Precise Orbit Determination for SARAL/AltiKa Validation and Future Improvements

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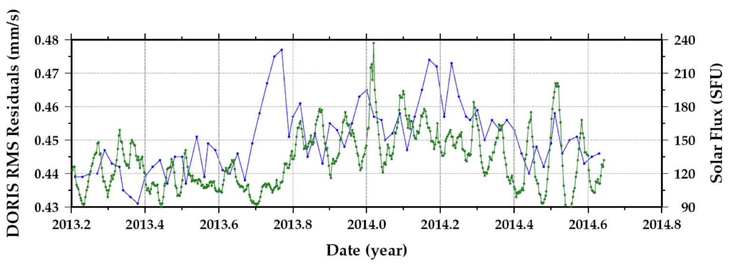
POD STANDARDS

Towards the GDR version E standards

- GDR-D POD standards are applied in the SARAL operational processing since March 14, 2013 (start of cycle 1).
- 2015 (TBD) : GDR-E standards (currently being defined)

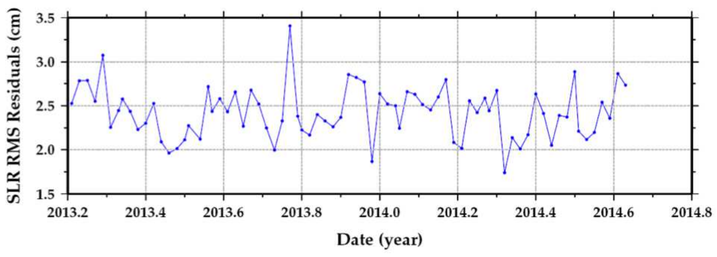
POE PERFORMANCE OF THE TRACKING SYSTEMS

RMS of DORIS post-fit residuals

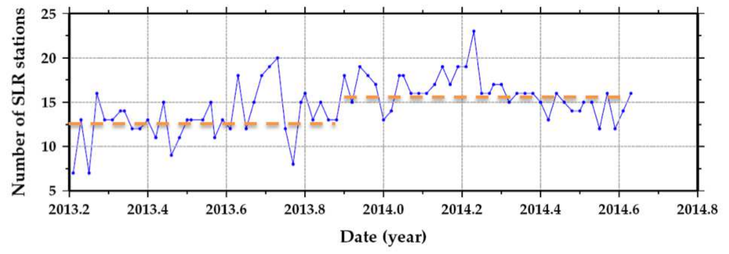


- Stable RMS of DORIS residuals.
- DORIS RMS residuals slightly increased after October 2013 effect of increasing solar activity.

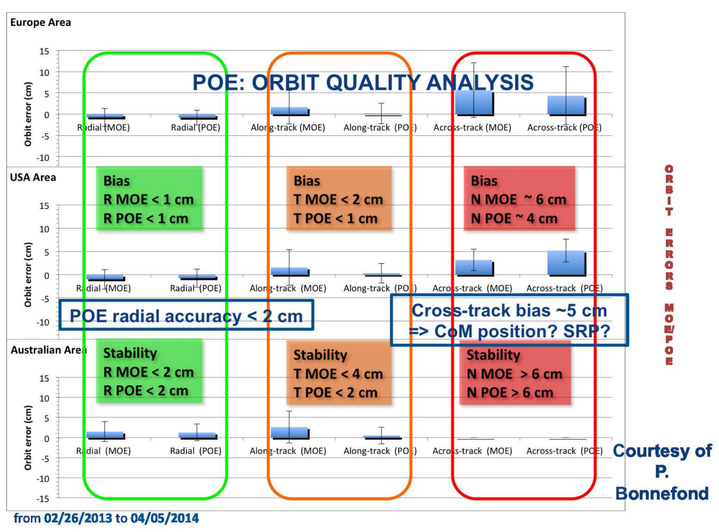
RMS of SLR post-fit residuals (all stations, all elevations included)



- RMS of SLR residuals is stable (close to 2.0 cm).
- Tracking is getting comparable to ENVISAT's ($\sim$ 12 $\rightarrow$ 15 tracking stations).

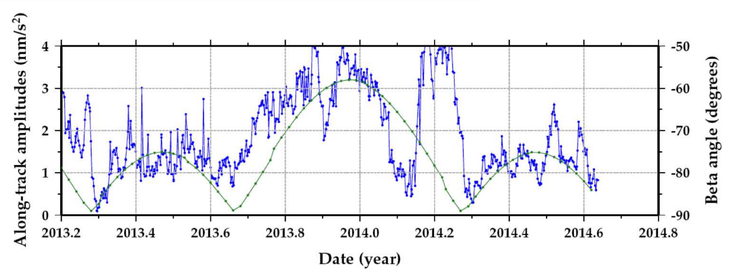


POE : ORBIT QUALITY ANALYSIS



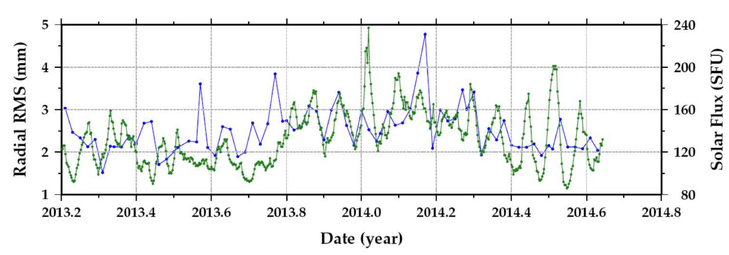
- POE radial accuracy $<$ 2 cm.
- Cross-track bias $\sim$ 5 cm $\Leftrightarrow$ CoM position ? SRP ?

