



# Absolute Sea Level Monitoring and Altimeter Calibration at Gavdos, Crete, Greece



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## Abstract

We present the mean sea level (MSL) monitoring aspect of the altimeter calibration facility under deployment on western Crete and the isle of Gavdos. The Eastern Mediterranean area is one of great interest for its intense tectonic activity as well as for its regional oceanography. Recent observations have convincingly demonstrated the importance of that area for the regional meteorological and climatological changes. Tide-gauge monitoring with GPS has gained importance lately since tectonics contaminate the inferred sea level variations, and a global network of tide-gauges with long historical records can be used as satellite altimeter calibration sites for current and future missions (e.g. TOPEX/POSEIDON, GFO, JASON-1, ENVISAT, etc.). This is at present a common IOC-GLOSS-IGS effort, already underway (TIGA). Crete hosts two of the oldest tide-gauges in the regional network and our project will further expand it to the south of the island with a new site on the isle of Gavdos, the southernmost European part of land. One component of our "GAVDOS" project is the repeated occupation of two already in existence tide-gauge sites at Souda Bay and Heraklion, and their tie to the new facility. We show here initial results from positioning of these sites and some of the available tidal records. Gavdos is situated under a ground-track crossing point of the present TP and JASON-1 orbits. It is an ideal calibration site if the tectonic motions are monitored precisely and continuously. Our plans include the deployment of additional instrumentation at this site: GPS and DORIS beacons for positioning, transponders for direct calibration, water vapor radiometers, GPS-loaded buoys, airborne surveys with gravimeters and laser profiling lidars, etc., to ensure the best possible and most reliable results.

## \* The GAVDOS Partners

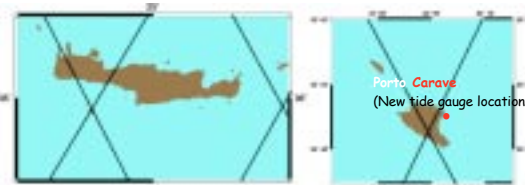
- Laboratory of Geodesy and Geomatics, Mineral Resources Engineering Department, Technical University of Crete, Greece, (PROJECT CO-ORDINATOR).
- JCET - Joint Center for Earth Systems Technology, NASA & University of Maryland Baltimore County, USA.
- AUTH - Department of Geodesy and Surveying, School of Rural and Surveying Engineering, Aristotle University of Thessaloniki, Greece.
- IMBC - Department of Oceanography, Institute of Marine Biology of Crete, Greece.
- SRES - Department of Satellite Geodesy, Space Research Institute, Austrian Academy of Science, Austria.
- KMS - Department of Geodynamics, National Survey and Cadastre, Denmark.
- ETHZ - Geodesy and Geodynamics Lab, Institute of Geodesy and Photogrammetry, Switzerland.
- OCA-CERGA - Observatoire de la Côte d'Azur, Centre d'Etudes et de Recherches en Géodynamique et Astronomie, Centre National de la Recherche Scientifique, France.
- HNS - Hellenic Navy Hydrographic Service, Greece.

## PROJECT IDENTITY DETAILS:

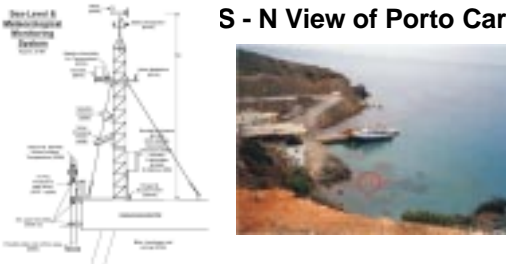
**EU Programme:** Energy, Environment & Sustainable Development  
**Contract Number:** EVRI-CT-2001-40019 (GAVDOS)  
**Work Programme:** Support for Research Infrastructures  
**Funding:** 60% European Union (approved)  
24% Swiss Federal government (approved)  
16% US Government (pending)  
**Duration:** 36 months (1-Dec-2001, 1-Dec-2004)

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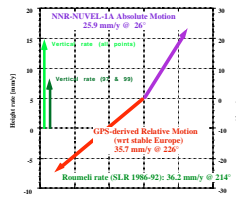
## S - N View of Porto Carave



