

# AQUA ALTA – THE OCEANOGRAPHIC TOWER OF ISMAR-CNR AFTER ALMOST 40 YEARS OF ACTIVITY

Mauro Bastianini<sup>1\*</sup>

<sup>1</sup> Institute of Marine Sciences - CNR, Venice, Italy - mauro.bastianini@ismar.cnr.it

## Abstract

The oceanographic tower “Aqua Alta” of the Institute of Marine Sciences of CNR is located in the Northern Adriatic Sea, 15 km offshore the Venice lagoon on 15 m of depth. The tower, operational since the early ‘70s, hosts a very large variety of instruments, meteorological, oceanographic, physical and chemical. Some of the time series collected on board are among the longest ones in the world. The tower allows both long term automatic instruments deployment, connected in real time with the land station, and extended periods for people on board for devoted campaigns. Multiple power sources, also controlled from land, are available. Measurements done during one of the worst historical storms has led to the evidence of one of the key processes controlling the tidal level in the lagoon in Venice in cases of serious floods.

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The oceanographic tower “Aqua Alta” of ISMAR-CNR (see Figure 1) is located 15 km offshore the coast of the Venice lagoon, in the Northern Adriatic Sea, on 16 metre of depth. It is the only fixed marine scientific structure in Italy, and one of the very few in Europe, that allows people on board for prolonged periods for intensive campaigns in the middle of the sea. The capability of having a structure in the open sea, large enough to withstand the worst storms, but small enough not to interfere, as with the large oil or gas platforms, with the surrounding environment allows highly accurate and hard to get measurements also in heavy difficult conditions.



Fig. 1. The oceanographic tower "Aqua Alta".

The tower has three floors plus the terrace at 12 metre height above the mean sea level. The structure is composed of four 60 cm diameter vertical poles, a few metres apart, connected at four different levels by multiple smaller poles. The tower is fully self-sufficient for what energy is concerned, powered by two diesel power generators complemented by a very large set of batteries plus solar and wind generators. “Aqua Alta” is fully equipped with a very large set of

instruments, devoted to meteorological, oceanographic and chemical parameters. Measurements go back to the early ‘70s, so that some time series provide sufficient information to consider climate changes. The abundant, sometime too much, submarine life has provided ample material for biological researches. Most of the instruments are devoted to long term measurements. However, a substantial part of the use of the tower concerns specific campaigns carried out for prolonged periods with people on board. Cavaleri provided in 1999 an extensive review of the researches on board till that year [1].

The wind and wave data available from board have provided essential information for the design of the barrages, presently under construction, that will save the Venice lagoon from the worst floods. The floods are associated to the sirocco storms.

An extremely intense one, the strongest in memory after the catastrophic 1966 one, happened in December 1979. Heavy damage was caused on board, with the second floor completely destroyed. Notwithstanding the lack of power, two mechanical instruments, an anemometer and a mareograph, provided essential data. In particular the latter provided the first evidence in the world of coastal set-up, the accumulation of water, with the consequent local sea level raising, that takes place as a consequence of wave breaking toward the coast.

This finding, properly modelled [2], is now integral part of the local tidal forecast system. Recently a substantial upgrading has been done on the tower, with the introduction of extensive remote control and data handling in real time. A new tide-wave recording system is in operation at 50 m distance from the tower, with direct connection, together with meteorological data, to the display in ISMAR. Some webcams have been installed for direct visualisation of the meteo-oceanographic situation and control of the area. An advanced experiment has just started with an automatic system, controlled from land, capable to obtain at high rate continuous 3-dimensional measurements of the sea surface under storm conditions.

## References

- 1 - Cavaleri L., 1999. The oceanographic tower Acqua Alta: more than a quarter of a century of activity. *Nuovo Cimento*, 22C (1): 1-111.
- 2 - Bertotti L., and Cavaleri L., 1985. Coastal set-up and wave breaking, *Oceanol. Acta*, 8 (2): 237-242.