LARES: Analysis of the first months of data

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Introduction

Can we assume the tentative COM correction for LARES to be appropriate?

→ Analysis of the estimated range biases for LARES

→ Comparison with estimated range biases for LAGEOS–1 and LAGEOS–2
# LARES (LAser RElativity Satellite)

## Mission Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Launch date</strong></td>
<td>13-Feb-2012</td>
</tr>
<tr>
<td><strong>Sponsor</strong></td>
<td>ASI/ESA</td>
</tr>
<tr>
<td><strong>Dimensions</strong></td>
<td></td>
</tr>
<tr>
<td>Diameter</td>
<td>364 mm</td>
</tr>
<tr>
<td>Mass</td>
<td>386.8 kg</td>
</tr>
<tr>
<td>Number of CCR</td>
<td>92</td>
</tr>
<tr>
<td><strong>Center-of-Mass</strong></td>
<td></td>
</tr>
<tr>
<td>Correction</td>
<td>133 ± 5 mm</td>
</tr>
<tr>
<td><strong>Orbit</strong></td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>1450 km</td>
</tr>
<tr>
<td>Inclination</td>
<td>69.5 degrees</td>
</tr>
<tr>
<td>Eccentricity</td>
<td>0.0</td>
</tr>
<tr>
<td>Period of revolution</td>
<td>114.8 min</td>
</tr>
<tr>
<td>Revolutions per day</td>
<td>12.54</td>
</tr>
</tbody>
</table>
SLR tracking of LARES

- 13–25 stations per week
- 7–12 fix stations for datum definition per week
SLR tracking of LARES


→ 217 days with LARES observations
→ Mean number of SLR observations per day: 276 obs/day ▲ 1932 obs/week
→ 58’312 normal points

Number of SLR residuals per day for satellite L60

Number of SLR residuals per week for satellite L60
Combined solution

ILRS Analysis Working Group

LAGEOS–1  Etalon–1  LARES
LAGEOS–2  Etalon–2
Combined weekly solution – Solution setup

- **Station coordinates**
- **Satellite orbits**: 1 arc per week
  - 6 osculating elements
  - Dynamic orbit parameters:
    - Constant acceleration in along-track
    - Once-per-rev in along-track
    - Once-per-rev in cross-track
  - **LARES specific**:
    - Air drag model: MSIS-E 00 with anomalous oxygen
    - Once-per-rev stochastic pulses along-track
- **Earth rotation**:
  - Polar motion (constant per day)
  - Length of Day LOD
- **Range biases**
  - for selected sites (LAGEOS and Etalon)
  - for every LARES station
- **Geocenter coordinates**

Datum definition:
Minimal constraint solution with NNR + NNT on SLRF2008

240–290 parameters / week
4’000–9’000 observations / week
LARES residual analysis

- Overall statistics for total number of 58’312 observations:
  - Mean bias: −0.4 mm, RMS: 20.6 mm (combined solution)
LARES Range Biases

Yarragadee, Australia

Greenbelt, USA

Zimmerwald, Switzerland

Graz, Austria
→ No systematic range bias for LARES
LARES Range Biases – Comparison with LAGEOS–1 and LAGEOS–2

Wettzell, Germany

Station Nr.8834

SLR range bias [mm]

+ 2.0 mm
- 1.2 mm
- 3.1 mm

LARES
LAGEOS-1
LAGEOS-2
LARES Range Biases – Comparison with LAGEOS–1 and LAGEOS–2

Grasse, France

Station Nr. 7845

- SLR range bias [mm]

+ 7.3 mm
+ 5.4 mm
+ 4.8 mm
LARES Range Biases – Comparison with LAGEOS–1 and LAGEOS–2

Monument Peak, USA

Station Nr. 7110

SLR range bias [mm]

-50
-40
-30
-20
-10
0
10
20
30
40
50

LARES
LAGEOS-1
LAGEOS-2

+ 8.8 mm
+ 8.3 mm
+ 7.6 mm
LARES Range Biases – Comparison with LAGEOS–1 and LAGEOS–2

Arequipa, Peru

Station Nr. 7403

SLR range bias [mm]

+ 14.0 mm
+ 16.8 mm
+ 12.4 mm

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Summary

- Analysis of the range biases for LARES only
  - Estimated range bias over all stations: $0.4 \pm 5.0$ mm (1σ)

- Comparison with estimated range biases for LAGEOS–1 and LAGEOS–2
  - No systematic offset between the three satellites
  - Range biases due to station specifics and not due to inaccurate COM correction

- The tentative COM correction of $133 \pm 5$ mm is appropriate.