Precise Orbit Determination by CNES/CLS (LCA) IDS Analysis Center in the framework of ITRF2013

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STANDARDS AND MODELS

We took the IERS conventions and the IDS recommendations

Gravitational forces:

Geopotential: EIGEN-6S2.v2.extended (with trend terms)
Ocean tides: FES2012
De-aliasing products coherent with the gravity filed
Third body: JPL DE421 *(IERS conventions 2010)*

Non gravitational forces:

Atmospheric drag: DTM 2012

Geometry:

Troposphere: GPT2/VMF1 + one gradient per station in North & East directions
Ocean loading: FES2012

Others:

The phase law for STAREC and ALCATEL antennas given by CNES has been implemented in GINS and has been used for our ITRF processing
For Cryosat-2, we applied the CNES 7-plate macromodel

ITRF2013 REPROCESSING

Available DORIS data have been processed from 1993/01 to 2013/12 to contribute to the realization of the ITRF2013

We consider here only the DORIS satellites used for altimetry

Software

We used GINS/DYNAMO software (GRGS) and CNES computer ressources

DORIS data processed

•For all missions the elevation cut off is 12°,
and a downweighting law is applied for elevations <= 20°

•For Jason-1 :
-Data are corrected by SAA model
-downweighting SAA stations in POD

•We do not use the SARAL DATA

Satellites	Period
Topex	Jan. 04, 1993 to Oct. 29, 2004
Jason-1	Jan. 01, 2002 to Jun.14, 2013
Envisat	Jul. 23, 2002 to Apr. 04, 2012
Jason-2	Jul. 14, 2008 to Dec. 27, 2013
Cryosat-2	Jun. 16, 2010 to Dec. 27, 2013
Hy2a	Oct. 02, 2011 to Dec. 27, 2013

ITRF2013 REPROCESSING STATUS

DORIS and SLR Orbit Residuals
OPR Acceleration Amplitude: Along-track and Cross-track
Radiation pressure coefficient Cr

Satellites	DORIS RMS (mm/s)	SLR RMS (cm)	Average Along-track OPR (nm/s^2)	Average Cross-track OPR (nm/s^2)	Cr
Topex	0.45	1.4	1.7	1.2	1.03
Jason-1	0.31	1.2	1.9	1.1	0.94
Envisat	0.39	0.97	1.1	1.1	1.05
Jason-2	0.31	1.2	2.6	1.5	0.97
Cryosat-2	0.34	0.94	3.3	2.3	1.0
Hy2a	0.33	1.15	0.48	1.77	0.86
Saral	*0.33*	*0.93*	*1.29*	*1.24*	*1.0*

Good level for DORIS and SLR orbit residuals
Average OPR Acceleration amplitudes are < 4 nm/s^2

Remark: since our ITR2013 contribution we have processed SARAL DATA

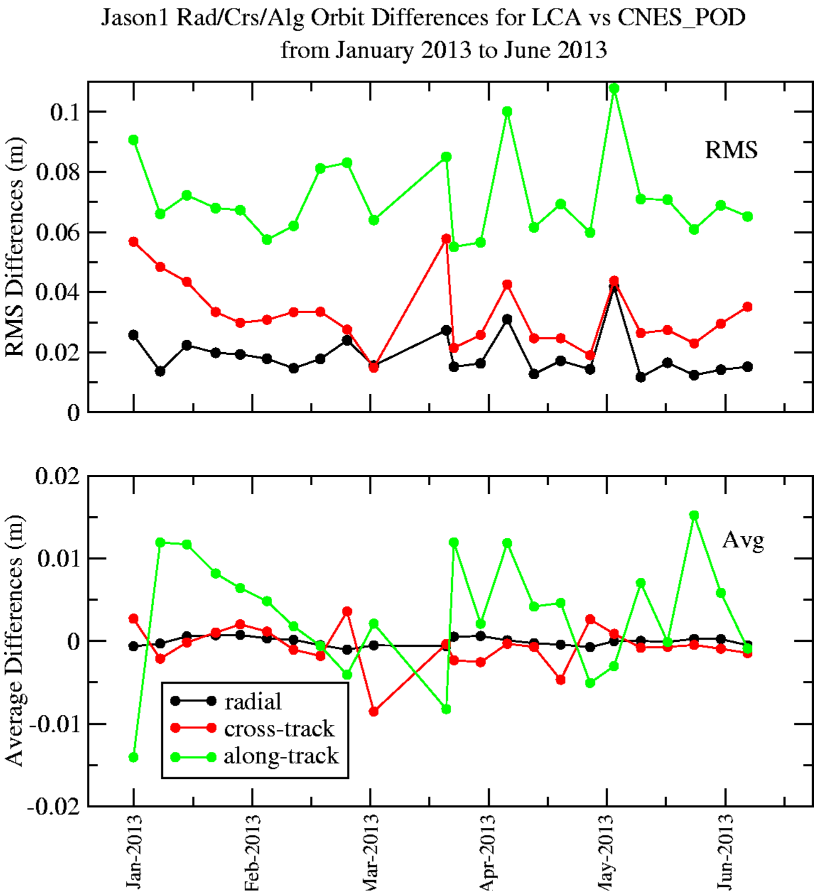
COMPARISON TO THE POE USED FOR ALTIMETRY

