

SEA-LEVEL OBSERVING ACTIVITIES IN ITALY

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Introduction

In the history of sea level measurement in Italy, the first instruments were installed and operated at Istituto Talassografico (ITS), at Trieste (1859), Venezia Punta della Salute (1871) by National Hydrographic and Marine Service (SIMN), Rimini (1867), Genova by the Navy Hydrographic Institute (IIM) (1883). Afterwards, between 1896 and 1897, also the sea level stations of Imperia, Livorno, Civitavecchia, Napoli (Arsenale e Mandracchio), Messina, Palermo, Catania, Ancona, Ravenna Porto Corsini, Cagliari, and La Maddalena started working. Then, in 1920 also the stations of Reggio Calabria and Vieste started and, under the management of the National Marine Service, the Italian sea level stations begun to have the characteristics of a real network rationally distributed on the territory. In 1986, the National Sea Level Network was completely restructured and the number of stations was reduced to 25, including: Imperia, Genova, Livorno, Civitavecchia, Napoli, Salerno, Palinuro, Messina, Palermo, Porto Empedocle, Catania, Reggio Calabria, Crotone, Taranto, Otranto, Bari, Vieste, Ortona, Ancona, Ravenna, Venezia Diga Sud Lido, Trieste, Cagliari, Carloforte, Porto Torres. It is necessary to add to the stations listed above the ones of Genova and Brindisi by IIM, Venezia Punta della Salute by SIMN, Trieste by ITS and Rimini managed by the municipality. In the meantime in all the stations of SIMN, the replacement of all the mechanical instruments with electronic instruments, powered by solar panels and with local data storage was done.

During this period, from 1986 to 1998, when the sea level network of SIMN were again restructured using updated real time technologies, the attention to the continuity of the reference level, which was characteristic of mechanical instruments, was not as good as it was before, due to poor maintenance procedure, and many gaps or jump of the reference level are detectable in the data analysis, compromising the continuity of the time series of sea level measurements.

Long and almost uninterrupted time series of sea-level data are therefore available only for few Italian stations, mainly for Trieste (ITS), Venezia Punta della Salute (SIMN now APAT, Agency for Environmental Protection and Technical Services), and Genova (IIM).

In Italy the following Organizations are involved in sea-level measurement:

- i) APAT, Agency for Environmental Protection and Technical Services in Rome, with regional Service in Venice;
- ii) Istituto Idrografico della Marina (IIM), Genoa;
- iii) Comune di Venezia, Centro Segnalazioni e Previsioni Maree (CSPM), Venice;
- iv) Istituto Sperimentale Talassografico (IST), Trieste.
- v) Regione Calabria
- vi) Regione Abruzzo

This paper gives a short summary of currently situation of Italian sea-level gauge stations according to the information from such Organizations.

APAT, Agency for Environmental Protection and Technical Services, is a governmental Organization formally belonging to the Minister of Environment, Territory and Sea. It is the official national service in charge of operating the National Sea-level Gauge Network.

The Italian tide gauge network is composed by 26 new stations uniformly distributed along the Italian coasts (figure 1) and located (mainly inside ports) at: Trieste, Venezia Lido, Ancona, Ravenna, Pescara, Ortona, Isole Tremiti, Vieste, Bari, Otranto, Taranto, Crotona, Reggio Calabria, Messina, Catania, Porto Empedocle, Lampedusa, Palermo, Palinuro, Salerno, Napoli, Cagliari, Carloforte, Porto Torres, Civitavecchia, Livorno, Genova, and Imperia.

The stations forming the RMN are now all equipped with two different tide gauges: a main electronic ultrasound instrument, with tubular guide and temperature compensation, and a secondary floating mechanic gauge with paper recording, which is used for a punctual measurement check, for the analysis of particular events or phenomena and as data recovery in case of occasional main instrument failure. Tide gauges are referred to geographic fixed points (benchmarks) found by high-accuracy levelling, verified with reference to the nearest IGM (Istituto Geografico Militare Italiano) benchmark. Stations are also provided with an anemometric sensor (wind speed and wind direction at a 10 meters height), a barometric sensor, an air temperature sensor and a water temperature sensor. All the stations are equipped with a local system of data management/storage and with a real-time transmission device connected with the APAT centre in Rome. Since the new tide gauge network has been fully operating, the APAT provides updated information concerning historical series, real-time observations, astronomical tide forecasts, and data analyses for both planning and scientific purposes. Tide gauge data and updated local tide constants are published on the annual bulletin. Moreover, APAT has carried out a recovery of the historical data collected by the pre-existing set of stations, both in paper and digital form, in order to add historical observations to the new National Network archive (www.apat.it).

