Gavdos/West Crete Cal-Val site: Over a decade calibrations for altimetry

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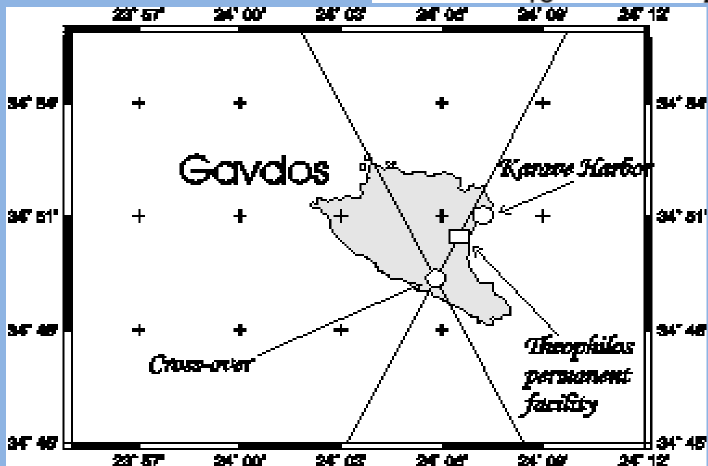
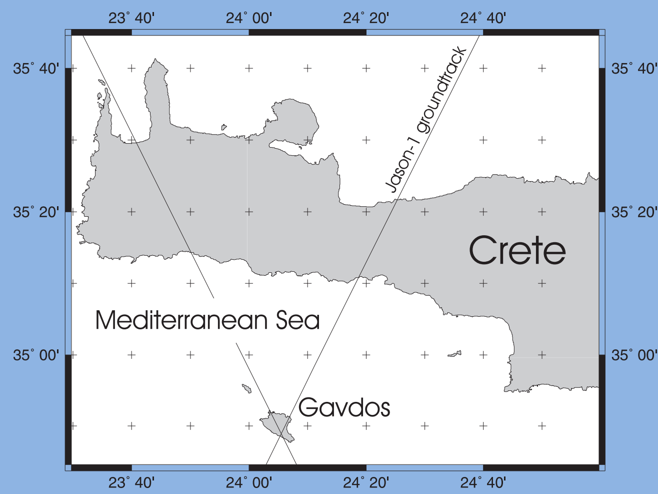
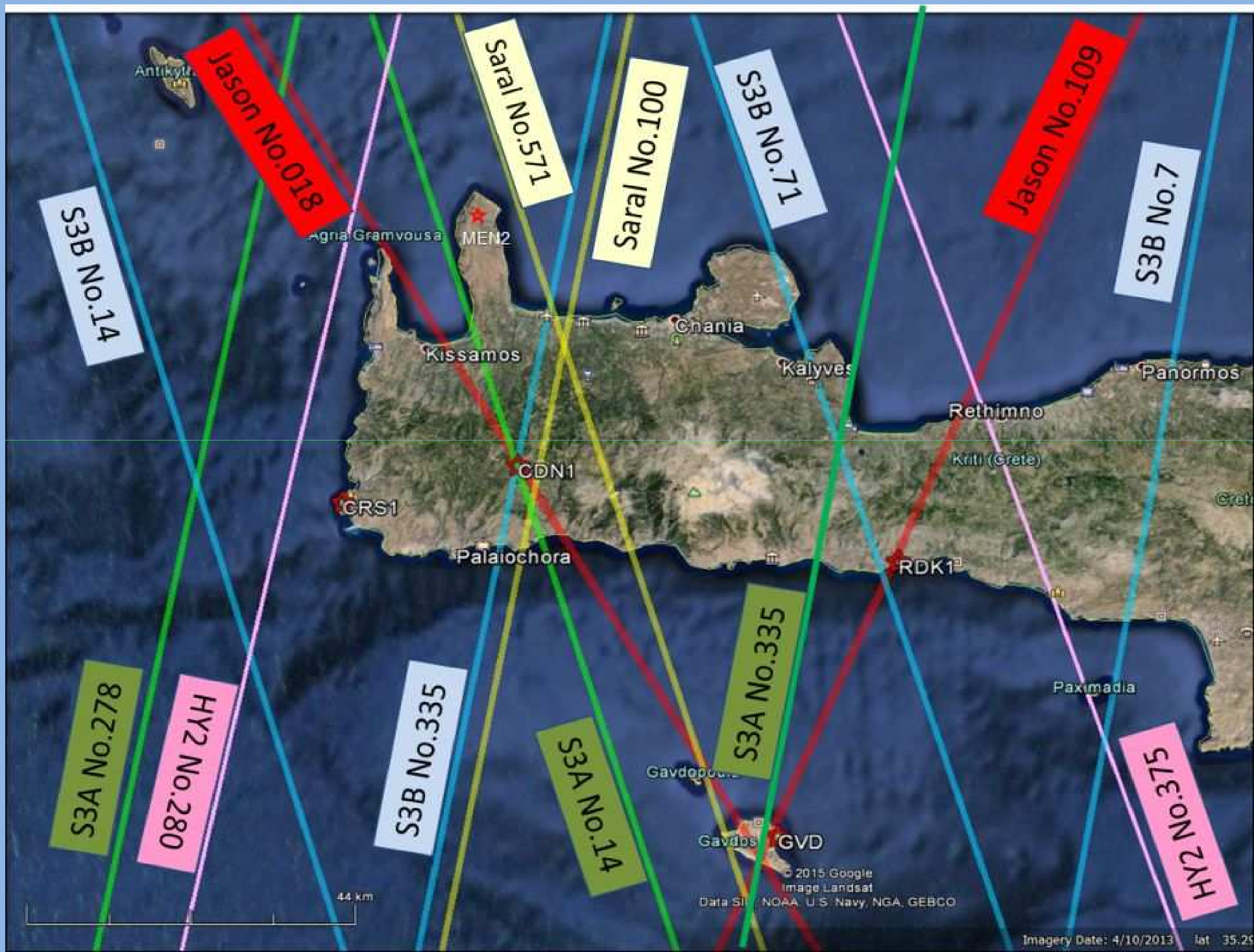
Gavdos Permanent Cal/Val Facility



