Sea Level, Tectonics, Environmental Monitoring and Altimeter Calibration in Eastern Mediterranean

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and ***THE GAVDOS TEAM*** *

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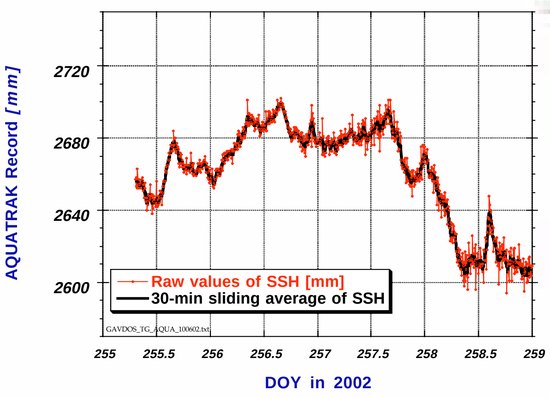
Abstract

The Eastern Mediterranean area is one of great interest for its intense tectonic activity as well as for its regional oceanography. Recent observations convincingly demonstrated the importance of the area for regional meteorological and climatologic changes. Monitoring tide-gauge locations with continuous GPS on the other hand removes the uncertainties introduced by local tectonics that contaminate the observed sea level variations. Such a global tide-gauge network with long historical records is already used to calibrate satellite altimeters (e.g. on TOPEX/POSEIDON, GFO, JASON-1, ENVISAT, etc.), at present, a common IOC-GLOSS-IGS effort --TIGA. Crete hosts two of the oldest tide-gauges in the regional network, at Souda Bay and Heraklion. We recently completed the instrumentation of a third, state-of-the-art mean sea level (MSL) monitoring facility in southwestern Crete, on the isle of Gavdos, the southernmost European parcel of land. Our project (GAVDOS) further expands the regional tide gauge network to the south, and contributes to TIGA and MedGLOSS. The presentation will focus on the altimeter calibration aspect of the facility, in particular, its application to the JASON-1 mission. Another component of the "GAVDOS" project is the repeated occupation of the older tide-gauges at Souda Bay and Heraklion, and their tie to the new facility. We will present results from positioning of these sites and some of the available tidal records. The Gavdos facility is situated under a ground-track crossing point of the original T/P and present JASON-1 orbits, allowing two calibration observations per cycle. It is an ideal site if the tectonic motions are monitored precisely and continuously. The facility hosts in addition to two tide gauges, multiple GPS receivers, a DORIS beacon for positioning and orbit control, a transponder for direct calibration, and is visited periodically by water vapor radiometers and solar spectrometers, GPS-laden buoys, and airborne surveys with gravimeters and laser profiling lidars. The French transportable laser ranging system (FTLRS) completed recently a co-location campaign at Chania, Crete, for improved orbit control over the site, and to ensure the best possible and most reliable results.

First Record from GAVDOS



A dedicated **GPS** receiver was installed in September 2003 at the Carave facility for continuous monitoring of local motions. The data will be delivered in near-real time via the UHF link that is already in-place between Gavdos and the Master site at TUC. All data will be then posted on the web and accessible via internet. A **DORIS** beacon was also installed during September 2003 on Gavdos, ~1.5 km from Carave, at the THEOFILOS control site. The French Transportable Laser System **FTLRS** spent ~7mo at TUC since the spring of 2003, with a shut-down period during July-August due to high temperatures.

* The GAVDOS Partners

TUC - 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.

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IMBC - Department of Oceanography, Institute of Marine Biology of Crete , Greece.

SRISG - 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 Cote d'Azur, Centre d'Etudes et de Recherches en Geodynamique et Astrometrie, Centre National de la Researche Scientifique , France.

HNHS - Hellenic Navy Hydrographic Service, Greece.

PROJECT IDENTITY DETAILS:

EU Programme :	Energy, Environment & Sustainable Development
Contract Number :	EVR1-CT-2001-40019 (GAVDOS)
Work Programme :	Support for Research Infrastructures
Funding :	60% European Union (approved)
	24% Swiss Federal Government (approved)
	16% US Government (approved)
Duration :	36 months (1-Dec-2001, 1-Dec-2004)