APAT includes a Service based in Venice (APAT-Venice) which manages a regional sea-level gauge network in addition to the national one, for the study of the lagoon and for civil protection purposes connected with storm surge hazard along the North Adriatic. The APAT-Venice manages a network of 52 sea level and meteomarine stations distributed in the lagoon basin and along the north Adriatic coast. Every station is equipped with electromechanical and mechanical instruments following IOC standards. The data storage is made locally on electronic and paper support and 25 stations are equipped for the real time data transmission. Some of the stations measure also wind speed and direction, precipitation, and atmospheric pressure.

The station in Punta della Salute is now equipped with a co-located suitable GPS (www.apatvenezia.it).

APAT, with 5 of its Sea level measurement stations, is directly involved in the implementation of a sea level coastal stations network in order to develop the NEAMTWS monitoring system of tsunami warning system in the Mediterranean

The Navy Hydrographic Institute (IIM) of Italy is located in Genova since 1872 and has the main task to systematically survey Italian seas and coasts, and their representation in form of charts and nautical publications which are the official documentation for navigation safety. As a military organization, it produces the classified documentation and the nautical instrumentation to military vessels. (<http://www.marina.difesa.it/idro/index.htm>).

Its activity mainly deals with navigation, including chart production. It manages two sea-level gauges (IIM, 2000) in the stations of Genoa and Brindisi, equipped with mechanical float gauges. Data are continuously recorded on paper and subsequently digitized.

The Institute operates the station in Genova, with a more than centennial time series of sea level, and the station in Brindisi.

New data analysis on the Genova time series are ongoing in collaboration with APAT.

CSPM is a public Organization belonging to the city administration of Venice. Its activity includes sea-level monitoring at 14 sea-level gauges and sea-level prediction. It is also in charge of issuing warnings to Venice population when particularly high sea-level events are predicted. CSPM operates 14 sea-level gauges, all provided with real time data transmission, located at:

- Punta Salute 1, the historical station along Giudecca channel,
- Punta Salute 2, along Canal Grande;
- Palazzo Cavalli, in the city of Venezia,
- Darsena Misericordia, in front of Murano;
- Murano, island of Murano
- Burano, island of Burano
- Saline, north lagoon
- Chioggia città, south lagoon;
- Malamocco mouth;
- Chioggia mouth;
- Lido south breakwater;
- Malamocco; north breakwater;
- Chioggia; south breakwater;
- CNR platform, 15 Km offshore Lido mouth.

The stations are equipped with a local storage system and a real time UHF transmission equipment to the central office of CSPM. The sea level measuring instruments are floating type or ultrasound type. The reference level is the local datum at Punta della Salute, connected to IGM datum.

IST is a research institute belonging to Consiglio Nazionale delle Ricerche (CNR). It operates one sea-level station in Trieste for research purposes, which is equipped with two float gauges. Analog records are made on paper, and digital records are stored on solid state memory. Atmospheric pressure, wind vector, air temperature and sea temperature are measured at two stations within 500 m from the sea-level gauge. Ferraro (1972) reports the details on the sea-level gauge, including the different zeroes adopted during the secular history of the station. Sea-level related activity includes sea-level modelling (Raicich et al., 1999b) and joint analysis of sea-level and atmospheric data time series on different time scales, namely from hourly/daily, as in the case of seiches and storm surges (Raicich et al., 1999a), to interannual/multidecadal, concerning mean sea level variability (Crisciani et al., 1994; Raicich and Crisciani, 1999). IST also publishes astronomic tide predictions for Trieste (Maselli and Raicich, 1999).

The Regional Administration of Calabria, south Italy, operates since about three years 3 sea level and meteomarine stations at Cetraro, Corigliano and Roccella Ionica.