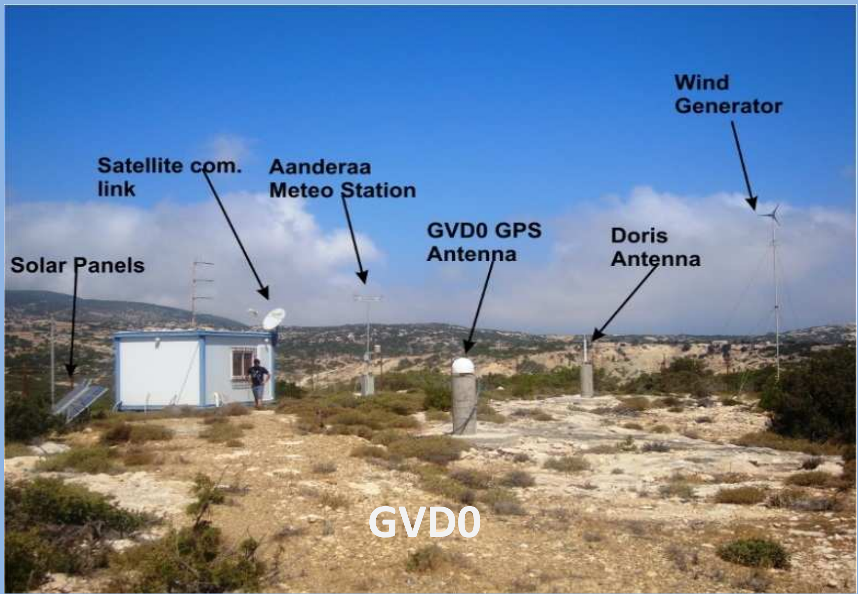


Tracks around Gavdos & Crete

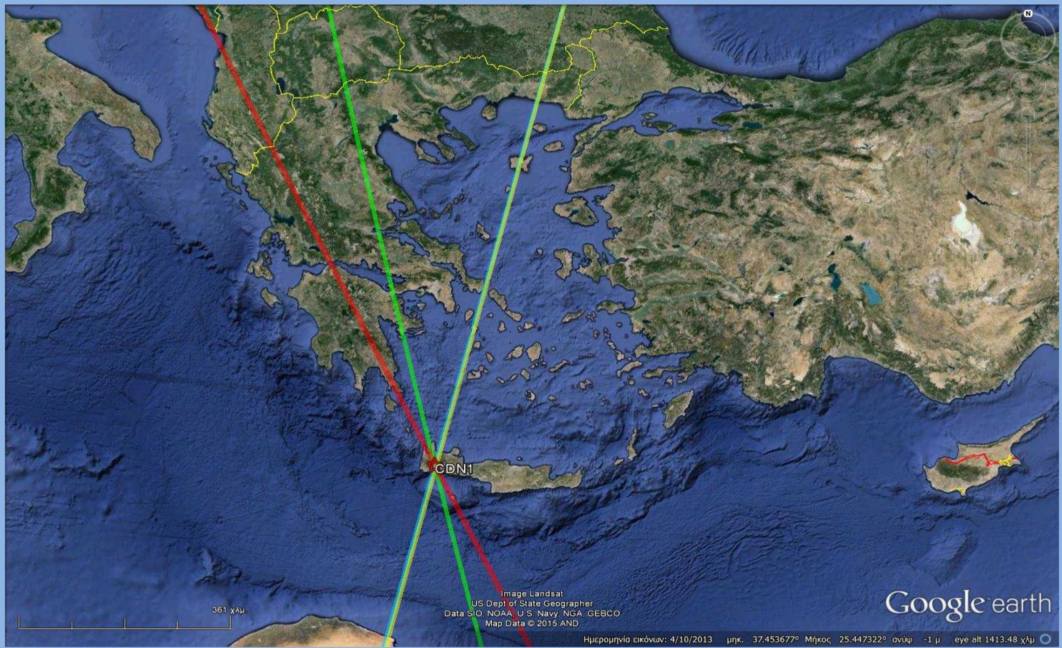


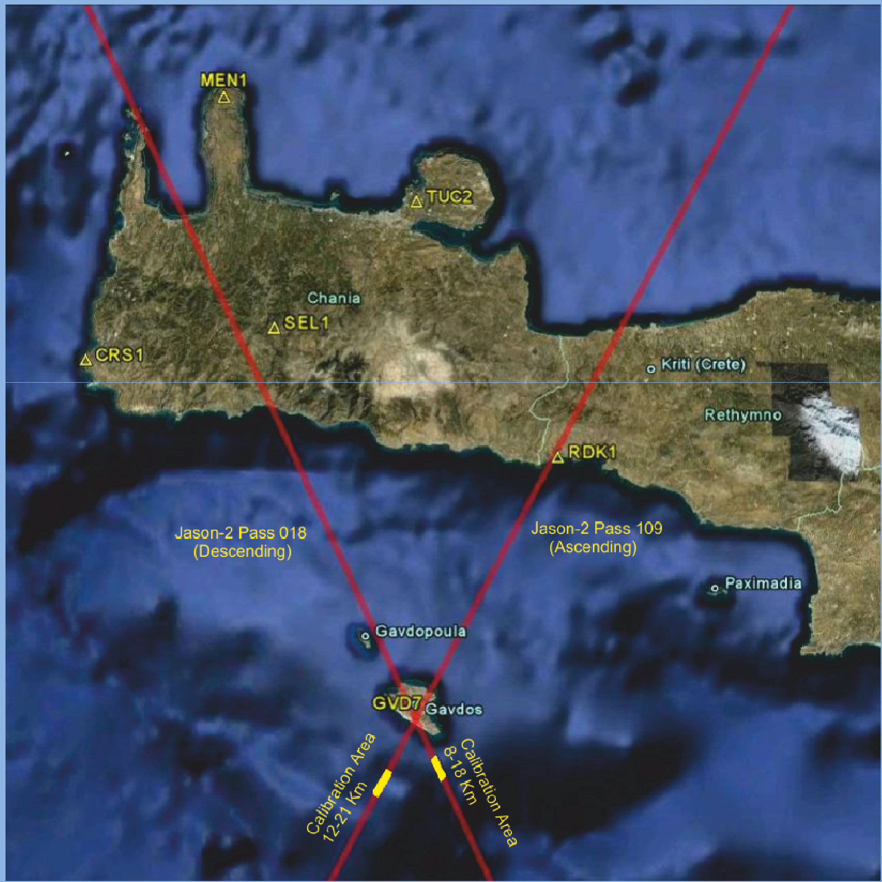
Gavdos and West Crete Facilities

GeoMatLab



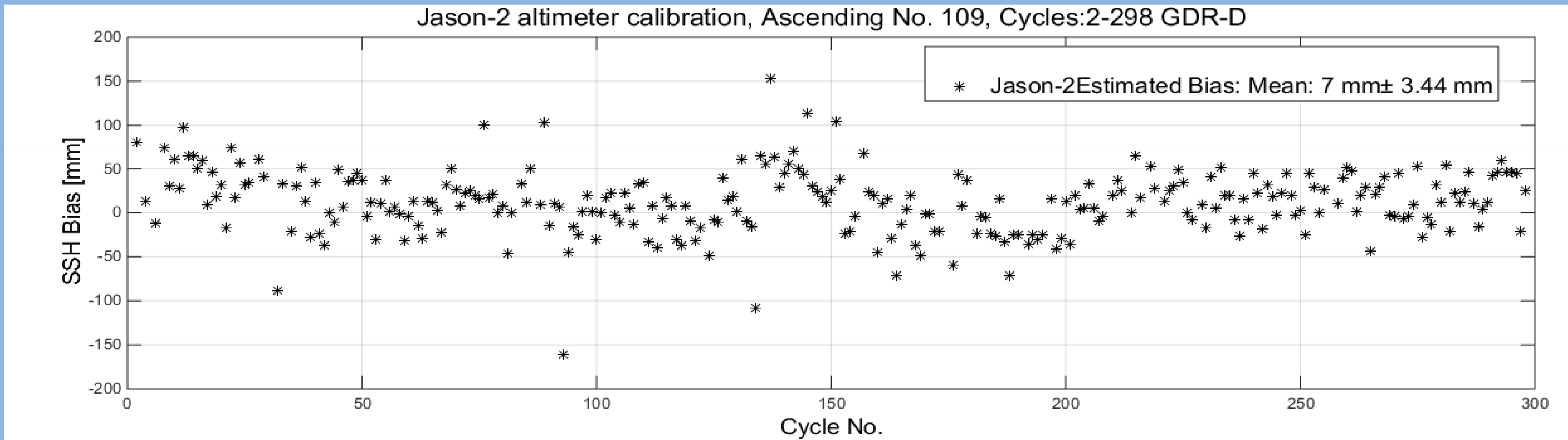
Land and Sea Calibrating regions





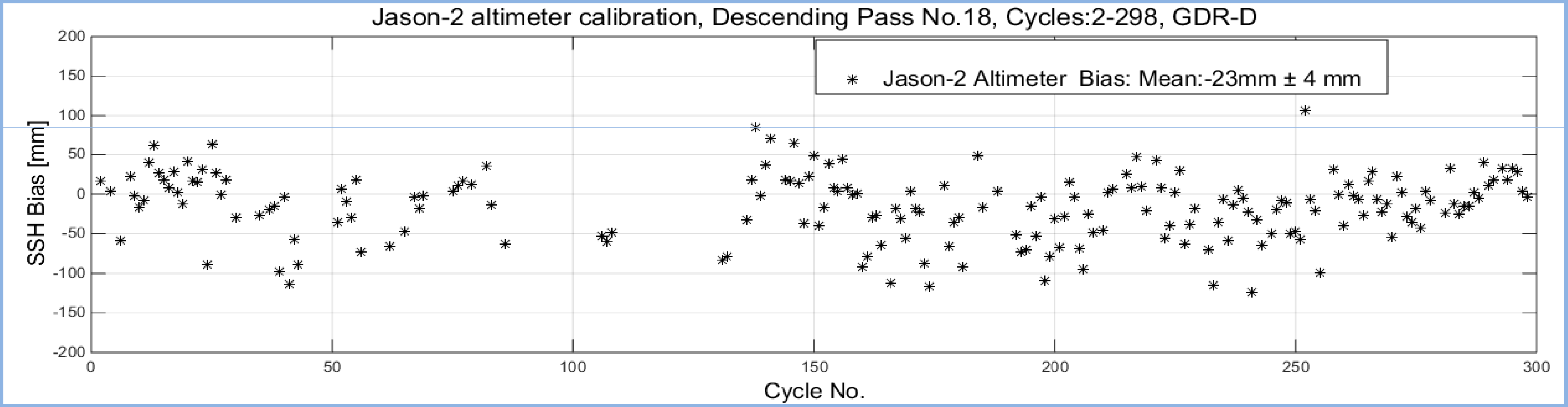
Jason-2 Ascending Pass No. 109

GeoMatLab



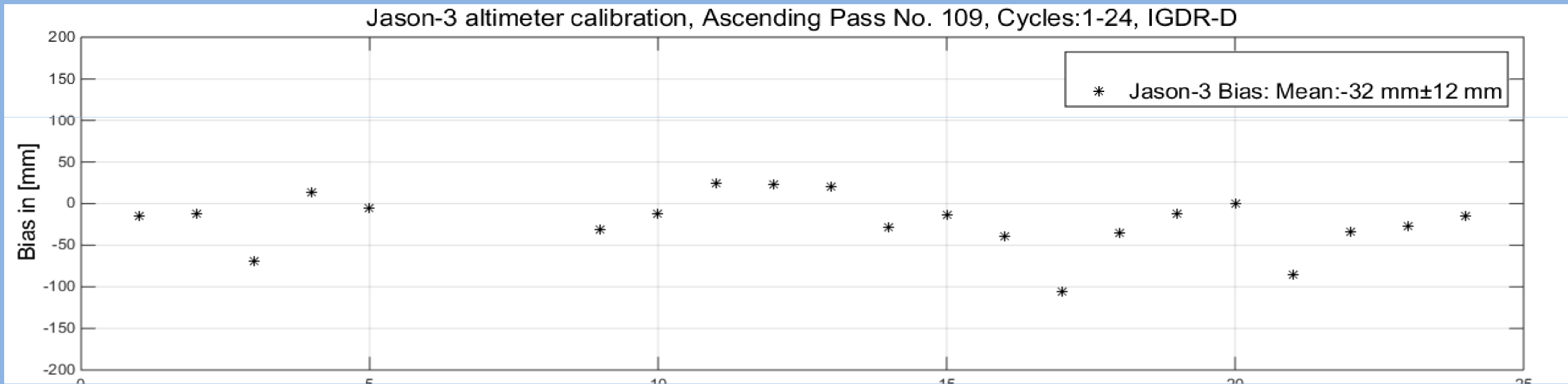
- Ascending Pass No.109, GDR-D , Cycles: 2-298;
- Calibration region **14.5km-24 km;**
- **Bias= +7 mm** ±3 mm, using local gravimetric geoid model;

