

# Three Years of Tide Gauge Measurements in the Pasajes harbour

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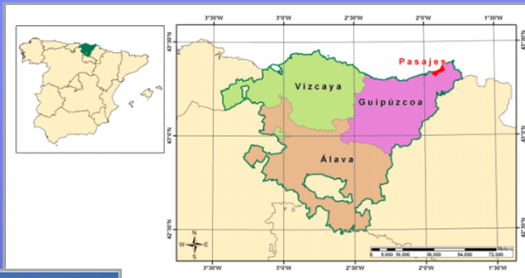
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In order to get sea level variations in the Pasajes harbour (Cantabrian Sea in the north of Spain) an automatic precision tide gauge was installed in 2007.



To obtain "real" sea level variations isolated from crustal movements or local deformations, a permanent GNSS station has also been installed in a nearby building of the tide gauge.

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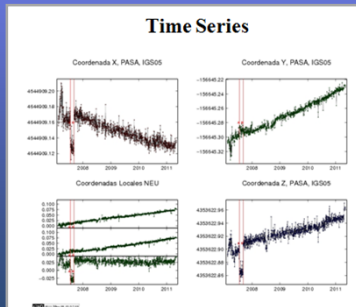
### TIDE GAUGE

A Digiquartz® 8DP070-GV submersible depth sensor provides the sea-level variations since February 2007.



### PERMANENT GNSS STATION

The aim of this GNSS station is the continuous measurement of vertical crustal movements to obtain absolute sea level variations by removing these local variations from the raw tide gauge data records.



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NITRIVAL NTP Targets



### TRIGONOMETRIC RECIPROCAL LEVELLING

Simultaneous reciprocal trigonometric levelling is the choice to link the GNSS Station's height and the Tide Gauge.




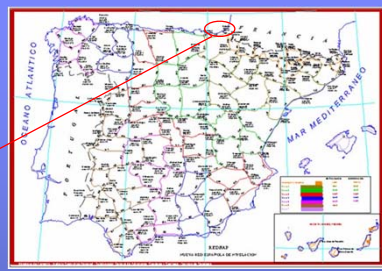

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### Bechmarks


Naming	
0	Tide Gauge
1000	TGBM-1
2000	TGBM-2
3000	TGBM-3
999	GNSS Station
66	Additional TGBM
10	REDNAP 2010/98







**SPiRiT LEVELLING**  
 Spirit levelling is used to get heights for all the Tide Gauge Bench Marks

REDNAP: 0201098



**FIG Working Week**  
 - Bridging the Gap Between Cultures  
 Marrakech, Morocco  
 May 18-22, 2011  
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It can be pointed that the different averages considered agree within a millimeter.

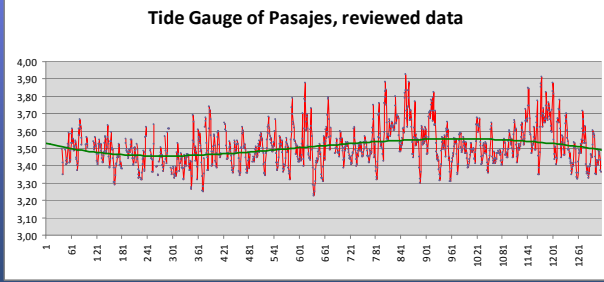
The raw sea level (without any additional correction) from May 2007 to December 2010 is of 3,5125 m.


The mean average for the reviewed data is 3.5136 m, the standard deviation is 0.1120 m.

### MEAN SEA LEVEL ANALYSIS


Measurement type	Average values
Average of the raw data daily average	3,5125
Average of the reviewed daily average (36 days less)	3,5136
Monthly values average	3,5114
Accumulated monthly data average	3,5125
5 minutes interval data average	3,5107
5 minutes interval accumulated data average	3,5127

**Tide Gauge of Pasajes, reviewed data**





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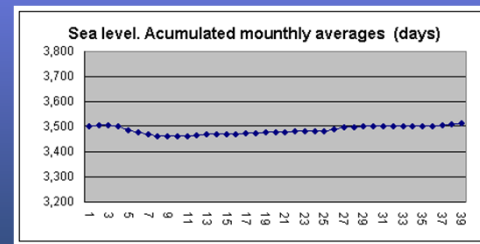
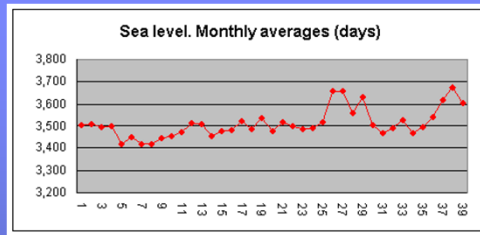


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## RESULTS

This results show that the GNSS/TG is fully operational and can be integrated in any sea level monitoring network to study the sea level or any other oceanographic application.

An evidence of this fact is the agreement signed by AZTI, Foral Council of Gipúzcoa and ARANZADI to warrant the continuity of the station as well as to ease the access to the registered data to any user who should be interested.



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