RESEARCH AND DEVELOPMENT OF AN IN-SITU REAL-TIME COASTAL MONITORING SYSTEM

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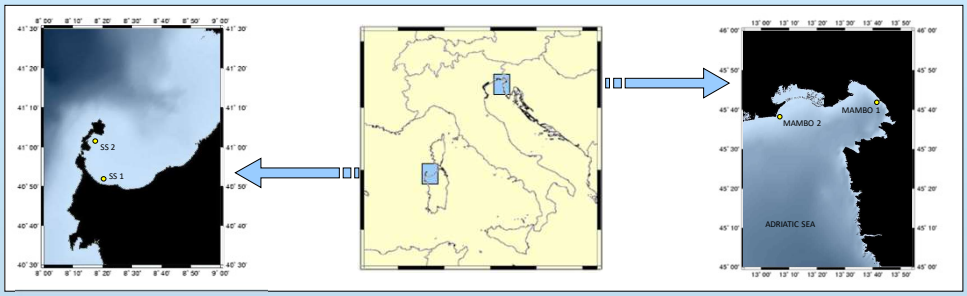
The coastal area is a complex system in which the effects of the forcing terms on the circulation and mixing present a marked space-time variability on widely differing scales. In order to study such a system, it is necessary to monitor continuously, at high frequency, oceanographic and meteorological variables.

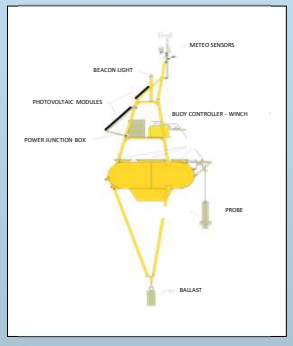
To meet this need, the OGS has developed a coastal meteo-oceanographic buoy, called MAMBO, constituted by a float, a hull, a tripod and a powering system based on batteries recharged by solar panels that have been expressly designed and assembled by an in-house technical team. The buoy is equipped with a mechanical winch driving a multi-parametric profiling probe which provides data on pressure, temperature, salinity, dissolved oxygen, chlorophyll, pH and turbidity over the entire water column. Meteorological data (air temperature, barometric pressure and wind) are also measured. Data are acquired every 3 hours and transmitted *via* GSM cellular phone to a receiving station at the OGS in *real-time* where they are automatically subjected to a first level quality-check and made available to the public at the OGS web site (http://doga.ogs.trieste.it/cgi-bin/mambo).

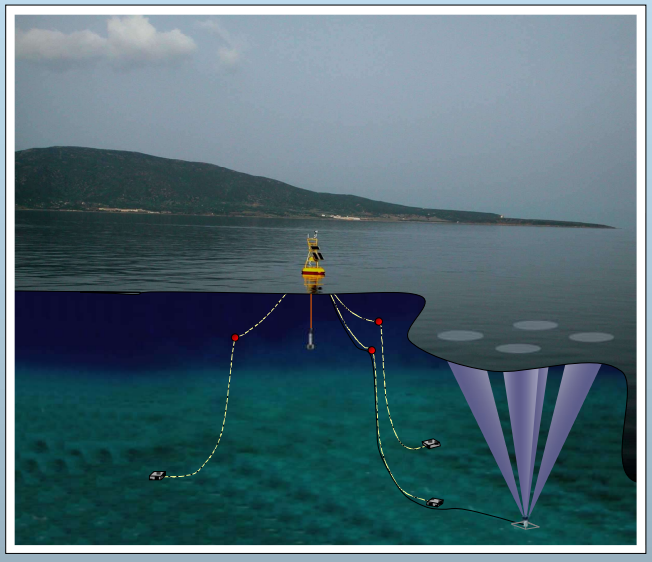
The buoy also serves as a convenient platform for a separate OGS-developed controller that manages an upward-looking ADCP-600kHz positioned on the sea floor close to the buoy. This controller regulates the ADCP power supply and permits the *real-time* transmission of pressure and current data to land *via* GSM cellular phone. Since there are no limitations due to batteries or memory capacity, currents can be sampled at high spatial and time resolution. Moreover, the controller permits to remotely change the configuration of the instrument in order to increase, for example, vertical resolution, and eventually, to record wave data.

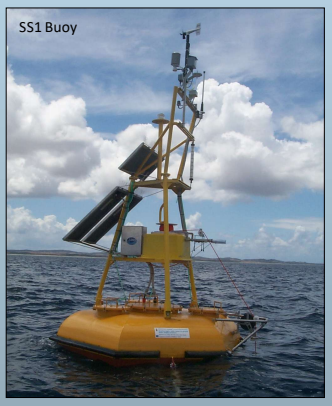
The first buoy of this type has been operating in the Gulf of Trieste (North Adriatic Sea) since 1998, and it is being continually improved.

Two others, supplied additionally with a GPS, a radiometer and a hygrometer and improved with respect to some mechanical parts, have been deployed since June 2000, in the coastal area to the north of Sardinia (Tyrrhenian Sea). The development of an effective quality control procedure, that can be applied in *real-time* to the acquired data and that can permit the design of an efficient maintenance program for the buoy sensors, is in progress.