Jason-2 Descending Pass No. 18



- Descending Pass No. 18, GDR-D , Cycles: 2-298;
- GOCE dynamic topography; Cal region **9km-20 km**;
- Bias= **– 23 mm** ± 4 mm

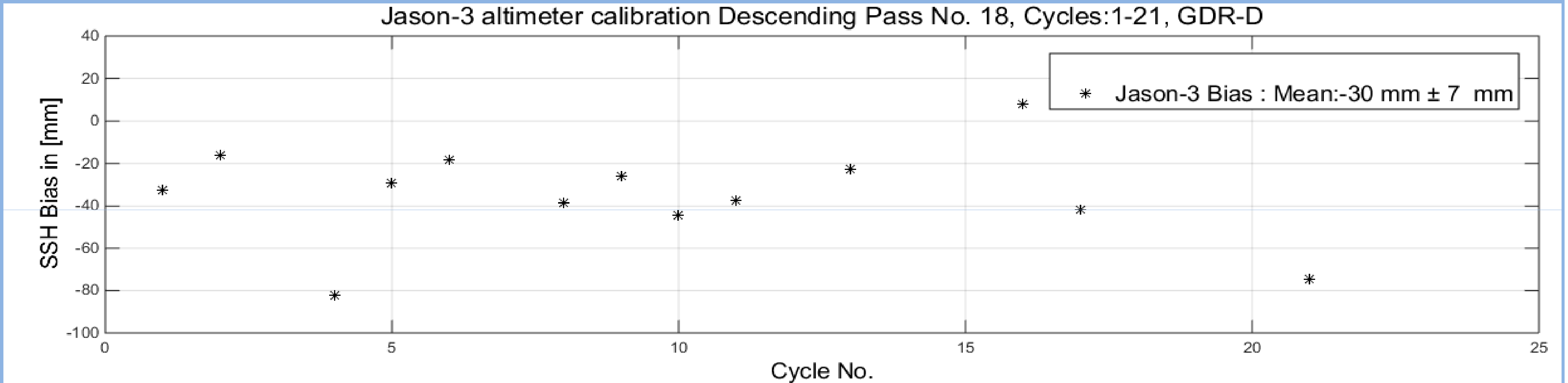
Jason-3 Ascending Pass No. 109



- Ascending Pass No.109, IGDR-D , Cycles: 1-24;
- Calibration region **14.5km-24 km;**
- **Bias= -32 mm** ± 12 mm, using local gravimetric geoid model;

Jason-3 Ascending Pass No. 18

GeoMatLab



- Descending Pass No.18, IGDR-D
- **Bias= -30 mm** ±7 mm, using local gravimetric geoid model;

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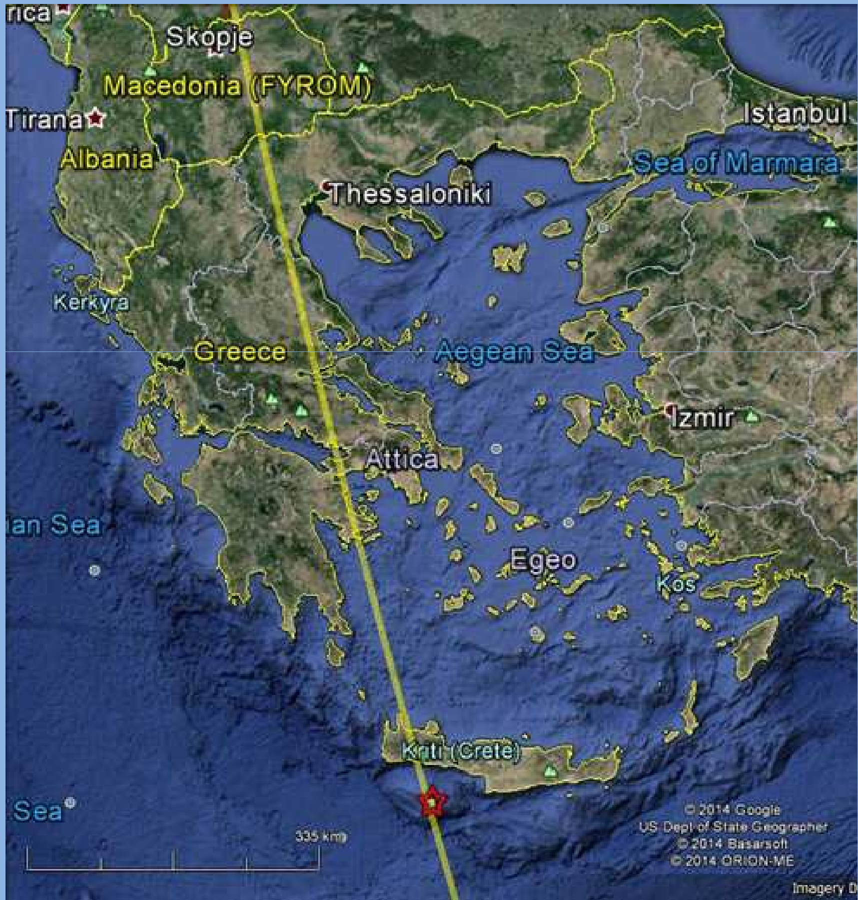
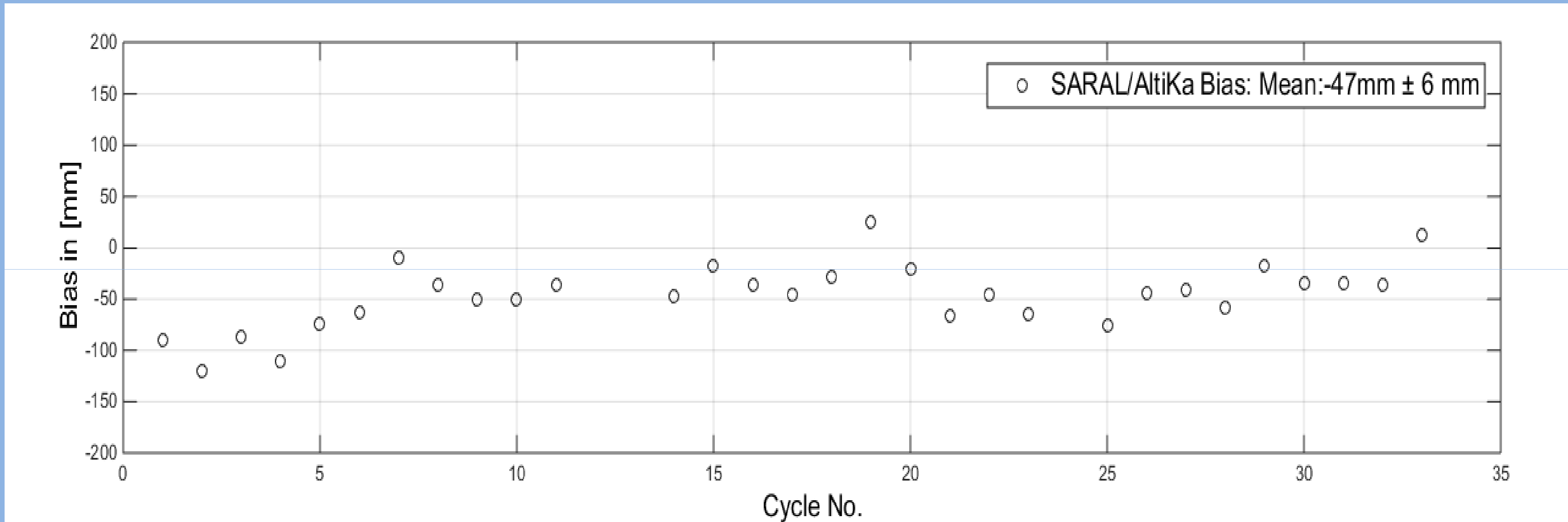
SARAL/AltiKa ground tracks



SARAL/AltiKa Pass No. 571 (Ascending)