AFFILIATION of ASSOCIATES

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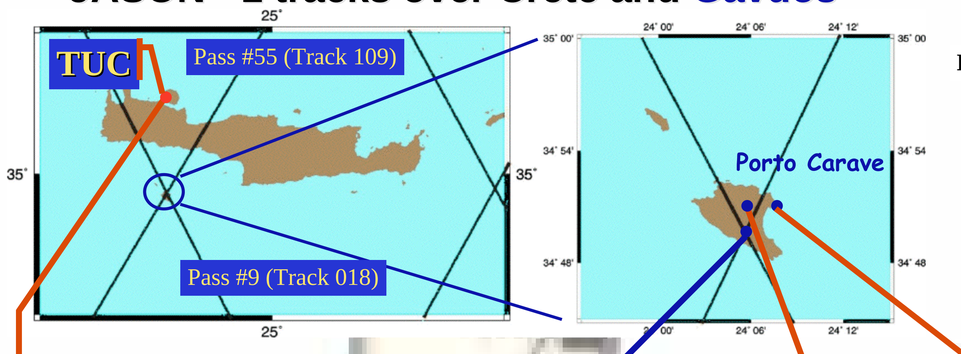
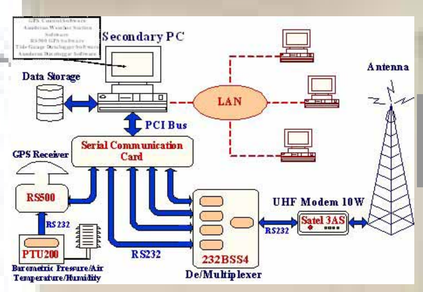
TZIAVOS, I. N. (3)
VERGOS, G. S. (3)

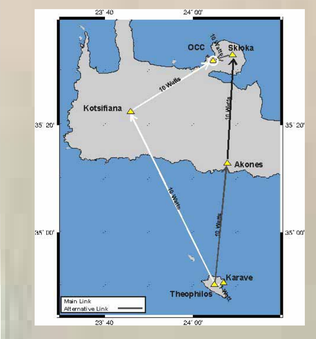
JASON - 1 tracks over Crete and Gavdos



The new GAVDOS Facility @ TUC: FTLRS Deployment



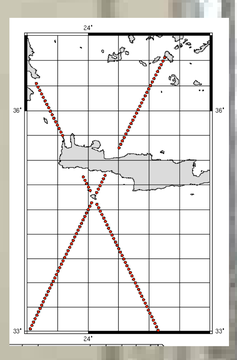
Local Communications Network



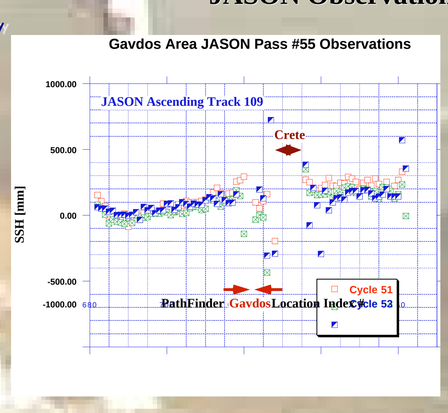
The new GAVDOS Facility @ Dias: Altimeter Transponder

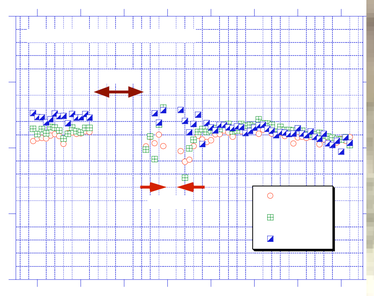
Preliminary 1997.0 FTLRS coordinates from GPS and LAGEOS 1 & 2 SLR data ITRF2000 TRF and EGM96 ellipsoid

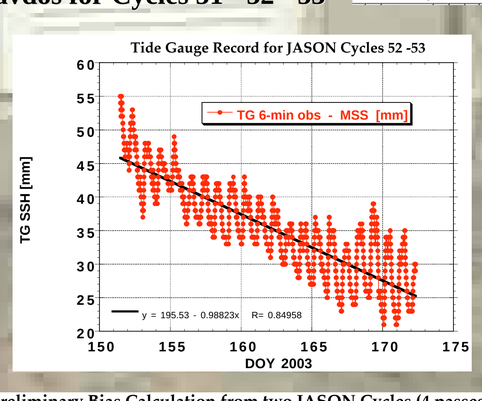
GPS Results for SLR0		
X [m]	Y [m]	Z [m]
4744552.5533	2119414.5451	3686245.1363
±1.0 [cm]	±1.0 [cm]	±1.0 [cm]
ϕ	λ	*h [m]*
35° 31' 58".95437	24° 04' 13".96631	161.0495
±1.25 [mas]	±1.40 [mas]	0.43 [cm]
FTLRS Results for SLR0		
Adopted	**Velocity**	**Vector**
V_x [m/y]	V_y [m/y]	V_z [m/y]
-0.0161	0.0190	0.0094
X [m]	Y [m]	Z [m]
4744552.6650	2119414.4160	3686245.0860
±0.21 [cm]	±0.22 [cm]	±0.19 [cm]
ϕ	λ	*h [m]*
35° 31' 58".95208	24° 04' 13".95990	161.0602
±0.057 [mas]	±0.077 [mas]	±0.25 [cm]
Eccentricity SLR0 Marker to IAR		
dX [m]	dY [m]	dZ [m]
+1.351	+0.604	+1.057



