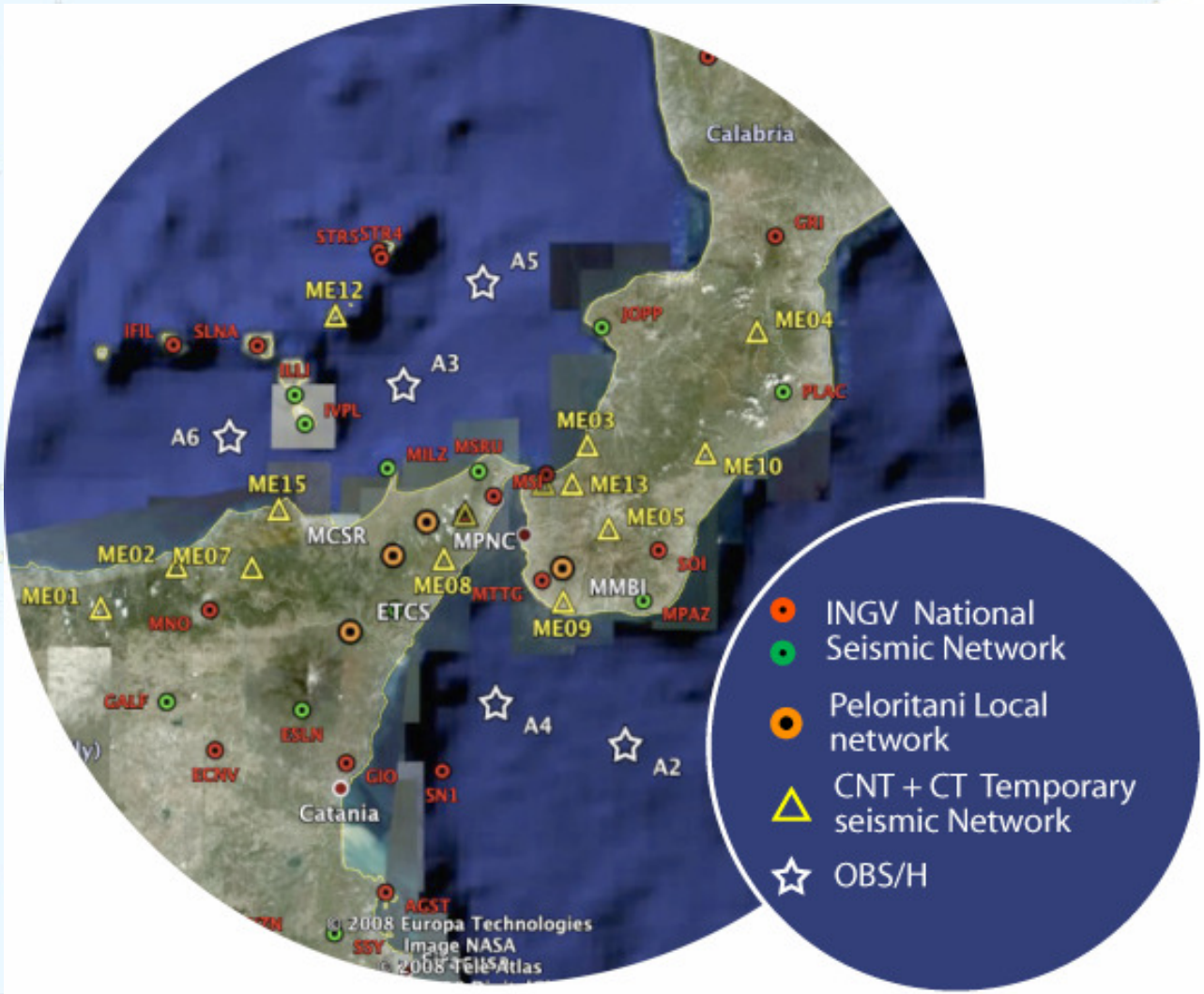
Responsible: Milena Moretti , INGV-CNT

Objectives

- Creation of a waveform archive that will collect, in a uniform format, all the available seismic stations present in the region.
- Refined earthquakes locations to define seismogenic structures inside the Messina Strait and in the surrounding region

