

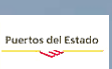
# Operational monitoring of sea level by CGPS in the Barcelona and l'Estartit harbours

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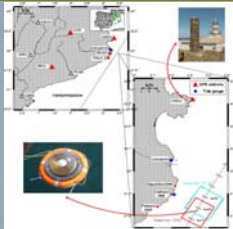
## Abstract

A description of the actual operational infrastructure at Barcelona and l'Estartit harbours is presented. The main objective is the implementation of these harbours as a precise geodetic areas for sea level monitoring and altimeter calibration for radar and airborne/spaceborne laser altimetry in the coastal areas.

At the Barcelona harbour there is a CGPS with a radar tide gauge from Puertos del Estado and a GPS belonging to Puerto de Barcelona, receiver Leica Geosystems GRX1200 GG Pro and antenna AX 1202 GG. A precise levelling has been made by the Cartographic Institute of Catalonia, ICC. Bathymetric campaigns have been made.

The instrumentation of sea level measurements has been improved by providing the Barcelona site with a radar tide gauge Datamar 3000C device and a Thales Navigation Internet-Enabled GPS Continuous Geodetic Reference Station (ICGRS) with a choke ring antenna, located at the EPSEB of the Technical University of Catalonia, UPC. It is intended that the overall system will constitute a CGPS Station of the ESEAS and TIGA networks. A radar tide gauge MIROS from Puertos de Estado is also located inside the harbour.

## 1- Cape of Begur calibration site



The tide gauge of l'Estartit is a traditional floating gauge placed 18 years ago and has an accuracy of  $\pm 2$  mm. Since 1996, the l'Estartit tide gauge has been co-located with geodetic techniques (GPS measurements of XU, Utility Network, and XdA, Levelling Network) and it is tied to the SPGIC (Integrated Geodetic Positioning System of Catalonia) project of the Institut Cartogràfic de Catalunya (ICC).

In 2006, due to the work for the expansion of the harbour, the tide gauge had to be moved. Before the work started, appropriate GPS measurements were carried out in order to ensure the connection of the tide gauge data. During October 2006 and May 2008, the tide gauge was inactive and it has been moved on to a new location inside the harbour.

In June 2008, new GPS and levelling measures have been done in order to tie the new location into SPGIC project and to co-locate old data respect the new one.

A significant contribution has been made related to Topex/Poseidon and Jason-1 calibration campaigns, direct and indirect, in March 1999, August 2000 and July 2002 near Cape of Begur.

Although l'Estartit does not have a GPS permanent station, it is possible to build a virtual one from the service "CATNET web" of the ICC. "CATNET web" is a data distribution system of a virtual GPS permanent station via web. From the coordinates where you want to place the virtual station, the time interval and the measurement rate, the system generates a RINEX file under the requested conditions.

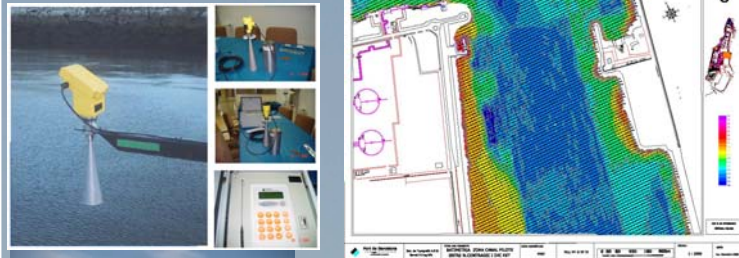
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## CGPS - Barcelona Harbour – Technical University of Catalonia UPC – Cartographic Institute of Catalonia – Puertos del Estado



At the UPC there is a CGPS, an Ashtech Internet Enabled Geodetic Reference System (ICGRS) from Thales Navigation with an Ashtech choke ring antenna dome margolin, and a meteorological station DAVIS PRO2

## BARCELONA HARBOUR



At Barcelona harbour there are now two tide gauges belonging to Puertos del Estado. One tide gauge, at 2, installed recently, is placed at the dock 140 of the ENAGAS Building. The radar sensor is over the water surface, on a L-shaped structure which elevates it a few meters above the quay shelf. 1-min data are transmitted to the ENAGAS Control Center by cable and then sent each 1 min to Puertos del Estado by e-mail. This sensor also measures agitation and sends wave parameters each 20 min. A provisional tide gauge bench mark has been defined while the levelling is being done. The second Tide Gauge, at 1, is placed at the east end of Alvarez de la Campa Berth, opposite to the Pier for Oil Tankers. It measures inside of a PVC pipe of 300mm of diameter, and it has another pipe of similar calibration and with protection against blows and sun. The memory unit, or LPTM, is inside of a pavilion, and data are sent by radio to the Port Authority Office. The nearest geodetic signal is the NGP 791. The Zero's situation is with respect the Sea Level Average in Alicante of 2.438m under NGP 791 it is over the foundation that gives support to the nearest bollard, opposite to the southern face of the pavilion. The NGP 792, placed next to the connection between the fences of the CAMPSA tanks and Can Tunis Institute, is taken as stable signal. There is a GPS station Leica Geosystems GRX1200 GG Pro and antenna 1202. Bathymetric campaigns inside the harbour have been made. In the framework of a Spanish Space Project, the instrumentation of sea level measurements is to be improved by providing the Barcelona site with a radar tide gauge, at 3, and with a continuous GPS station nearby. The radar tide gauge is a Datamar 3000C device and a Thales Navigation Internet-Enabled GPS Continuous Geodetic Reference Station (ICGRS) with a choke ring antenna. It is intended that the overall system will constitute a CGPS Station of the ESEAS (European Sea Level) and TIGA (GPS Tide Gauge Benchmark Monitoring) networks.

## 2. Sea Level Monitoring by Airborne LIDAR



The airborne calibration campaign with a Partenavia P-68 (ICC) carrying an Optech Lidar ALTM-3025 (ICC) was made on June 16, 2007, overflying l'Estartit harbour (about 6 km wide by 50 km long) and mapping with observe lidar strips of about 800 m, wide. The validation of this new technology LIDAR may be useful to fill coastal areas where satellite radar altimeters are not measuring due to the large footprint and the resulting gaps of about 20-40 km within the coastline. Measurements with a GPS Buoy were made during the experience and a GPS reference station was installed in Aiguablava. A DSM of l'Estartit harbour area was derived in the first results from the campaign. On October 12, 2007, another LIDAR campaign was made at night with a Cessna Caravan 208B.

