WP 1
Coordinator
Antonio Avallone

**RENEW:
stREngthening the
National nEtWorks
data production**

Assigned Budget: 5 M€

SUMMARY of Operational Units (OU) and Activities

OU Short Name	Activity	OU Name	Applicant
OU-06	**1.1**	**INGV Sezione Irpinia - IRP**	APPLICANT: INGV
OU-14	**1.2**	**Istituto Nazionale di Oceanografia e di Geofisica Sperimentale - OGS**	CO-APPLICANT: OGS
OU-01	**1.3**	**INGV Osservatorio Nazionale Terremoti - ONT**	APPLICANT: INGV
OU-15	**1.4**	**University of Genova, DISTAV (Department of Earth, Environment and Life Sciences)**	CO-APPLICANT: UNIGE
OU-16	**1.5**	**University of Bari, DiSTeGeo**	CO-APPLICANT: UNIBA
OU-09	**1.6**	**INGV Sezione di Palermo - PA**	APPLICANT: INGV
OU-11	**1.7**	**ISPRA 01 - Geological Survey of Italy and DG-SINA**	CO-APPLICANT: ISPRA

Involved research infrastructures

- **GNSS networks**

- **Seismic networks**
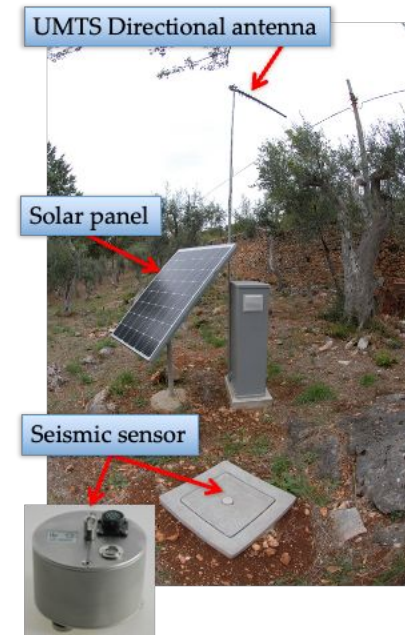
- **Hydrogeochemical network**

Activity 1.1 - Strengthening the RING network (Ref. Vicari, INGV-IRP)

Long-term deformation

High-rate deformation

Maps by Raffaele Moschillo (INGV-IRP)

Norcia eq

co-seismic dynamic displ.

Interseismic velocity field

4 GNSS CONSTELLATIONS

GPS
6 Orbital planes
24 Satellite + Spare
55° Inclination Angle
Altitude 20,200 km

Galileo
3 Orbital planes
27 Satellite + 3 Spares
56° Inclination Angle
Altitude 23,616 km

GLONASS
3 Orbital planes
21 Satellite + 3 Spares
64.8° Inclination Angle
Altitude 19,100 km

BeiDou
6 Orbital planes
35 Satellite + 3 GEO + 27 MEO + 3 IGSO
55° Inclination Angle
Altitude 38,300 km, 21,500 km

RETE INTEGRATA NAZIONALE GNSS
ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

Legend
▲ Full GNSS
▲ Only GPS

Sources: Esri, USGS, NOAA

A new scientific and technological step-forward for higher accuracy results at different spatial and temporal scales.
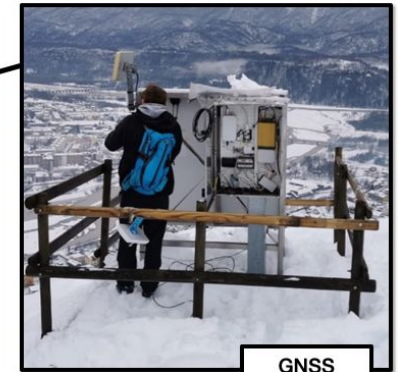
Activity 1.2 - Strengthening the FReDNet GNSS network & OGS seismic network (Ref. Zuliani, OGS)

Improvement of <u>data provision</u> (full GNSS and new broadband seismometers, dissemination), and of <u>deformation field resolution scale</u>

