Bias Detection Techniques And Capabilities

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# Bias Detection Techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Bias Detection Capability</th>
<th>Detection Level</th>
<th>Orbit Determination Required?</th>
<th>Simultaneous Data Required?</th>
<th>Station Coordinates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>System Characterization</td>
<td>Absolute</td>
<td>≤1mm</td>
<td>NO</td>
<td>NO</td>
<td>N/A</td>
</tr>
<tr>
<td>Portable calibration standard</td>
<td>Absolute</td>
<td>≤1mm</td>
<td>NO</td>
<td>NO</td>
<td>N/A</td>
</tr>
<tr>
<td>Collocation</td>
<td>Relative</td>
<td>1-2mm</td>
<td>NO</td>
<td>YES</td>
<td>Local Tie</td>
</tr>
<tr>
<td>Simultaneous Arc</td>
<td>Relative</td>
<td>5-10mm</td>
<td>YES</td>
<td>YES</td>
<td>Fixed</td>
</tr>
<tr>
<td>Short Arc (few days)</td>
<td>Absolute</td>
<td>10-20mm</td>
<td>YES</td>
<td>NO</td>
<td>Fixed</td>
</tr>
<tr>
<td>Long Arc (several days)</td>
<td>Absolute</td>
<td>6-14mm</td>
<td>YES</td>
<td>NO</td>
<td>Fixed</td>
</tr>
<tr>
<td>Long Arc (28 days)</td>
<td>Absolute</td>
<td>5-10mm</td>
<td>YES</td>
<td>NO</td>
<td>estimated</td>
</tr>
</tbody>
</table>
Limiting Factors in Absolute Bias Detection using an Orbit

1. Station Position,
2. # of Passes,
3. Satellite Signature,
4. Tropospheric model,
5. GM,
6. And others models
1999 Graz Range Biases (pass-by-pass)

Bias (mm)


Bias Detection
Graz Range Bias
(short arc comparisons)

Month in Year 2000

CRL 7839 Bias = 7 +/- 2
CSR 7839 Bias = -2 +/- 3
DEO 7839 Bias = 22 +/- 3
MCC 7839 Bias = 3 +/- 2
Mt. Stromlo Range Bias
(short arc comparisons)

- CRL 7849 Bias = -11 +/- 2
- CSR 7849 Bias = -14 +/- 2
- DEO 7849 Bias = -2 +/- 2
- MCC 7849 Bias = -1 +/- 1

Month in Year 2000

Bias (mm)

Passes
Wettzell Range Bias
(short arc comparisons)

<table>
<thead>
<tr>
<th>Month</th>
<th>Bias (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>-13 +/- 10</td>
</tr>
<tr>
<td>2</td>
<td>-7 +/- 6</td>
</tr>
<tr>
<td>3</td>
<td>-35 +/- 8</td>
</tr>
<tr>
<td>4</td>
<td>-12 +/- 7</td>
</tr>
</tbody>
</table>

Passes

- CRL 8834 Bias = -13 +/- 10
- CSR 8834 Bias = -7 +/- 6
- DEO 8834 Bias = -35 +/- 8
- MCC 8834 Bias = -12 +/- 7
Zimmerwald and Graz

CSR Short Arc Results

Zimmerwald fixed a 18mm bias, but the Zimmerwald bias changed by 10mm, What happened to the other 8mm.
Most of the other 8mm went into Graz in the opposite direction.
Short Arc Conclusions

• Individual pass results can vary significantly between analyst centers

• Also, monthly mean range biases can differ significantly from the Analysis Centers (AC),
  – The prime cause of this is coordinate differences

• But, the monthly bias trends between ACs track each other to the 5-10mm level.

• A change in a site’s bias influences the ‘apparent bias’ in neighboring sites (in the opposite direction).
Graz Range Bias
(long arc 28-day coordinate solutions)

Bias Detection
1999 Graz Range Bias Comparison
(short arc versus long arc)

Modeling Constants
LAGEOS CoM 251mm
GM 398600.4415
Graz Range Bias Comparisons

(fixed vs estimated coordinates)

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

Range Bias (mm)

CSR Long Arc Range Bias with coordinate estimation
CSR Short Arc Range Bias (fixed coordinates)
Conclusions

• When coordinates are fixed, range bias trends reflect site height movement (i.e. seasonal trends in RB are artificial)
• To get the BEST absolute range bias results you need to estimate coordinates and RBs simultaneously.
• The Analysis WG has an action to develop a consolidated range bias report.