DESIGN AND DEPLOYMENT OF LOW-COST DRIFTING BUOYS FOR COASTAL MONITORING APPLICATIONS.

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Abstract – Several Low-Cost Drifting Buoys (LCDB) have been designed and constructed at ICMAN-CSIC to determine flow characteristics of The Guadalquivir Estuary. Position and velocity of the drifters can be sent to a local server every ten minutes. The battery module has been dimensioned to provide experiment duration longer than two weeks. Flow patterns registered by the LCDB successfully match Acoustic Doppler Current (ADC) data from some others moored ADC profilers.

Keywords – Low-cost drifting buoys, GPS/GPRS tracker, hydrodynamic pattern, real-time coastal monitoring

I. INTRODUCTION

Guadalquivir estuary is located at the South West of The Iberian Peninsula. Its last 80-kilometre stretch (the estuary hereafter) flows from Sevilla, the main fluvial harbour in Spain, to its mouth at Sanlúcar de Barrameda, in the Gulf of Cádiz, and it is characterised by its significant fluvial traffic (4.6 million tones during 2008). Water currents in the estuary are greatly influenced by a quite complex tidal regime and by periodical discharges from Alcalá del Río dam.

To help understanding these hydrodynamic features, we have designed, constructed and deployed several low-cost drifting buoys (LCDB) along the estuary. By tracking their position, it is possible to determine superficial flow patterns and turbulent dispersion taking place in the estuary.

The deployment of these LCBDs has been performed along various stretches of the estuary and the registered velocity patterns have been validated against current data obtained from several Acoustic Doppler Current Profilers (ADCP) moored along the estuary [1].

II. DESING AND CONSTRUCTION

The drifter covers have been constructed using 63-mm-tick Polyvinyl Chloride (PVC) PN-10 pipes. These covers are 50-centimetres-length, watertight, hollow cylinders containing two external battery packs and a low-cost GPS/GPRS personal tracker, as shown in figure 1. Surrounding the cover, there is a floating foam-ring that keeps one third of the drifter above the water surface. The bottom side of the cover has an anchor attached in order to minimize the influence of the wind in the movement of the drifter.

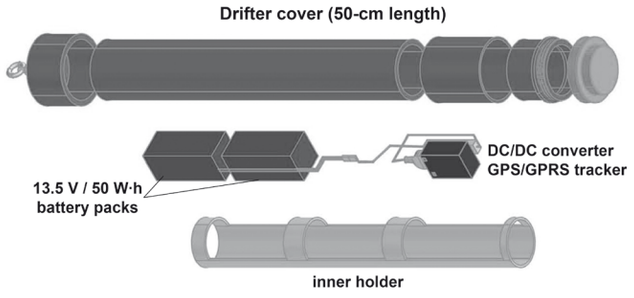

Fig. 1. LCDB components and diamensions.

The battery packs consist of 18 AA-alkaline cells, supplying a nominal voltage of 13.5 volts and a capacity of 50 watts•hour. The two battery packs are connected in parallel and grant power autonomy longer than two weeks when position reports are sent every ten minutes. A DC/DC converter conditions this power supply avoid damages in the GPS/GPRS tracker.

The GPS/GPRS tracker is a low-cost commercial model with the following characteristics: GPS frequency 1.1575.42MHz, Datum is WGS-84, Reacquisition < 0.1sec, TTFF Position Accuracy is 10 meters RMS without SA and Velocity Accuracy 0.1m/s without SA. This tracker can be configured to send automatic position-velocity reports periodically. In our deployments, this period has been set to 10 minutes, although it can be changed on the fly via SMS at any time.

The automatic reports sent by the tracker are GPRMC NMEA sentences, also know as "Recommend Minimum NMEA sentences, and they are transmitted via GPRS to a local server. When there is not GPRS service, these reports are recorded in internal memory in order to be sent when the GPRS service is re-set. The GPRMC sentence consists of twelve comma-delimited words, including satellite derived time, date, latitude, longitude, speed and bearing.

III. LCDB DEPLOYMENTS

Buoy deployments began on April 19, 2009, in the Guadalquivir estuary. The average duration of buoy drifts was more than six hours (tidal period). Buoys were deployed from a boat in a transect. Transect deployments were made by crossing the reach normal to flow at a constant speed and releasing the buoys along a line at approximately equal intervals. Transect deployments were used to map surface velocities and determine flow patterns. In addition, several deployments were carried out in the vicinity of the new lock of the Seville harbour.

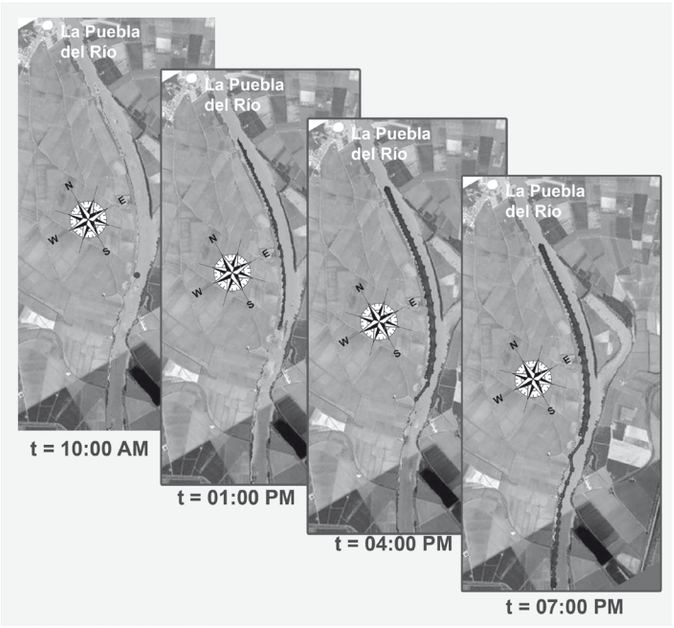

Fig. 2. Trajectory followed by one of the drifters nearby La Puebla del Río (Sevilla).

IV. I.T. INFRASTRUCTURE

In order to register the LCDB position in real-time, the GPRMC NMEA sentences sent by the drifter are periodically stored by the server. A Java application has been developed in the server to communicate with the trackers and build up a database with all that information. This application also allows the user to export the data in some standard formats (ASCII, xls, mat, kmz) easing the graphical representation of the information.

V. ACKNOWLEDGEMENTS

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REFERENCES

[1] F.J. Gutiérrez, G. Navarro, J. Ruiz, "Real-Time Telemetry of Hydrodynamic and Hydrological Variables", Sea Technology, (in press).