Analysis of Sea Level Trends with Altimetry Around the Coastal Zone of Gavdos Permanent Cal/Val Facility

S.P. Mertikas[1], Zervakis V. [2], Tziavos I.[3], Andersen O. B. [4], X. Frantzis[1], Daskalakis A.[1], Vergos G.[3] , Ampatzidis D.[5]

[1]*Geodesy and Geomatics Engineering Lab, Technical University of Crete,Chania, Crete, Greece, mertikas@mred.tuc.gr*

[2]*Department of Marine Sciences, University of the Aegean, University Hill, Mytilene, Greece,*

[3]*Department of Geodesy and Surveying, Aristotle University of Thessaloniki, Thessaloniki, Greece.*

[4]*Danish National Space Center, Copenhagen, Denmark*

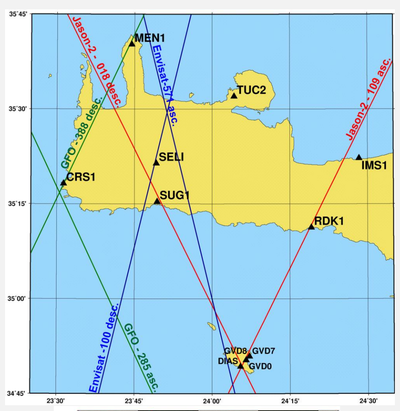
[5]*Space Geomatica Ltd., Crete, Greece.*

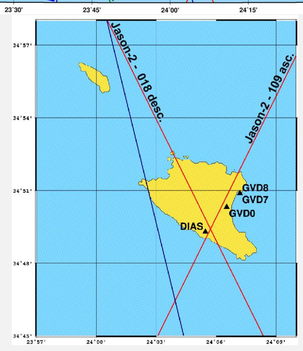
GeoMatLab

Abstract

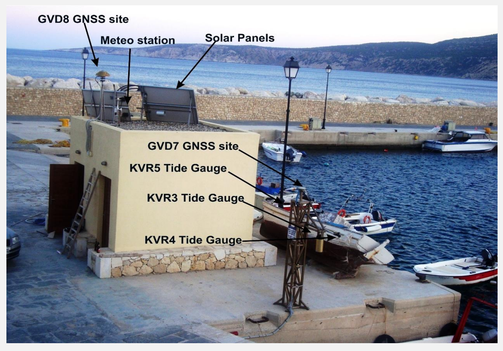
The aim of this work has been to examine and monitor the sea level trends in the coastal areas around the permanent Cal/Val facility of Gavdos. Results are based on the produced calibration values for the Jason-2 satellite altimeter as monitored over 4 years of calibration and along the pass No. 18 and No. 109. Different reference surfaces and models have been chosen for this evaluation. Finally, this work describes the relation between these parameter trends and the region's local characteristics.

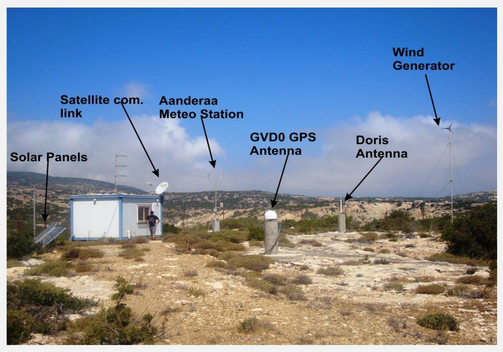
1. The permanent Calibration Facility in Gavdos, Crete





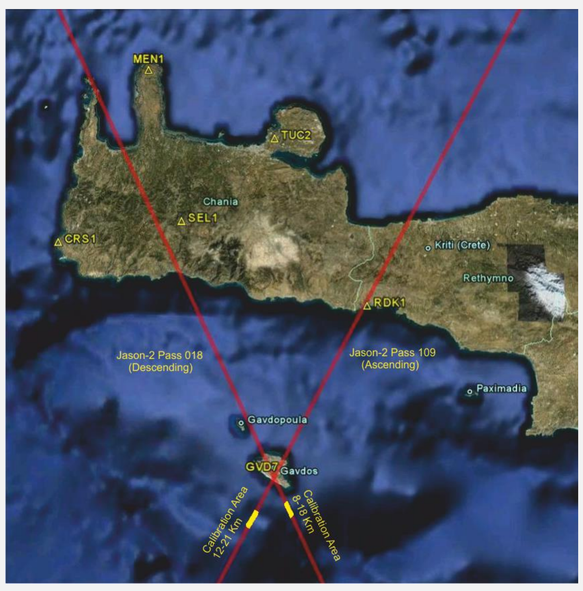
Satellite Ground tracks over Crete and Gavdos