Adria reference frame

Cheloni et al., 2014

GNSS STATION
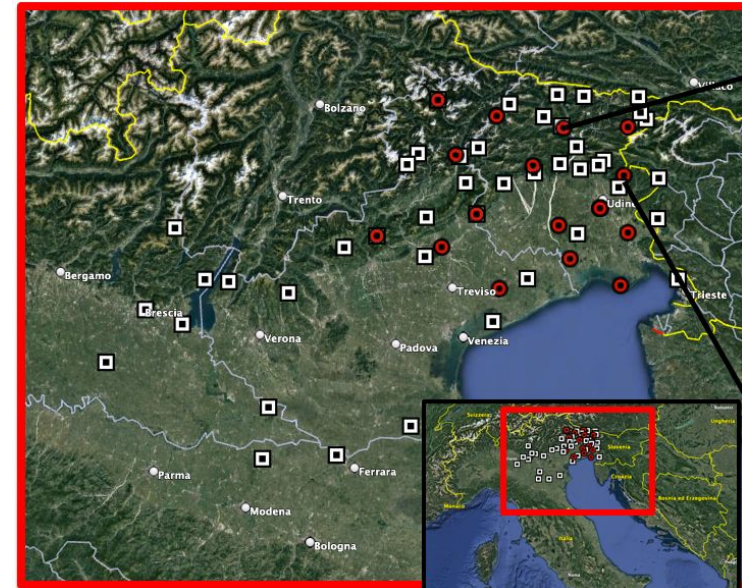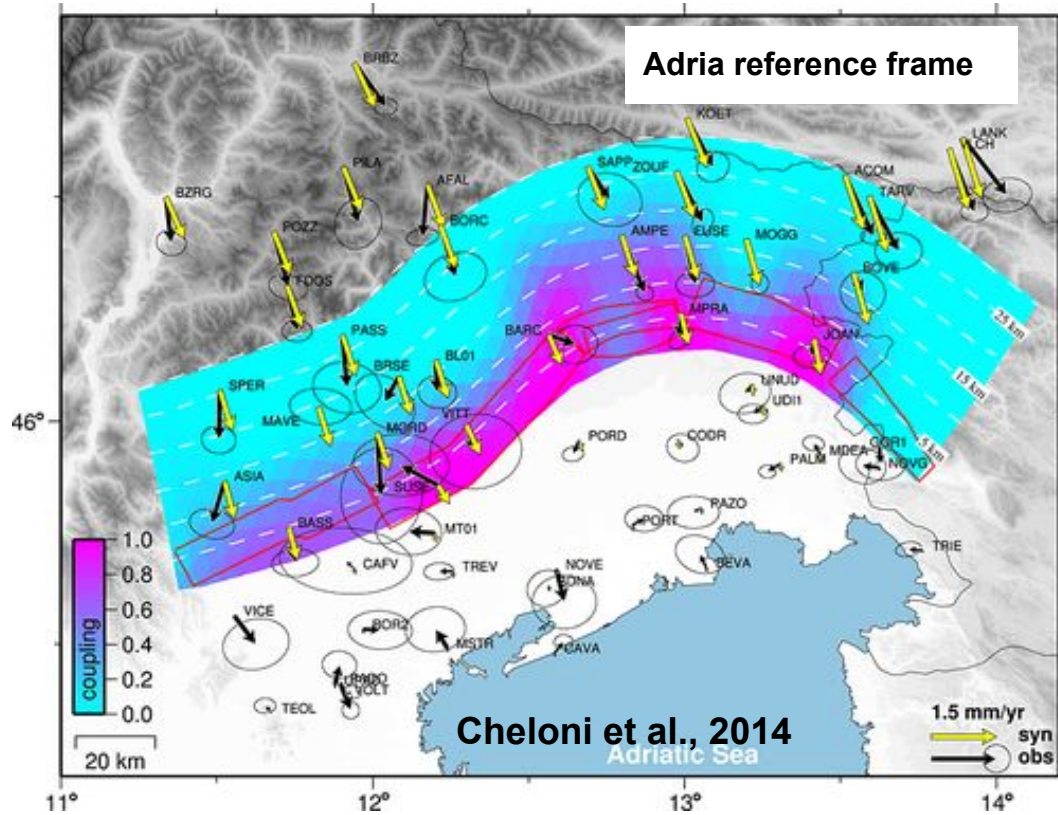
GNSS ANTENNA

