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# MEET WP5

Coordinator

*Mario Mattia*

Assigned Budget: 3.5 M€



## ING(V) @ Messina: a brief history

- 1949**, ING granted of a building for scientific purposes in Messina, Viale Regina Margherita, in a city park presently titled to Aldo Moro. It has hosted over the years various geophysical instruments;
- 1980s**, Prof. Broccio of the University of Messina worked here, in collaboration with ING;
- 2017**, INGV ceded the park (about 10,000 m<sup>2</sup>) to the Municipality of Messina, and began to plan the creation of a real scientific and technological headquarter in Messina;
- 2021**, After an attempt to establish a Supersite, INGV promoted and signed a research agreement with UNIME, UNICT, UNINA1 and UNIPA for carrying out research activities in the Messina Strait area.





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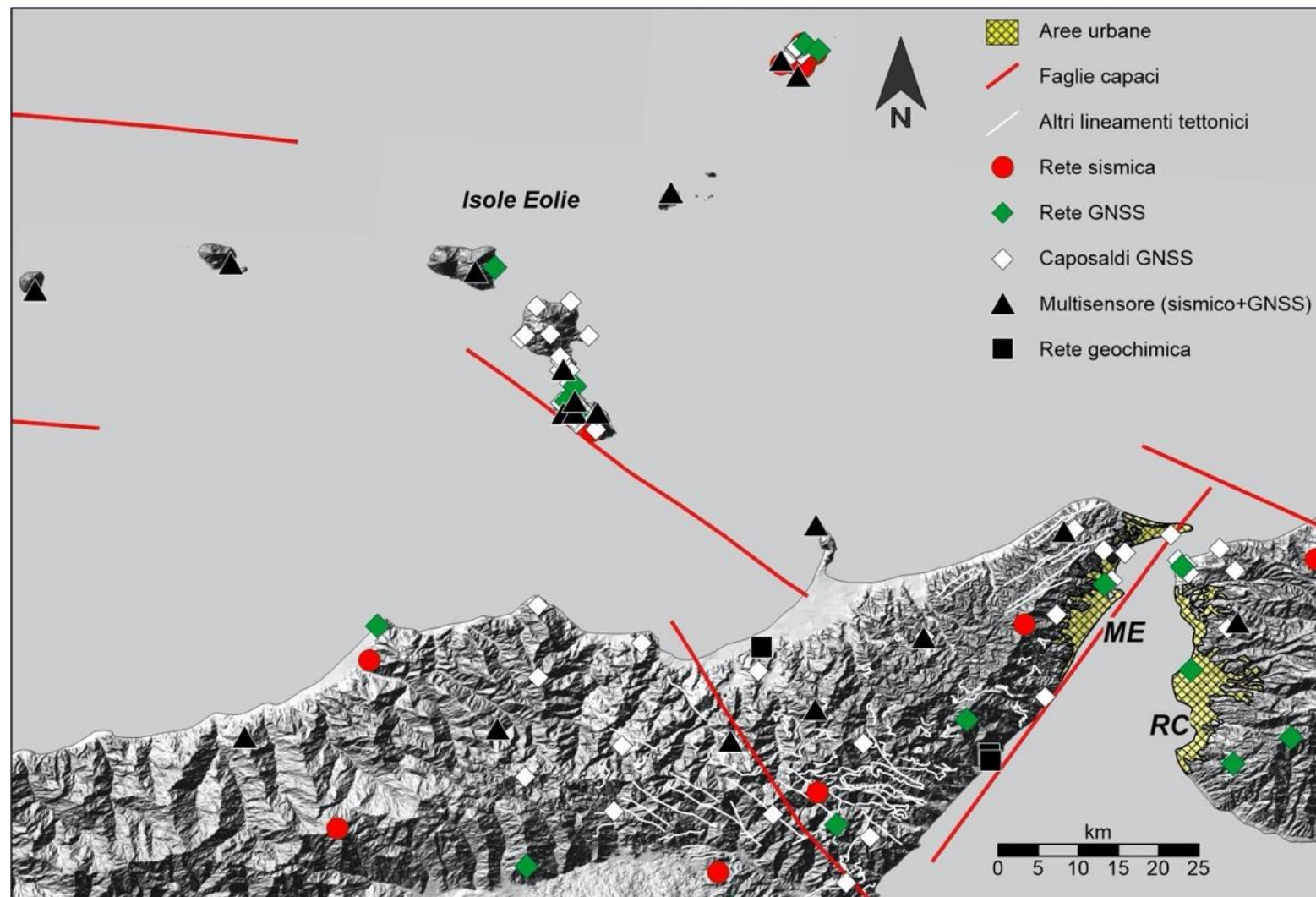
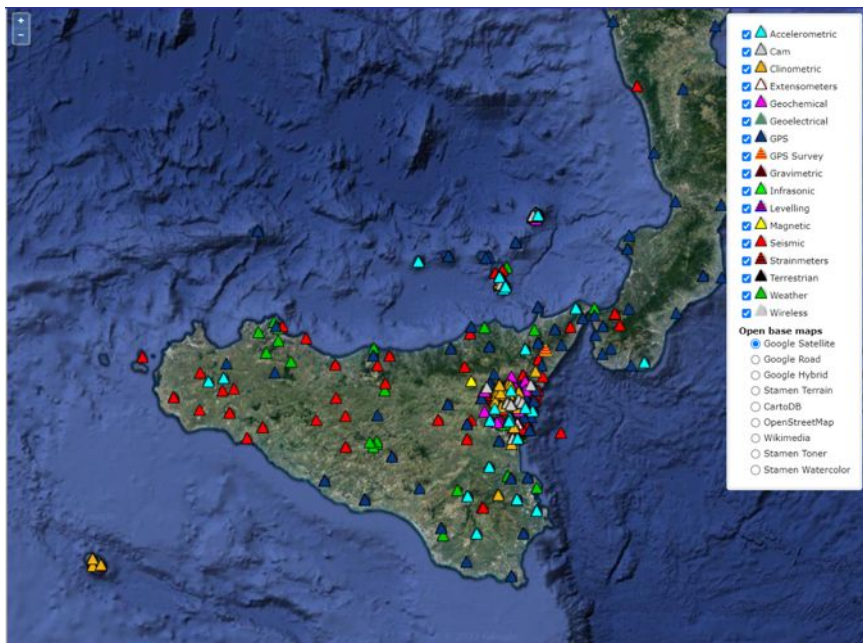
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# INGV monitoring networks