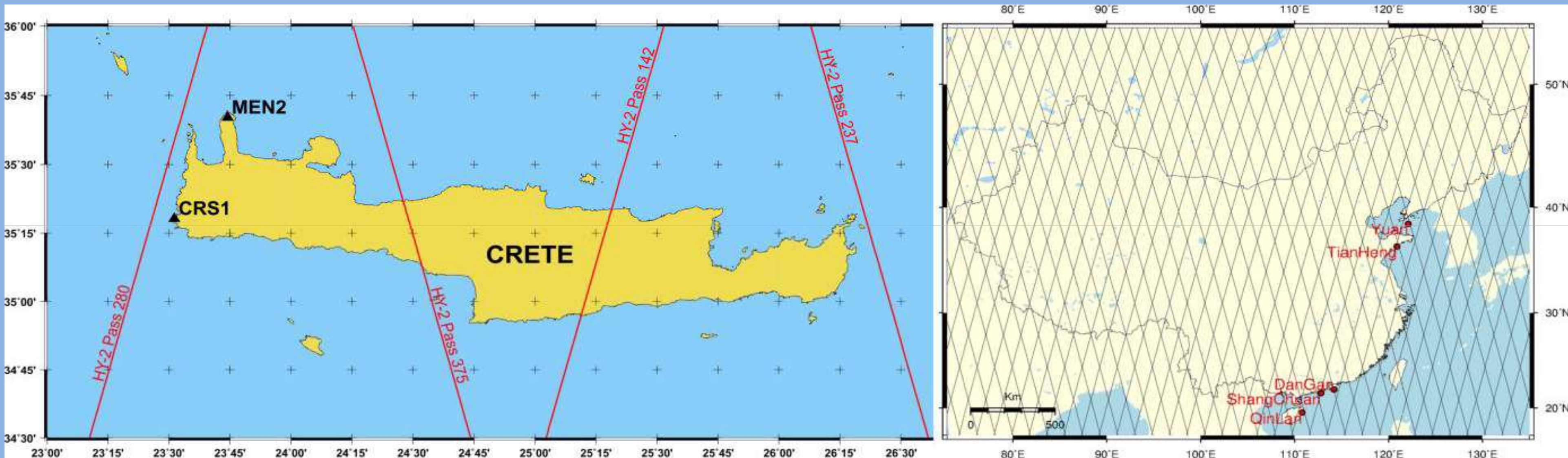
GeoMatLab



- Ascending Pass No.571, GDR-T
- **Bias= -47 mm** ±6 mm, using local gravimetric geoid model;

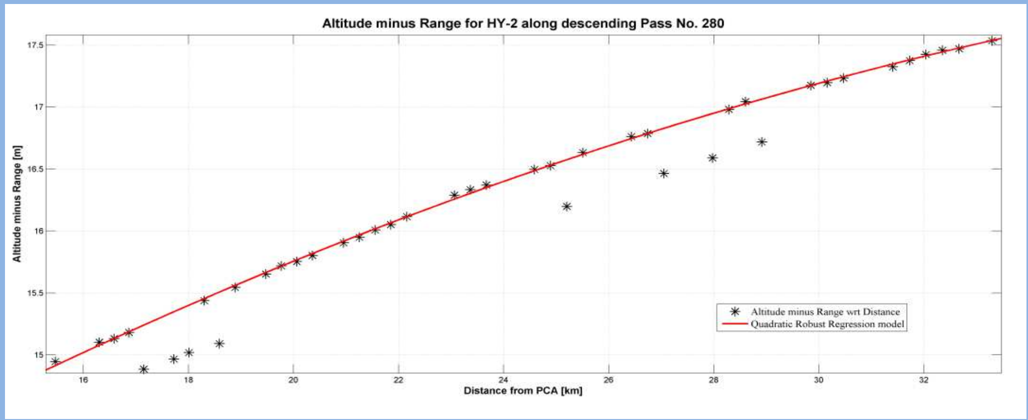
Chinese HY-2 calibration using CRS1

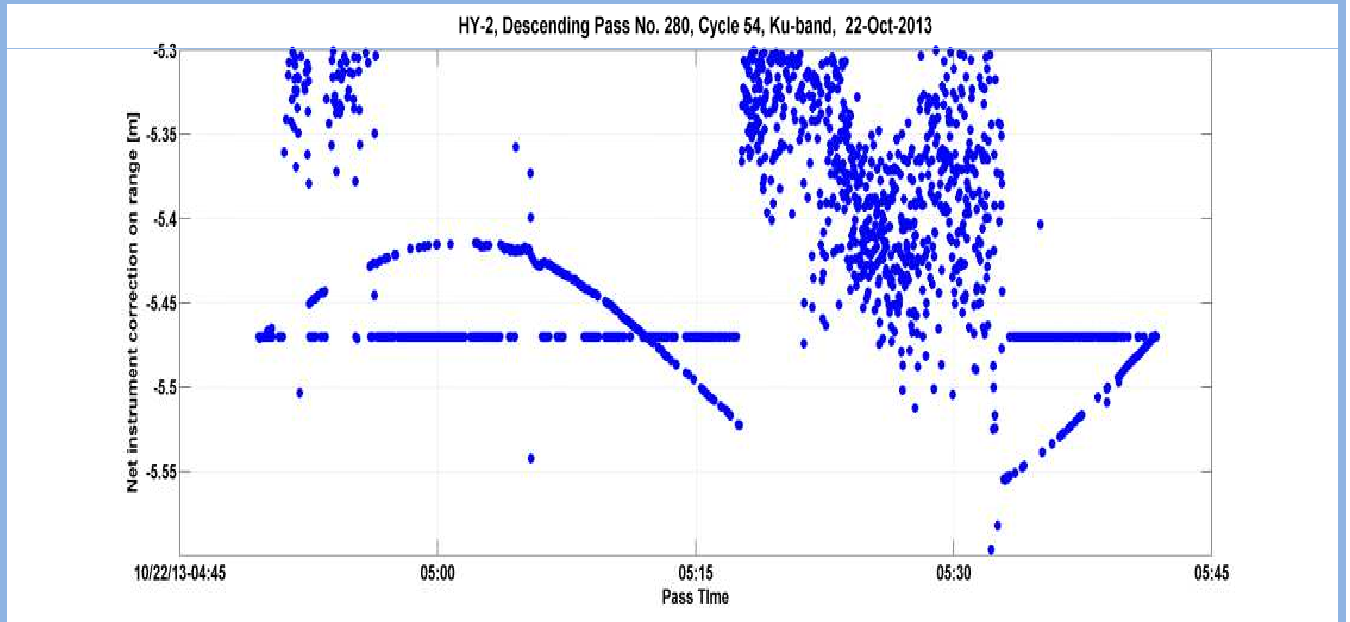
GeoMatLab



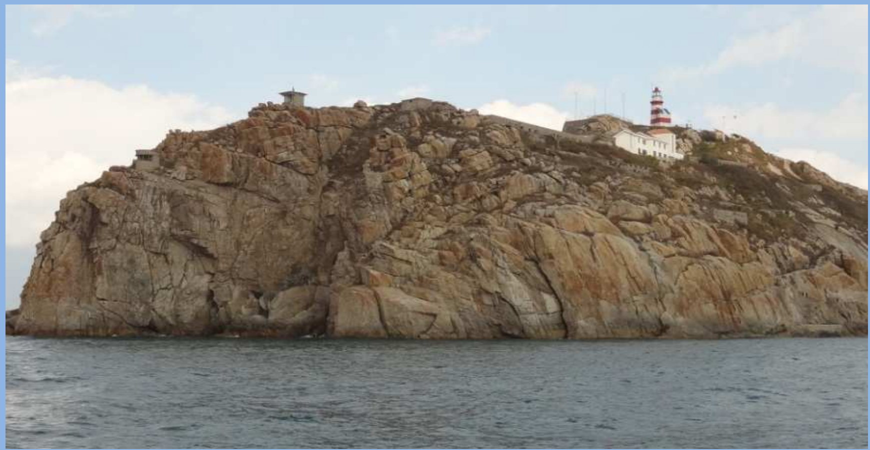
- 1-Hz Data , Time-tagging problems, Missing values in orbit.
- **HY-2 Bias = +2.879 m** (Preliminary in 2012, Pass No.280)

