Status of the DORIS analysis center at IGN-IPGP in 2022

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Status of the IGN CA

- Satellites:
SPOT 2,3,4 & 5 ; JASON 1,2 & 3 ; SENTINEL 3 A & B ; HY2A ; SARAL (Attitudes/ quaternions + Macromodels ok)

Envisat & Topex (Macromodels ok, it remains to implement the attitude laws)

- Data : Doppler & Rinex

- Tools to provide the SP3 orbit files for DORIS satellites

- The first « operational » scripts to process DORIS data with GipsyX have been developed (see below for the first results obtained)

First tests : models, parameters and solution descriptions

- Daily arcs with 3h before and after to reduce board effects have been computed for Jason-2, Jason-3, SARAL and Sentinel-3A over 1 month (June 2014 for Jason-2, June 2018 for the other satellites).

- The sentinel 3A macromodel used by JPL differs from the macromodel recommanded by IDS for ITRF2020 repro. The main difference correspond to a different rotation axis of the solar panels.

- The rinex data process consist to recreate doppler observations from the phase measurements.

- The SAA stations are removed for all satellites except SARAL.

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Orbit and satellite modeling	
Earth's gravity field	EIGEN-GRGS.RL04MF
Ocean tides	FES2004
Thermosphere	DTM2000
Orbital parameters	- Constants (sin and cos) per rev for along- and cross-track - 3 drag coefficients per day - Initial position and velocity
Station positions	
Reference frame	DPOD2014
Ocean loading	FES2004
Clock parameter	One parameter per 20 min (random-walk) per station and satellite
Measurement delay	
Troposphere	VMF1
Troposphere parameters	- ZTD per 30 min (random-walk) per station and satellite - 1 East and 1 North gradient per station and satellite

First tests: Rinex versus Doppler

RMS of residuals over one month (June 2014) : 0.39 mm/s^{-1} for the two solutions JAS2_IDS and JAS2_DOP_IDS :
No significative difference for the RMS of residuals

Orbit difference between JAS2_IDS and JAS2_DOP_IDS over one month (June 2014):

	Radial (mm)	Along-track (mm)	Cross-track (mm)
Orbit difference JAS2_IDS - JAS2_DOP_IDS			
MEAN	0.0	4.3	0.0
RMS	1.7	8.4	8.9
Orbit overlap JAS2_IDS			
MEAN	0.1	0.6	0.7
RMS	5.8	18.8	27.0
Orbit overlap JAS2_DOP_IDS			
MEAN	0.3	1.1	0.6
RMS	5.5	16.7	26.9

A bias exists on the along-track component.

It seems to come from the DOP solution as it exists between the JAS2_DOP solution and the SSA POD solution.

First tests: quality check of the GipsyX orbit solutions

* We compare the orbits computed with Gipsy-X and the POD orbits provided by SSALTO for few DORIS satellites.

* For Jason-2, values provided by H. Capdeville for the comparison between the AC GRG orbits and SSA orbits..

* The comparison is done over one month
(June 2014 for JAS2 and June 2018 for the other satellites).