☐ OGS Seismic Network
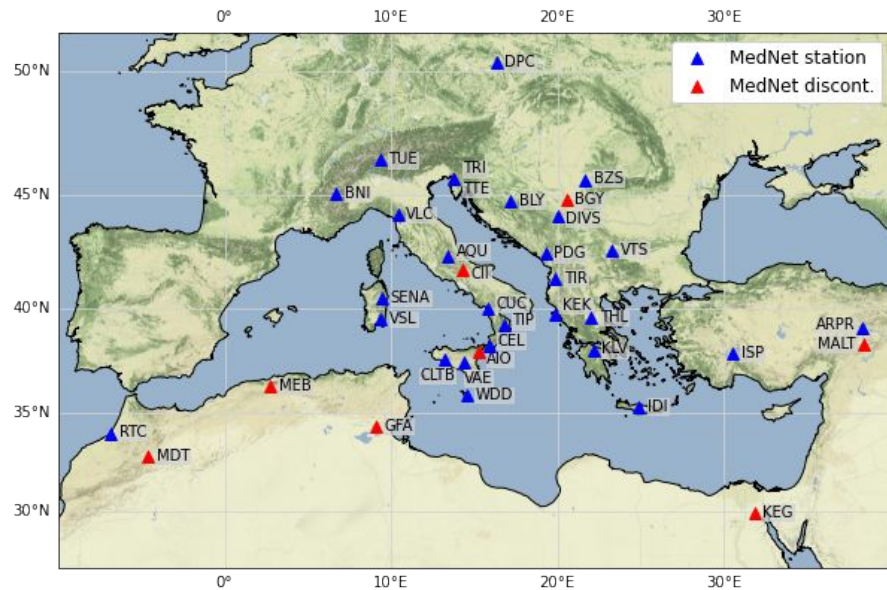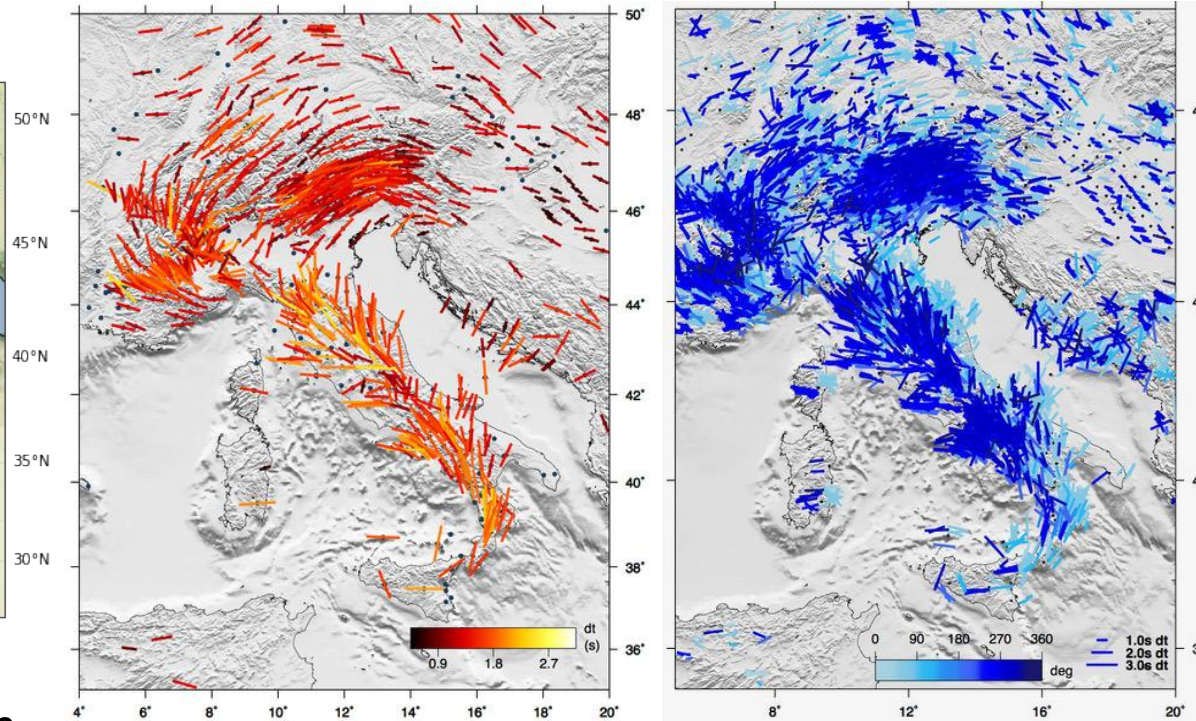● FReDNet GNSS Network

Activity 1.3.1 – Strengthening the INGV seismic networks - MedNet (Ref. Danecek)

The **Mediterranean Very Broadband Seismographic Network (MedNet)** constitutes a backbone network of highest quality very broadband seismological stations in the Euro-Mediterranean Region

Measurement of seismic anisotropy
In some regions MedNet stations are crucial

(Courtesy of Silvia Pondrelli)

Activity 1.3.2 - Strengthening the INGV seismic networks - National Seismic Network (Ref. D'Alessandro)

Seismic monitoring networks are important tools for the study and characterization of seismicity, seismogenic sources and Earth structure.