POD CONFIGURATION	LCA Analysis Center	CNES GDR-D
Arc length **Ddata processed**	3.5 days DORIS +SLR	10 days or 7 days DORIS + SLR and +GPS (for satellites with GPS receiver onboard)
Gravity model	**EIGEN-6S2.v2.extended** up to degree 95 including time variable terms up to degree 50 (bias & drift per yr from 2002 to 2012, periodic 18.6, 1, 0.5yrs) **Solid Earth Tides:** from IERS2010 **Ocean tides** FES2012 **Atmospheric gravity** : 3hr ERA-interim / ECMWF up to degree 50 Non tidal oceanic gravity: TUGO R12 up to degree 50	**EIGEN-RGS_RL02bis_MEAN-FIELD(2011)** Non-tidal TVG : Annual, Semi-annual, and drifts up to deg/ord 50 **Solid Earth Tides:** from IERS2003 **Ocean tides** FES2004 **Atmospheric gravity** : 6hr NCEP pressure fields + tides from Biancale-Bode model
Sufaces Forces	**Radiation Pressure model**: tuned for Jason-2 **Earth Radiation :** Albedo and IR pressure values interpolated from ECMWF 6hr grids	**Radiation Pressure model:** the same except for Jason-2 **Earth Radiation** : Knocke-Ries albedo and IR satellite model
Satellite reference	**Attitude Model** : nominal attitude law for all satellites	**Attitude Model** : nominal attitude law except for Jason-1 and Jason-2 : Quaternions
Displacement of reference points	**Earth tides:** IERS2010 conventions **Ocean Loading**: FES2012	**Earth tides:** IERS2003 conventions **Ocean Loading**: FES2004

COMPARISON TO THE POE USED FOR ALTIMETRY

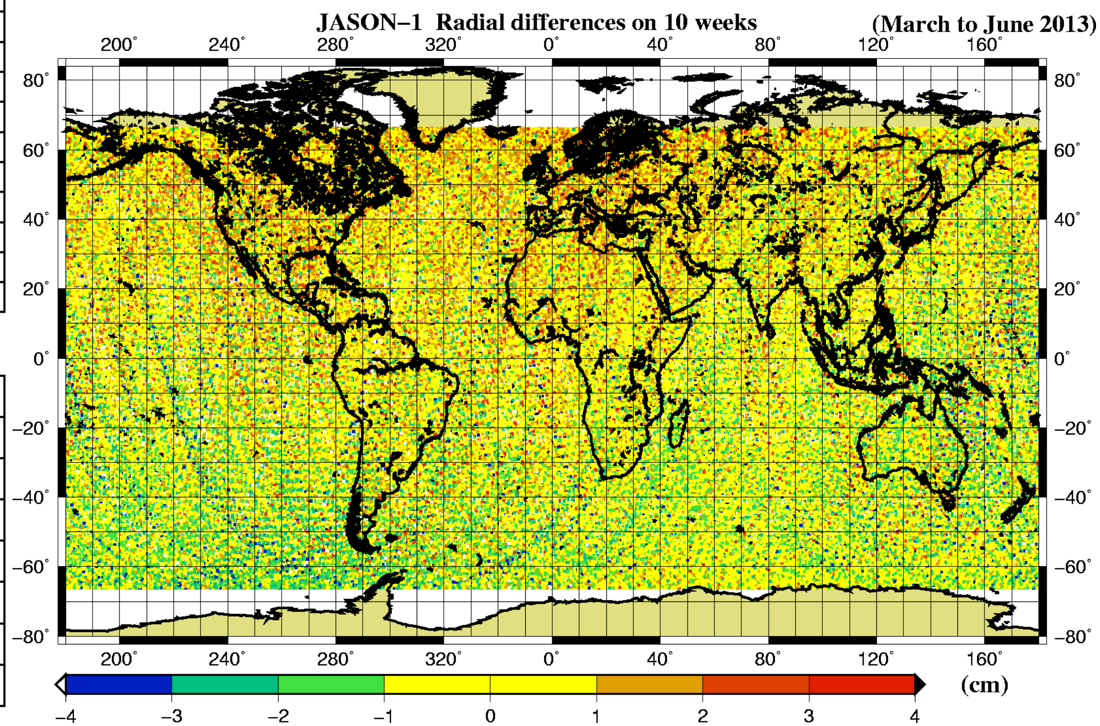
Jason-1 Orbit Comparison LCA vs CNES GDR-D POE