JASON Observations over Gavdos for Cycles 51 - 52 - 53





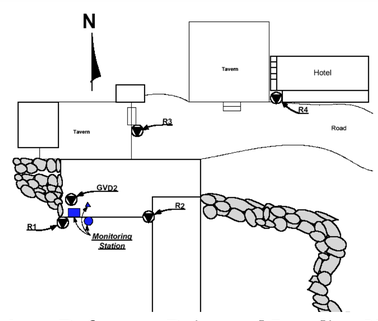


Preliminary Bias Calculation from two JASON Cycles (4 passes)

Cycle #	Arc #	DOY 2003	JASON SSH [mm]	TG SSH [mm]	Bias [mm]
52	9	156.1	124 ± 86	41.3 ± 1	83
	55	159.7	52 ± 172	37.7 ± 1	14
53	9	166.0	202 ± 69	31.5 ± 1	171
	55	169.6	63 ± 274	27.9 ± 1	35
Average					**75.8**
Std. Dev.					**±200**

Preliminary JASON bias estimates:

- –Ascending pass #55 :
  - •Cycles 52 and 53: 49 ± 229 mm
- –**Descending pass #9 :**
  - •**Cycles 52 and 53: 127 ± 78 mm**
- –Average of two passes #9+#55 :
  - •Cycles 52 and 53: 76 ± 220 mm
- –Weighted mean of two passes #9 + #55 :
  - •Cycles 52 and 53: 118.9 ± 74 mm



Local Area Reference Point and Leveling Network

Benchmark Information

Number of Tidal Benchmarks: 5
Primary BM Designation: *GPS*
SRM Designation:
Designation of other BM's:
BM Descriptions Published In: *TUC*
Were all BM's recovered during this visit? *yes*
Were any BM's destroyed since last recovery? *No*

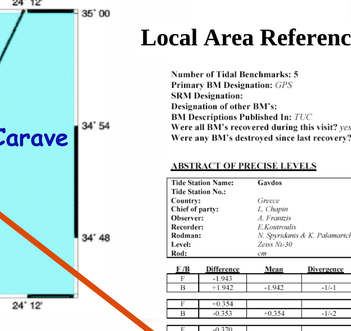
Leveling Information

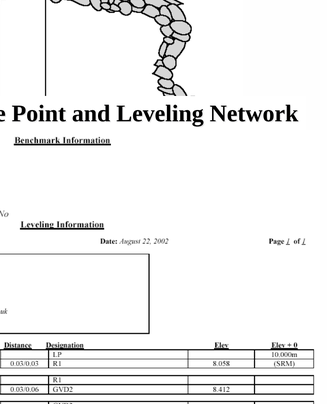
ABSTRACT OF PRECISE LEVELS — **Date:** *August 22, 2002* — **Page** *1* of *1*

Tide Station Name:	Gavdos
Tide Station No.:	
Country:	*Greece*
Chief of party:	*L. Chapin*
Observer:	*A. Frantzis*
Recorder:	*E.Kontiroulis*
Rodman:	*N. Spyriskanis & K. Palamartchouk*
Level:	*Zeiss Ni-30*
Rod:	*cm*

F /B	Difference	Mean	Divergence	Distance	Designation	Elev	Elev + 0
F	+1.943				LP		10.000m
B	+1.942	+1.942	+1/-1	0.03/0.03	R1	8.058	(SRM)
F	+0.354				R1		
B	+0.353	+0.354	+1/-2	0.03/0.06	GVD2	8.412	
F	+0.370				GVD2		
B	+0.371	+0.370	+1/-1	0.02/0.08	R2	8.042	
F	+0.007				R2		
B	+0.007	+0.007	0/-1	0.02/0.10	R3	8.035	
F	+1.188				R3		
B	+1.188	+1.188	0/-1	0.02/0.12	R4	9.223	
F	+0.174				R4		
B	+0.174	0.174	0/-1	0.02/0.14	R5	9.397	

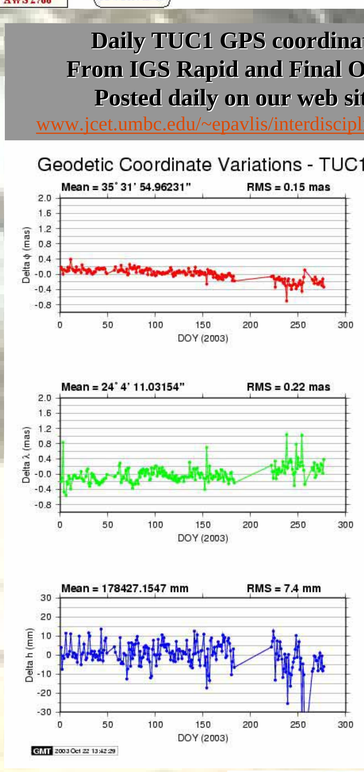
The new GAVDOS Facility @ Carave: GPS + TGs





The new GAVDOS Facility @ Theofilos: GPS + DORIS + Wind Generator

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



JASON Science Working Team Meeting
17-21 November 2003
Arles, France