The Regional Administration of Abruzzo, central Italy, operates since about 20 years a sea level and meteomarine station at Pescara.

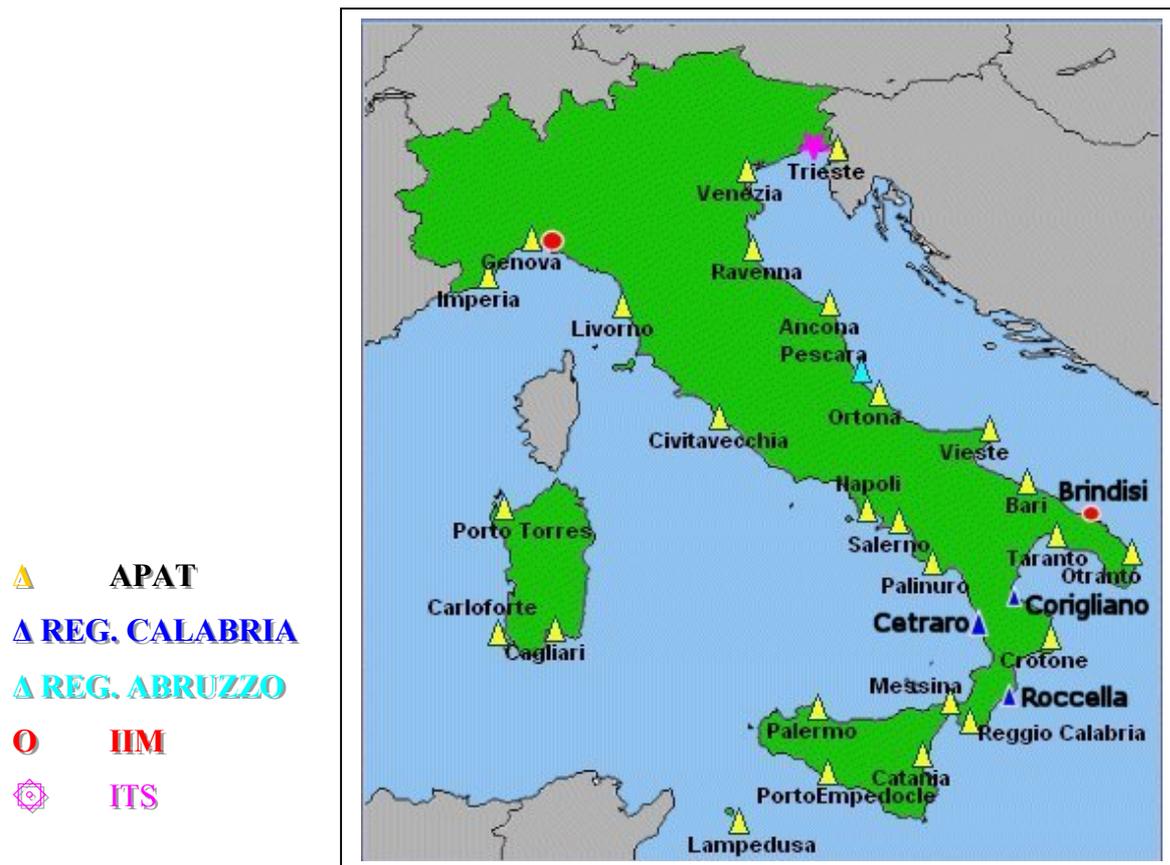


Fig. 1 – The Italian Sea Level Network

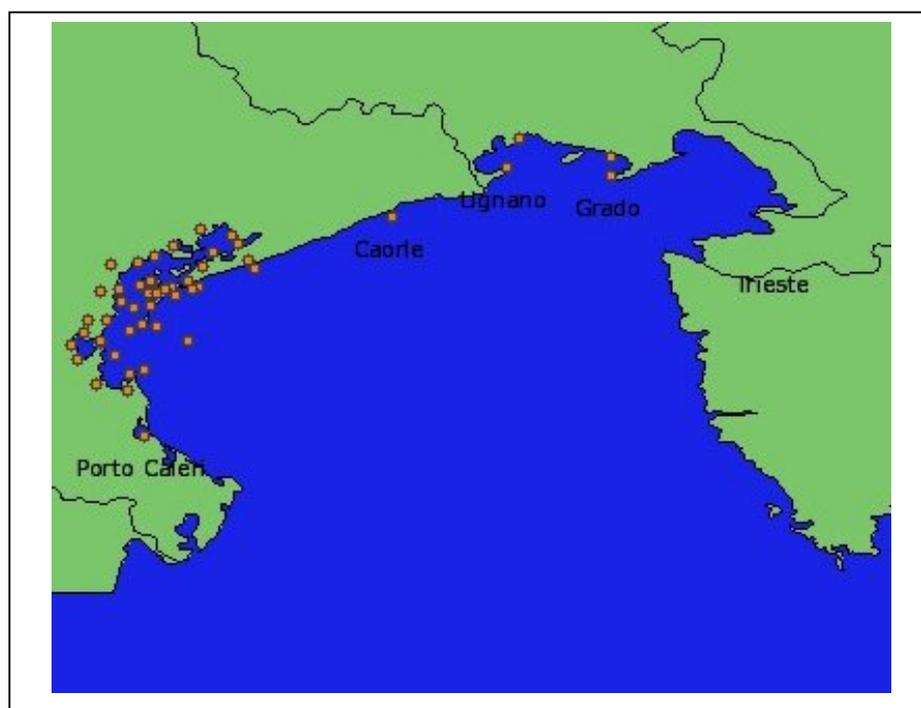


Fig. 2 – The APAT- Venezia sea level network of the lagoon and the North Adriatic

