A review of some systematic errors observed in the Precision Orbit Determination of recent DORIS satellites

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Introduction

- Systematic errors (along-track bias, macromodels signatures, network signatures) that might be of interest for the IDS analysts
  - Provide updated figures with the latest standards (GDR-D) and satellites (HY2A)

- DORIS ORBITS:
  - Laser statistics
  - Jason2 / HY2A GPS to DORIS comparison
  - Updated Empiricals and Macromodels

- DORIS NETWORK
  - Annual Signatures on specific beacons
  - Phase maps?
SLR statistics on DORIS-only orbits

- Fit a range bias and along-track bias per pass on SLR residuals obtained on DORIS-only orbits.
- Mean along-track bias is similar to the time bias between DORIS and SLR.
- Range bias is affected by remaining orbit error (radial, cross-track), and SLR modeling error (LRA position).

JASON2 pass, 7090 station, 2011/8/24 20:29:47 - Range Bias: 2.27 cm, Al. Track Bias: 5.74 cm
Number of passes

Monthly number of non-edited passes (7090,7105,7810,7839,7840,7941)
Standard deviation of along-track bias per pass

Monthly Standard Deviation of along-track bias per pass (7090, 7105, 7810, 7839, 7840, 7941)

Monthly Standard Deviation of along-track bias per pass (7090)

JASON-1  JASON-2
ENVISAT  CRYOSAT
HY2A
Average range bias per pass

Monthly Median of range bias per pass (7090, 7105, 7810, 7839, 7840, 7941)

- JASON-1
- JASON-2
- ENVISAT
- CRYOSAT
- HY2A
Standard deviation of range bias per pass

Monthly Standard Deviation of range bias per pass (7090, 7105, 7810, 7839, 7840, 7941)

JASON-1  JASON-2  ENVISAT  CRYOSAT  HY2A

Monthly Standard Deviation of range bias per pass (7090)
RMS after fit

Monthly average RMS after fit (7090, 7105, 7810, 7839, 7840, 7941)

Monthly average RMS after fit (7090)

JASON-1  JASON-2
ENVISAT  CRYOSAT
HY2A
Common interval between 05/10/2011 and 03/03/2012 (151 days)
Comparison of GPS Vs DORIS orbits

Radial RMS

Along-Track RMS

Cross-Track RMS
DORIS-based 24 hr 1/rev, along-track

Along-Track (cosine)

- Cryosat, RMS = 0.19 $10^8$ m/s^2
- Jason-2, RMS = 0.11 $10^8$ m/s^2
- HY2A, RMS = 0.06 $10^8$ m/s^2
- Envisat, RMS = 0.12 $10^8$ m/s^2
- Jason-1, RMS = 0.09 $10^8$ m/s^2

Along-Track (sine)

- Cryosat, RMS = 0.24 $10^8$ m/s^2
- Jason-2, RMS = 0.10 $10^8$ m/s^2
- HY2A, RMS = 0.39 $10^8$ m/s^2
- Envisat, RMS = 0.08 $10^8$ m/s^2
- Jason-1, RMS = 0.09 $10^8$ m/s^2
DORIS-based 24 hr 1/rev, cross-track

Cross-Track (cosine)

Cross-Track (sine)
RMS of DORIS Residuals

RMS of DORIS residuals on DORIS-only orbits

- Cryosat, median RMS = 0.49 mm/s
- Jason-2, median RMS = 0.43 mm/s
- HY2A, median RMS = 0.44 mm/s
- Envisat, median RMS = 0.48 mm/s
- Jason-1, median RMS = 0.42 mm/s

mm/s

DORIS RMS per Beacon

Monthly Median RMS per pass of JIUB residuals on DORIS-only orbits


Cryosat
Jason-2
HY2A
Envisat
Jason-1

Monthly Median RMS per pass of JIUB residuals above 30° on DORIS-only orbits

DORIS RMS per Beacon

Monthly Median RMS per pass of CADB residuals on DORIS-only orbits

Monthly Median RMS per pass of CADB residuals above 30° on DORIS-only orbits
CONCLUSIONS

- Average SLR / DORIS Along track bias is largely reduced (< 2 cm) using the latest DORIS datasets

- Accuracy of DORIS-only dynamic orbits estimated by SLR residuals is similar for different satellites:
  - better than 2 cm RMS radial, ~5 cm along-track and cross-track

- Good agreement between DORIS-only and GPS-only dynamic orbits

- Macromodels for most recent satellites (Cryosat-2, HY2A) have margins for improvement

- DORIS residuals after JASON-1 orbit change should be carefully monitored
PROSPECTS

- Extend the phase-residual maps derived from Jason-2 with Cryosat-2 and HY2A data – and test impact on phase residuals of proposed new PCO/PCV for STAREC Antennas

Thanks !