Radial/Cross-track /Along-track Orbit differences



Orbit geodetic period

Radial orbit differences (on 10 weeks from March to June 2013)



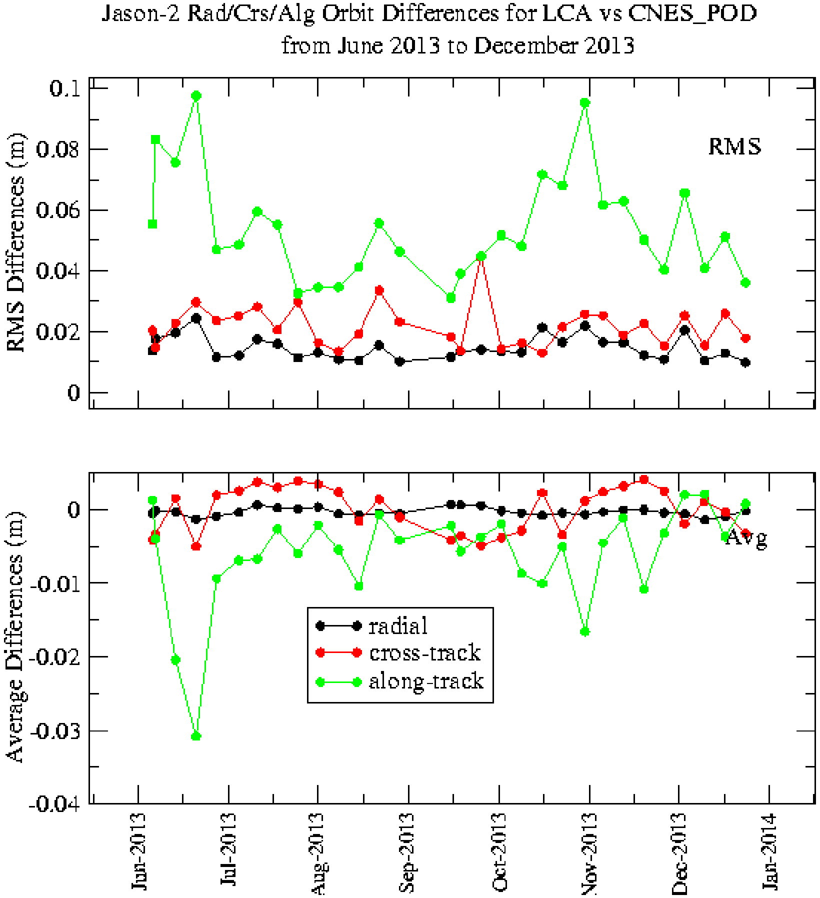
Good agreement between LCA orbits and CNES GDR-D POE (in particular radial)

No clear Radial geographical systematic differences (slightly N/S)

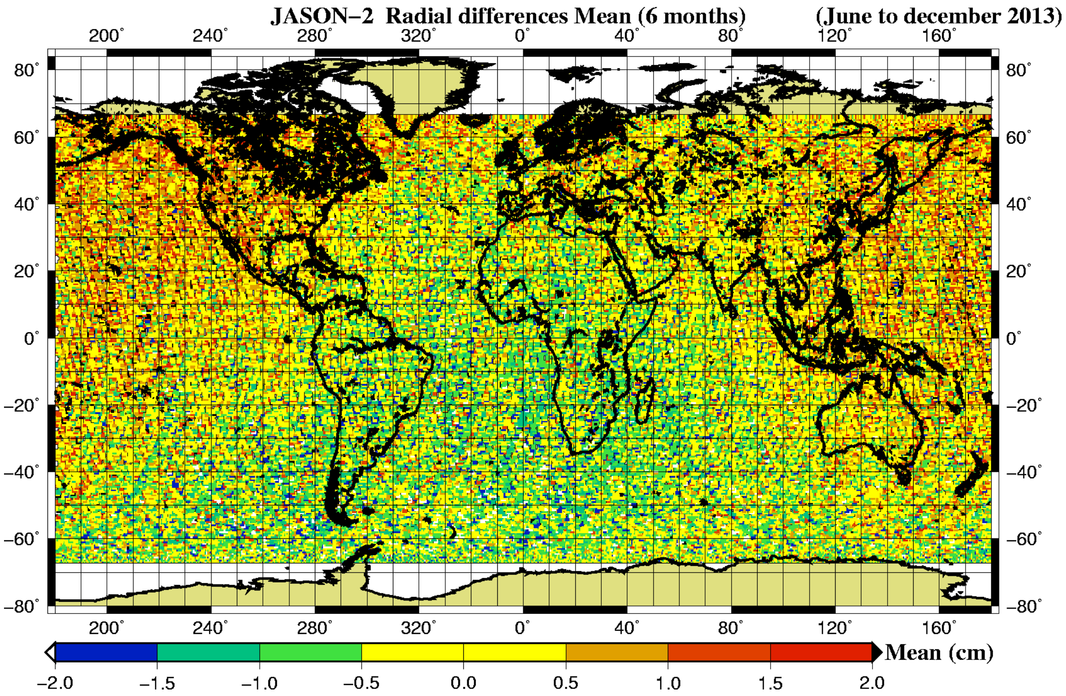
COMPARISON TO THE POE USED FOR ALTIMETRY

