



# Eastern Mediterranean Dynamics and JASON-1 Altimeter Calibration Results from the GAVDOS Project



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and **THE GAVDOS TEAM**

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Daily TUC1 GPS coordinates  
From IGS Rapid and Final Orbits  
Posted daily on our web site:  
[www.jcet.umbc.edu/~epavlis/interdisciplinary.html](http://www.jcet.umbc.edu/~epavlis/interdisciplinary.html)

## Abstract

Our main objective is the operation and exploitation of a regional absolute sea level monitoring and altimeter calibration facility applicable to many missions, in the Eastern Mediterranean. The core calibration facility was initially established with joint EU, NASA, and Swiss Federal Government funding in 2002. The main site is located under a crossing point of the Jason-1 ground-tracks (passes 018 and 109), and adjacent to an ENVISAT pass, on the isle of Gavdos, about 50 km to the south of the main island of Crete, Greece. The facility hosts in addition to two tide gauges, multiple GPS receivers, a DORIS beacon, a transponder for direct calibration, and is visited periodically by additional systems that collect data to control and validate the operational results. A 2003 co-location at the TUC facility site with the French Transportable Laser Ranging System (FTLRS) established a link and referenced the entire GAVDOS network of sites in the ITRF2000 frame. The facility has been fully operational since October of 2003. The comparison of tide gauge data collected at the site (Jason cycles 70 through 90), resulted in a Jason altimeter bias best estimate of  $144.7 \pm 15$  mm (3-s error), [Pavlis et al., 2004]. The project is now continuing under the OSTM program with funding from NASA and the Greek government. Our immediate plans include the relocation of the Gavdos facility to the final and originally intended location, on a new pier (finally constructed), a move that will improve vastly the protection of the facility from heavy winter storms and minimize the need for maintenance. The GPS receiver has been continuously operational throughout the past year, the tide gauges however were placed in storage in order to avoid damage during the construction period. With the final move, and considering that the island now has "off the wall" electric power at all time, the tide gauge site at Karave will be upgraded to include an ISDN line and a computer, so that we will be able to download all of the data, including GPS observations, on a hourly/daily basis. Once this is accomplished in early 2006, we will join the TIGA and IGS networks as originally intended. Our future plans include also the establishment of an identical setup at a site on the main island of Crete, at Kastelli, near the TUC site (60 km west of TUC), on a TUC-owned area and situated exactly under the descending Jason-1 pass 018. This gives us access to a second site and use of the altimeter measurements made to the north of Crete, in the Aegean Sea. It will thus allow the collection of additional information on the circulation and currents of the area between the Cape Maleas and Western Crete (e.g. Cretan cyclone). The project is also starting to produce results on the basis of the new IGRDs and extending our efforts to include the ENVISAT and GFO missions.

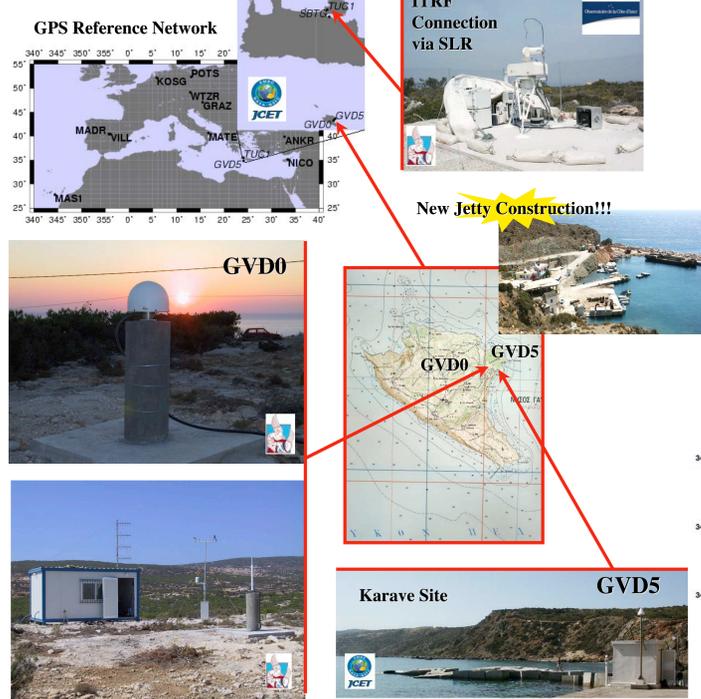
Mertikas, S. P., E. C. Pavlis and P. Drakopoulos. 2003. GAVDOS: A satellite radar altimeter calibration and sea-level monitoring site on the island of Gavdos, Crete, H. Dahlin, N.C. Flemming, K. Nittis, S.E. Petersson eds. *Building the European Capacity in Operational Oceanography*, Proceedings of the 3<sup>rd</sup> EuroGOOS Conference, 3-6 December 2002, Athens, Greece, pp. 258-264, Elsevier Oceanography Series 69.

