TWO BUOY DESIGNS FOR REAL TIME OCEANOGRAPHIC DATA ADQUISITION

González J[1], Herrera JL[2], Lorbada S[1], Varela RA[1]

[1]Universidad de Vigo, España, josegonzalez@uvigo.es
[2]Instituto de Investigaciones Marinas-CSIC, Vigo, España

Universidad de Vigo

Introduction

Buoys utilization for oceanographic purposes, mainly in physical oceanography, has become a major goal over the last decades. When compared with oceanographic cruises, which allow obtaining spatial resolution on sampling, this approach brings us the possibility of obtaining high temporal resolution data series in a sampling point. Although traditional moorings have the same purpose, buoys have two main advantages: the possibility of having communication, and thus, real time acquisition of data, and obtaining longer temporal series, as buoys are equipped with autonomous power supplies.
Nevertheless, buoys design must be adapted both to the mooring location and to the particular weather and oceanographic conditions. The objective of this work is to present two tested buoy designs for real time data acquisition, serving both for lakes/embayments or coastal ocean environments.

Material and Methods

With the aim of obtaining physical and biological real time data, two different buoy designs were developed.
The first design, created for oceanic waters, was intended for mooring locations up to 30-40 m depth, where waves action is the main oceanographic factor to be considered. Additionally, maritime traffic is an important factor to take into account when designing these buoys, due to the risk of an accident. For these conditions, buoys with a dimension of 4 m in diameter are used. They are composed by a watertight double hull over which a turret (3 m tall) is installed. Although to reduce the effect of waves on the buoy is recommended to diminish floatability reserve and consequently its size (Berteaux, 1976), due to the heavy anchorage system used and the need of a turret with the double purpose of increasing its visibility and resisting possible impacts from boats, is necessary to increase the buoy dimensions. Inside the hull, all electronics compounds are installed, while in the turret are located the solar panels, communication antennas and meteorological sensors. Three of these buoys have been installed up to the date. In each of them, a series of probes and sensors have been installed to determine both hidrography/dynamics (i.e., current profilers or CTDs) and water quality (i.e., using multiparametric probes to determine pH, chlorophyll *a* concentration, turbidity, dissolved oxygen concentration, etc.).
The second design was developed for monitoring of rivers, lakes or the inner part of estuaries. At these locations, the main forcing conditions to be considered are both tides and currents. For these locations a smaller buoy was designed (1.5 m in diameter). This design is based on a metallic frame over which plastic buoys are installed on the perimeter. In the inner part, protected by the structure, is located a watertight box in which all the electronic compounds are installed. Over the structure, as a roof, solar panels are installed to fuel the buoy. Six buoys of this type have been installed up to the date, three in water reservoirs, monitoring water quality (turbidity, dissolved oxygen concentration, pigment concentration, pH, etc…) and other three in a river mouth, monitoring both turbidity and currents
Both systems, in spite of the differences in structural aspects and size, operate in a similar way. These systems are powered with solar energy, which allows the buoy to work autonomously and they are permanently linked to a central computer, which receives the data at 10 minutes intervals.