Broadband seismometers can be helpful for the reconstruction of accurate lithospheric models with the most modern techniques based on surface waves dispersion analysis, seismic interferometry and receiver function from both teleseismic events and seismic microtremors.
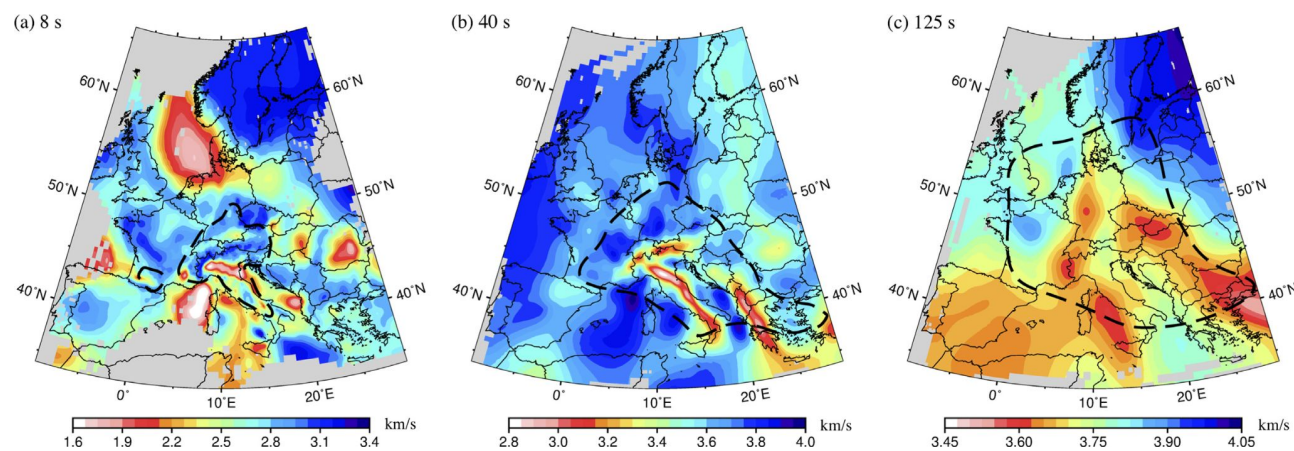
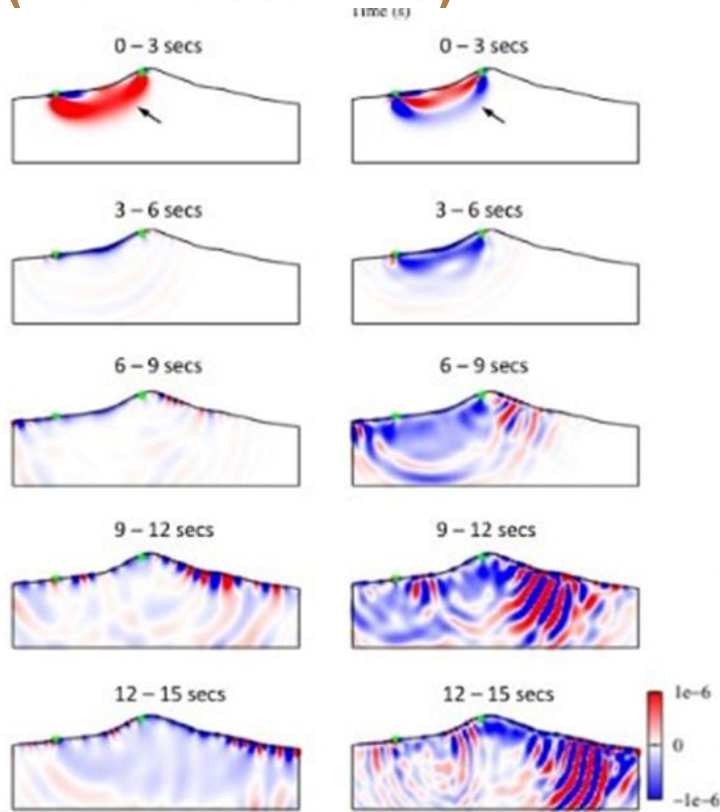Group velocity maps at representative periods 8, 40 and 125 s (Lu et al., 2018).
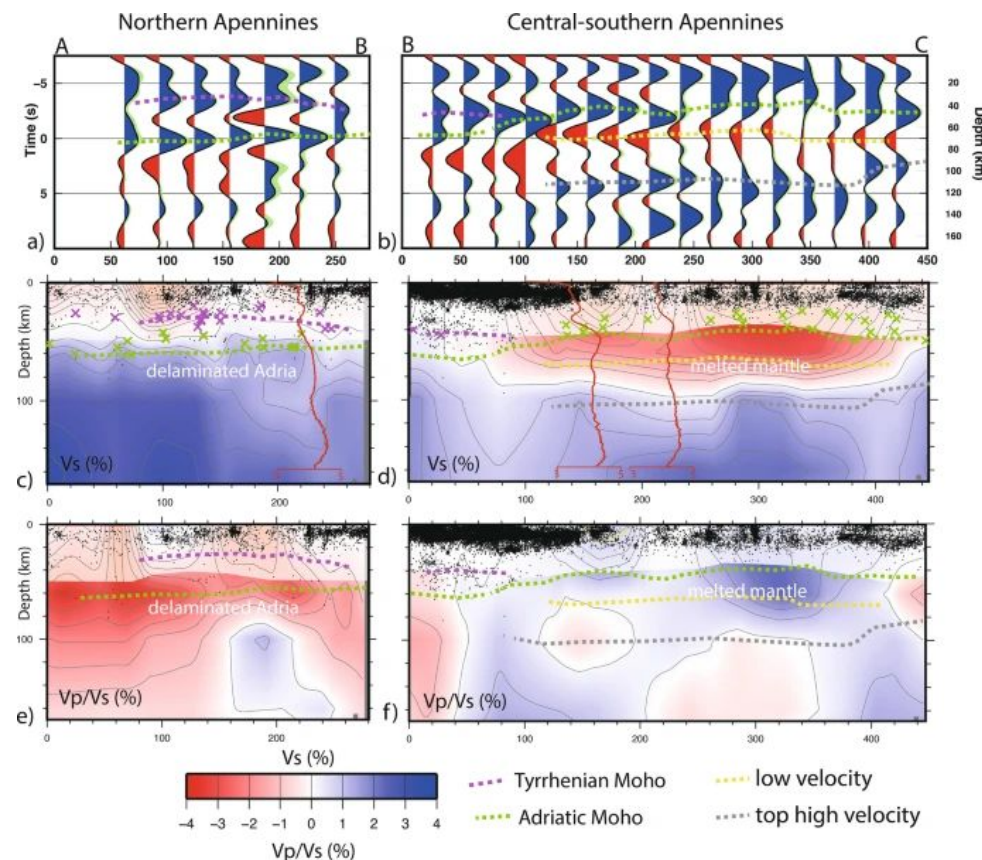
Velocity profile of the Vs structure as defined by RF stacking for the northern (a) and central-southern Apennines (b) (Chiarabba et al., 2020)
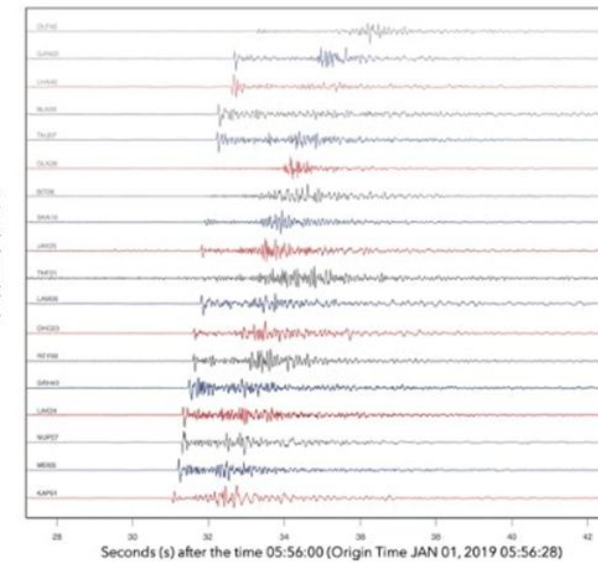
Activity 1.3.3 - Strengthening the INGV seismic networks - Mobile Seismic Network (Ref. Zuccarello)

