Multi-Mission Crossover Calibration First Results for Jason-2

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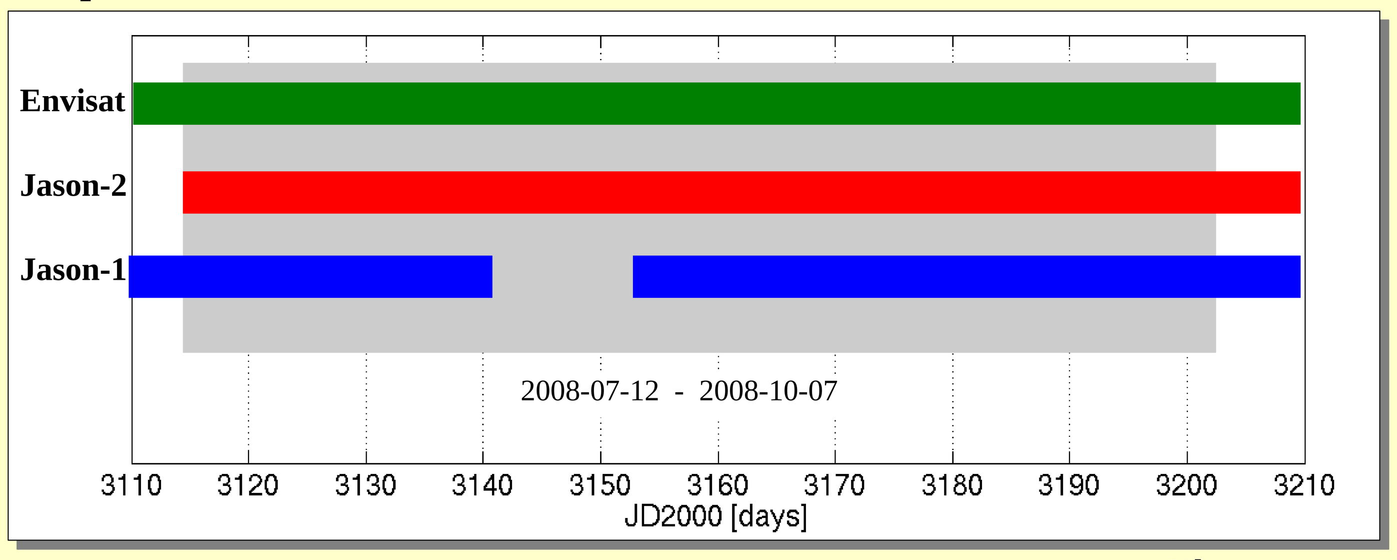
Discrete Crossover Analysis (DCA)

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



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).

Jason1 IGDR (Version C)*	Cycles 240 to 248	EOT08a[2], smoothed ionosphere, IGDR atmospheric correction
Jason2 IGDR (Version C)	Cycles 001 to 009	EOT08a, smoothed ionosphere, IGDR atmospheric correction
Envisat IGDR	Cycles 070 to 072	EOT08a, GPS ionosphere (JPL GIM), MOG2D