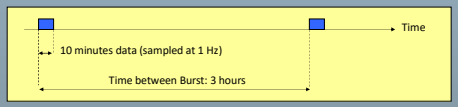






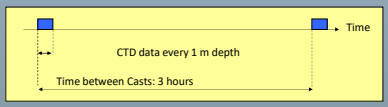
Buoy	Strumentation Boarding	Activated
Mambo 1	Meteo station	September 1998
	Profiling CTD	September 1998
	Self Rec. ADCP	September 1998
	Real-Time ADCP	April 2001
Mambo 2	Meteo station	Scheduled: May 2002
	Profiling CTD	Scheduled: May 2002
SS 1	Meteo station	June 2000
	Profiling CTD	June 2000
SS 2	Meteo station	October 2000
	Profiling CTD	October 2000

METEOROLOGICAL STATION

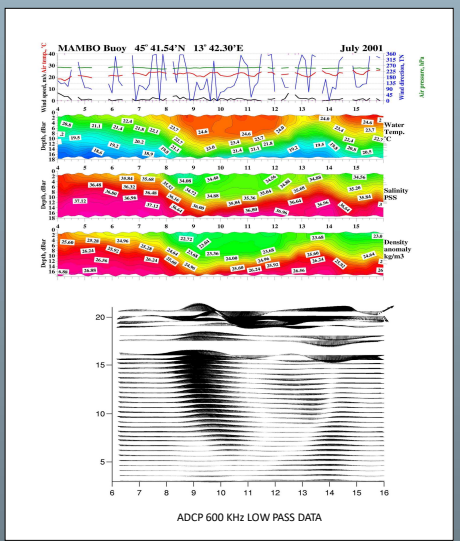


Sensor	Range	Accuracy
Barometric Pressure	800 to 1100 hPa	0.5 hPa (@ 20° C)
Temperature	-50 to 50 ° C	0.3 ° C (@ 0° C)
Relative Humidity	0 to 100 % RH	3 % (from 10 to 90 % - @ 20 ° C)
Electronic Compass	0 to 360 degrees	2 degrees
Wind Direction	0 to 355 degrees (Electrical)	0.5 degrees
Wind Speed	0 to 60 m/s	0.3 m/s
Solar Radiation	0 to 1500 W/m^2	75 W/m^2

CTD PROBE



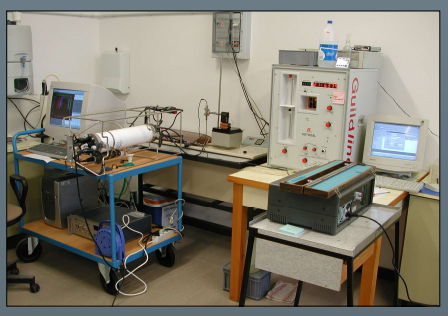
Sensor	Range	Accuracy
Pressure	0 to 40 dBar	0.04 dBar (0.1 % full scale)
Temperature	-3 to 50 ° C	0.003 ° C (@ 0° C)
Conductivity	0 to 64 mS/cm	0.003 mS/cm
Oxygen	0 to 50 ppm	0.1 ppm
Ph	0 to 14	0.01
Turbidity	0.02 to 2500 FTU	2 %
Clorophyll	0 to 15 µg/l	0.1 µg/l



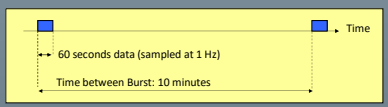
ADCP 600 KHz LOW PASS DATA

QUALITY CONTROL

The CTD sensors of the buoys are periodically calibrated in the OGS calibration laboratory to correct the acquired data for eventual sensor drifts.
Temperature sensors are checked according to the ITS-90 international scale using a reference grade platinum resistence thermometer.
The platinum thermometer used is regularly checked (in-house) at the two defining points (triple point of water and melting point of gallium).
Conductivity sensors are calibrated by immersing them in a stable temperature bath. Water temperature and data from conductivity sensor are taken.
Water samples are also collected and then analysed for salinity by direct comparison with standard sea-water.
Corrected conductivity is derived from corrected salinity and corrected temperature in the bath.
Pressure sensors are tested by applying several pressure values generated by a pressure balance.



ADCP



CONCLUSIONS

The buoy designed and assembled by OGS was tested from 1998 in very strong wind and wave conditions.

The buoy system is completely autonomous due to the low power consumption and the presence of batteries recharged by photovoltaic cells.

The GSM phone permits to remotely control the sampling parameters.

The profiling system of the buoy presents two main advantages with respect to multisensorial chains:

- low cost
- simplicity of the calibration procedure.

This buoy is one of the most innovative systems in coastal operational oceanography due to its seaworthiness, the high vertical resolution of the probe measurements, the high frequency sampling rate and the real-time data availability.

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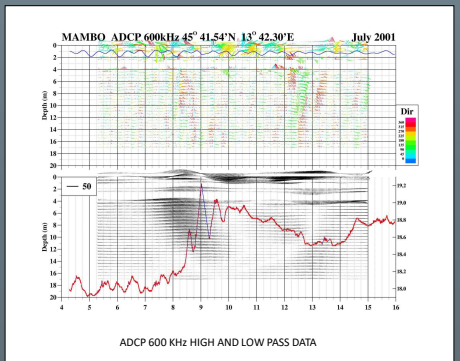

ADCP 600 KHz HIGH AND LOW PASS DATA