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
Land and Sea Calibrating regions
Jason-2 Ascending Pass No. 109

- 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 = $-23 \text{ mm} \pm 4 \text{ mm}$
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

- Descending Pass No.18, IGDR-D
- Bias = -30 mm ± 7 mm, using local gravimetric geoid model;
SARAL/AltiKa ground tracks
SARAL/AltiKa Pass No. 571 (Ascending)

- Ascending Pass No.571, GDR-T
- **Bias** = -47 mm ± 6 mm, using local gravimetric geoid model;
Chinese HY-2 calibration using CRS1

- 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= $-27.8 \text{ cm} \pm 2.7 \text{ cm}$, Mean = $-27.6 \text{ cm} \pm 2.7 \text{ cm}$
B= $-28.5 \text{ cm}$ against Jason-2, Cycles 198, 204, 205, 207 (No. 018),
B= $-23 \text{ cm}$ against SARAL/AltiKa, 8 and 10 (No. 571)
All cycles of HY-2 are being calibrated with recent GDR Data.
GVD3: Transponder Calibrations in Gavdos

2003
CDN1: ESA Sentinel-3 Altimeter Calibration
CDN1 Transponder Calibrations

**Sentinel-3, 9-Apr-2016**

**Cryosat-2, 25-Apr-2016**

**Jason-2, 2-Oct-2015**

**Jason-2, 7-May-2016**

**Jason-3, 17-Apr-2016**

La Rochelle - France – Nov. 2016

OSTST meeting
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 $B = 15\text{ mm} \pm 7\text{ mm}$,
- 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].
Sentinel-3A Sea-Surface Calibrations
Sentinel-3 altimeter calibrations

Same orbit as the transponder orbit at CDN1,
Data Gaps exist in Sentinel-3 GDR on **Pass No. 14** next to Gavdos
Sentinel-3A, Pass No. 335 (Descending),
Passing over Gavdos and at cross-over of Jason No.18 & No.109,
Mean Range Bias = \( +35 \text{ mm} \pm 10 \text{ mm} \).
### Summary of Cal/Val

#### • Sea-Surface Calibrations

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Ascending</th>
<th>Descending</th>
<th>Average</th>
<th>Cycles</th>
</tr>
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<tbody>
<tr>
<td>Jason-1</td>
<td>+28 mm</td>
<td>+50 mm</td>
<td>+39 mm</td>
<td>70-100</td>
</tr>
<tr>
<td>Jason-2</td>
<td>+7 mm</td>
<td>-23 mm</td>
<td>-8.0 mm</td>
<td>2-298</td>
</tr>
<tr>
<td>Jason-3</td>
<td>-30 mm</td>
<td>-32 mm</td>
<td>-31.0 mm</td>
<td>1-24</td>
</tr>
<tr>
<td>SARAL/AltiKa</td>
<td>-47 mm</td>
<td></td>
<td>-47 mm</td>
<td>1-34</td>
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<tr>
<td>HY-2</td>
<td></td>
<td>+278 mm</td>
<td>+287 mm</td>
<td>54-62</td>
</tr>
<tr>
<td>Sentinel-3</td>
<td>+4 mm</td>
<td>+35 mm</td>
<td>+20 mm</td>
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#### • Transponder Calibrations

<table>
<thead>
<tr>
<th>Satellite</th>
<th>Ascending</th>
<th>Descending</th>
<th>Average</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>JA-2 (Gavdos)</td>
<td>-13.6 mm</td>
<td>+15.6 mm</td>
<td>+1.1 mm</td>
<td>2011-2012</td>
</tr>
<tr>
<td>JA-2 (CDN1, Crete)</td>
<td>+15.0 mm</td>
<td></td>
<td></td>
<td>2015-2016</td>
</tr>
<tr>
<td>JA-3(CDN1, Crete)</td>
<td>+38.0 mm</td>
<td></td>
<td>J3-J2=23mm</td>
<td>2016</td>
</tr>
</tbody>
</table>
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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• EU
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