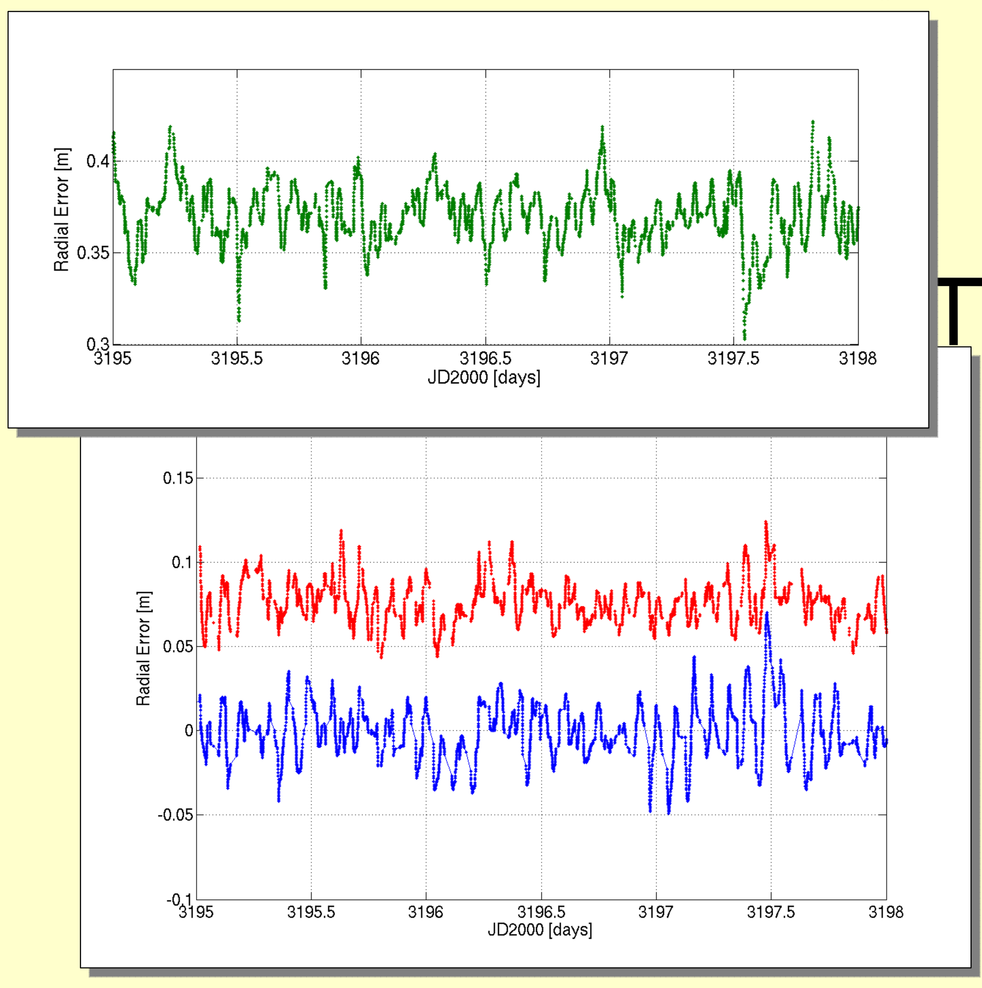
** JMR Time Tag Error (1sec) for most cycles*