DPC 2007-2009
High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

WP2.2 Six months activity



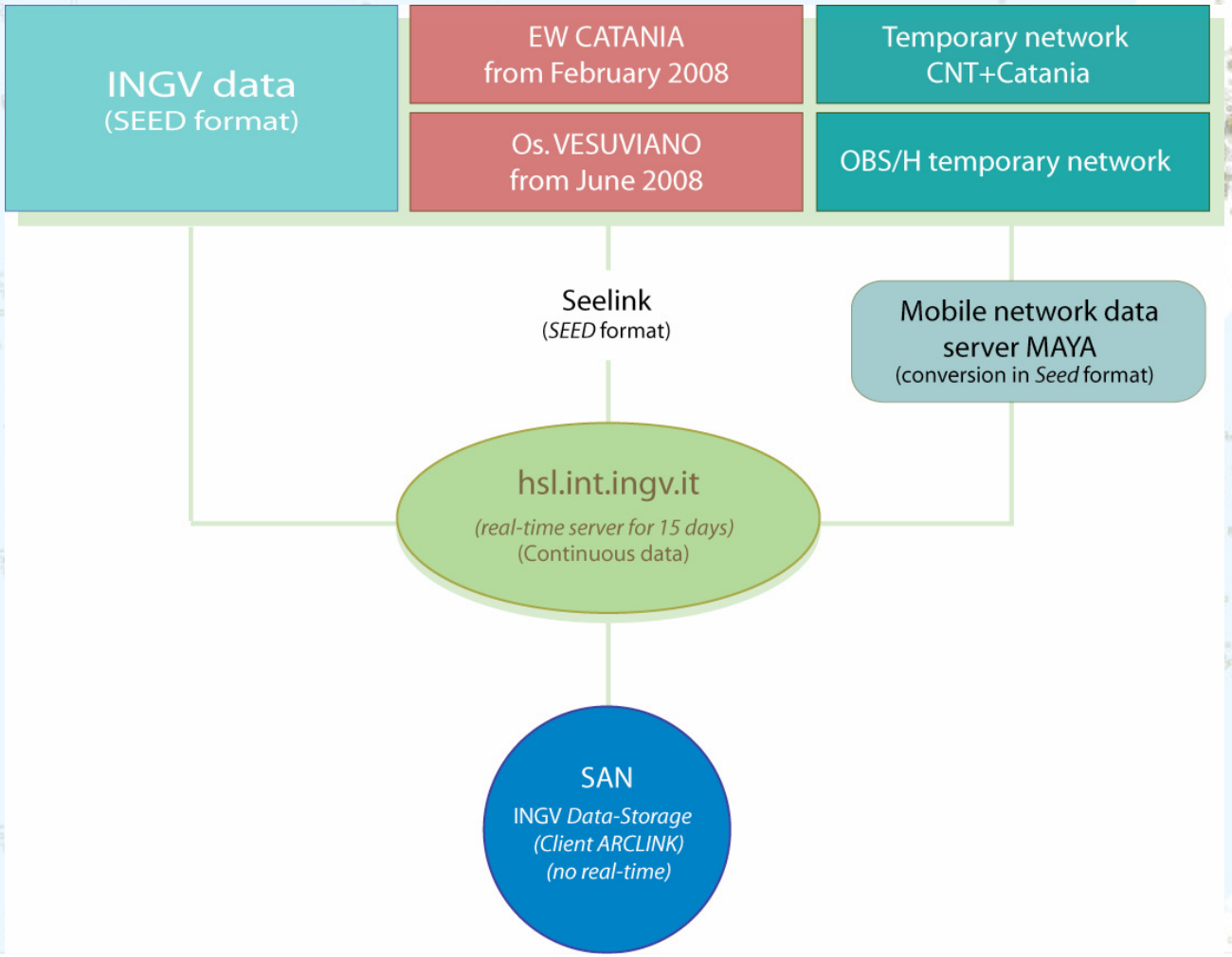
Stations which contribute to the DATABASE

The temporary stations have been deployed on November 2007 and the data has been collected on a regular basis; the OBS deployment was performed from mid July to the beginning of November. The first data should be available for processing by the end of November 2008.

Rome, 19 November 2008

DPC 2007-2009
High-resolution multi-disciplinary monitoring of active fault test-site areas in Italy

WP2.2 Six months activity



The data is stored in the original format on the mobile network data server MAYA, then it is converted to SEED data format and fed to the HSL *seedlink/arclink* server. The assembled data set is stored in HSL together with RSN data and is accessible in real-time for 15 days. After this period the data is moved to the CNT SAN and can be retrieved through the *arclink* interface.

WP2.3 Seismic Anisotropy

Responsible: Davide Piccinini, INGV-Sismologia e Tettonofisica

Objectives

- Develop a semi-automatic code able to evaluate the anisotropy of S waves
- Apply it to the crustal earthquakes located by WP2.2 for characterizing the deformation and fracture field of the crust.