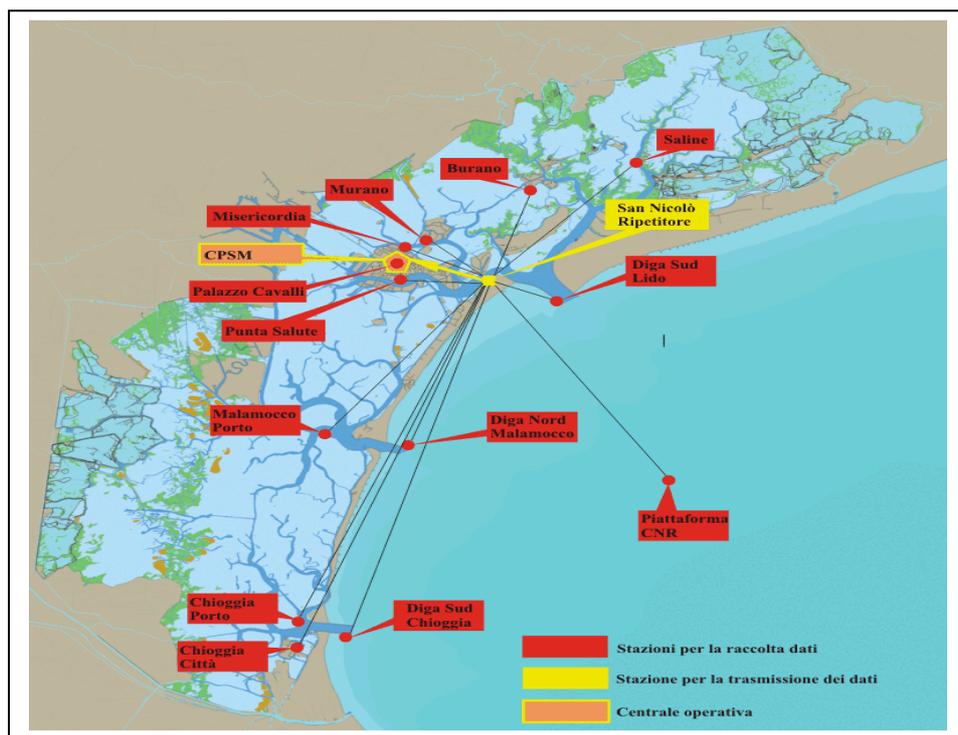


Fig. 3 – CFSM sea level network in the Venice lagoon.

GPS receivers, operated by University of Bologna, have been installed also at the APAT sea-level stations at Marina di Ravenna (July 1996) and at Punta della Salute, and at IST station in Trieste (March 2000).

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