Mean Bias of Jason-1 is forced to zero => all biases with reference Jason-1

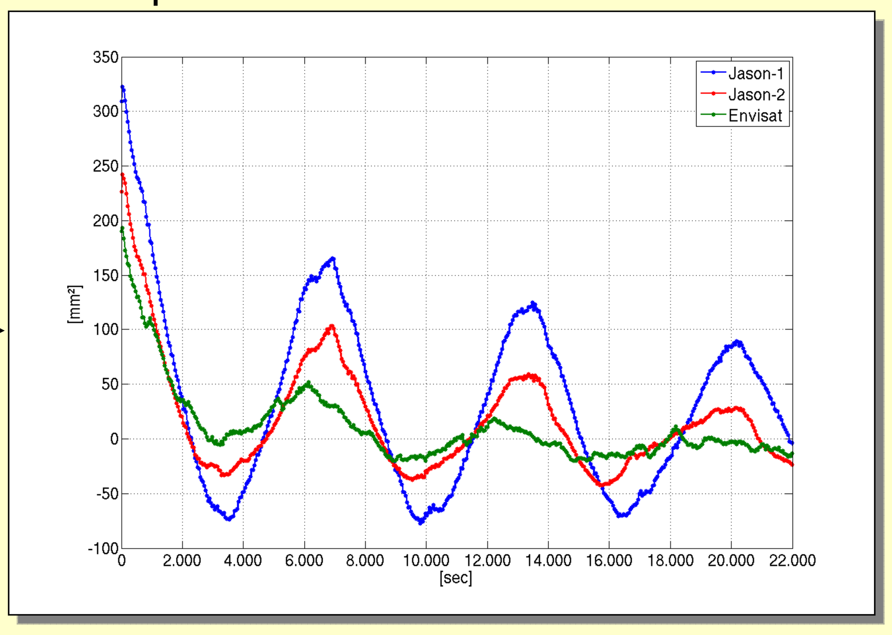
Radial Errors

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

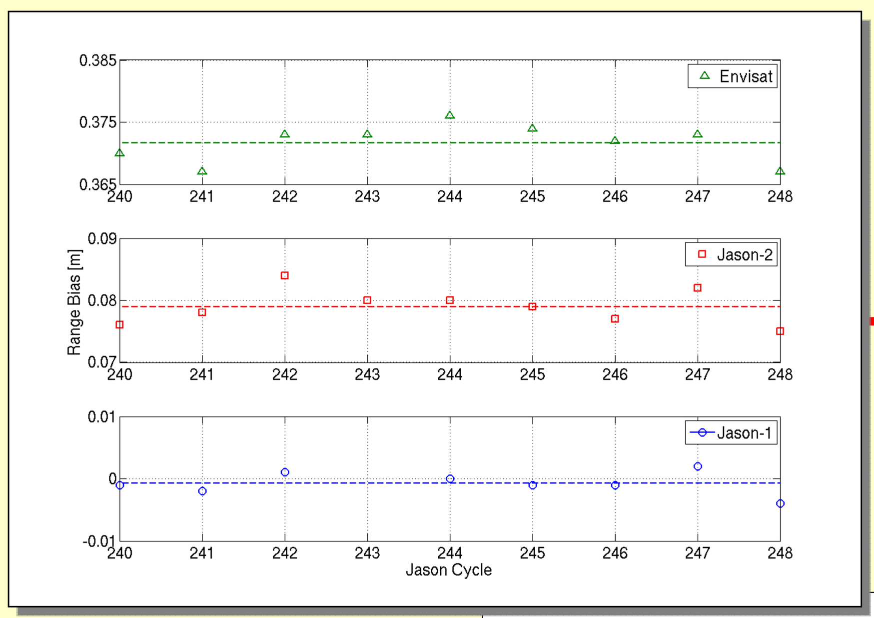


All mission show auto-correlation pattern with clear peaks at orbit revision times.

Jason-2 shows less variations and less correlation of nearby passes than Jason-1.

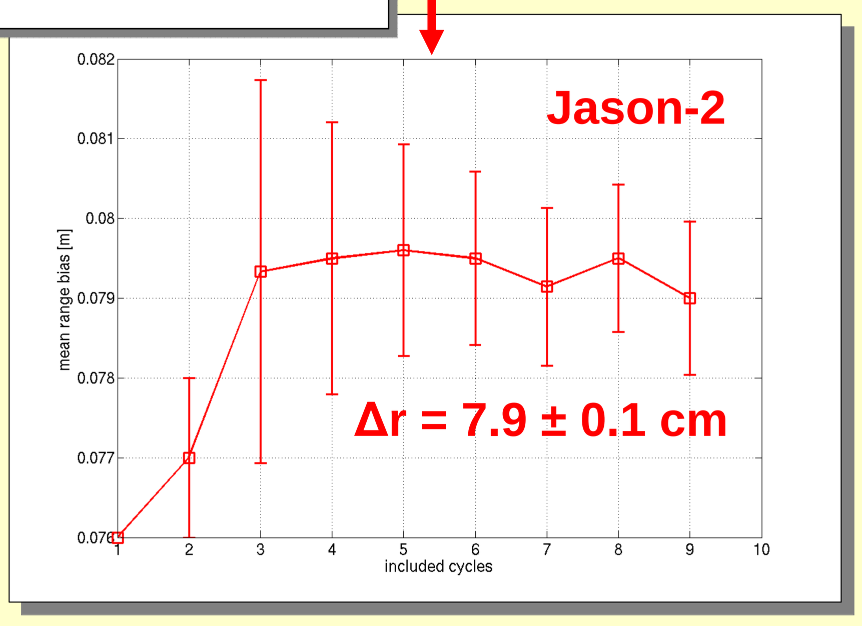
Relative Range Biases

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

Jason-2 shows a relative range bias of about 8 cm with respect to Jason-1.

