Multi-Mission Crossover Calibration  
First Results for Jason-2

D. Dettmering and W. Bosch  
Deutsches Geodätisches Forschungsinstitut (DGFI), Munich, Germany  
(dettmering@dgfi.badw.de)

Discrete Crossover Analysis (DCA)
The Discrete Crossover Analysis is a tool to estimate radial errors for contemporaneous altimeter systems, analysed in a multi-mission scenario. Besides the crossover differences, the DCA minimizes consecutive differences to ensure a certain degree of smoothness of the radial component without introducing an analytical error function. The method produces error time series including relative range biases, systematic differences in the centre-of-origin realization, as well as geographically correlated error pattern for all included missions.

Input Data

<table>
<thead>
<tr>
<th>Mission</th>
<th>Period</th>
<th>Calibration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jason-1 IGDR (Version C)</td>
<td>Cycles 240 to 248</td>
<td>EOT08a, smooth ionosphere, IGDR atmospheric correction</td>
</tr>
<tr>
<td>Jason-2 IGDR (Version C)</td>
<td>Cycles 001 to 009</td>
<td>EOT08a, smooth ionosphere, IGDR atmospheric correction</td>
</tr>
<tr>
<td>Envisat IGDR</td>
<td>Cycles 070 to 072</td>
<td>EOT08a, GPS ionosphere (JPL GIM), MOG2D</td>
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</tbody>
</table>

Data from Envisat was included in order to stabilize the crossover geometry and to bridge temporal data holes from Jason-1.

All available single- and dual-satellite crossovers with max. time differences of 3 days were computed and analysed (between 22000 and 40000 per cycle, with max. 1% outlier).

Relative Range Biases

Mean biases between the three missions for the nine 10-day periods.

Systematic error patterns due to geographically distributed errors are eliminated.

Jason-1 is reference mission

Δr = 7.9 ± 0.1 cm

Relative Range Biases

To Compute Range Biases and Centre-of-Origin Shifts for each 10-day period the model

\[ x_i = \Delta x + \Delta \xi \cos \lambda \delta + \Delta \eta \sin \lambda \delta \]

was fitted by least squares.

Δx = -1.8 ± 0.6 mm  
Δy = 3.6 ± 0.8 mm  
Δz = -0.2 ± 1.0 mm

Centre-of-Origin shifts

The shifts for all missions don’t exceed 1 cm and Jason-2 shifts clearly remain less than 5 mm.

Geographically Correlated Errors

Time series of radial errors (relative range bias removed) allows to assess geographically correlated errors. This is done with Kaula’s first order analytic solution of the satellite motion from series of ascending and descending passes.

Radial Errors

Radial Errors are obtained for the whole period analysed.

Subset of radial error components of Jason-1 (blue), Jason-2 (red), and Envisat (green)

Empirical Auto-Covariance Function

All mission show auto-correlation pattern with clear peaks at orbit revision times. Jason-2 shows less variations and less correlation of nearby passes than Jason-1.

Δx, Δy, Δz

The amplitudes of both error pattern are small but differ - although the orbit configuration is identical and the same gravity field was used for the orbit computation. This is an indication that also other errors (like SSB) map into the radial errors.

Conclusion

Global multi-mission crossover analysis was performed with three altimeter missions in order to get information on the radial error of Jason-2 altimeter. The error time series allows to compute the mean range bias as well as centre-of-origin shifts and geographically correlated errors.

Jason-2 shows a mean range bias of about 8 cm referred to Jason-1 and improved centre-of-origin shifts (< 5mm) and geographically correlated error pattern (<2cm).

References