Grigoli et al., 2022

Montesinos et al., 2021
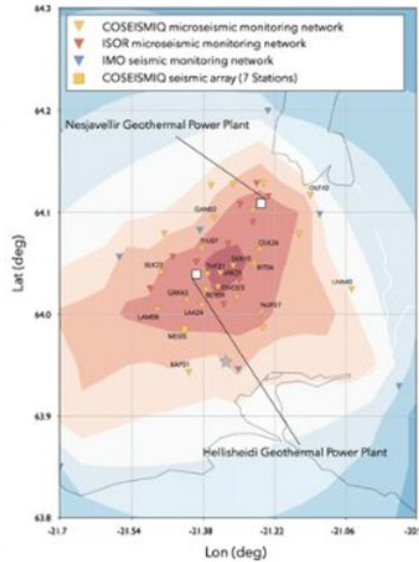
Support national and international monitoring and research efforts at local scale:

● Implementation of new 3D seismic analysis

● Advanced seismological monitoring (e.g., from seismotectonics to earthquake volcanoes processes, from the site effects to the buildings responses, among others)

● Advanced seismic array analysis through high spatial resolution data.

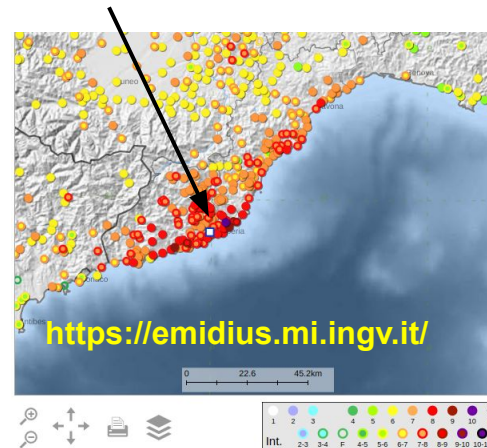# Activity 1.4 - Strengthening the UNIGE seismic network (Ref. Spallarossa, UNIGE)

Improvement of monitoring and scientific capacity in North-West Italy through new high-quality instrumentation:
- Low-noise, Broad-band velocimetric seismic sensors
- High resolution, high dynamic range and low power digitizers

This new instrumentation will be used for renewing some older seismic stations (blue stars) and for a new site (yellow star) in the area of the 1887 Mw6.2 earthquake.

https://emidius.mi.ingv.it/
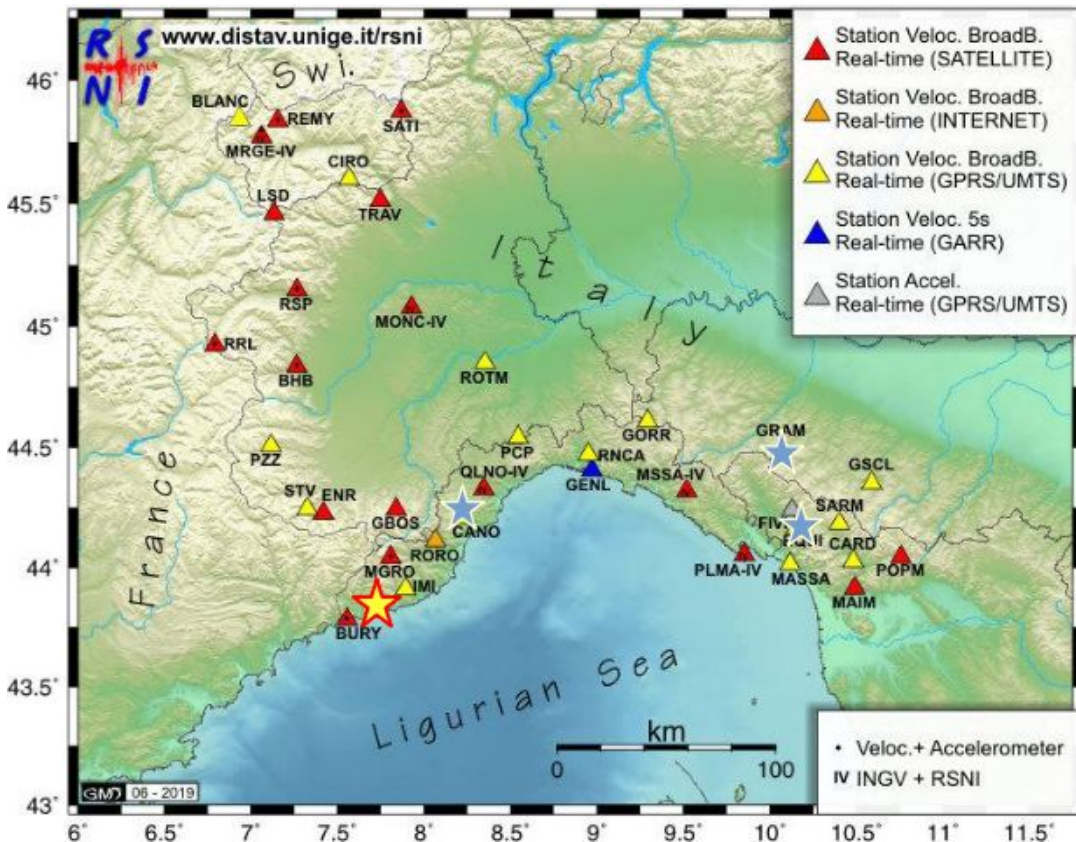
Sinergy and compliance at national scale with INGV RSN will be assured.