HY-2 problems with GDR





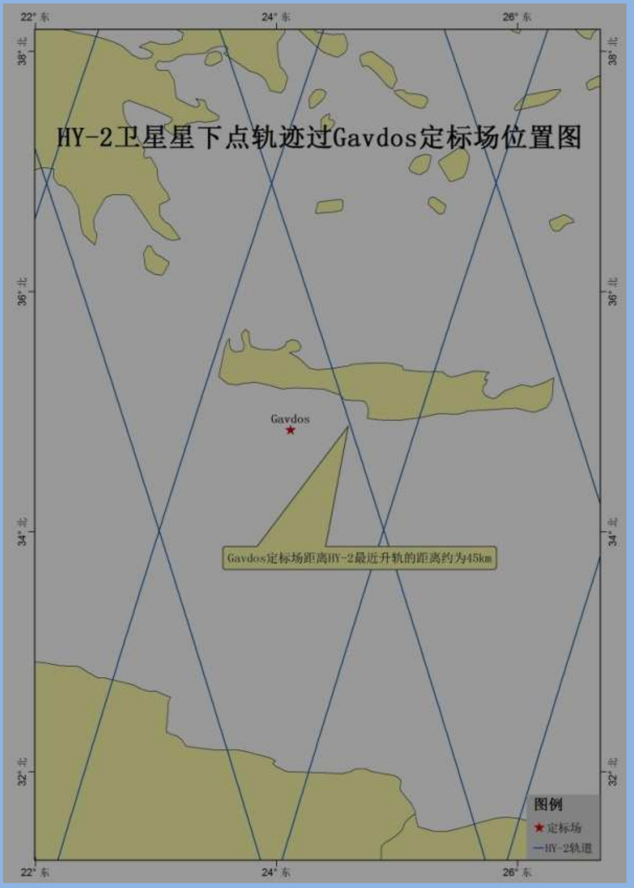
HY-2 Cal/Val sites



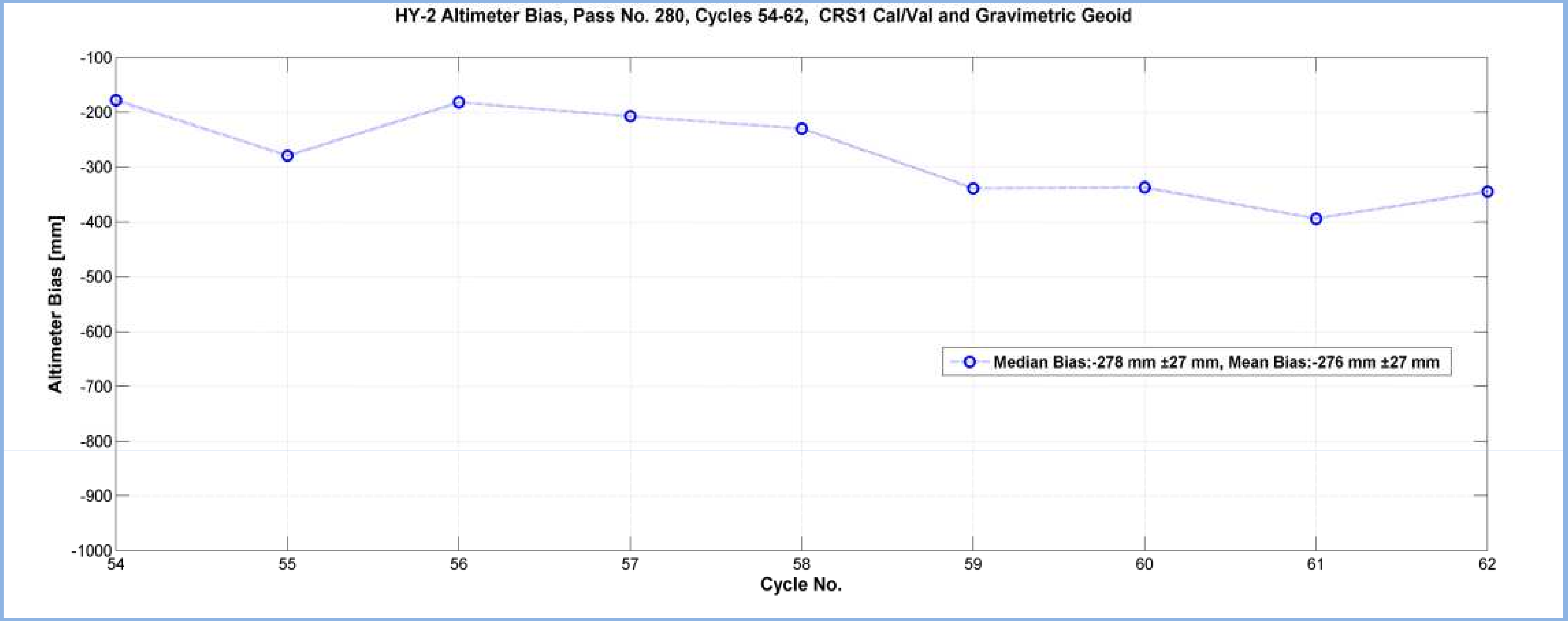
Qianli-Yan, QuingDao, China

Crete: CRS1 is the Cal/Val site for HY-2, Only 10 km from PCA,

HY-2 ground tracks over Crete

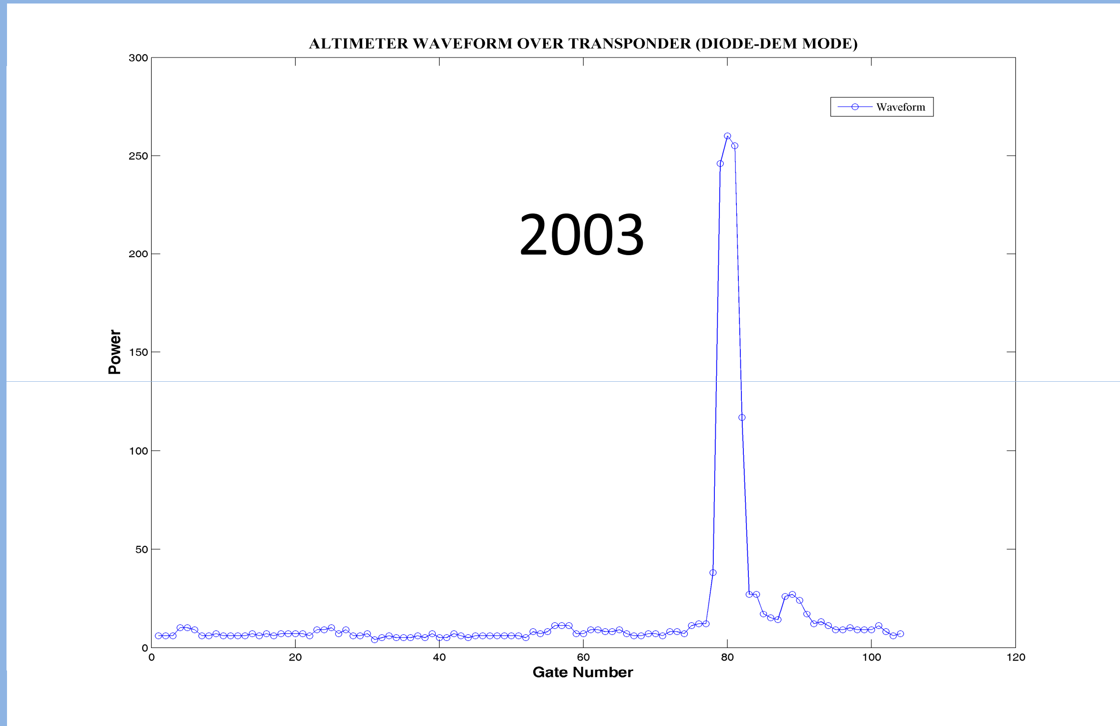


HY-2 altimeter bias with CRS1

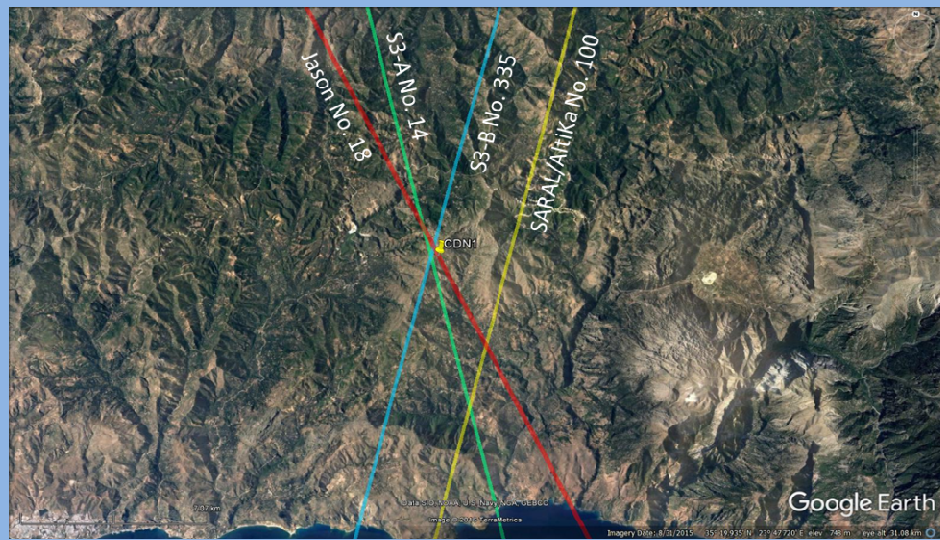


Descending Pass No. 280, Cycles 54-62 using S-GDR data at 20 Hz,
Calibrating regions: **9-16 km (south), 10-18 km (north),**
Median bias= **– 27.8 cm** ±2.7 cm, Mean = **– 27.6 cm** ±2.7cm
B= **–28.5 cm against Jason-2,** Cycles 198, 204, 205, 207 (No. 018),
B= –23 cm against SARAL/AltiKa, 8 and 10 (No. 571)
<u>All cycles of HY-2 are being calibrated with recent GDR Data</u>.