Jason-2 Orbit Comparison LCA vs CNES POE

Radial/Cross-track /Along-track Orbit differences



Radial orbit differences Mean (6 months June to December 2013)



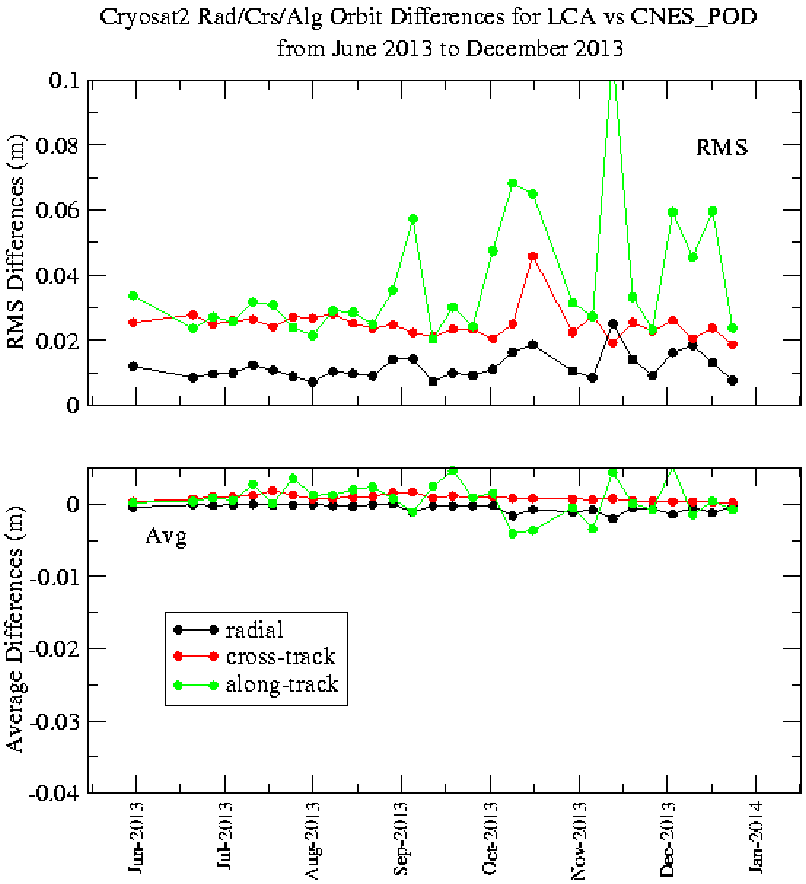
Good agreement between LCA orbits and CNES GDR-D POE (in particular radial)

Radial geographical systematic differences: south Atlantic patch (N/S)