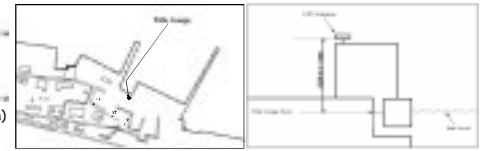
## Monitoring Equipment Arrangement



## Observed Motion at TUC Base Site 1997 - 2000

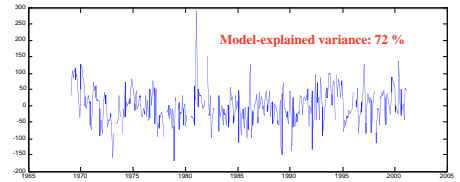


## Tidal Analysis for Souda Bay Tide-gauge 1967 - 2001



35° 29' 14" 9340 ±0.4 mm  
24° 4' 57" 0894 ±1.2 mm  
28.0566 m ±1.8 mm

## Residual Sea Level Signal: Monthly Mean - [Linear Trend + Long Period Tides]

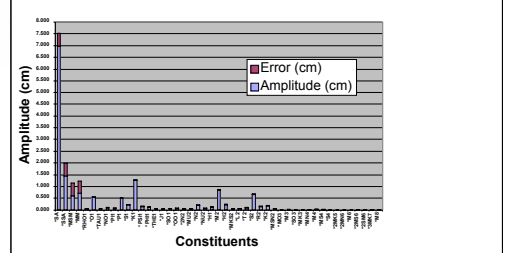


	Amplitude (cm)	Error in Amp.	Phase (months)	Error in Phase (months)
Vertical	-1.7	0.0001	7.5	0.0001
SA	6.23	0.01	20.81	0.04
SSA	1.07	0.01	20.81	0.04
IR by cycle	3.93	0.01	247.0	0.04
SR by cycle	2.03	0.01	20.81	0.04

Tide	Amplitude	$\sigma_{amp}$	Phase	$\sigma_{phs}$	SNR	Tide	Amplitude	$\sigma_{amp}$	Phase	$\sigma_{phs}$	SNR
*S1A	4.976	0.033	69.44	4.17	1.70E+02	*M2	0.233	0.023	30.25	5.73	1.00E+02
*S2A	1.459	0.033	292.20	20.95	7.5	*M3	0.025	0.023	236.90	33.81	2.4
*M2	0.026	0.033	320.50	50.50	1.3	*S2	0.042	0.023	172.23	20.00	3.4
*M4	0.726	0.033	77.59	43.35	1.7	*T2	0.021	0.023	77.99	14.46	3.0
*M6	0.026	0.033	59.77	44.53	1.1	*S2	0.044	0.023	172.89	1.97	6.40E+02
*O1	0.526	0.026	121.17	3.44	4.70E+02	*M2	0.028	0.023	277.89	8.32	3.1
*P1	0.026	0.026	238.87	57.05	1.3	*M2	0.079	0.023	172.89	6.79	9.8
*M2	0.044	0.026	177.13	23.39	1.1	*M2	0.042	0.023	307.58	32.46	3.3
*T2	0.044	0.026	120.21	22.39	6.6	*M3	0.026	0.026	349.90	24.34	5.8
*M1	0.502	0.026	163.72	2.84	4.00E+02	*M3	0.013	0.026	349.90	24.34	5.8
*S1	1.264	0.026	178.86	1.07	2.60E+03	*S2	0.026	0.026	168.45	30.58	2.1
*S2	0.226	0.026	93.84	33.79	3.8	*M3	0.020	0.026	107.62	30.04	3.4
*M1	0.320	0.026	178.20	14.76	1.7	*M4	0.022	0.026	48.92	22.04	2.4
*M3	0.026	0.026	228.93	47.50	1.3	*M4	0.024	0.026	58.71	18.60	1.9
*J1	0.037	0.026	178.20	33.43	2.3	*S4	0.027	0.026	59.29	19.24	2.1
*S2	0.039	0.026	168.48	33.79	1.4	*M2	0.025	0.026	236.46	46.78	1.6
*O2	0.041	0.026	168.32	29.76	2.8	*M6	0.020	0.026	236.46	37.75	1.1
*M6	0.020	0.026	228.82	38.48	1.0	*S2	0.025	0.026	236.46	37.75	1.1
*M2	0.038	0.026	189.14	34.73	2.7	*S2	0.025	0.026	236.46	37.75	1.1
*M2	0.044	0.026	194.42	30.08	3.7	*S2	0.025	0.026	236.46	37.75	1.1
*M2	0.020	0.026	194.50	110.63	0.1	*M2	0.025	0.026	236.46	37.75	1.1
*M2	0.020	0.026	194.48	1.00	1.40E+03	*M2	0.025	0.026	236.46	37.75	1.1

Amplitude  $\Delta \sigma_{amp}$  in cm  
Phase  $\Delta \sigma_{phs}$  in degrees

## Amplitudes of Constituents (snr>1) Period: 1982-2000



JASON-1 Science Working Team Meeting  
10 - 12 June 2002  
Biarritz, France