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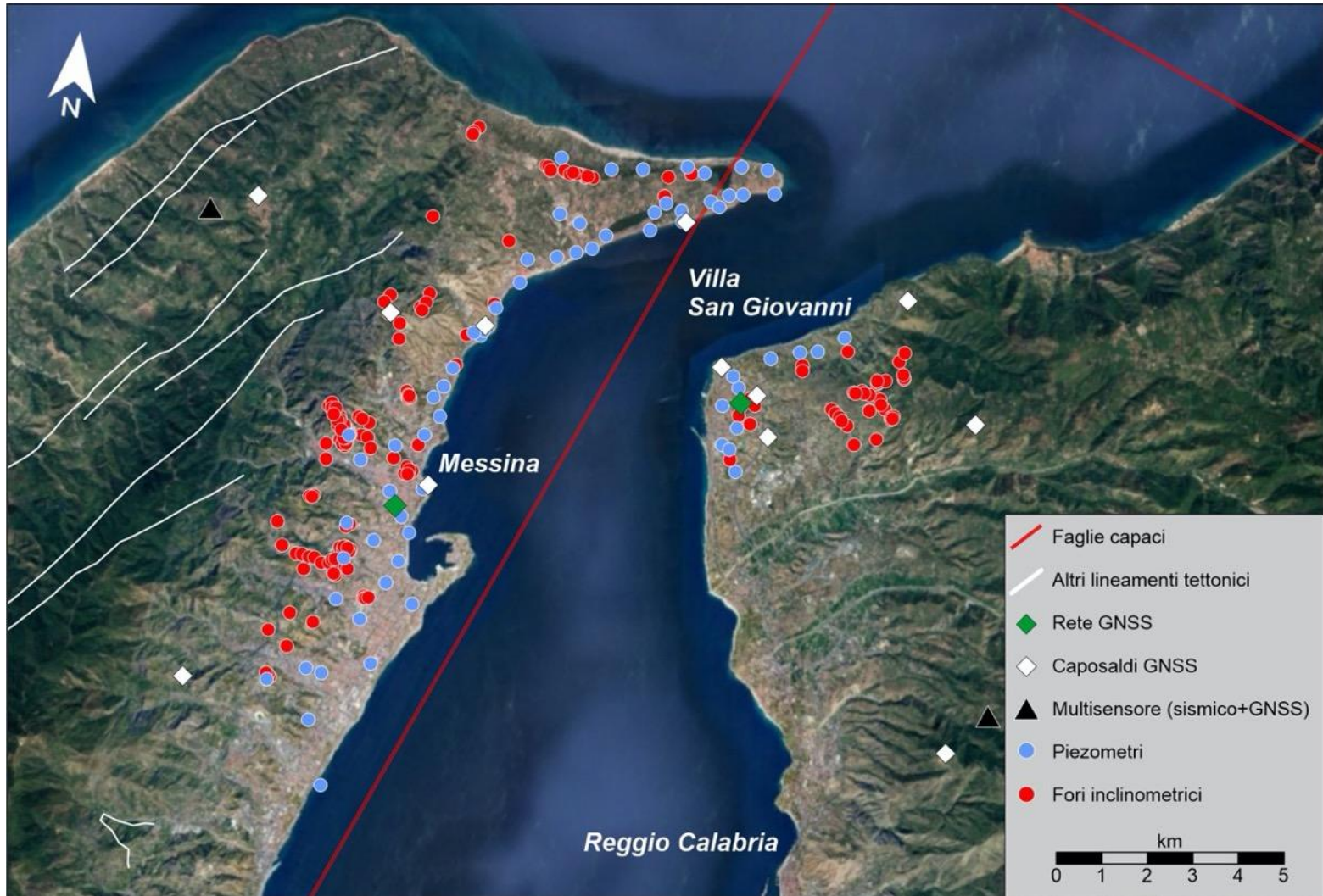
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## The Strait of Messina S.p.A. network