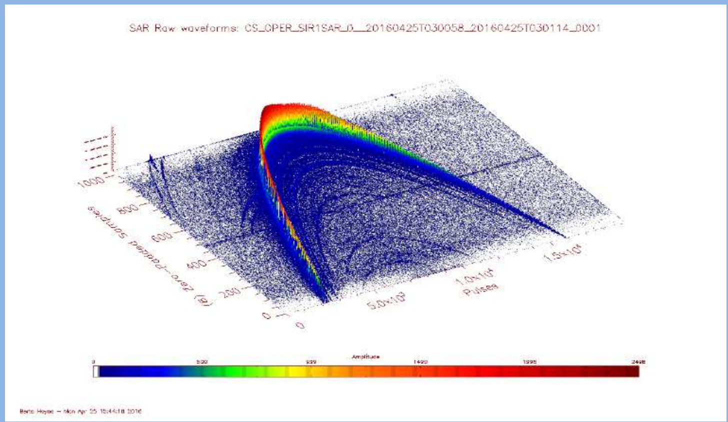
GVD3: Transponder Calibrations in Gavdos



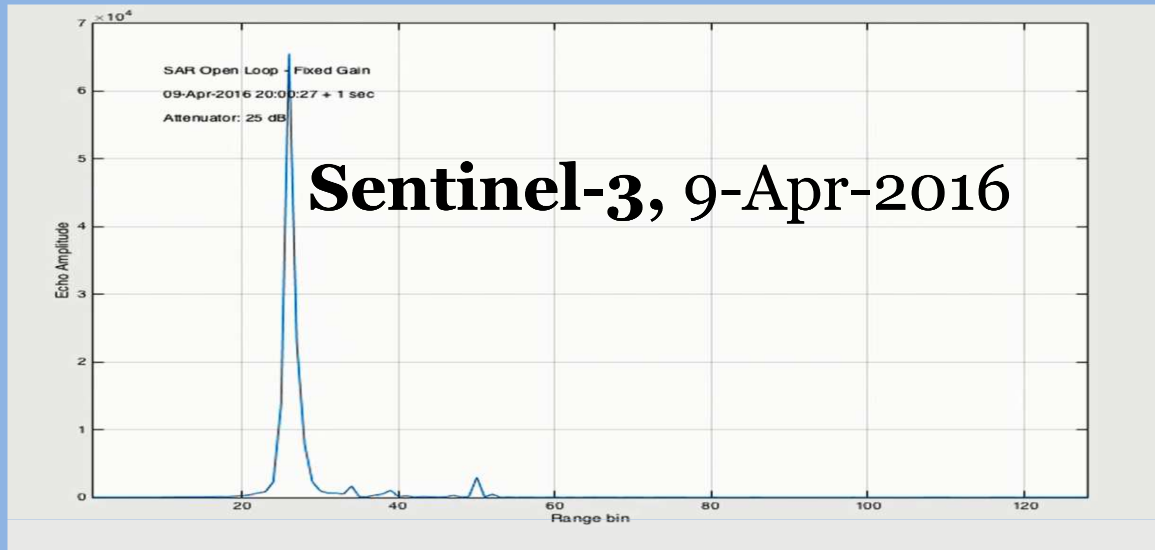
CDN1: ESA Sentinel-3 Altimeter Calibration