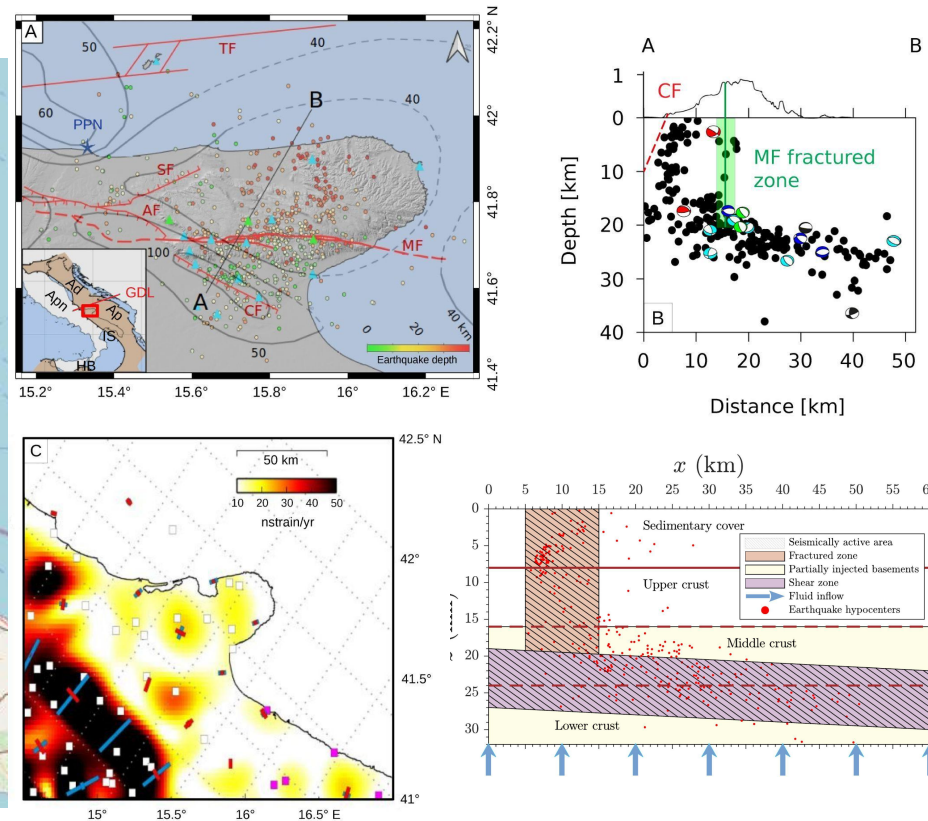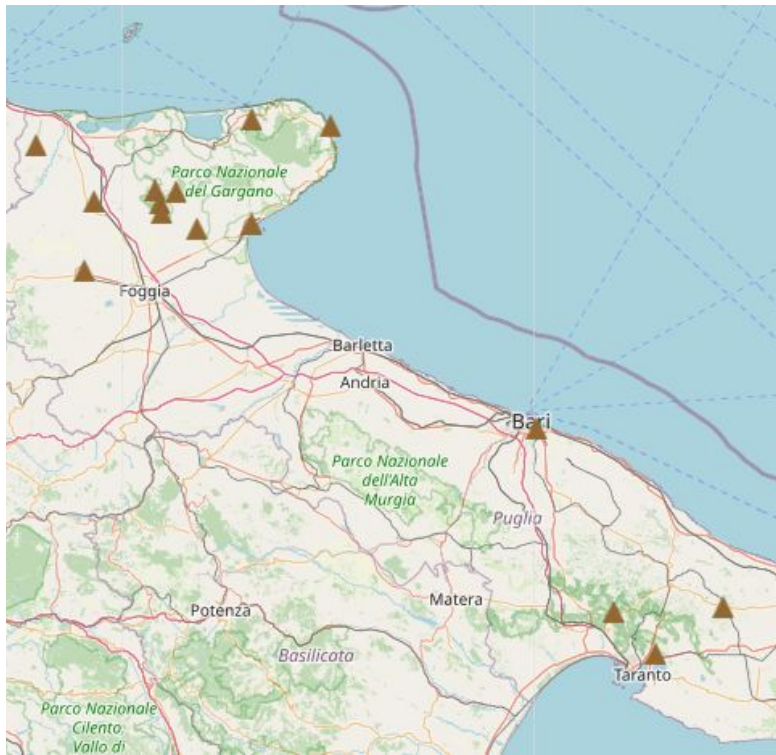# Activity 1.5 - Strengthening the OTRIONS seismic network (Ref. Tallarico, UNIBA)

