Global Multi-Mission Crossover Calibration
First Results for Jason-2

Denise Dettmering and Wolfgang Bosch
Deutsches Geodätisches Forschungsinstitut

OSTST Meeting, Nice, November 10-12, 2008
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Outline

• Discrete Crossover Analysis (DCA)
• Multi-Mission Crossover Calibration Results
• First Results of Relative Calibration of Jason-2 Altimeter
Discrete Crossover Analysis (DCA)

Input Data:
- Crossover differences in all combinations (single- and dual-satellite)
- Max. time difference 3 days

Model:
- Radial errors of the two passes per crossover were modeled
- Weighted least squares adjustment minimizing both, crossover differences and consecutive errors
- No analytical function for the radial errors
- Segmentation with time intervals of 3+10+3=16 days
- Sum of errors of reference mission are forced to zero; avoids rank defect (relative calibration w.r.t TOPEX or Jason-1)
Error Decomposition

• Post processing per mission and cycle: Splitting radial errors into relative range biases and centre-of-origin shifts

• Least squares adjustment

\[ x_i + \nu_{x_i} = \Delta r + \Delta x \cdot \cos \varphi \cos \lambda + \Delta y \cdot \cos \varphi \sin \lambda + \Delta z \cdot \sin \varphi \]

\[ x_i : \text{radial errors (from DCA)} \]

\[ \Delta r : \text{relative range bias} \]

\[ \Delta x, \Delta y, \Delta z : \text{centre–of–origin shifts} \]

• Geographically correlated errors (mean and variable part) accessible through sum/difference of ascending/descending errors
Multi-Mission Crossover Calibration

Input Data:
• Data from TOPEX, Poseidon, ERS-1, ERS-2, GFO, Jason-1, ENVISAT, and ICESat analysed for period 1992 - 2007
• Consistent models (e.g. tides, ionosphere, DAC, ...) whenever possible

Results (per mission):
• Radial Errors (time series, spectral properties assessable)
• range biases per 10 days and global mean range biases
• Centre-of-origin shifts
• Geographically correlated errors
Global Mean Range Bias per Mission

Validation

DCA external results
Geographically Correlated Mean Errors

Mean range biases removed

Jason-1

Envisat

TOPEX

GFO

-0.05 -0.04 -0.03 -0.02 -0.01 0.00 0.01 0.02 0.03 0.04 0.05 [m]
First Results for Jason-2

- Jason-2 GDR not yet included in the last Multi-Mission Crossover Analysis
- Only IGDR-C available

Input Data:
- IGDR for 3 missions: Jason-1, Jason-2, and Envisat
- Jason-1 as reference mission (relative calibration w.r.t Jason-1)
- Time interval of 9 cycles (240-248)
- Ocean tides: EOT08a
- Ionosphere: smoothed for Jason, JPL GIM for Envisat
Subset of Estimated Errors

(Jason-1 as reference mission)
Auto-Covariance Function

Radial Errors

~ 1.9 cm
~ 1.6 cm
~ 1.5 cm

orbit revision time

Jason-1
Jason-2
Envisat
Cross-Covariance Function

Radial Errors: Jason-1 ↔ Jason-2

Maximum 0.63 at ~ -50sec

computed from 10 days (JD3190 to 3200)
Relative Range Biases
(w.r.t. Jason-1)

- **Envisat**
  - 37.2 ± 0.1 cm

- **Jason-2**
  - 7.9 ± 0.1 cm

- **Jason-1**
  - -0.1 ± 0.1 cm
Range Bias - Validation

Range Bias Jason-2 (neg. sign), this study

With correction
Mean = -7.911
StdDev = 0.1637

No Correction
Mean = -8.331
StdDev = 0.1626
Relative Centre-of-Origin Shifts

Graph showing the shifts in dx, dy, and dz over Jason-1 cycles.
Conclusions

Discrete Crossover Analysis provides ...
- ... radial errors with high temporal and spacial resolution
- ... range biases as well as centre-of-origin shifts
- ... geographically correlated errors

is not limited ...
- ... to special missions
- ... to special orbit configurations (e.g. tandem flights)

shows ...
- ... good agreement in global mean range bias with results from other calibration methods
- ... a relative range bias between Jason-1 and Jason-2 of 7.9 cm