In 2016 the monitoring network implemented for the Messina Strait Bridge project is transferred to INGV from the french company *EDF Fenice*, following the closure of the Strait of Messina S.p.A.

It consists of 66 piezometric and 120 inclinometric holes (not instrumented), to be used in the MEET WP5 «NEMESI» for the upgrade of the existing monitoring network.





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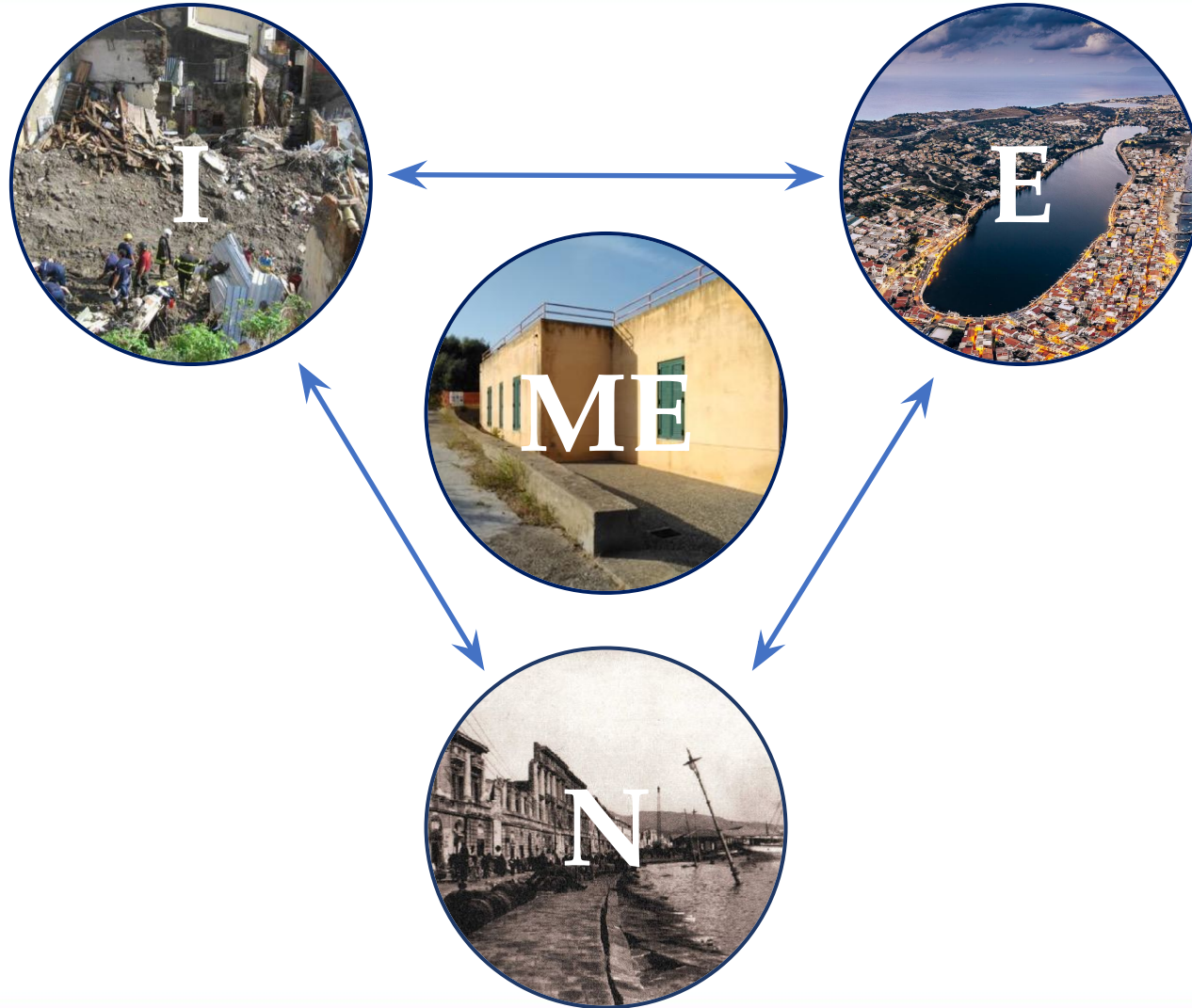
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MEET WP5