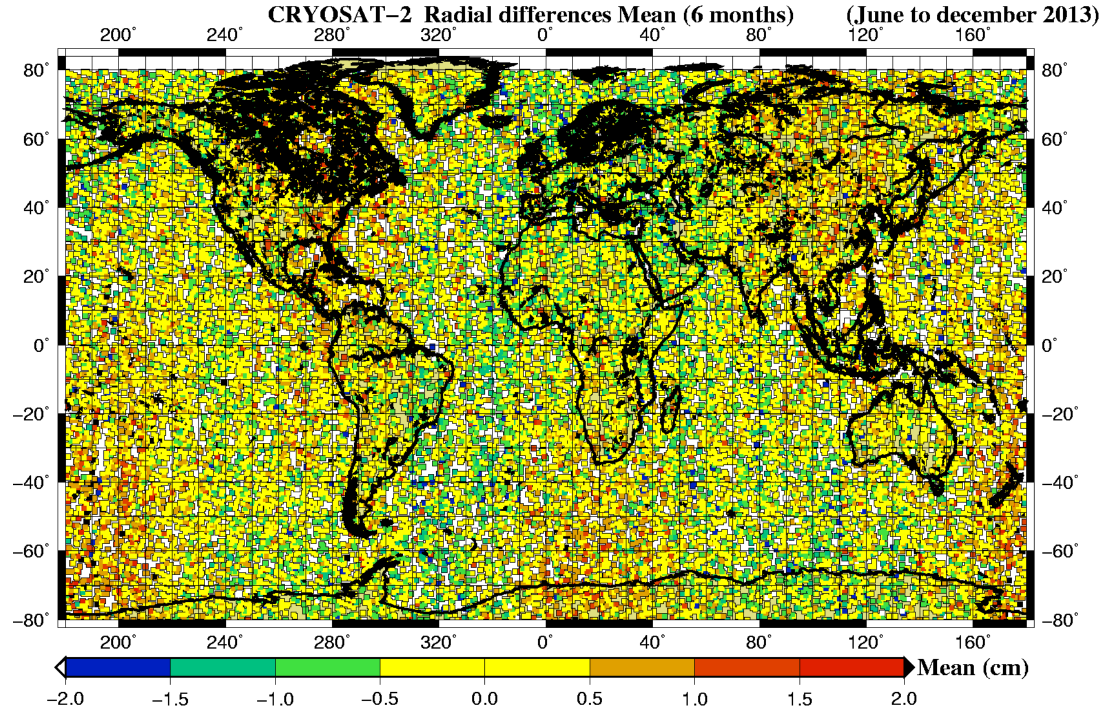
COMPARISON TO THE POE USED FOR ALTIMETRY

Cryosat-2 Orbit Comparison LCA vs CNES GDR-D POE

Radial/Cross-track /Along-track Orbit differences



Radial orbit differences Mean (6 months June to December 2013)



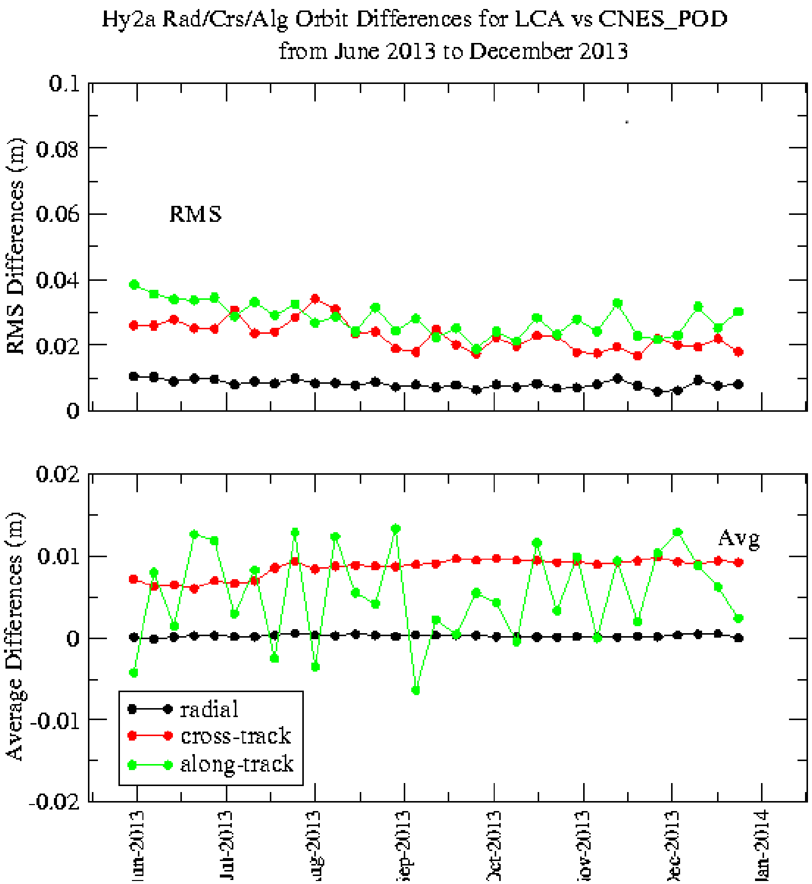
Good agreement between LCA orbits and CNES GDR-D POE (in particular radial)

