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NOVELTIS

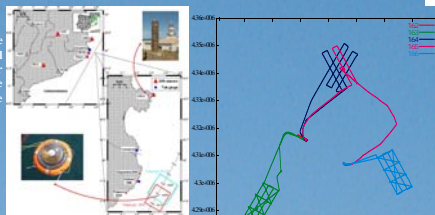


Abstract

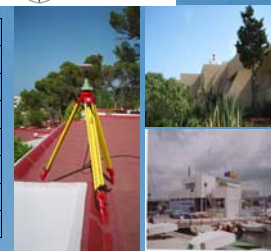
Three Begur Cape experiences on radar altimeter calibration and marine geoid mapping made on 1999, 2000 and 2003 are overviewed. One campaign has also been made in June 2003 at the Ibiza island area. Direct absolute calibration estimating the Topex Alt-B bias was performed during the satellite overflight by using GPS buoys. The advantage of that method is that neither geoid modelling nor tidal error is needed. Other main objective was to map the profile of the Mean Sea Surface (mss) along the closest T/P and Jason-1 groundtrack. Mapping the marine surface for indirect altimeter calibration has an advantage of allowing the calibration of any radar sensor that crosses the studied area but, in turn, the disadvantage is that the method requires ocean tide and geoid knowledge, which reduces the accuracy of the bias estimate by a factor of 2.

Campaign	Overflight (UTC time)	Cycle	SSH _{GPS} (m)	SSH _{Alt} (m)	BIAS (mm)	Altimeter product
1999	18/03 of 08:45:41	T/P 239	49.118 ± 0.319 49.090 ± 0.323	49.052 ± 0.04 49.053 ± 0.04	+65.2 ± 321.4 +37.1 ± 325.6	M-GDR TOPEX-B
2000	07/07 of 07:34:47	T/P 287	49.243 ± 0.074	49.209 ± 0.04	+34.3 ± 79.6	M-GDR TOPEX-B
2002	26/08 of 15:37:07	J 23	49.289 ± 0.061	49.184 ± 0.08	+105.2 ± 103.5	H-GDR Jason-1

A technical Spanish contribution to the calibration experience has been the design of GPS buoys and GPS catamaran taking in account the University of Colorado at Boulder and Senoosa/Capraia. For the mapping of the extended calibration areas centered on satellite ground tracks, the catamaran was tracked by the Patrol Deva, from the Spanish Navy. An additional absolute altimeter direct calibration was performed on June 14. Collected data came from five GPS reference stations deployed at Ibiza, San Antonio and Portinatx, and from vertically-referenced tide gauges located at Ibiza and San Antonio. We present first results on Jason-1 altimeter calibration using the marine geoid derived from data collected during the campaign. Moreover, the geoid activities (e.g., GPS, leveling) has permitted to build a very accurate (few mm) local network linked to the European one, with a reference frame compatible with the satellite altimetry missions (ITRF2000).



Trajectories of the catamaran around Ibiza Island.



GPS reference stations at Portinatx, Ibiza and San Antonio.

GPS static processing

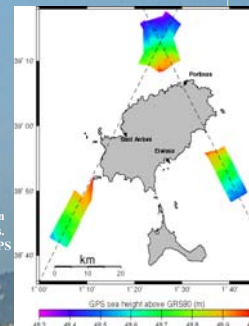
The reference system used has been ITRF2000 epoch 2003.45. Software used for computing static baselines is Bernese v4.2. The coordinates of EBRE, MALL and ALAC stations have been obtained from weekly solution published by IUREF, which correspond to the week of data collection. These coordinates are:

For ALAC	X = -509085.1991	Y = -42672.2259	Z = 3935857.7019 (m)
For MALL	X = -4915369.4626	Y = 226199.8333	Z = -4039649.7957 (m)
For EBRI3	X = -4832538.6329	Y = -41537.8769	Z = -4147461.3128 (m)

Marker Name	ARP Height	Antenna Type	Antenna Number	Receiver Type	L1/L2 phase centre
IBIA	0.8447	TRIMBLE-4000 ST/SST	TRM 14532.00	ASHTECH: XII Z-12	0.0780 / 0.0744 m
IBIB	1.1510	LEICA: AT502	LEI AT502	LEICA: SR530 3.02	0.0683 / 0.0712 m
SANA	0.6385	ASHTECH: Choke Ring	ASH 701945E_M	ASHTECH: IGRS Z 12	0.1090 / 0.1279 m
SANB	0.1438	TOPCON choke ring ant CR3	TOPCON CR3 GGD	TOPCON: LEGACY-E L1/L2	0.0805 / 0.1035 m
PORT	0.9510	LEICA: AT502	LEI AT502	LEICA: SR530 3.02	0.0618 / 0.0654 m

PS data collected (gray) and kept (black). Dashed lines represent the Jason-1 passes: ascending N°187 (South West – North East) and descending N°248 (North West – South East).

Contour Map of the gridded GPS sea surface heights (weighted mean)



Tide gauges description

In June 2003, one campaign for the calibration and validation of the altimeter data was done in the Ibiza Island. GPS stations, one GPS buoy, one GPS catamaran and two tide gauges were utilized in this campaign. Tide gauges are installed in the Ibiza and San Antonio harbours.

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>).

The San Antonio tide gauge was deployed by IMEDEA institute by the beginning of 2002 in the framework of the calibration and validation activities for the ENVISAT radar altimeter RA-2.

Data from both Ibiza and San Antonio tide gauges have been analysed for the period with data available, in order to obtain harmonic constants (table 1) and mean sea levels. This zone presents a very small tide and is characterized as microtidal, that is one of the reasons to select this area for the altimeter calibration and validation.

GPS kinematic analysis

The kinematic solutions are based on high rate GPS data (1 Hz). The mobile receivers (Catamaran and Buoy) ellipsoidal heights are solved relative to the coordinates of the chosen reference stations. This processing was carried out independently by the Cartographic Institute of Catalonia (POSGPS software) and by the Observatoire de la Côte d'Azur-GEMINI (Track software).

Statistics of the Jason-1 altimeter bias for passes 187 and 248 using Ibiza and San Antonio tide gauges

Pass	Mean (mm)	σ (mm)	Sea change (mm)	σ (mm)
187	169.0	33.4	119.0	23.4
248	177.0	24.5	122.0	17.4

Jason-1 SSH biases from calibration studies (Pascale Bonnefond, 2006)

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	+105.0 ± 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	Martinez-Benjamin et al.
Regional	+100.0 ± 1.0	91.0 ± 8.0	21 / 21	Jan et al.

Conclusion

The bias found in San Antonio is very close to found at other calibration sites notably the Corsica one where the geographically correlated errors should be comparable (orbit, sea state). More dedicated calibration sites, as Ibiza or San Antonio, can help to control the geographically correlated errors that are significant at single sites.

The area covered by the GPS Catamaran represents a huge amount of GPS data. The overall precision of the resulting "marine geoid", obtained in the IBIZA2003 campaign, is estimated to be at the level of 3 cm rms.

On the other hand, this campaign has permitted to obtain a very accurate geoidetic network with systematic errors below 5 mm.

ACKNOWLEDGMENTS

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