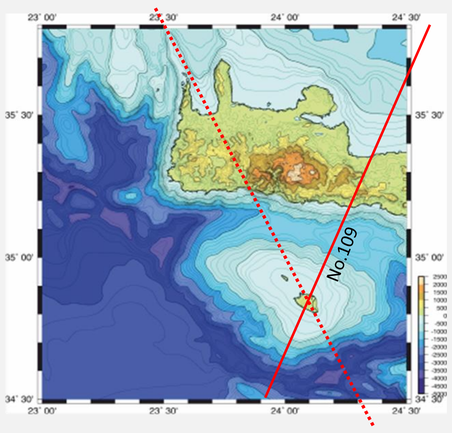


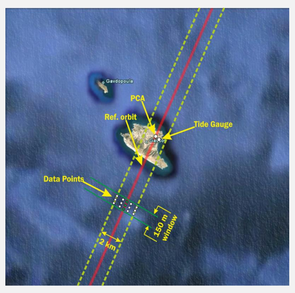
The Cal/Val facility

2. Calibrating Regions and Trends monitored for 4 years



No.18



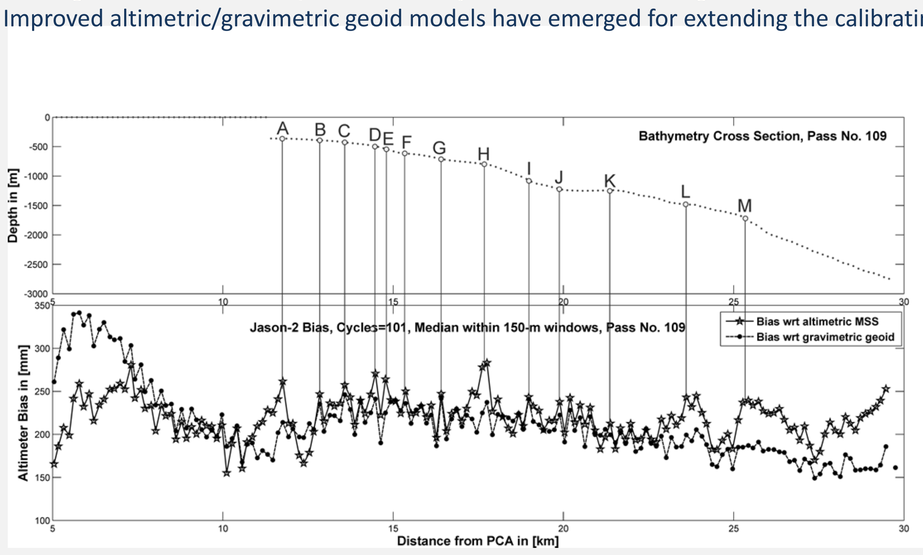


- Jason-2 has been calibrated continuously over 4 years;
- Snapshots of sea surface with a 10-day sampling rate;
- Bias systematically higher (1-3 cm) at certain locations;
- Slight slope, but systematic, at other places;
- Steep bathymetry ranging from 200 to 3500 m over 10 km;
- Earthquake prone region with frequent events (Subduction zone).

2. Bathymetry and Altimeter Bias with distance

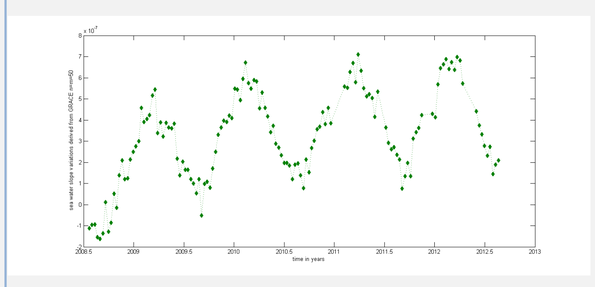
Variations of bias (GDR-T data) as a function of distance from PCA, along ground track for Jason-2 calibrations, reveal:

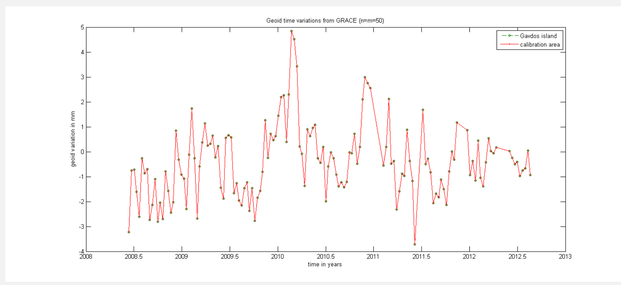
- Riddles on sea surface of short-wavelength features (1-3 cm over 1-2 km),
- Reflecting clearly changes in the topography of sea floor at 3000 m depths below;.
- Geoid gravimetric model required minor adjustments in certain regions within the calibrating region;
- Improved altimetric/gravimetric geoid models have emerged for extending the calibrating regions.