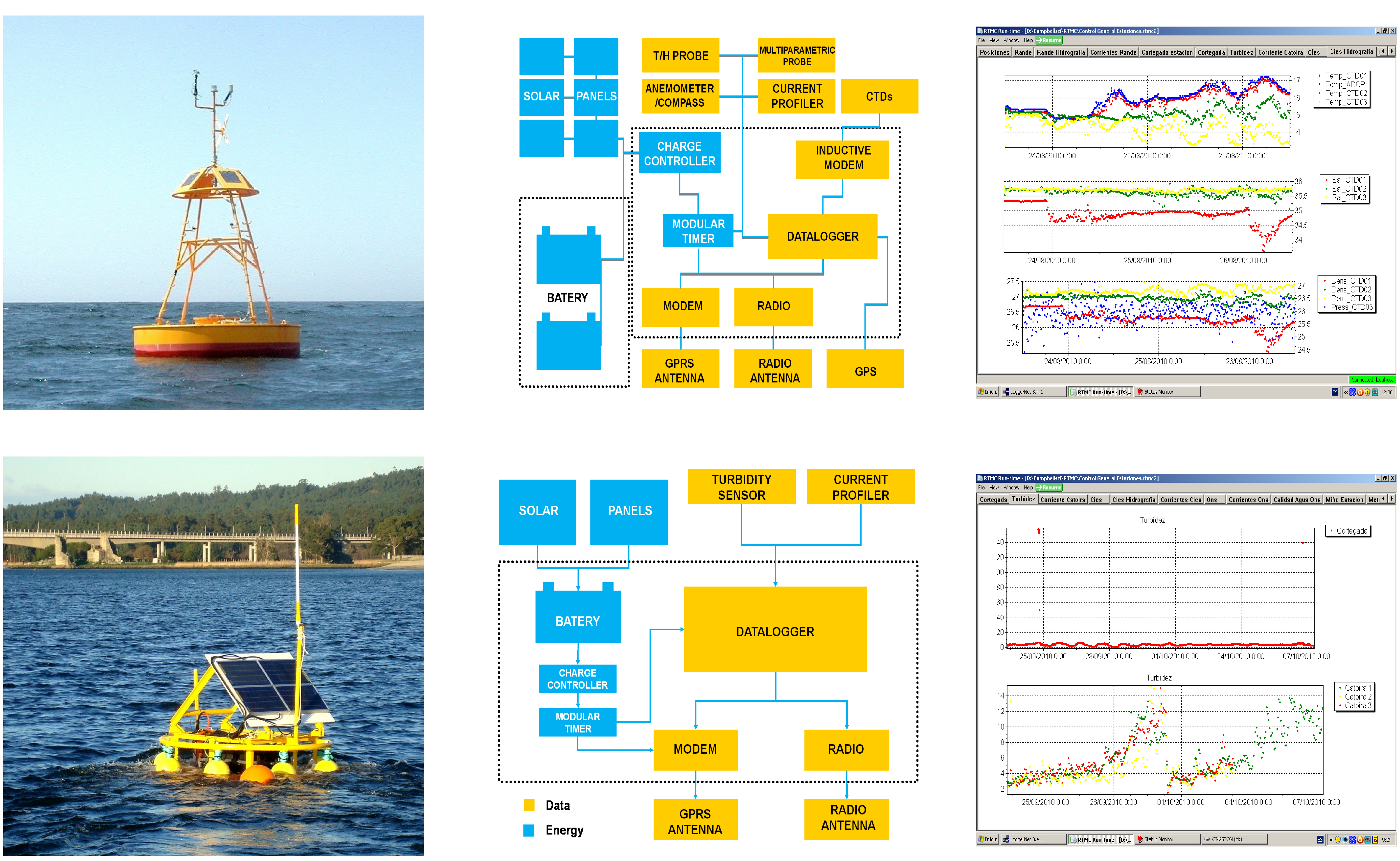

Figure 1. This figure shows, from left to right, the buoy desing, its electronical composition and a capture of the real time graphs obtained, both in the oceanic (upper line) and in the emabyments buoys (lower line).

Results and Discussion

When structures like bridges or bateas (wooden floating platform for mussel grown) are present in the interest area, the described monitoring systems can be installed on them, avoiding the need of mooring a new structure. Two examples of this case are those monitoring stations installed in a bridge of the inner part of the Ría de Vigo and in a batea moored at the Ría de Arousa. Nevertheless, this situation is not frequently found and it is necessary the use of buoys.
The described designs have demonstrated their fitness to monitoring purposes in the two considered conditions. Smaller buoys have been working on water reservoirs since 2008 and in a river mouth since 2009. In the other hand, bigger buoys have been moored on shelf, two in front of the Ría de Vigo (2008) and the Ría de Pontevedra (2010), respectively, and another one in front of the mouth of the Miño river (2010). Thus, their adequacy to meteorological and hydrodynamic conditions has been tested in both conditions for up to two years.
Additionally, at those locations where maritime traffic is intense, the external buoy structure must be able of resisting a possible impact from a boat. This issue is of higher importance in the outer buoys, where the consequences of an accident are especially severe. Thus, double hull in the bigger buoys is of great importance. In this sense, these buoys are able of resisting impacts from boats, as the damage on the external part does not affect the inner part of the buoy.
These buoys designs have allowed to create an observation net, and thus obtaining a real time monitoring system for the selected variables in those locations where buoys are moored, from water quality variables (turbidity, dissolved oxygen concentration, pigment concentration, pH, etc…) to current profiles. Data from the oceanic buoys are shown at www.observatorioraia.org.
Additionally to the advantages of obtaining real time data, these systems allow the implementation of an alert system for critical variables. Clear examples of its application are the monitoring of salinity or water temperature for marine cultures, or turbidity to evaluate environmental risks in engineering works developed in marine environments, as bridges construction. In these cases, it is possible to establish critical values for the considered variables, so when these values are reached, an alert via e-mail or SMS is sent, allowing prevention both of environmental and economical losses.

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