## The pillars

**E**NVIRONMENT

**I**NFRASTRUCTURES

**N**EOTECTONICS

*Built around the INGV **ME** headquarter*



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# MEET WP5

was funded with 3,500,000 €, also including the hiring of 5 temporary (2 years contract) staff units (4 technicians and 1 researcher);

WP5 is structured in 4 actions:

- 5.1) Technological implementation of instrumental networks
- 5.2) Development of Urban Seismic Observatories and seismic-accelerometric networks in industrial areas with high risk of major accidents
- 5.3) Enhancement of the Messina INGV office - Data Acquisition Center
- 5.4) Enhancement of the Messina INGV office - Development of systems for acquisition, analysis, archiving and automatic distribution of data

*Renovation of the INGV Messina office currently underway.*

## 5.1 Technological implementation of instrumental networks (*Action Leader Paolo Madonia*)

Upgrade of the existing network aimed to monitor seismicity and micro-seismicity of the Strait area, to evaluate the deformation rate associated to the main active faults and the effects of the rainfall/runoff regime on hillslope stability and recharge of groundwater bodies under the climate change scenario.

### Sub-actions:

**5.1.1)** New 5 seismic-accelerometric stations added to the present 13 sites seismic network;

**5.1.2)** New 4 GNSS stations added to the present 20 sites network with 4 new stations, acquiring high frequency position and meteorological data;

**5.1.3)** New hydrogeological network (10 standard + 1 master station) based on the usability of the Stretto di Messina S.p.A. boreholes;

**5.1.4)** New borehole tiltmeters network (4 stations), providing high-precision data (5 nrad resolution);

**5.1.5)** Mobile lab for inspection and maintenance of overground and borehole monitoring networks, downhole hydrogeological surveys and in situ non-destructive tests on geomaterials;

**5.1.6)** Multidisciplinary lab, hosted in the Messina INGV office, for the geophysical characterization of soils and shallow crustal structures, and analysis and modeling of geodetic, geotechnical and remote sensing data.

## 5.2 Development of Urban Seismic Observatories and seismic-accelerometric networks in industrial areas with high risk of major accidents (*Action Leader Domenico Patanè*)

Creating rapid response monitoring networks, based on the most recent micro-electronic MEMS sensors (low-cost and low energy consumption devices), and computing technologies (Artificial Intelligence, Machine Learning, Internet of Things, etc.). The Urban Seismic Observatories, similar to those already operational in the city of Catania (PON EWAS), will be implemented at Messina and Reggio Calabria and in the industrial area of Milazzo (ME).

### Tasks:

- Implementation of a strong-motion monitoring system in densely urbanized areas, by means of a dense network (35 stations) of low cost, high sensitivity and ultra-low noise accelerometric sensors;
- Extension of the INGV-OE seismic laboratory (L.E.D.A., Laboratory of Earthquake engineering and Dynamic Analysis), at the University of Enna KORE, devoted to calibration, dynamic tests and diagnosis of seismic instruments. Acquisition of a laser system for primary low frequency calibration and of a vertical shaker to be added to the existing system; accreditation of calibration and calibration measures in accordance with ISO 17025.





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### 5.3 Enhancement of the Messina INGV office - Data Acquisition Center (*Action Leader Marcello D'Agostino*)

The recent availability of new INGV offices at Messina, in the building located in Viale Regina Margherita 87, (Parco Aldo Moro), aims to create a driving force for research activities on the geodynamics of the Messina Strait area. For this reason, the choice of hosting a Data Acquisition Center at the INGV offices must be considered strategic for the pursuit of the aforementioned purposes.

#### **Tasks:**

- Creation of a Data Processing Center, supporting acquisition, storing and processing of data from the monitoring networks, supporting intensive server workloads such as Artificial Intelligence, Deep Learning and High Performance Computing;
- Creation of a Cloud Computing infrastructure for virtual machines, bare metal and containers, able to control and distribute pools of computing, storage and network resources, made available by the Data Center for all monitoring and research needs



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## 5.4 Enhancement of the Messina INGV office - Development of systems for acquisition, analysis, archiving and automatic distribution of data (*Action Leader Massimo Rossi*)

The main function is to offer a telecommunication infrastructure to all remote monitoring and research stations, both permanent and periodically used. Its specific aim is the connection to the EPOS platforms for data distribution. The INGV office in Messina, will be equipped with all the necessary technologies to ensure effective and secure data transmission, both wired and wireless, connected to INGV data transmission backbones and external facilities.