First tests: quality check of the GipsyX orbit solutions

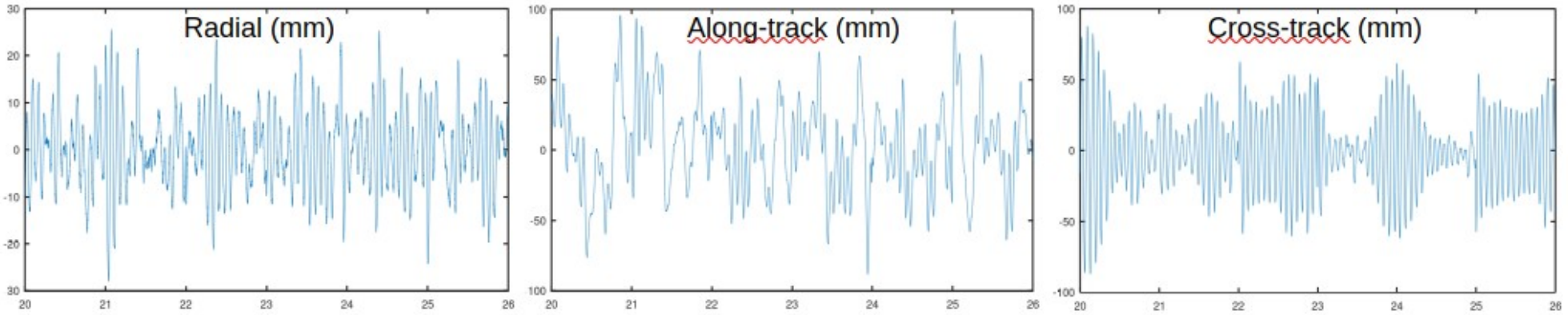
	Radial (mm)	Along-track (mm)	Cross-track (mm)
Orbit difference JAS2_IDS – JAS2_SSA			
MEAN	0.1	0.2	-0.9
RMS	6.1	19.2	24.5
Orbit difference JAS2_GRG – JAS2_SSA			
RMS	7	21	19
Orbit difference JAS3_IDS – JAS3_SSA			
MEAN	-0.1	0.6	-0.1
RMS	8.3	27.7	28.7
Orbit difference SRL_IDS – SRL_SSA			
MEAN	0.3	3.7	-1.1
RMS	8.8	32.0	28.1
Orbit difference S3A_IDS – S3A_SSA			
MEAN	0.1	-6.3	0.3
RMS	8.4	33.8	21.3

No significative bias detected.

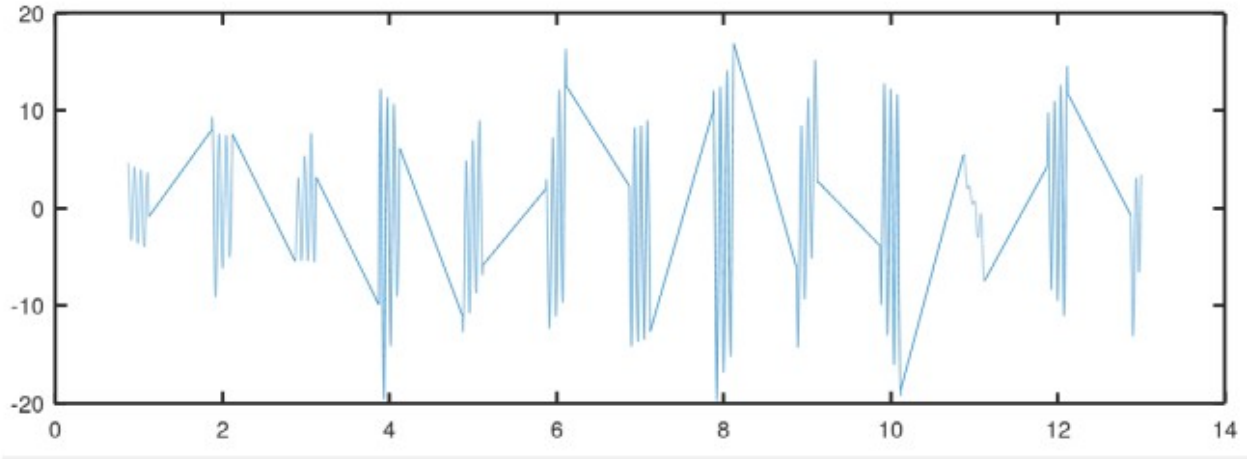
For JASON-2, the quality of the Gipsy-X orbit is comparable to the GRG AC.

For other satellites, the level of precision seems pretty good (**radial < 1 cm for all the satellites**).

