VENICE AND ITS LAGOON

Total surface: 540 km², of which:
- 8% land above sea level (littorals, reclaimed areas, islands, embankments)
- 92% "watersystem": channels (11.9%), shallows, mud flats and salt marshes (80.1%).

TIDE GAUGE AND METEOROLOGICAL NETWORK

Observed parameters:
- sea level
- meteorological parameters (air pressure, wind velocity and direction, humidity, temperature...)

Real time acquisition, with frequency of 5 minutes

WAVE-METER NETWORK

10 measurement stations equipped with ultrasonic hydrometers ID0810B.
Observed parameter: wave height.
Real time acquisition, with frequency of 15 minutes.

WATER FLOW MONITORING

1 measurement station equipped with an Acoustic Doppler Current Profiler.
Observed parameter: current velocity.
Real time acquisition with frequency of 10 minutes.

FORECAST ACTIVITY by ICPMS OPERATIONS ROOM

Example of tidal forecast by ICPMS - Municipality of Venice (ICPMS website)

The ICPMS technical staff elaborates three times a day the two-day long tide forecast.
- Observed data from the monitoring network and meteorological data are analysed.
- Numerical models are used to compare and integrate the first analysis

Numerical models:
1. Statistical models: SIMPLIFIED, COMPLETE and EXTENDED
2. New Statistical models:
   - EXPERT with Adriatic pressure atm. field
   - EXPERT with Adriatic wind field
3. Neural models: Multi Layer Perceptron, Fuzzy Logic, GMDH
4. Hydrodynamic finite element model SHYFEM
5. Hydrodynamic finite difference model HYPSE

ACQUA ALTA

A sea level higher than 80 cm above the local datum of Punta Salute: the water begins to cover the lower areas of the city.

MAIN CAUSES

a) Low atmospheric pressure and winds (storm surge)

The presence of a low atmospheric pressure event on the Northern part of the Tyrrhenian sea results in a Southern wind (Scirocco) on the Adriatic sea

b) Sea surface oscillations (seiches)

Wind or difference in atmospheric pressure between the two extremities of the Adriatic sea can produce a difference in the level of marine surface. Gravity always seeks to restore the horizontal surface of the basin.

Vertical harmonic motion results, producing an impulse that travels the length of the basin. The impulse is reflected back from the end of the basin, generating interference. Repeated reflections produce standing waves, i.e. seiches which could be in phase with the highest level of the astronomical tide and lead to "acqua alta".

c) Tides

Semidiurnal tide: two maximum and two minimum tides each day. Micro-tidal basin: tidal range less than two meters.

d) Trend

During the XX century the frequency of flooding tides higher than 110 cm has increased about 13 times. During the period 2000-2010 a number of 6 exceptional events (≥ 140 cm) occurred. Moreover, the eustatism due to climate changes and the phenomenon of land subsidence cause arise in the relative sea level, making the flooding tides more frequent.