No clear radial geographical systematic differences

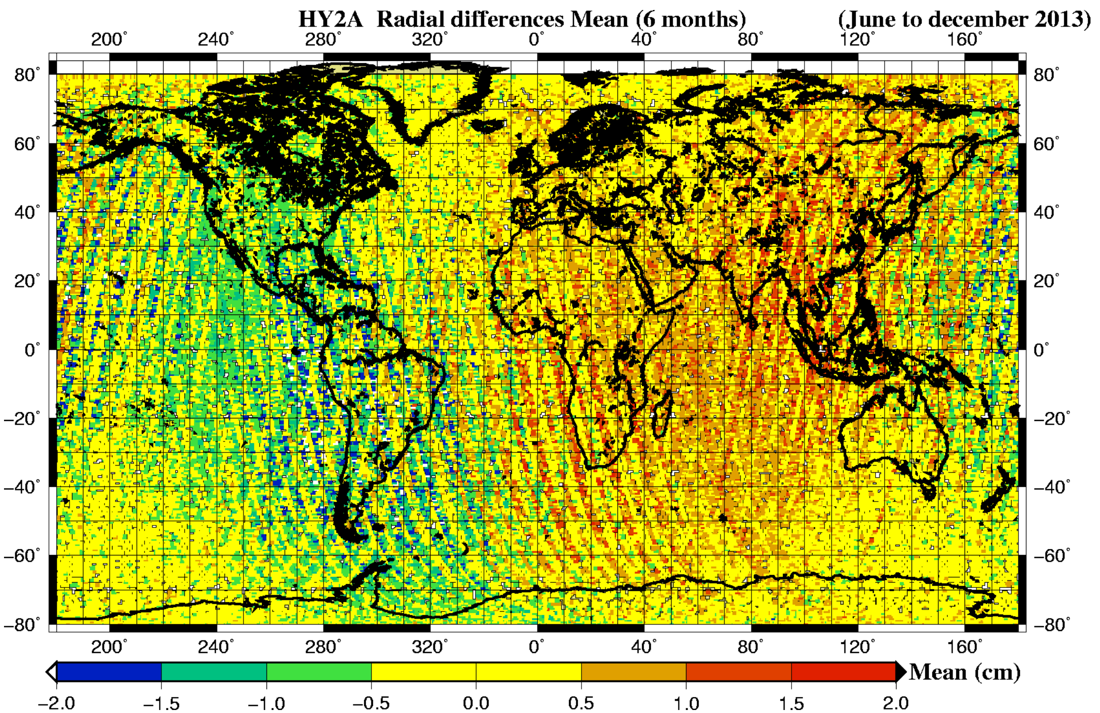
COMPARISON TO THE POE USED FOR ALTIMETRY

Hy2a Orbit Comparison LCA vs CNES GDR-D POE

Radial/Cross-track /Along-track Orbit differences



Radial orbit differences Mean (6 months June to December 2013)



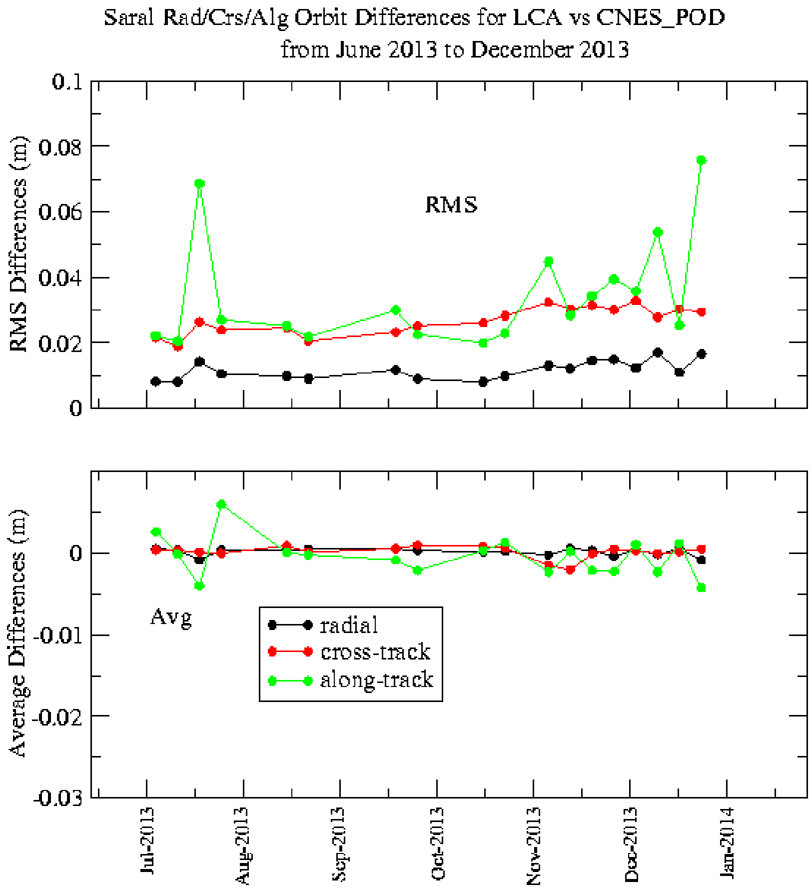
Good agreement between LCA orbits and CNES GDR-D POE (in particular radial)