WP2.3 Six months activity

We are comparing different codes developed under MatLab which use both covariance matrix decomposition and cross-correlation techniques to estimate the anisotropic parameters of "**fast direction**" and of "**delay time**". The resulting code will be applied and automatic evaluation of anisotropy will be computed on the analyzable earthquakes.

SPY

Fast direction: Covariance Matrix Decomposition

N-E --> F-S

Delay Time : Cross-Correlation

Waveform selection:

Incang<45°

Swave S/N>4

Hamplitude>Vamplitude

ANISOMAT

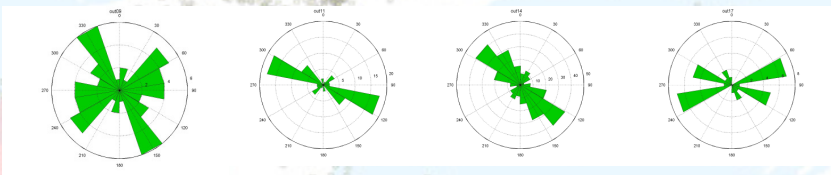
Fast direction & Delay Time: Cross-Correlation

Waveform selection:

Incang<45°

Henergy>2.5Venergy

dataset recorded Val d'Agri 2005-2006
20 stations 3comp
830 earthquakes



AG09 AG11 AG14 AG17

WP2.4 Ground deformation pattern of the Calabro-Peloritani area and the Messina Straits from GPS networks and terrestrial data

