

CGPS AT IBIZA, L'ESTARTIT AND BARCELONA HARBOURS FOR SEA LEVEL MONITORING AND ALTIMETER CALIBRATION

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Abstract

Sea level is an environmental variable which is widely recognised as being important in many scientific disciplines as a control parameter for coastal dynamical processes or climate processes in the coupled atmosphere-ocean systems, as well as engineering applications. A major source of sea-level data are the national networks of coastal tide gauges, in Spain belonging to different institutions as the Instituto Geográfico Nacional (IGN), Puertos del Estado (PE), Instituto Hidrográfico de la Marina (IHM), Ports de la Generalitat, etc.

L'Estartit floating tide gauge was set up in 1990. Data are taken in graphics registers from each two hours the mean value is recorded in an electronic support. L'Estartit tide gauge series provides good quality information about the changes in the sea heights at centimeter level, that is the magnitude of the common tides in the Mediterranean. This data has been used to compute the Mean Sea Surface MSS using GPS Buoys along an ascending track of Topex/Poseidon (July 2000) and Jason-1 (August 2002).

In the framework of the Spanish Space Project ref:ESP2005-05829, the instrumentation of sea level measurements has been improved by providing a radar tide gauge and a continuous GPS station complementing the actual infrastructure at the Barcelona harbour. The main objective will be the estimation from the time series of sea level change in the areas of Barcelona and l'Estartit. It is intended that the overall systems will constitute a CGPS station of the TIGA (GPS Tide Gauge Benchmark Monitoring) network.

1.- Cape of Begur and Ibiza calibration sites



General distribution of Begur calibration site. The GPS network of the ICC in Catalonia and the calibration area offshore Begur Cape indicating the surveying points on both the 1999-2000 and the 2002 campaigns. It is represented the nominal TIP ground track in the center and the parallel internal and the external ground tracks for the mapping of the sea surface.



The instrumentation consists on the reference station at the coast and the GPS buoys. The near tide gauge is only used when performing the indirect method. The reference station close to the satellite ground track is needed in order to achieve kinematic buoy solutions within centimeter accuracy level, which is the typical error assumed for the range measurement of the altimeter.

In all the campaigns, the buoy solution has been computed by using a differential kinematic strategy with short baselines, assuming common atmosphere corrections (ionosphere and specially troposphere) between the fix receiver and the rover. The mean value of the baselines is of 14.3 km and 14.9 km in 1999 and in 2000, respectively, and of 22.4 km in 2002. Previously, the coordinates of the fiducial site at the coast have been fixed by computing the free-network solution that involves several permanent IGS-ITRF stations of the ICC in Catalonia.

Apart of the tide gauge at l'Estartit, two ancillary sensors were temporarily installed at Llafranc harbor in 1999 in order to study the spatial and temporal variability of the tides in that area from the simultaneous records.

In 1999 and 2000 campaigns the direct estimation of the altimeter bias was realized during the overflight of the TOPEX/POSEIDON onto a point marked as TOP-08 and in the 2002 campaign the overflight occurred onto TOP-11, in Fig.1. Overflight times have an uncertainty of about 10 sec.

CGPS AT IBIZA HARBOUR

Puertos del Estado (Spanish harbours) installed a new tide gauge station at Ibiza harbour between 2002 and 2003. The station belongs to the REDMAR network, composed at this moment by 21 stations distributed along the whole Spanish waters, including also the Canary islands (<http://www.puertos.es>).

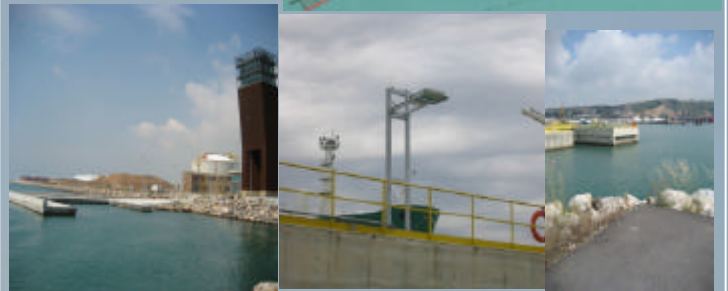


Jason-1 SSH biases from calibration studies: GDR-B (includes a new POE orbit and improved Jason Microwave Radiometer JMR calibration) reduces the geographically correlated errors from Jason-1, leading to more coherent results from local and regional studies

Site	GDR-A (mm)	GDR-B (mm)	# of cycles	Reference
Harvest	+141.8 ±6.3	+97.4 ±7.4	108 / 29	Haines et al.
Corsica	+107.9 ±6.7	+86.3 ±8.6	84 / 21	Bonnefond et al.
Bass Strait	+152.3 ±7.7	+106.0 ±8.3	18 / 18	Watson et al.
Gavdos	+131.0 ±15	NA	20 / NA	Pavlis et al.
Ibiza	+120.5 ±4.4	NA	33 / NA	Martínez-Benjamin et al.
Regional	+100.0 ±1.0	91.0 ±8.0	21 / 21	Jan et al.

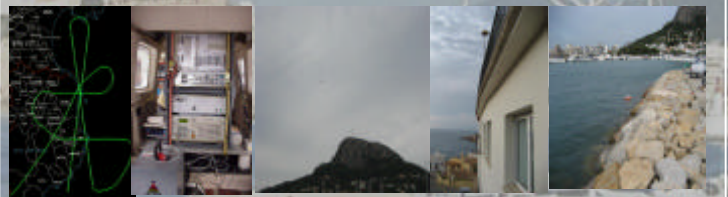
Biases given at the 2002.0 reference epoch

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 not 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 geodesic 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. 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.