### Tasks:

- Adaption of the internal systems of the Messina INGV building to current standards for interconnecting workstations, laboratories and the high-speed data center in both wired and wireless mode;
- High-speed CED Internet connection, based on cloud technologies, private-public and processing and archiving "on-demand" protocols and systems, continuously optimizing computing resources;
- Development of a geographic network based on a mixed radio/terrestrial/satellite system for the acquisition of data from the monitoring network and the mobile lab;
- Implementation of adequate security and data protection systems (firewall, backup, cloud storage) to prevent external attacks and hacking.



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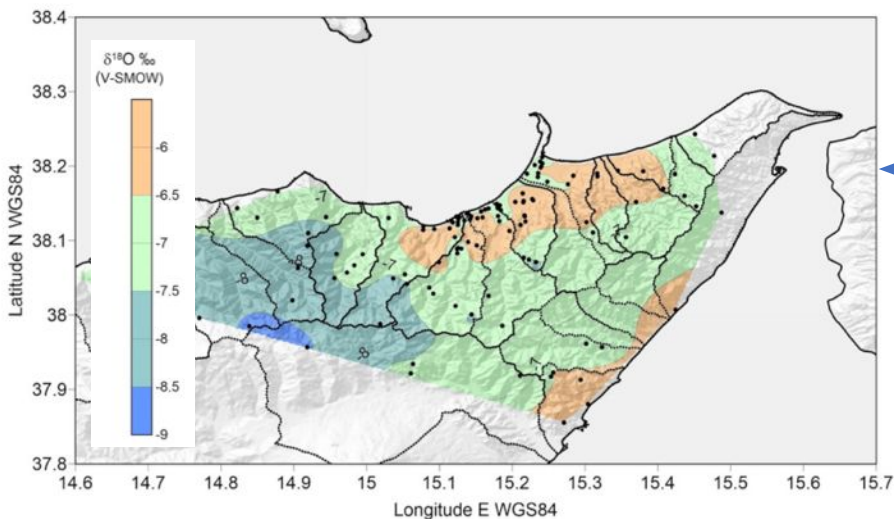
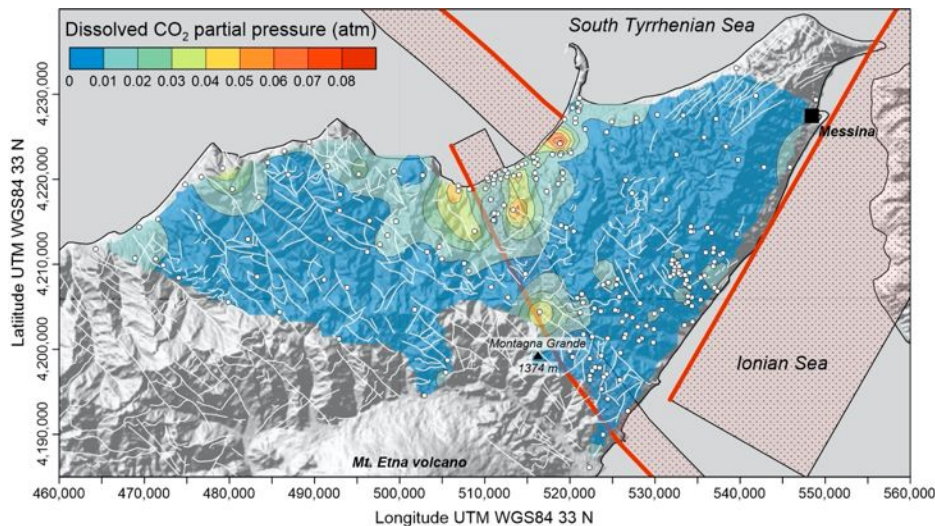


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## Funds allocation

ACTION	TOTAL	PERSONNEL	POSITIONS
5.1 (Monitoring Network)	1,442,904 €	313,040 €	2 Technicians, 1 Researcher
5.2 (OSU)	877,143 €	99,760 €	1 Technician
5.3 (Data Acquisition Center)	829,250 €	-	-
5.4 (Telecommunication)	350,703 €	99,760 €	1 Technician



Article  
**Application of Geostatistical Tools to the Geochemical Characterization of the Peloritani Mts (Sicily, Italy) Aquifers**

Marianna Cangemi <sup>1</sup>, Valentina Censi <sup>1</sup>, Paolo Madonia <sup>2,\*</sup> and Rocco Favara <sup>3</sup>