Responsible: Mario Mattia – INGV CT

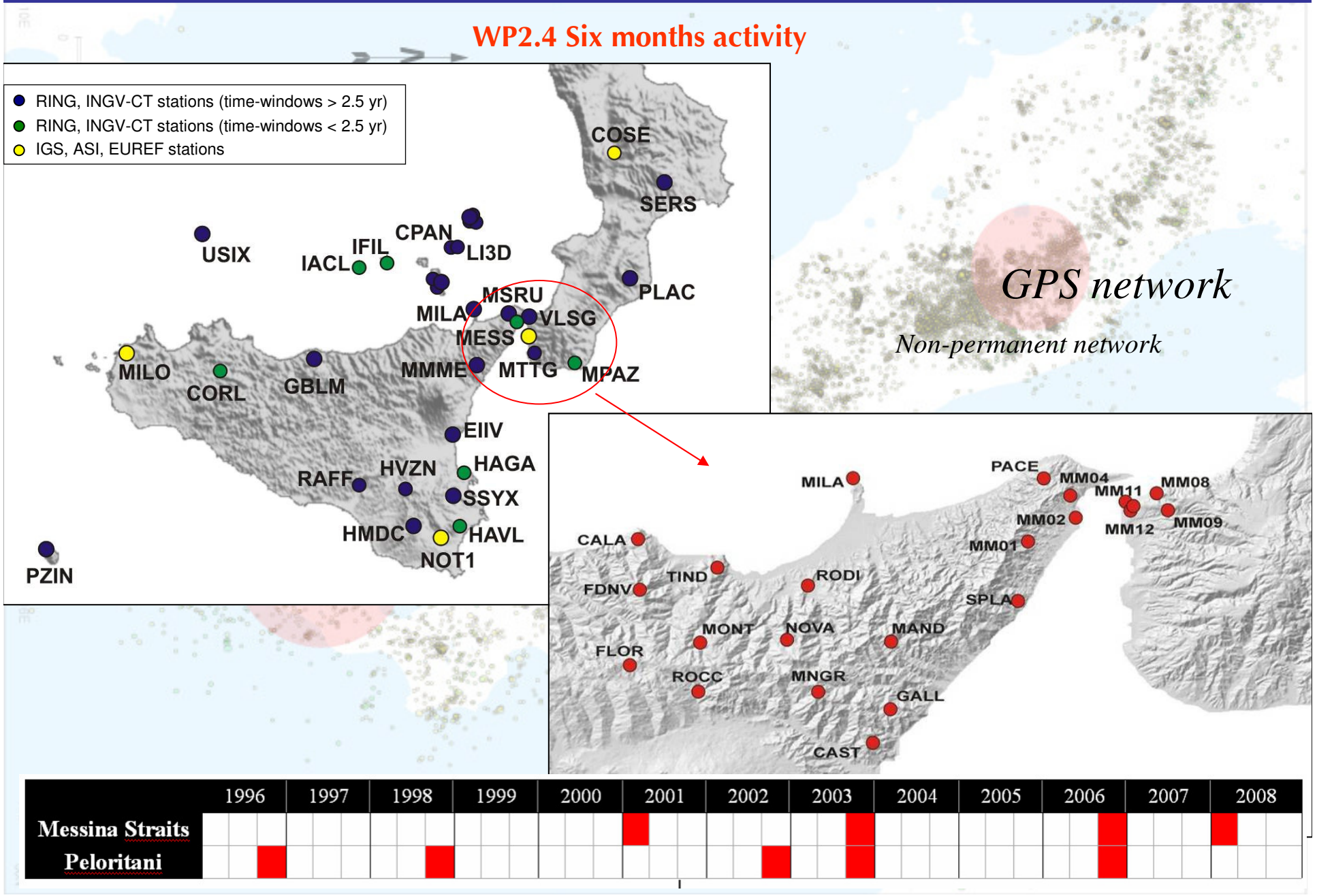
Objectives

- Velocity and strain rate field across the Messina Straits and the Calabrian Arc from the analysis of periodical and continuous GPS data
- Elastic block modelling, inter-seismic strain loading and deep geometry of the 1908 Messina fault
- Analysis of triangulation data for the estimates of the strain rates in the Messina Straits and the interseismic tectonic loading on the fault responsible for the 1908 Messina earthquake
- Modelling of the source responsible for the December 28, 1908 earthquake, by using a numerical approach (i.e. finite element)