Amplitude estimated 1-cpr empirical accelerations along-track



- Beta-dependent patterns reveal unmodeled systematic surface force effects (concerns both SRP and drag) $\Leftrightarrow$ Shall be calibrated for the next GDR-E POD standards, now a complete beta prime cycle ($\sim$ 1.5 year) is available

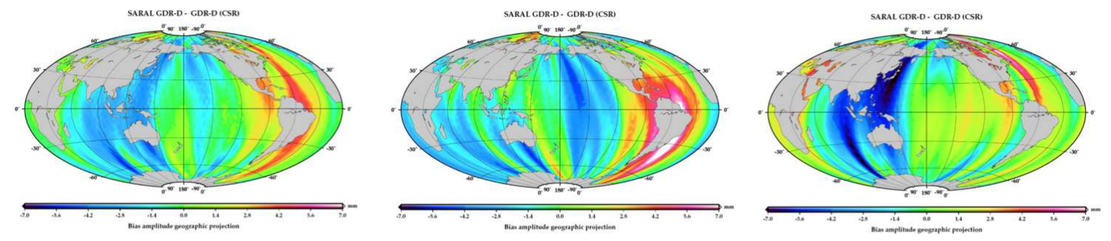
Internal orbit comparison: final POE vs. intermediate dynamic orbit



- The stochastic process added in final POE orbits accommodates modeling errors in the order of 2-3 mm RMS (especially during high levels of solar and geomagnetic activity).

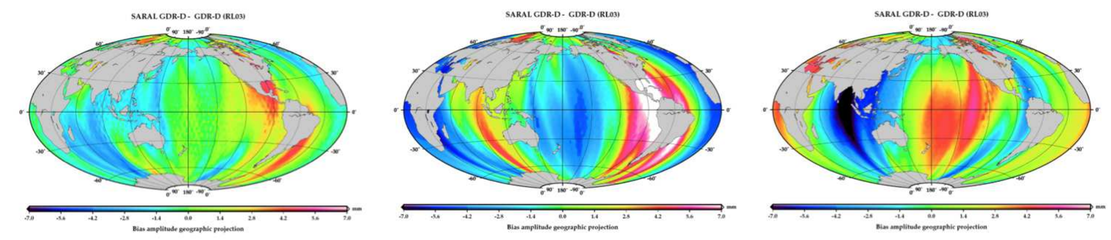
POE : TIME VARYING GRAVITY EFFECTS

Mean geographically correlated radial differences between POE and the same orbit using the monthly GRACE gravity field solutions from CSR



- TVG-induced orbit errors map mainly into a longitudinal "order-1" pattern ($<$ 5 mm), that could impact tide gauge calibration analysis.

Mean geographically correlated radial differences between POE and the same orbit using an updated mean gravity field model



- EIGEN-GRGS.RL03.MEAN-FIELD: mean field proposed for the next GDR-E standards $\Leftrightarrow$ Improvements expected by update.

PROSPECTS FOR THE NEXT GDR-E STANDARDS

Measurement models

- Terrestrial Reference Frame and Earth Orientation.
  - ITRF2013 based (DORIS, SLR, GPS: ITRF2008 $\rightarrow$ ITRF2013).
  - Earth orientation: IERS2010/ITRF2008 $\rightarrow$ IERS2010/ITRF2013.
- Displacements of reference points.
  - Ocean loading (FES2004 $\rightarrow$ FES2012).
  - S1-S2 atmospheric pressure loading, implementation of Ray & Ponte (2003) by van Dam.
- Orbits around the center-of-mass of the total Earth system.
  - Seasonal non-tidal geocenter motion ("Climatological model" SLR-only; from J. Ries).
  - Ocean tidal geocenter motion + S1-S2 atmospheric tidal geocenter motion.
- Models for propagation delays.
  - New DORIS beacons phase map correction.

Dynamic models

- Geopotential.
  - EIGEN-GRGS.RL02bis.MEAN-FIELD (based on 8 years of GRACE/LAGEOS RL02 data, static field, time-variable terms up to degree and order 50: annual, semi-annual and drift terms)
    $\rightarrow$ EIGEN-GRGS.RL03.MEAN-FIELD : based on 10 years of
    - GRACE/LAGEOS RL03 data,
    - GRACE+GOCE static field,
    - time-variable terms up to degree and order 80 :
      - annual, semi-annual terms, one bias and drift for each year.

    $\Leftrightarrow$ accounts for interannual variability.
  - C21/S21 modelled according to the IERS 2010 Conventions.
  - Ocean tides: FES2004 $\rightarrow$ FES2012.
- Surface forces.
  - Calibrated semi-empirical solar radiation pressure models.
  - Drag from atmospheric density model: DTM-94 $\rightarrow$ DTM-2013.
- Estimated dynamical parameters.
  - Improved stochastic solutions.

CONCLUSION

- Overall $\sim$ 2 cm POE and MOE stable radial orbit accuracy.
- Cross-track bias ($\sim$ 5 cm) of unknown origin (Z CoM offset or bias in SRP model difficult to distinguish) and TVG mismodeling errors ($<$ 1 cm) are expected to be reduced in the next GDR-E standards.
- Orbits reprocessing tentative schedule.
  - Beginning of year 2015 :
    - Operational orbits switch to GDR-E, reprocessed GDR-E orbits are made available, GDR-D standards are abandoned

ACKNOWLEDGMENTS

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