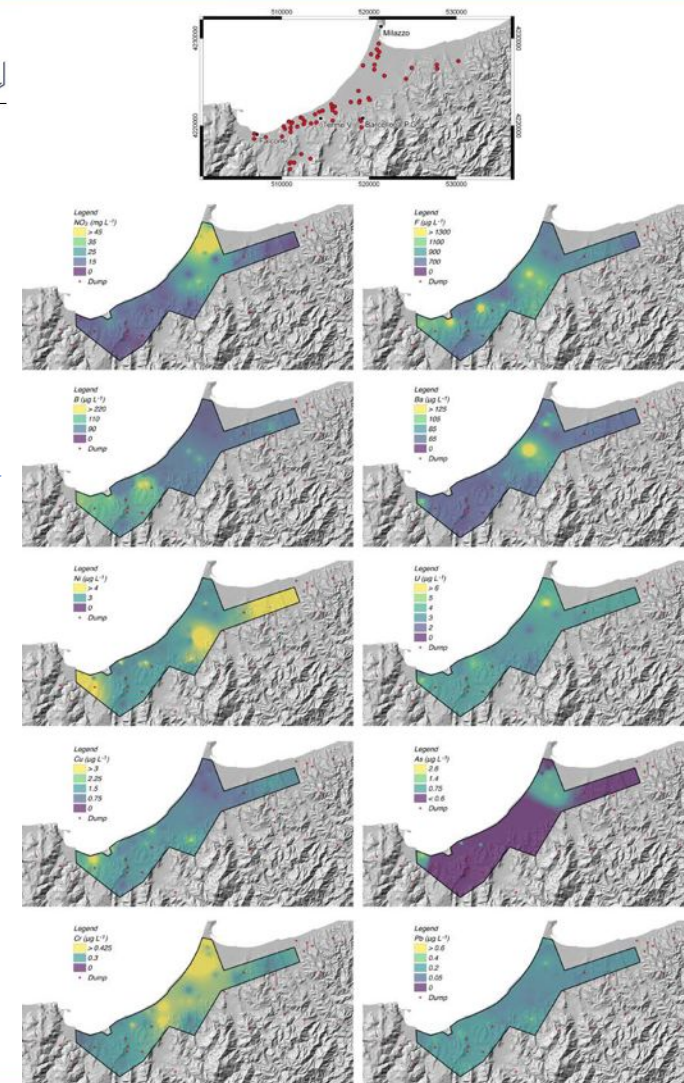
Article  
**Heavy Metal Concentrations in the Groundwater of the Barcellona-Milazzo Plain (Italy): Contributions from Geogenic and Anthropogenic Sources**

Marianna Cangemi <sup>\*</sup>, Paolo Madonia, Ludovico Albano, Alessandro Bonfardeci, Maria Grazia Di Figlia, Roberto Maria Rosario Di Martino, Marco Nicolosi and Rocco Favara



Article  
**Modeling Rain Isotopic Composition under Orographic Control: A Landscape Approach for Hydrogeological Applications**

Paolo Madonia <sup>1,\*</sup>, Marianna Cangemi <sup>2</sup> and Rocco Favara <sup>3</sup>





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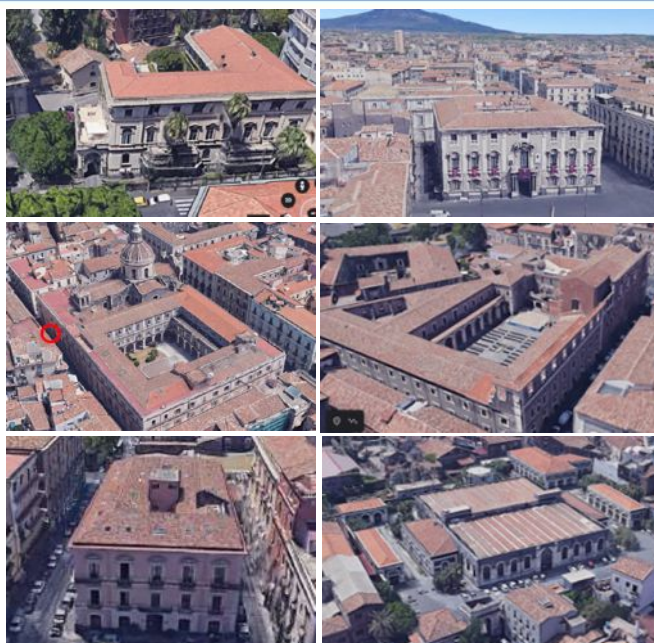
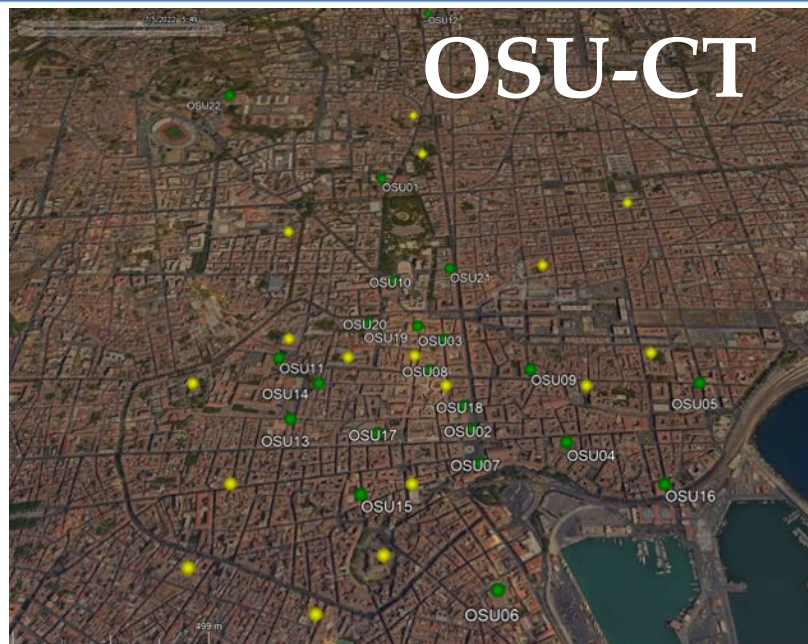
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### SCHEDA STAZIONE - OSU02