Lavecchia et al., 2022

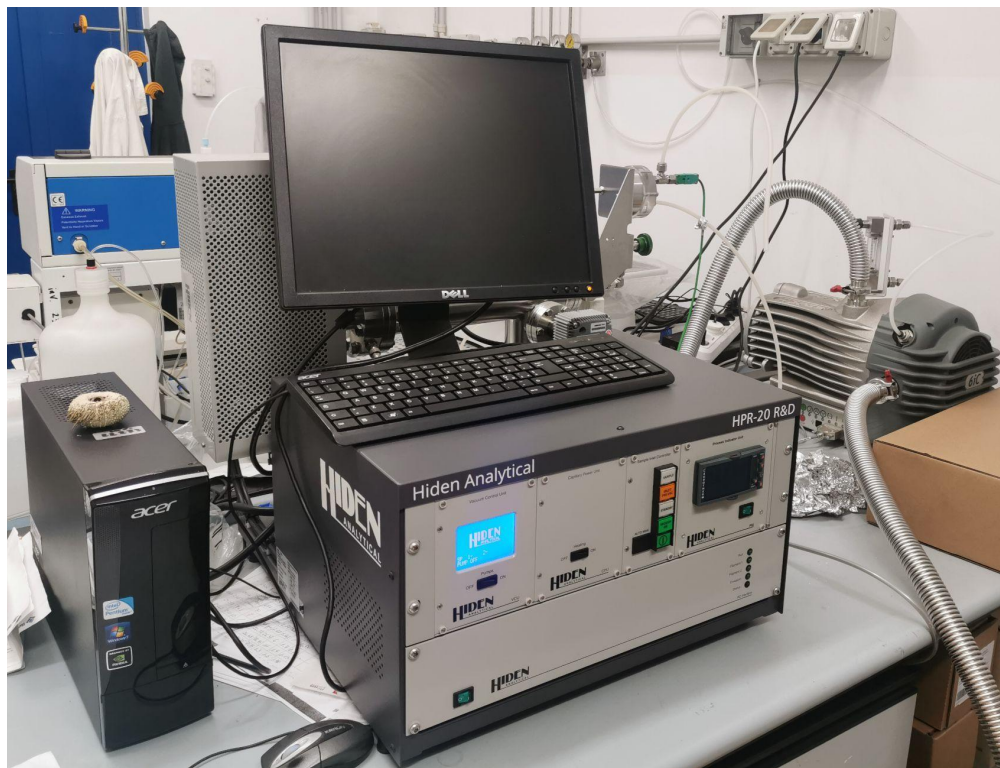1. Upgrade and extension of the **OTRIONS** network with **four Broadband seismic stations.**
2. Upgrade of **data transmission** by four satellite internet connection.

1. The OTRIONS network operates in synergy with RSN**.**
2. The seismic data will be analyzed with machine learning approach.
3. The seismic data are used for velocity and attenuation tomography.
4. The seismic network will be integrated with geodetic stations.

Activity 1.6.1 - Strengthening the INGV TABOO infrastructure (Caracausi, Moretti)

Hiden Analytical Quadrupole

To improve the multidisciplinary approach to investigate the seismo-genetic processes in the NFOs EPOS community

1. Installation of **hydrogeochemical** stations able to measure **Temperature, Electric Conductivity and Water Level**.

1. Installation of a **quadrupole** to be implemented as part of the NFO_TABOO project to determine concentrations and isotopic compositions of **He, Ar, Kr and Xe in gases** to bind the atmospheric component from the deep one.

1. Deployment and maintenance of remote stations (seismic, geodetic and hydrogeoch.).

Activity 1.6.2 - Developing the Hydrogeochemical network (Ref. Pecoraino, INGV-PA)

A national hydrogeochemical network is a tool with considerable potential for cross-cutting applications in the environment, active tectonics, volcanism and water resource management.

The continuous monitoring stations will measure chemical and chemical-physical parameters of water wells and springs but also in atmosphere and soils.

Main scientific aims this activity will be:

1) the creation of an infrastructure with **homogeneous data acquisition systems and protocols** to guarantee the acquisition, archiving, processing of data and their usability by the scientific community.

