Geographically Correlated Errors (GCE) from Multi-Mission Crossover Analysis (MMXO)

Wolfgang Bosch (bosch@dgfi.badw.de), Denise Dettmering, and Roman Savcenko
Deutsches Geodätisches Forschungsinstitut (DGFI), München, GERMANY

Introduction

Geographically correlated errors (GCE, errors with equal sign in ascending and descending passes) are of particular danger: they map directly to sea surface heights and are not visible in single-satellite crossover differences. In general, GCE are discovered only in retrospect when new, improved orbits become available and are compared with previously edited ephemeris. Here, it is shown that a multi-mission altimeter scenario allows a reliable estimate of GCE pattern by analysing single- and dual satellite crossover differences in all combinations.

The central question:

„Are GCE pattern (new - old orbits) consistent with GCE pattern from MMXO (using old orbits)?"

... is investigated with recently reprocessed GRACE-based GSFC orbits for Topex (Beckley, et al. 2007) compared with radial errors estimated with the originally released JGM-3 orbits taken from NASA's GDR-B edition.

MMXO basics

- For a given multi-mission scenario, take single and dual-satellite crossover differences Δx_{ij} in all combinations.
- Minimizing both, $\Delta x_{ij} = x_i - x_j$ and $\delta x_i = x_{i+1} - x_i$, i.e.consecutive differences of radial errors for each mission allows to estimate x_i at all crossovers.
- The dense time series of radial errors, x_i captures relative range biases, but also common error components of ascending and descending passes (≡ GCE).

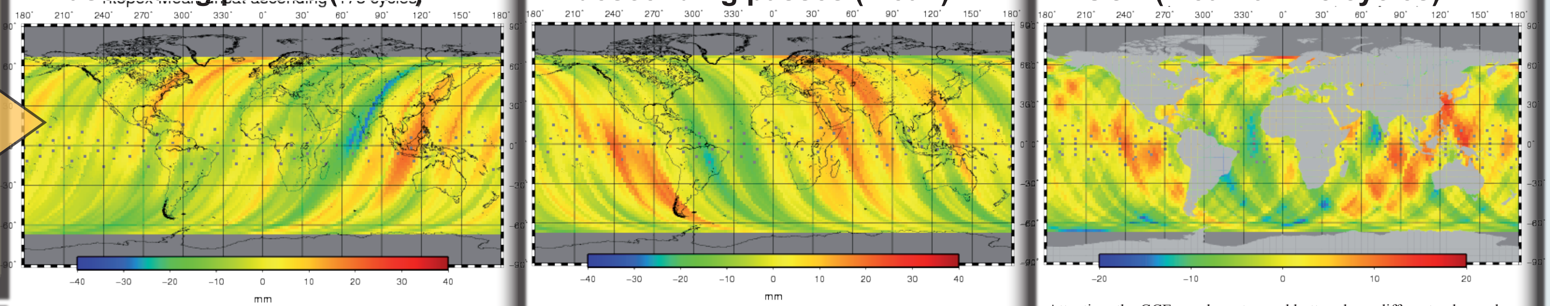
Topex GCE pattern (GRACE - JGM-3 orbits)

- Long time TOPEX/Poseidon data was available e.g. by NASA as GDR-B with orbits based on the JGM-3 gravity field.
- New, GRACE-based orbits, generated by GSFC (Beckley et al. 2007) were merged into the upgraded GDR-B data.
- GCE pattern are derived as difference between the new, GRACE-based orbit and the JGM-3 orbit taken from NASA's GDR-B data.

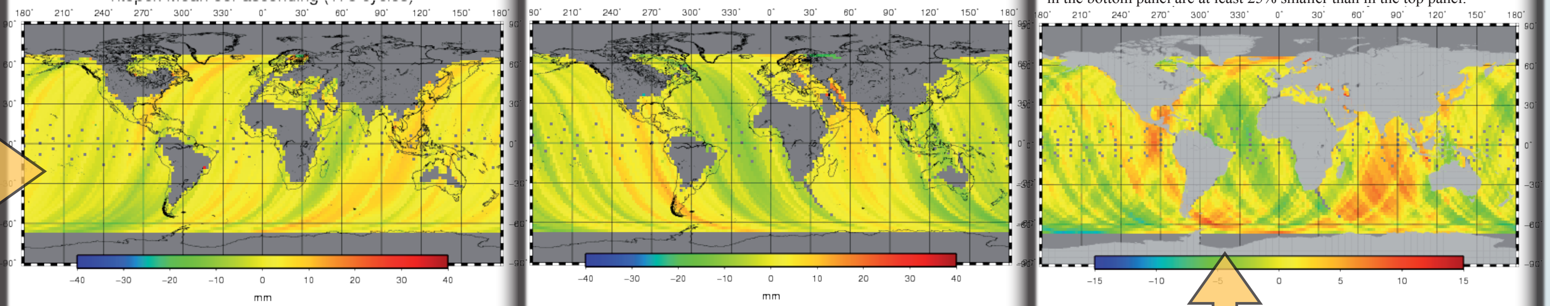
Topex GCE pattern from MMXO

- Since the launch of TOPEX/Poseidon (Oct 1992) there were at least two, casually up to five altimeter systems operating simultaneously.
- Using all single- and dual satellite crossover differences a multi-mission crossover analysis (MMXO) is performed (Bosch 2006).
- Using Topex GDR-B data (NASA) with JGM-3 orbits
- MMXO gives complete time series of radial errors for all missions analysed.
- GCE pattern are derived as arithmetic mean of radial errors of ascending and descending passes.

ascending passes (mean) | **descending passes (mean)** | **GCE (mean of 178 cycles)**



Attention, the GCE panels on top and bottom have different color scales to better demonstrate the coincidence of the GCE pattern. The amplitudes in the bottom panel are at least 25% smaller than in the top panel.



Conclusion and Outlook

- The MMXO has the potential to investigate GCE pattern for the most recent orbit computations.
- The amplitudes of the MMXO estimates is some 25 % smaller than the differences between new and old orbit.
- This may be adjusted by a carefully balanced weighting scheme in the MMXO analysis.
- In order to obtain an objective weighting scheme a Variance-Covariance Estimation (VCE) procedure will be implemented to get a realistic balance of different missions.

Result

- Long-term averages of radial errors estimated for JGM-3 orbits (bottom panel) exhibit nearly identical GCE pattern as the differences GRACE orbits minus JGM-3 orbits (top panel).
- The amplitude of MMXO derived GCE is, however, some 25 % smaller.

References

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Bosch, W. (2006) Discrete crossover analysis (DCA). IAG Symposia, Vol. 130, 131-136, Springer

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