x_i

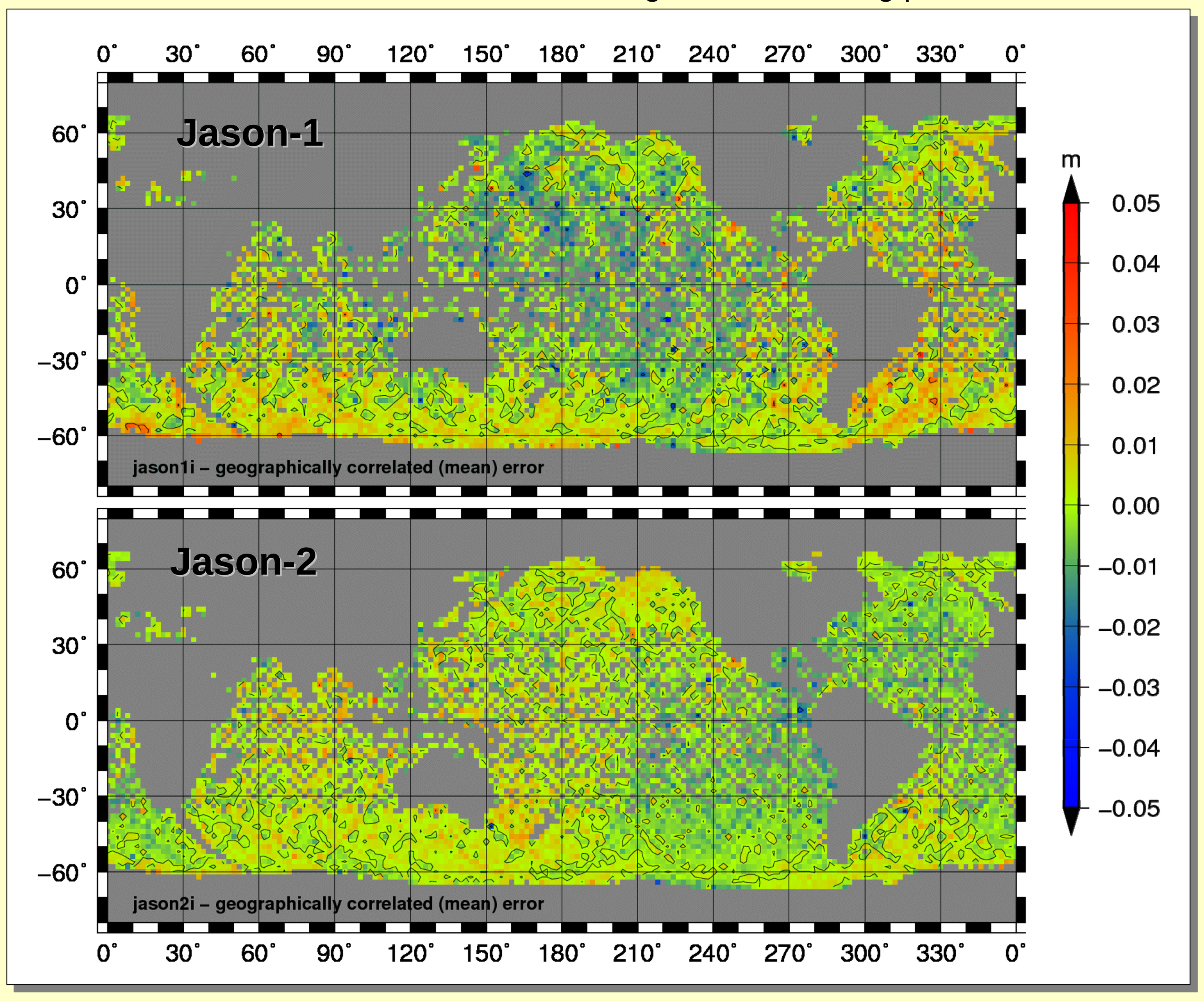
To Compute Range Biases and Centre-of-Origin Shifts for each 10-day period the model

$$x_i + v_{x_i} = \Delta r + \Delta x \cdot \cos\varphi \cos\lambda + \Delta y \cdot \cos\varphi \sin\lambda + \Delta z \cdot \sin\varphi$$

was fitted by least squares.

