



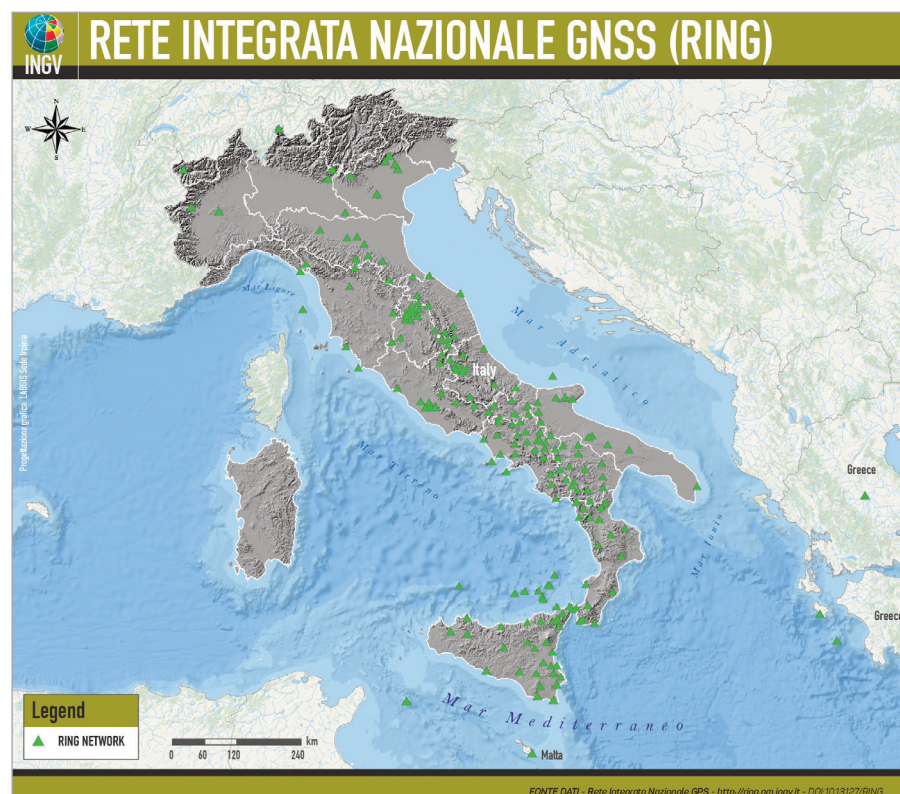
GROUND-BASED operational monitoring in support of space applications

Most application services based on space data need to be integrated or validated with observations gathered on the Earth's surface by instrumental networks. INGV develops and maintains regional scale monitoring networks over Italy and the Mediterranean area, as well at polar and equatorial latitudes, able to provide real time streams of various geophysical parameters and observations. Some of the measured parameters are openly accessible in real time through web services, while others are subject to specific provision conditions.

Measurement of ground data can also be carried out during campaigns organized ad hoc for validation or calibration, or for high resolution monitoring of specific geophysical events or hazards.

INGV owns and operates a large variety of geophysical instruments for use in the lab or in the field, and its personnel is able to measure nearly any geophysical and geochemical parameter. INGV also develops new geophysical and geochemical instruments and holds patents in this field.

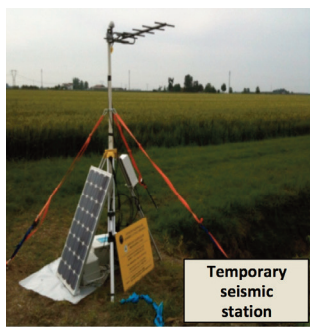
Operational GNSS monitoring: the RING network



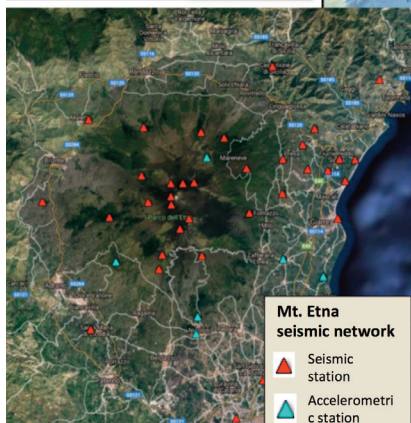
The INGV network of GNSS stations, named RING (**Rete Integrata Nazionale GNSS**), is a nation-wide network of about 200 permanent stations, established since 2004.

All 30-sec GNSS data are available open access; high frequency data are also available on demand (1-20 Hz). In the next year, a general upgrade is planned in order to acquire also GLONASS and GALILEO data for most RING stations. Since the 1990's INGV has developed comprehensive capacities in GNSS network setup, data processing and data use for geophysical analysis and modeling. Occasionally INGV performs measuring campaigns on geodetic benchmarks in critical areas or during seismic sequences. This dataset is useful for regional densification and integration with other geodetic observations. GNSS data processing is performed in different Data Analysis Centers at INGV, each using different analysis approaches and processing software, national solutions are combined for optimal treatment of uncertainties. GNSS data are used also for validation and calibration purposes of other satellite-based products (e.g. InSAR).





Temporary seismic station



Mt. Etna seismic network
 ▲ Seismic station
 ▲ Accelerometric station

Operational SEISMIC MONITORING

INGV develops and manages the **National Seismic Network**, consisting of over 500 **velocimetric and accelerometric stations**, and more local seismic networks on the active volcanoes. Their signal is used to monitor in real time the natural and **anthropogenic seismic activity**, whose parameters are provided in near real time (2 minutes) to the Italian **Civil Protection Department**. The raw and processed seismic data are rapidly provided for **open access** with publication delay increasing with quality level (automatic, manually revised).

INGV also **deploys temporary stations** in the field for a higher resolution monitoring during earthquake/volcano emergencies or to follow specific phenomena. Space geodetic observations from GNSS and InSAR need to be integrated with seismic information to identify earthquake ruptures or magmatic sources

MARINE observation NETWORKS

Recently, innovation and marine technology advancements have given a boost to the development of systems and tool for observing deep-sea processes. Today, the scientific community can study those processes using time-series of data acquired at the seafloor and along the water column. EMSO, the **European Multidisciplinary Seafloor and water column Observatory**, is a brand new research infrastructure providing long time-series of data acquired by in situ observatories in deep-sea key-sites around Europe from the north-east Atlantic Ocean to the Mediterranean and the Black Sea. They provide geophysical measurements (e.g., seismic, geomagnetic), oceanographic measurements (e.g., temperature, salinity, water current), acoustic and sea level measurements. Additional systems, providing new type of measurements (e.g., geodetic) are close to be integrated in EMSO and will expand the spatial coverage and disciplinary range.



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