First tests: quality check of the GipsyX orbit solutions



Orbit difference between SRL_IDS and POD SSA for SARAL over 6 days (2018-06-20 to 2018-06-26)



Orbit overlap for JAS3_IDS Radial component (in mm)

First tests: macromodels comparison

- No significative difference for the RMS of residuals
- Orbit difference **over one month (June 2018 for S3A):**

Orbit difference S3A_IDS - S3A_JPL			
MEAN	-0.3	-0,1	3,0
RMS	0,9	0,5	3,2
Orbit difference S3A_IDS - S3A_SSA			
MEAN	0.1	-6.3	0.3
RMS	8.4	33.8	21.1
Orbit difference S3A_JPL - S3A_SSA			
MEAN	0.5	-6.3	-2.8
RMS	8.4	33.8	21.3
Orbit overlap S3A_IDS			
MEAN	0.9	4.5	-1.4
RMS	7.0	24.9	26.8
Orbit overlap S3A_JPL			
MEAN	0.9	4.5	-1.5
RMS	7.0	25.0	26.6

The macromodel used by **IDS** and by **JPL** are **equivalent**, except over the cross-track component but it is impossible to determine the best one as the statistics and residuals are very close.

TESTS ITRF2020P

- Processing :

4 years of SENTINEL-3A (2017-2020)

2 years of SARAL (2015-2016) (Issue with 2014 under investigation)

4 years of JASON-2 (2010-2013)

3 years of SPOT-5 (2005-2007)

6 years of SPOT-2 (1998-2003)

(Issue with a priori orbits – Iteration probably needed in few cases)

- For each periods, computation with **DPOD**, **ITRF2020P wo & w annual/semi-annual signals**

Challenges for new DORIS users

- Raw data have to be cleaned :

* Some Rinex files present stations (with or without 1 measurements) which does not exist at the epoch of the rinex files !

* Some data have the wrong name of stations :

Fictional example: AAAA from 01-01-2000 to 12-10-2002

AAAB from 30-12-2002 to …

The data files between 30-12-2002 and 10-01-2003 presents measurements from the station AAAA …

We have check all the data of all the satellites and compare the stations present in the doppler/rinex files with the existing stations in DPOD or ITRF2020 !

- Inconsistency in some log files and log event in the ids website !

* Date problem between log files and log event (begin and end of stations)

* Inconsistency in log file between the Antenna part and the beacon part too

ITRF2020P : orbit comparison

wrt SSA (after 2010) / GRG (before 2010) - in mm

Using DPOD

	R	T	N
S3A	6.0	23.7	17.9
SRL	6.3	28.2	24.0
JA2	5.2	18.5	19.2
SP5	6.0	22.5	18.8

Using ITRF + PSD

	R	T	N
S3A	6.4	23.6	18.9
SRL	7.7	31.5	26.3
JA2	5.7	20.1	21.3
SP5	5.8	22.9	19.8

Using ITRF + PSD + Freq

	R	T	N
S3A	6.4	23.7	18.9
SRL	7.7	31.6	26.2
JA2	5.7	20.1	21.4
SP5	5.8	22.8	19.8

- Medians of daily RMS

ITRF2020P : orbit comparison

in mm

ITRF2020P + PSD + Freqs / ITRF2020P + PSD

	R	T	N
S3A	0.3	0.6	0.5
SRL	0.3	0.5	1.2
JA2	0.3	0.8	1.1
SP5	0.4	0.6	0.5

ITRF2020P + PSD + Freqs / DPOD

	R	T	N
S3A	1.6	6.0	8.0
SRL	3.7	10.9	12.1
JA2	2.1	7.5	9.5
SP5	0.9	3.0	4.9

- Medians of daily RMS

ITRF2020P : 6h daily overlaps

daily computation J ± 3h

Orbit overlaps - DPOD - in mm

	R	T	N
S3A	3.5	14.8	8.8
SRL	5.4	24.7	15.5
JA2	3.8	13.3	9.9
SP5	3.6	16.4	9.2

Orbit overlaps – ITRF2020P - in mm

	R	T	N
S3A	3.8	16.6	10.4
SRL	6.0	26.8	17.3
JA2	4.4	14.5	11.8
SP5	3.6	16.6	9.6

- Medians of daily overlap RMS

To do ...

- Send SP3 orbits for evaluation
- Send the list of detected errors in DORIS data to CNES
- Compute HY2A & CRYO2
- Estimate stations : mono satellite and multi satellites