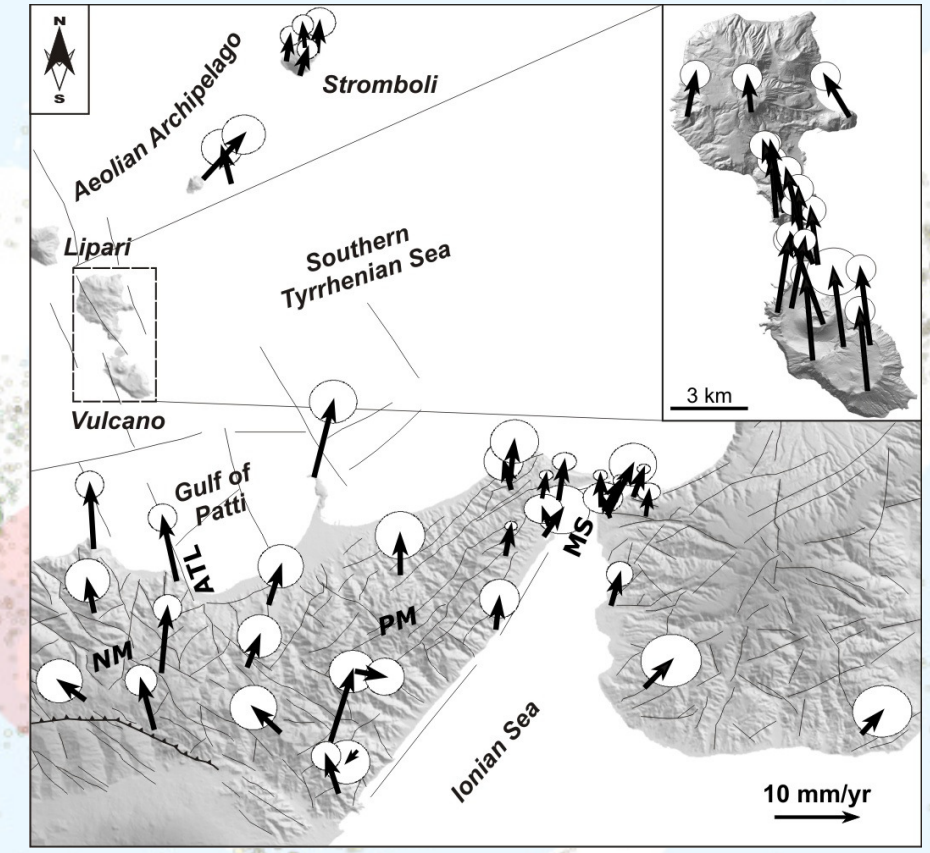
S5 *Permanent network* DPC 2007-2009

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

WP2.4 Six months activity



WP2.4 Six months activity

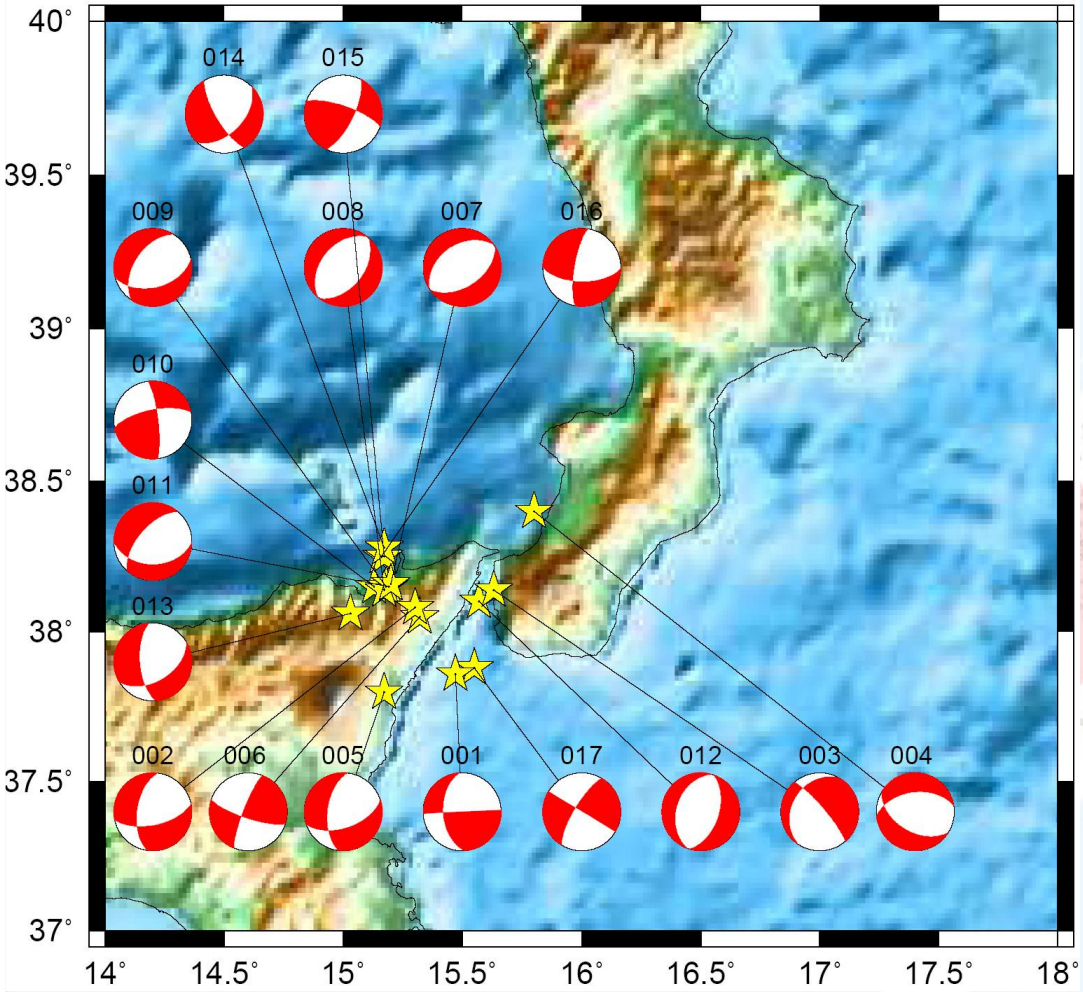


Simplified tectonic map of north-eastern Sicily and southern Calabria. ATL, Aeolian-Tindari-Letojanni fault system; MS, Messina Strait; PM, Peloritani Mts.; NM, Nebrodi Mts.. Inset shows a detailed zoom of the dense Lipari-Vulcano network.

WP2.5 Fault mechanisms and stress regime
Responsible: Giancarlo Neri Universita' di Messina

- **Objectives**
- Analysis of the earthquake focal mechanisms and of the seismogenic stress and seismic strain fields in the Messina Straits area.
- The new results will lead us to obtain expectably remarkable progresses in the knowledge of tectonic stress accumulation mechanisms and consequent processes of seismogenic faulting in the area of our interest.

WP2.5 Six months activity



Focal mechanisms for the events selected for testing the "Cut And Paste" (CAP) method in the Messina Straits area.

The first semester activity of the UR-Messina consisted both in the preparation of the earthquake dataset relative to seismicity occurring during 1988-2007 in the Messina Straits area and the starting of focal mechanism computations by the application of different techniques. Up to date, the analyses have been performed using the information collected during the last twenty years by the local and national permanent seismic networks. In the following semesters, in cooperation with others RUs of this Project, we plan to use also the data coming from the current INGV experiment in the study area.