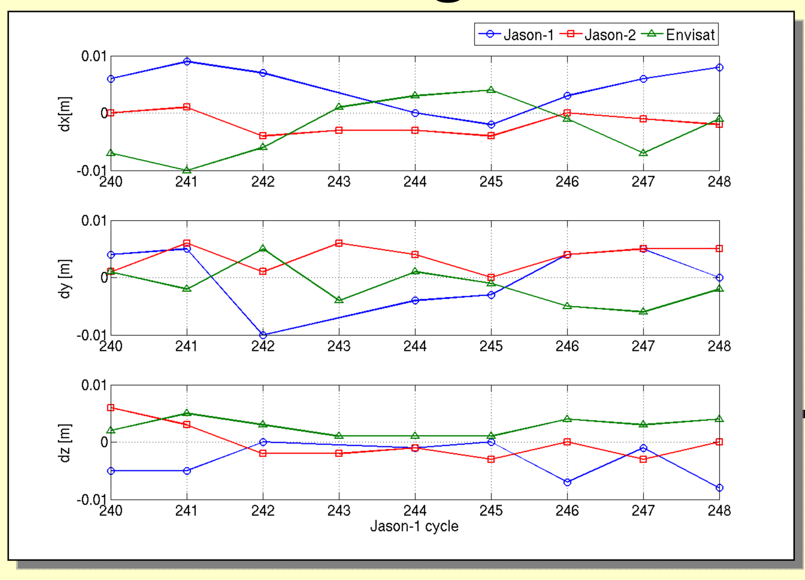
Geographically Correlated Errors

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.



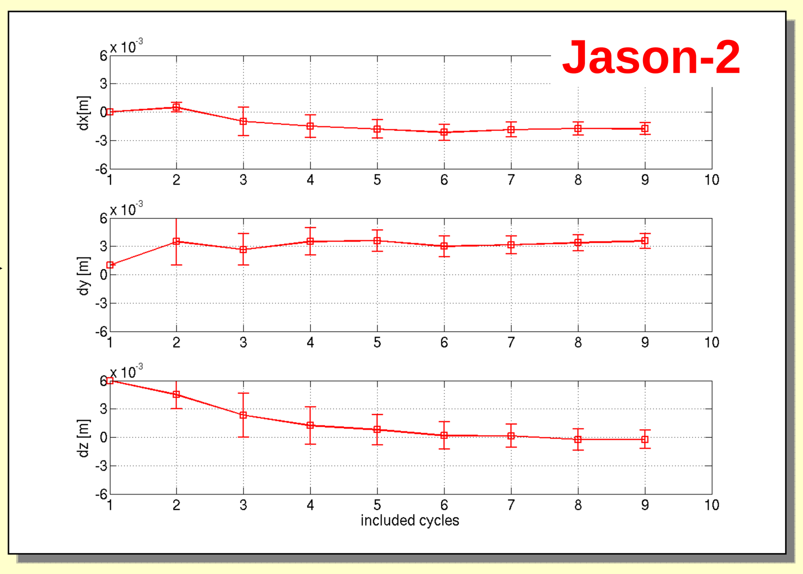
The amplitudes of both error pattern are small but differ - although the orbit configuration is identical and the same gravity field was used for the orbit computation. This is an indication that also other errors (like SSB) map into the radial errors.

Centre-of-Origin shifts



Δx,Δy,Δz

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



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

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

[1] Bosch, W.: Discrete Crossover Analysis. In: Dynamic Planet, IAG Symposium, Vol. 130, 131-136, Springer, Berlin, 2007

[2] Savcenko, R., W.Bosch(2008), EOT08a - empirical ocean tide model from multi-mission satellite altimetry, Report No. 81, Deutsches Geodätisches Forschungsinstitut, München

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