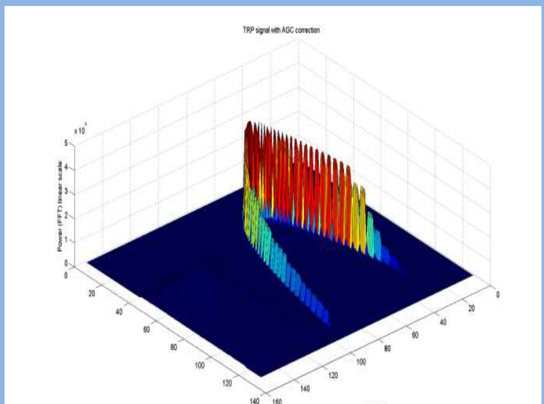
CDN1 Transponder Calibrations



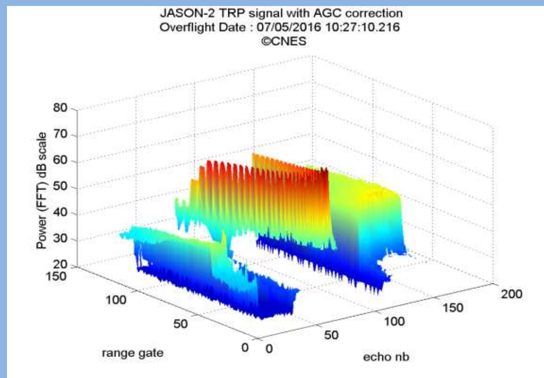
Cryosat-2, 25-Apr-2016



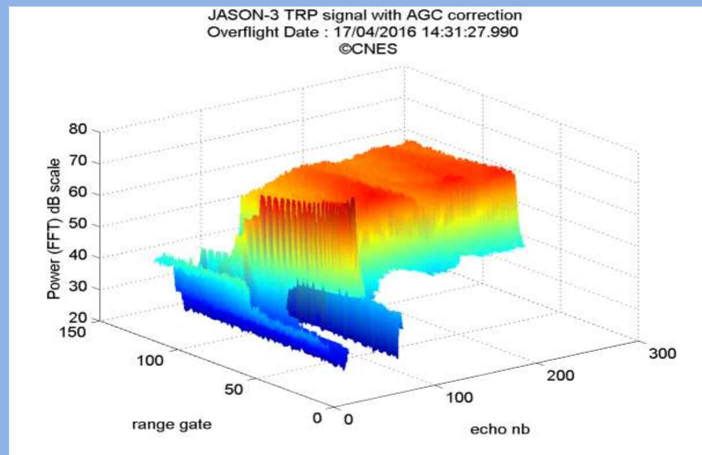
Sentinel-3, 9-Apr-2016



Jason-2, 2-Oct-2015

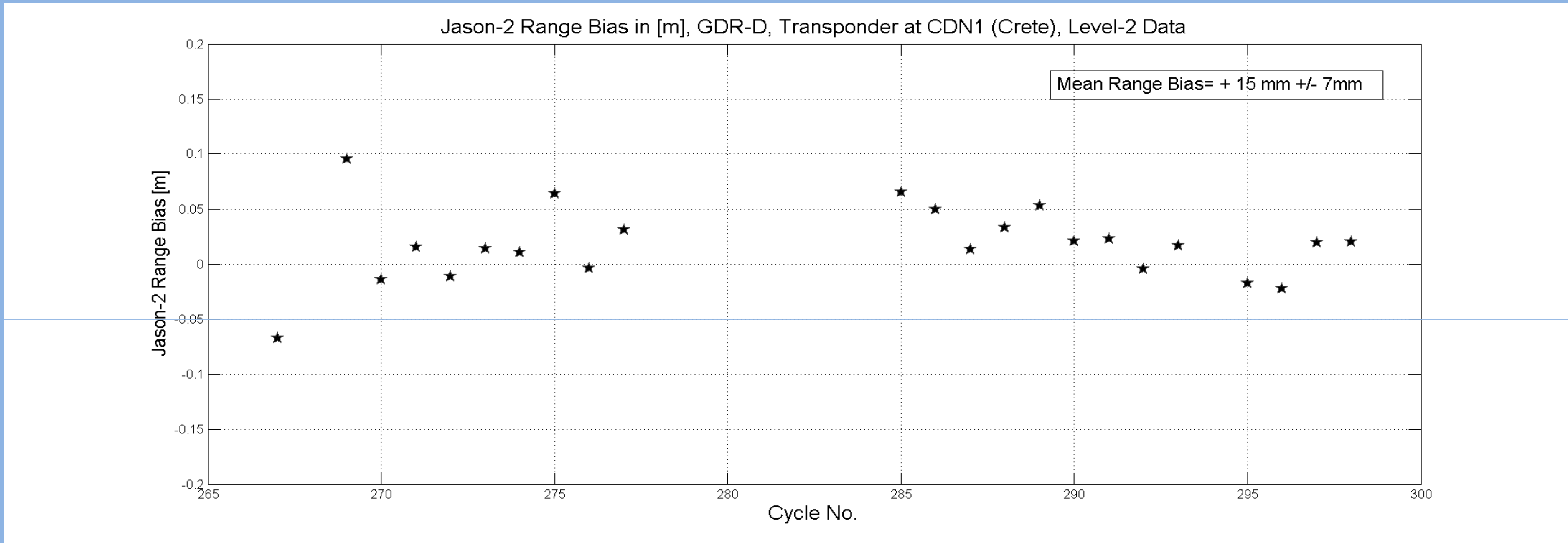


Jason-2, 7-May-2016



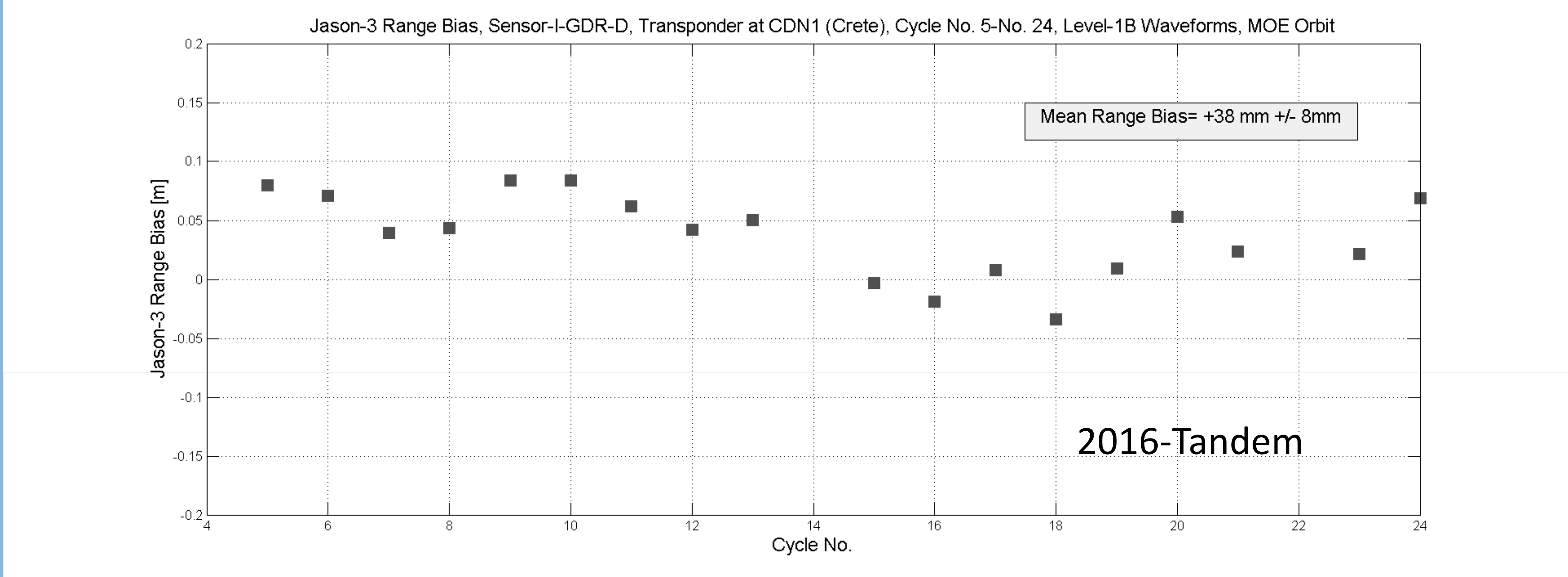
Jason-3, 17-Apr-2016

Jason-2 Transponder Calibrations



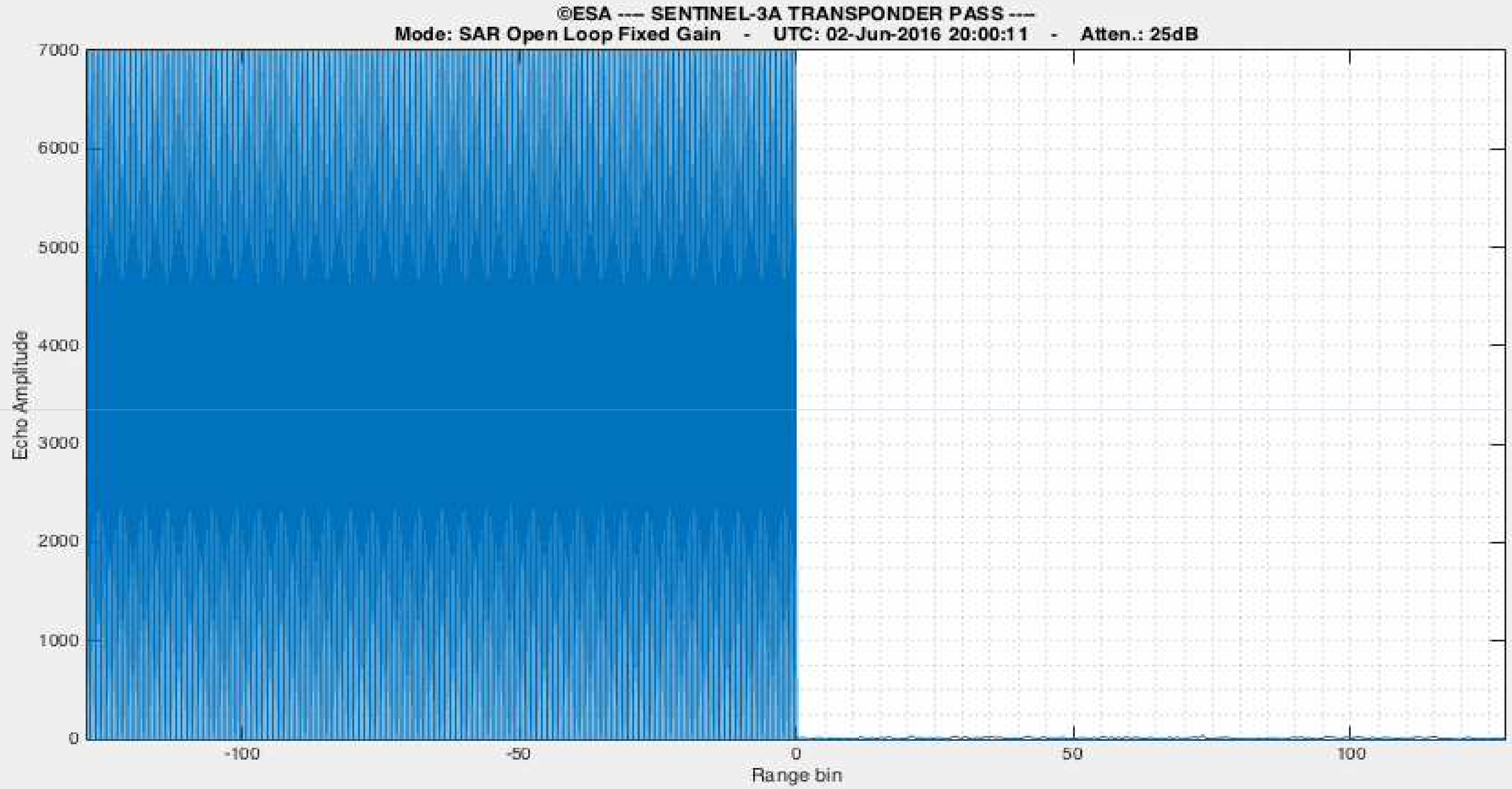
- Descending Pass No. 18, in 2015 and in 2016 (in Tandem with Jason-3),
- Precise Orbit [POE], Sensor-GDR-D,
- Range Bias B= **+15 mm ± 7 mm**,
- Variations may be due to **yaw steering** applied in Jason-2 & Jason-3.

Jason-3 transponder Cal/Val



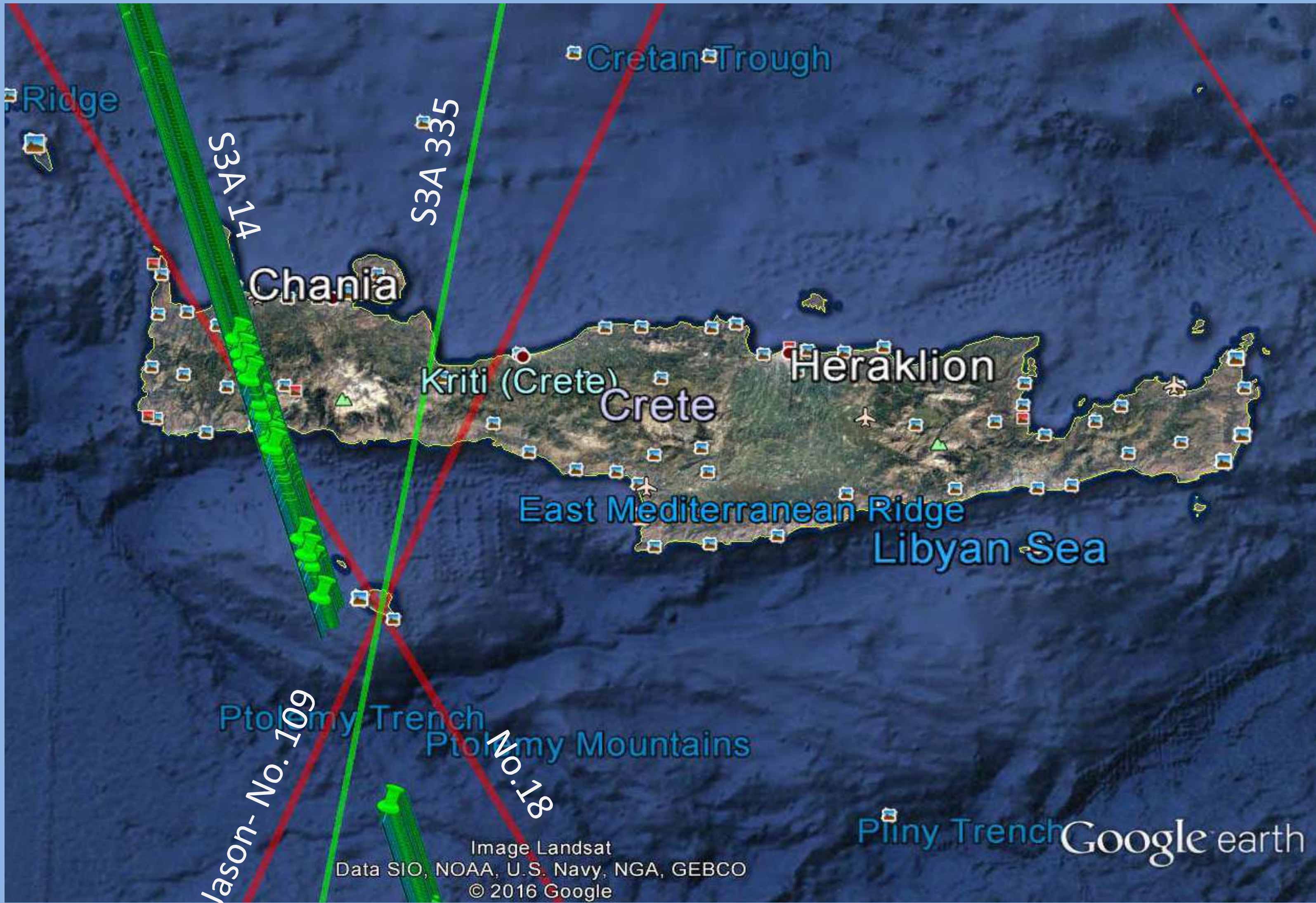
- Transponder Cal/Val in tandem with Jason-2 (2016),
- Sensor-I-GDR-D, Cycles 5-24, MOE Orbit,
- Jason-3 **Range Bias= +38 mm ±8 mm [J3-J2=23mm]**.