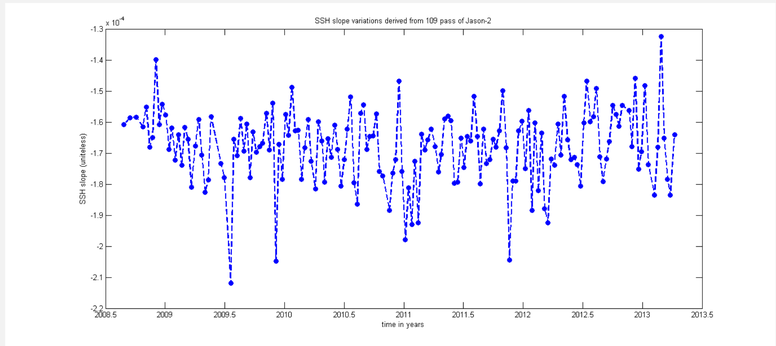


4. Monitoring trends of sea surface at calibrating regions

- Time variations of geoid and its corresponding heights using GRACE satellite ;
- Sea surface slopes observed by altimetry over time and in the region 17.5 -24 km from Gavdos ;
- The Inverse Barometer effects are removed from Sea Surface observations;
- No systematic changes are observed on sea surface above ellipsoid over 4 years;

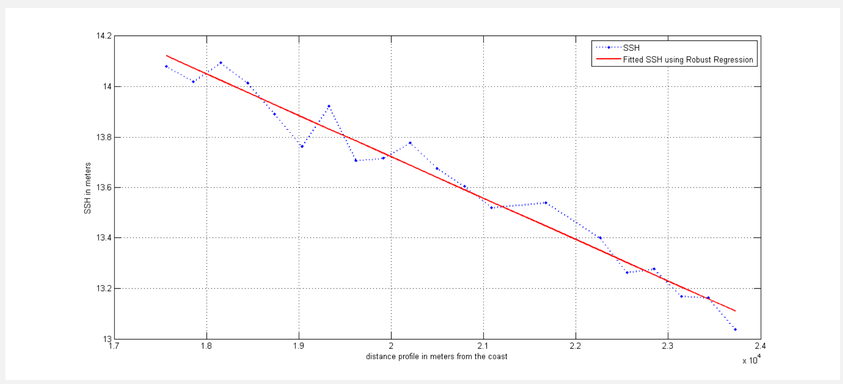


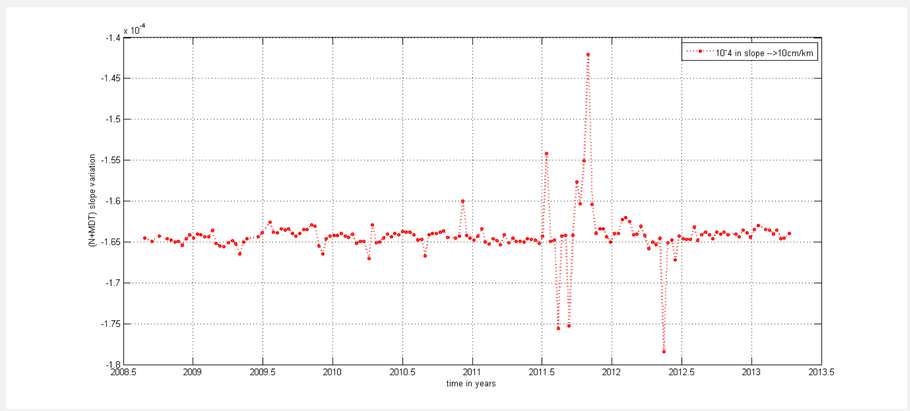




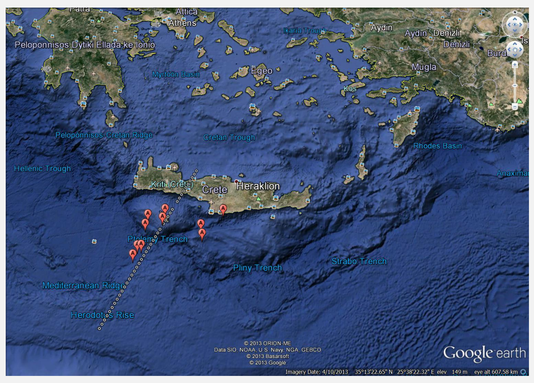
5. Slope variations for the sea surface over time

- At each Jason-2 cycle the slope of the sea surface (GDR-D data) is estimated over 17.5-24 km;
- The Inverse Barometer effect is removed from the sea surface heights;
- Robust linear regression is fitted to these data;
- The slope of this robust linear surface is determined at each cycle;
- No significant slope changes were observed over 4 years;
- If differences of slopes between sea-surface heights and sea-level anomalies (with pole , loading and solid earth tides) are plotted over time then, unusual behavior is observed from 12-6-2011 till 25-3-2012;
- Erratic behavior in last diagram coincides with La Nina occurrence between June 2011- April 2012.





6. Earthquake events larger than M=4, 2011-2013



- Locations of earthquake epicenters occurred in 2011-2013, along ascending orbit No.109;
- Magnitude larger than M=4;
- On 27-Sept-2011 M=4.7, located very close to Jason-2 satellite orbit;
- The peak on the diagram showing the difference in slopes between SSH and SLA happens on 29-Sept-2011.

Acknowledgments:

The plots showing the time series of geoid heights and equivalent water heights using GRACE/LAGEOS are based on the CNES/GRGS online data.

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