1) Recognition over time and interpretation of variations in geochemical parameters attributable to active tectonics, that provide fundamental information to **understand seismogenic processes** and to identify the **presence of tectonic-structural discontinuities**

1) The implementation of stations to allow the continuous acquisition of other **geochemical parameters** both in the well (e.g. **PCO2, dissolved gases**) and in the atmosphere and soils (e.g. **gas and isotopic compositions, CO2 fluxes**).

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Activity 1.7 - Strengthening the Hydrogeochemical data management Platform (Ref. Comerci, ISPRA)

1. The collaboration with the ARPAs (in the framework of the SNPA) will be exploited to increase the number of sites of the future national, continuous and near-real-time hydrogeochemical monitoring network. This collaboration is crucial for the sustainability of the hydrogeochemical network.

2. Improvement of the Hydrogeochemical Platform (already tested) through a hybrid cloud system that will guarantee continuous data collection, access, interoperability and sharing on a transnational level.

3. Compliance with standardised IT protocols according to INSPIRE technical regulations and FAIR principle will be guaranteed
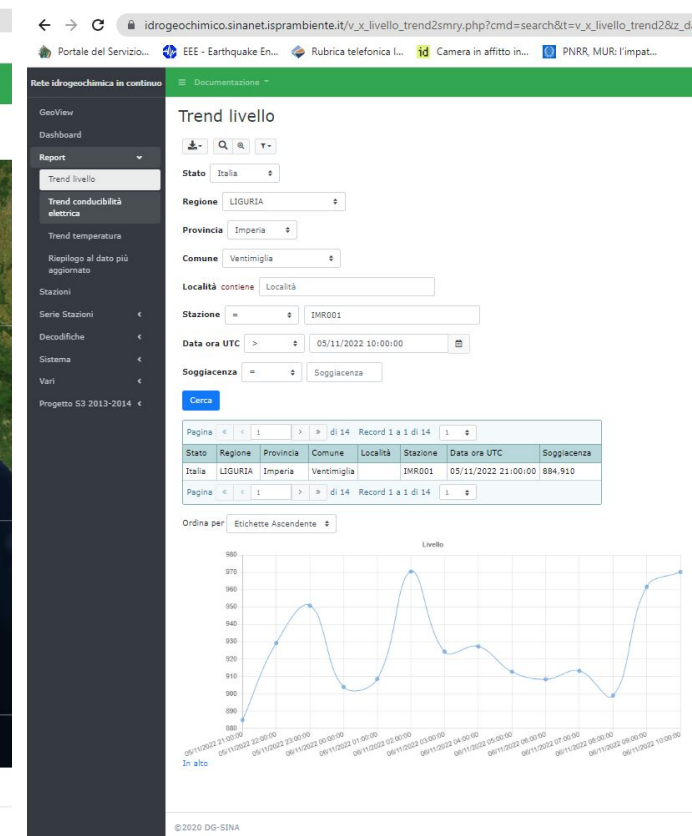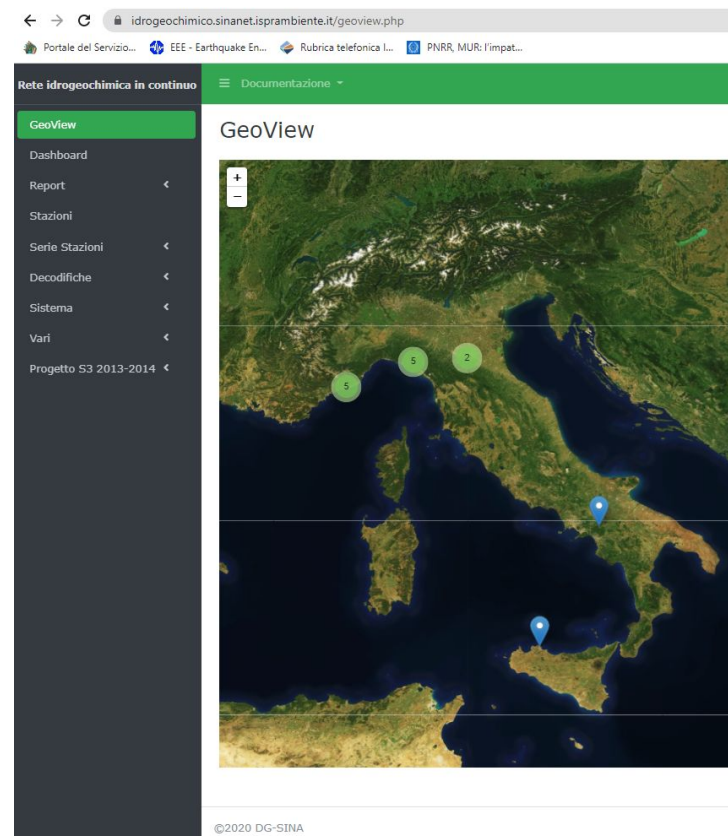
WP1 summary - The proposed scientific visions mean:

- Renewing significant part of the RING (National) and FredNet (North-East Italy) networks with new full-GNSS instruments;

- Improving seismic network infrastructures at Mediterranean, National and regional/local scales with up to date and innovative instrumentation;

- Improving seismic and geodetic data storage & acquisition, with new design solutions for the data room equipment and environment, making it the ideal place for safely running physical and virtual servers

- Development of a national hydrogeochemical network and improvement of their data distribution platforms;