Radial geographical systematic differences: East/West patches

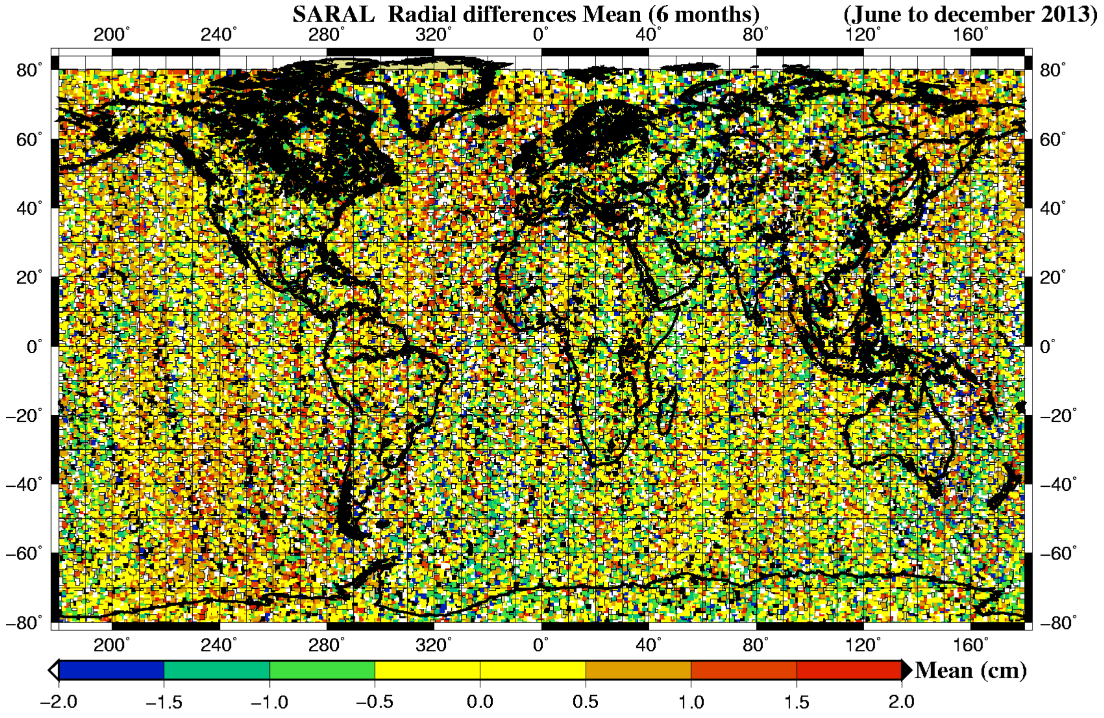
COMPARISON TO THE POE USED FOR ALTIMETRY

Since the ITRF2013 contribution we processed first SARAL orbits
Saral Orbit Comparison LCA vs CNES GDR-D POE

Radial/Cross-track /Along-track Orbit differences



Radial orbit differences Mean (6 months June to December 2013)



Good agreement between LCA orbits and CNES GDR-D POE (in particular radial)

No clear radial geographical systematic differences

CONCLUSION AND PERSPECTIVE

Conclusion

Good agreement between LCA orbits and CNES GDR-D POE
(in particular radial)

In the framework of the ITRF2013 we have reprocessed in homogeneous context all DORIS data available from 1993/01 to 2013/12
(in particular: Topex / Envisat / Jason-1 / Jason-2 / Cryosat-2 / Hy-2a + Saral)

LCA Orbits in sp3 format are available on the DATA Center (CDDIS and IGN)
ftp://cddis.gsfc.nasa.gov/pub/doris/products/orbits/lca/