#### Palazzo degli Elefanti

Il palazzo sede del Municipio di Catania, situato sul lato nord della piazza dei Duomo, fu insediato nel 1588 dopo il devastante terremoto del 1693, su progetto originario commissionato a Giovan Battista Longobardi. La facciata orientale, meridionale e occidentale furono invece progettate in una fase successiva da Giovan Battista Vaccaro, mentre quella settentrionale fu di Carmelo Battaglia. L'edificio, in parte distrutto da un incendio doloso nel 1844, fu oggetto di interventi di restauro a partire dal 1946 e ultimato nel 1952. Gli interni furono in parte riprodotti nelle stile originario. Gli arzoncamenti (diorammi, invece, furono sostituiti da tele in c.a. con semplice soletta piana oppure con graticcio/stravere in una sola direzione, tra questi si annoverano la copertura e tutto il resto del secondo piano. La copertura a falde fu realizzata con capriate Poltronca in c.a., su esec. in replica a una struttura di travetti in c.a. che sorregge un soletta latero-cerchiato inclinato. Nel 2004 il dipartimento della protezione civile ha installato nei diversi piani 14 sensori accelerometrici LVDI multifasici e un sistema automatico di monitoraggio permanente, al fine di monitorarne lo stato di salute confrontando eventuali variazioni delle sue caratteristiche dinamiche, situazione indice di potenziale danneggiamento.