CDN1: Sentinel-3 Transponder Cal/Val site



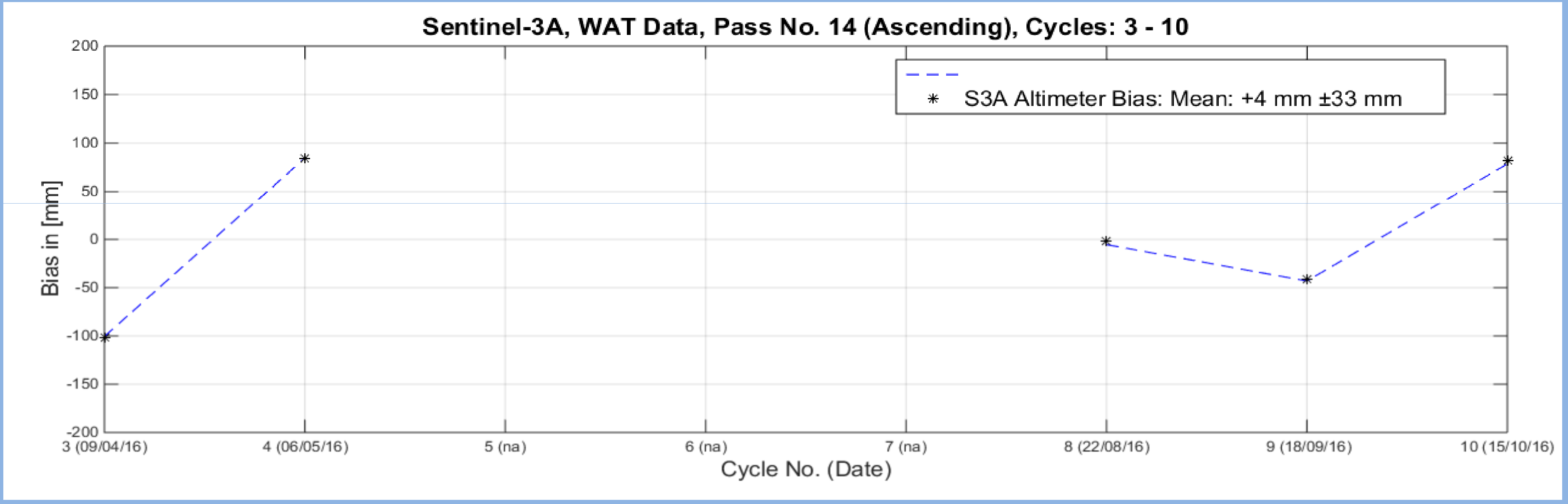
Sentinel-3A Sea-Surface Calibrations

GeoMatLab



Sentinel-3 altimeter calibrations

GeoMatLab



Same orbit as the transponder orbit at CDN1,
Data Gaps exist in Sentinel-3 GDR on **Pass No. 14** next to Gavdos

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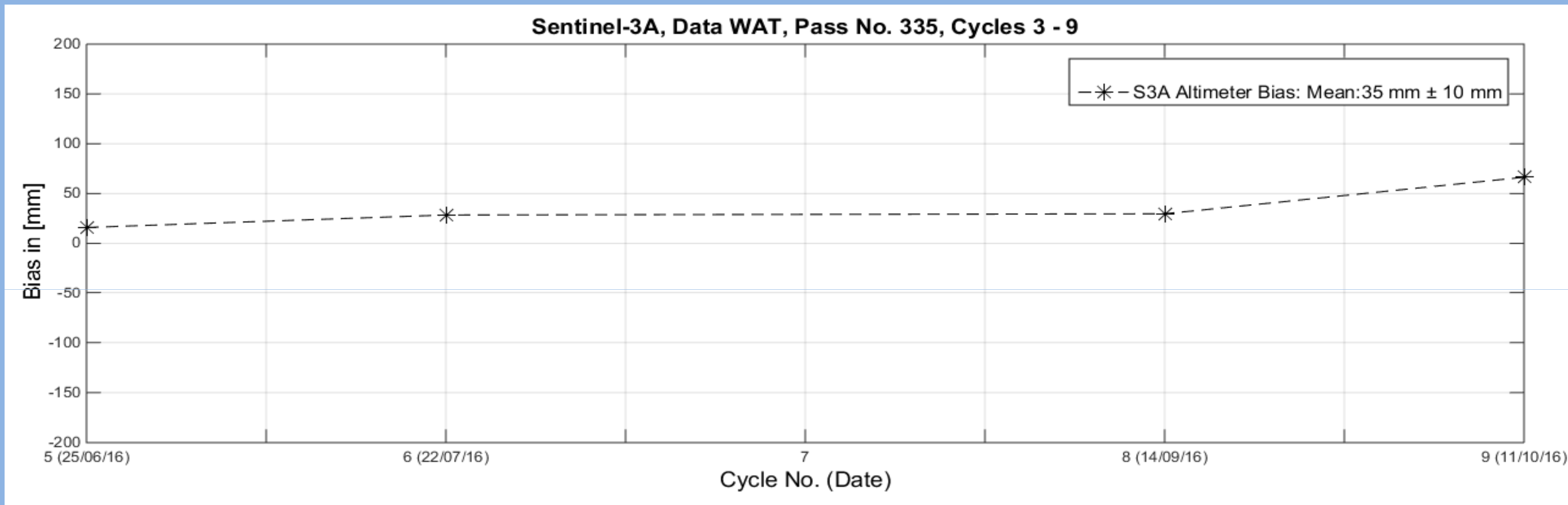
Sentinel-3A, Descending Pass No. 335

GeoMatLab



Sentinel-3A, Pass No. 335 (Descending),
Passing over Gavdos and at cross-over of Jason No.18 & No.109,
Mean Range Bias **= +35 mm ± 10 mm**.

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Summary of Cal/Val

- Sea-Surface Calibrations

Satellite	Ascending	Descending	Average	Cycles
Jason-1	+28 mm	+50 mm	**+ 39 mm**	70-100
Jason-2	+7 mm	–23 mm	**-8.0 mm**	2-298
Jason-3	-30 mm	-32 mm	**– 31.0 mm**	1-24
SARAL/AltiKa	– 47 mm		**– 47 mm**	1-34
HY-2		+278 mm	**+287 mm**	54-62
Sentinel-3	+4 mm	+35 mm	**+ 20 mm**	

- Transponder Calibrations

Satellite	Ascending	Descending	Average	Year
JA-2 (Gavdos)	-13.6 mm	+ 15.6 mm	**+1.1 mm**	2011-2012
JA-2 (CDN1, Crete)		+ 15.0 mm		2015-2016
JA-3(CDN1, Crete)		+ 38.0 mm	**J3-J2=23mm**	2016

Fiducial Reference Measurements 4ALT

- Gavdos/Crete: Permanent Altimeter Calibration Facility (PACF): Long-term (15yrs) & consistent calibration of altimeters: (1) Bias & drifts; (2) Biases among missions; (3) Connect different missions.
- To attain Fiducial Reference Standard:
  - documented SI (Système international d'unités) traceability,
  - independence from the satellite geophysical retrieval process,
  - uncertainty budget for all FRM instruments and measurements,
  - defined FRM measurement protocols.
  - Specification of uncertainty budgets for:
    - Instrument measurements; Cal/Val Methodology employed; Algorithms, Models (geoid, MSS, dynamic topography, transponder, etc.).
- Changes are made at PACF to attain FRM4ALT;

Future

- **FRM4ALT workshop in May 2017 in Crete**;
- All Chinese HY-2 Cal/Val cycles are recalibrated at CRS1 Cal/Val site;
- Variations in transponder Cal/Val may be due to yaw steering applied to Jason-2, Jason-3;
- On 11-Nov-2016 both Sentinel-3 and Jason-3 fly over CDN1 **by 20 sec apart**;
- Common ground and settings for calibrations.

Acknowledgements

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- ESA/ESTEC
- EU
- CNES