Perspective

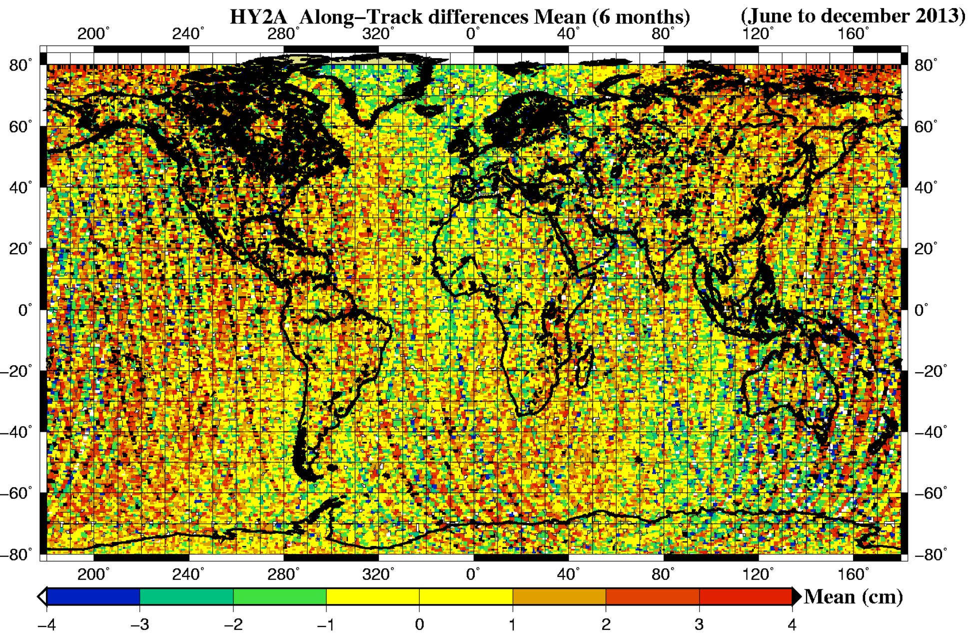
Routine Delivery in the same processing context
Exploitation of the ITRF reprocessing to improve models
(solar pressure models, …)

BACK SLIDES

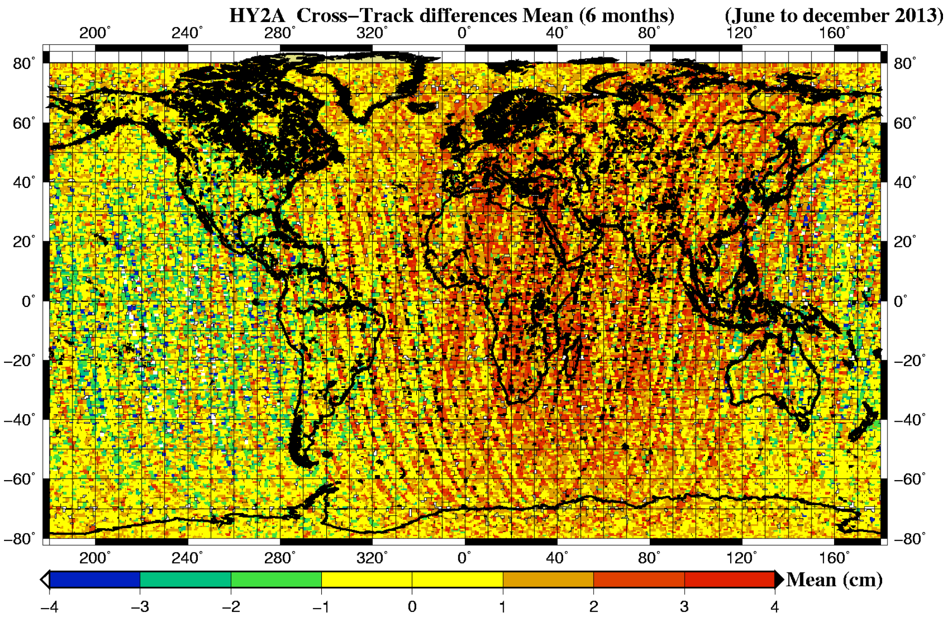
ITRF2013 REPROCESSING STATUS

HY-2A Orbit Comparison LCA vs CNES GDR-D POE

Along-track orbit differences Mean (6 months June to December 2013)



Cross-track orbit differences Mean (6 months June to December 2013)



Cross-track geographical systematic differences East/West patches

ITRF2013 REPROCESSING STATUS

HY-2A drag coefficient

-we note a correlation with the daily Along-track constant acceleration adjusted by GSC in their processing

- for LCA this daily Along-track bias is mainly absorbed by drag coefficient

-when GSC along-track acceleration is higher the OPR amplitudes increase