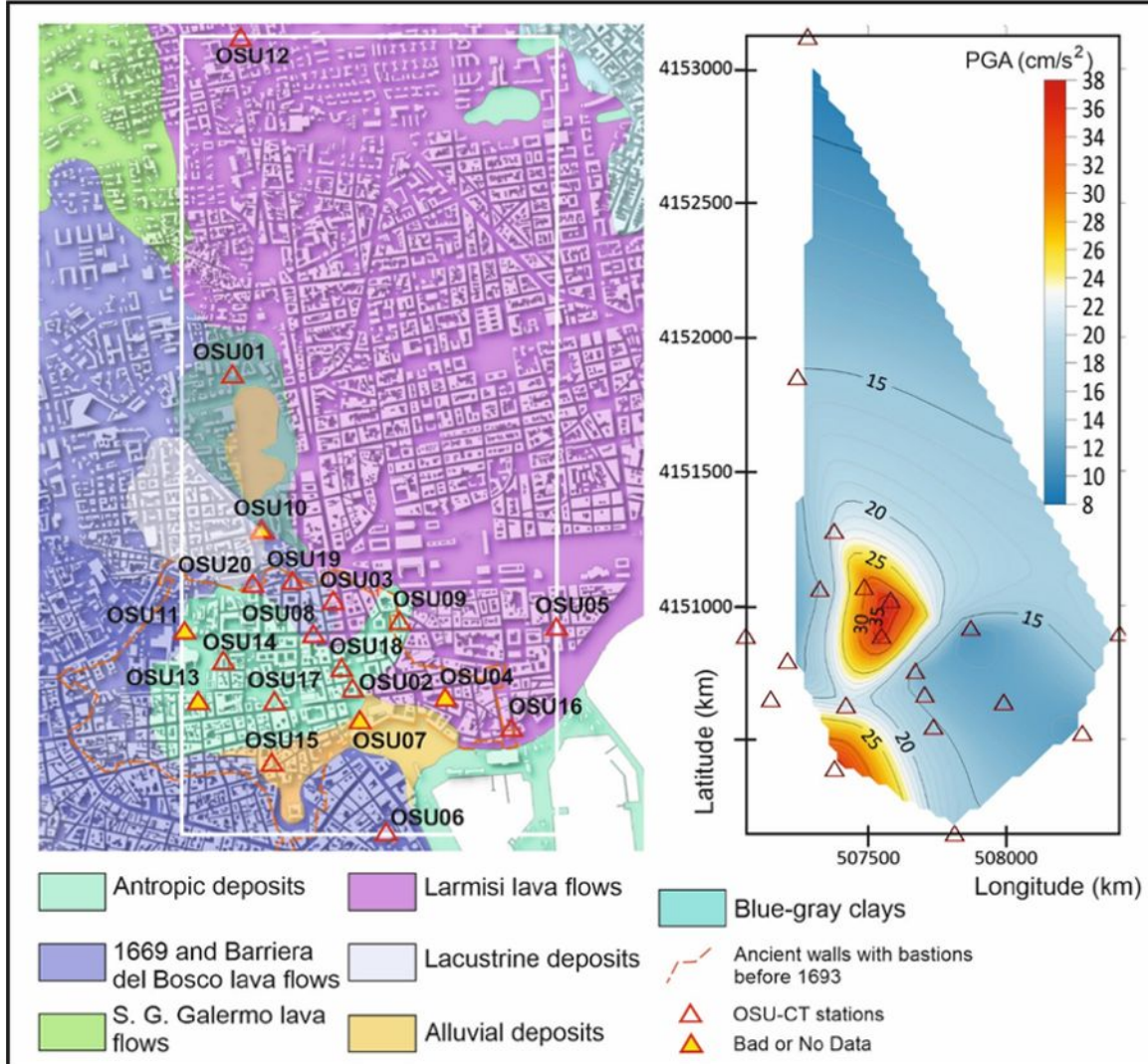
Stazione OSU02	
<b>INFORMAZIONI GENERALI</b>	
Codice	OSU02
Municipalità	Catania
Network	OSU
Longitudine [N]	37°51'35S
Longitudine [E]	15°28'19S
Quota [metri s.l.m.]	29
Data di installazione	27/05/2020
<b>Acquisizione</b>	
OSU_AQ2	Canal 11 Fattore di conversione 1 count = 0.630 gV
	Accelerometro 3-C ADXL355
Canali	HNZ, HNL, HNE
Analog Device ADXL355	MEMS digitale a 20bit (SPI su SBIC)
Fondo scala	7µg
Sensibilità	2.500 ± 0.150/g
Fattore di Scala [g/LSB]	3.9 µg/LSB
Campionamento	200 Hz
<b>Velocimetro 3-C ETL3DVis</b>	
Canali	ENC, ENL, ENE
Period	5 s
Sensibilità V [mm/s]	300
Poles	-0.889 ± 0.089 rad/s

OSU-CT	OSU-CT
Observatorio Sismico Urbano	Observatorio Sismico Urbano
Nome	OSU02
City/Prov.	OSU02
<b>Incidente</b> <a href="#">View Incident</a>	
Altri	
GPS	Integrazione con PPS
Modulo GPS	Sen: M202 10W
Trasmissione dati	Streaming continuo su: Portacavo 30020AK
Formato dati	Streaming sul SBIC
Formato dati	Streaming
Software per Early Warning	Software per EWS in corso

Installazione	Fig.	Descrizione
OSU0201	Struttura	Struttura (torre) appoggiata su due piloni e contenitore dei sensori (c.a. in c.a. a 100 cm dal primo piano) (senza c.a. in c.a.)
OSU0202	Struttura	Struttura (torre) appoggiata su due piloni e contenitore dei sensori (c.a. in c.a. a 100 cm dal primo piano) (senza c.a. in c.a.)
OSU0203	Struttura	Struttura (torre) appoggiata su due piloni e contenitore dei sensori (c.a. in c.a. a 100 cm dal primo piano) (senza c.a. in c.a.)

● Località della stazione





Article

## The Urban Seismic Observatory of Catania (Italy): a real-time seismic monitoring at urban scale

Domenico Patanè<sup>1</sup>, Giuseppina Tusa<sup>1</sup>, William Yang<sup>1</sup>, Antonio Astuti<sup>2</sup>, Antonio Colino<sup>2</sup>, Antonio Costanza<sup>1</sup>, Giuseppe D'Anna<sup>1</sup>, Sergio Di Prima<sup>1</sup>, Gioacchino Fertitta<sup>1</sup>, Salvatore Mangiagli<sup>1</sup>, Claudio Martino<sup>3</sup>, Orazio Torrisi<sup>1</sup>

<sup>1</sup> Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Catania-Osservatorio Etneo

<sup>2</sup> Meridionale Impianti S.p.A.

<sup>3</sup> Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Vesuviano