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Pavlis, E. C., S. P. Mertikas and the GAVDOS Team. 2004. The GAVDOS Mean Sea Level and Altimeter Calibration Facility: Results for Jason-1, 3<sup>rd</sup> Jason special issue, *Mar. Geod.*, (27), 3-4, DOI:10.1080/01490410490902106, pp. 631-655.

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## TECTONICS



## TUC Position Comparison: GPS & SLR

Cartesian Coords. Epoch	X	Y	Z
SLR @ 1997.0	4744552.665 ± 0.0060	2119414.426 ± 0.0060	3686245.095 ± 0.0060
SLR @ 2003.7	4744552.558 ± 0.0060	2119414.553 ± 0.0060	3686245.158 ± 0.0060
GPS @ 2003.7	4744552.5579 ± 0.0054	2119414.5528 ± 0.0054	3686245.1347 ± 0.0076

## Gavdos GPS Site Positions & Rates

Geocentric Coords. & Epoch	X	Y	Z
GVD0 @ 2004.6	4783636.3296 ± 0.0003	2140711.9860 ± 0.0002	3623246.2746 ± 0.0002
Rates [mm/yr]	North: -25.98 ± 0.08	East: -14.40 ± 0.16	Up: -2.00 ± 0.37
GVD5 @ 2004.6	4782619.7314 ± 0.0003	2141235.1602 ± 0.0002	3624092.1771 ± 0.0003
Rates [mm/yr]	North: -26.50 ± 0.15	East: -15.67 ± 0.28	Up: -1.40 ± 0.66

## Gavdos TG (GVD5) Height: 21.775 m

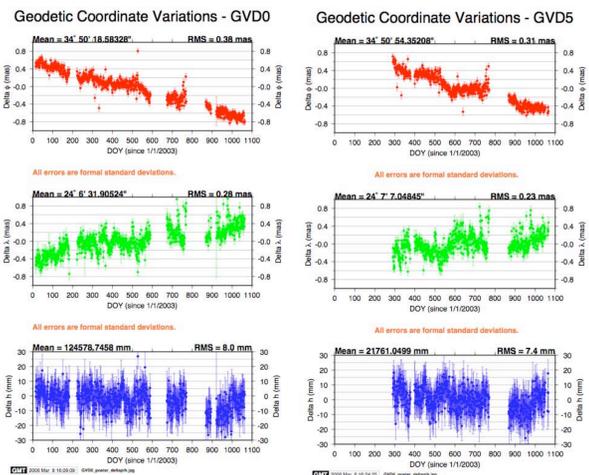
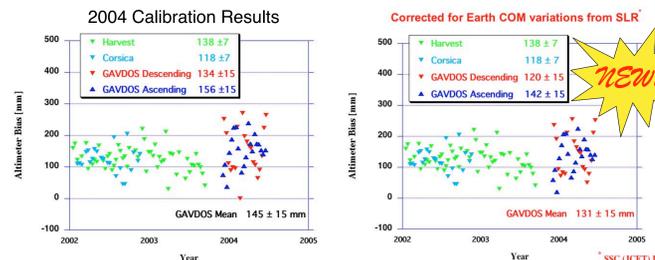
Revised Gavdos GVD5 Height: 21.775 m

Previous Gavdos GVD5 Height: 21.762 m

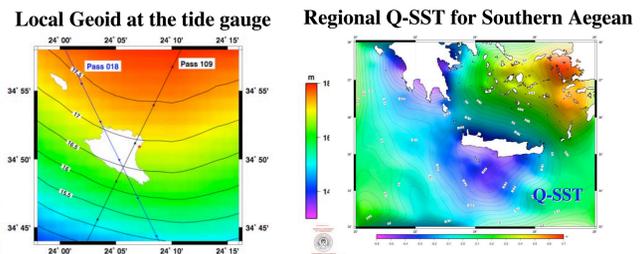
Δh Correction to previous Bias : -0.013 m

**REVISED CALIBRATED BIAS: 131 mm**

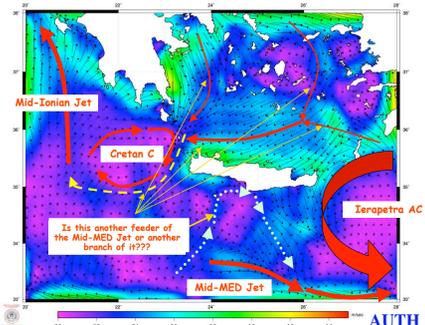
## JASON Re-Calibrations over Gavdos for Cycles 70-90



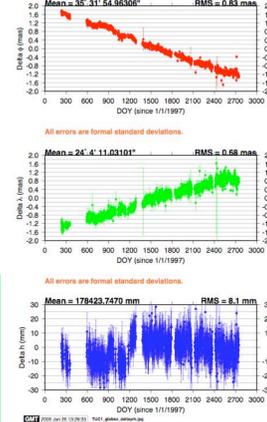
## ALTIMETRY & OCEANOGRAPHY



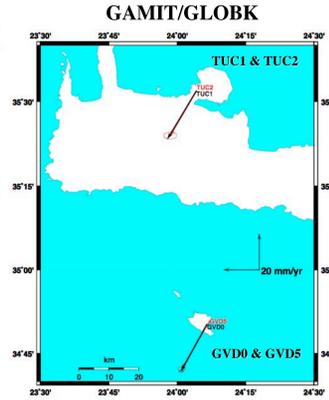
## Regional Circulation from a Combination of Gravimetric and Marine Geoids, and the Estimated Q-SST



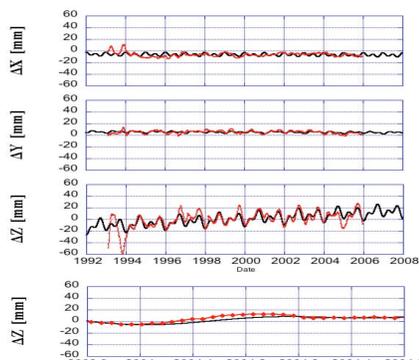
## Geodetic Coordinate Variations - TUC1



## Tectonic Motion from GAMIT/GLOBK



## Variations of Geocenter (TRF Origin) from SLR



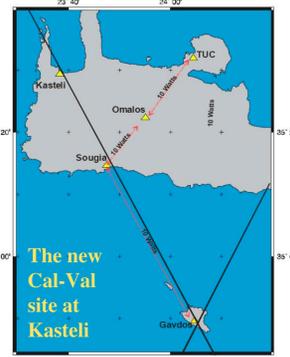
Pass No.	OLD Mean Bias	NEW Mean Bias
18	134.7 ± 5.4	132.9 ± 5.4
109	157.1 ± 5.2	155.4 ± 5.2
18 + 109	145.9 ± 5.3	144.1 ± 5.3

## Summary

The re-analysis of the Gavdos GPS network data with an extended set of 3 years of data and the strict "navigation" of the sites in the ITRF2000 TRF, resulted in a 13 mm reduction of the estimated JASON-1 bias. A small correction of 2 mm was also applied, based on the SLR monitoring of the origin of the TRF wrt the "geocenter".

In this phase of the project, we are nearing the completion of the new jetty at Karave, and the instruments will be re-deployed this spring.

Additionally, we have now identified a second location on mainland Crete, at Kastelli, where a second calibration facility will be constructed this spring and summer.



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