DPOD2020: a DORIS extension of ITRF2020 for Precise Orbit Determination

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DPOD2020: Motivations

The DPOD solutions were initiated to overcome some intrinsic drawbacks of each ITRF realization:

- Addition of new stations to the tracking network after the end of the ITRF defined time span (ex: SJVC, SVBC).
- □ Stations may be affected by position and/or velocity discontinuities that occur after the release of the ITRF realization (ex: COBB – M8.2 EQ in 2021/07/29).
- Positions and velocities may be improved by using data over a longer time span.
- □ Some problems in data processing might be found after the computation of the ITRF.





DPOD2020: Realization

The DPOD2020:

- □ Is a DORIS cumulative position/velocity solution aligned to ITRF2020.
- Pure linear displacement model.
- ← To be uploaded on board of DORIS navigation software.
- IDS CC discontinuity file
 IDS CC velocity continuity constraints.
 Stacking using DORIS-to-DORIS ties.
- Velocities of new sites with very short observation time spans are constrained to velocities deduced from GNSS/SLR/VLBI ITRF2020 colocated stations.

Updated twice a year.





DPOD2020 Version 1.0 (v01)

Based on IDS 19 weekly combined solution (ESA 13, GOP 67, GRG 43 and GSC 52) from 1993.0 to 2022.0.

- □ IDS 19 is the extension of the IDS contribution to ITRF2020 (IDS 16) with downweighting of the SAA stations from ESA and GOP solutions since the adding of Jason-3.
- □ Stations with constrained velocities due to short time span:

Site	DORIS station	Reference station	Technique	Source
Ajaccio	AJAB	AJAC	GNSS	ITRF2020
Huahine	HUAA	7123	Laser Ranging	ITRF2020
Höfn	HOFC	HOFN	GNSS	ITRF2020
San Juan	SJUC	OAFA	GNSS	ITRF2020



DPOD2020 v01 - DORIS Network





DPOD2020 v01- Discontinuities



46 of the 88 sites are free of any discontinuity. 105 discontinuities: 52 with geophysical origin and 19 are related to technical events. 78 of these 105 discontinuities are included in the ITRF2020.



DPOD2020 v01 vs ITRF2020

Coordinate differences estimated at the mean epoch of each time segment of each station



75% of the 3D differences are smaller than the position errors. 80% of the 3D differences are smaller than 10 mm.



DPOD2020 v01 vs ITRF2020 – Alcatel vs Starec

Coordinate differences estimated at the mean epoch of each time segment of each station



Unit: mm	Alcatel	Starec
Nb of pts	58	236
Max	40.9	29.8
Median	8.4	4.1
RMS	11.3	7.0
Mean	9.4	5.4
STD	6.3	4.4

Four times less Alcatel time segments and two times larger differences with Alcatel antennas.

Larger Alcatel differences may reflect how the associated stations were included in the stacking.

However, mean and median are smaller than 10 mm.



DPOD2020 v01 vs DORIS-to-DORIS/GNSS surveyed ties

Coordinate differences estimated at the date of the surveyed ties GNSS station positions are estimated from ITRF2020 with PSD corrections.

DORIS-to-DORIS ties

DORIS-to-GNSS ties



80% of the DORIS-to-DORIS tie residuals are smaller than 20 mm. 80% of the DORIS-to-GNSS tie residuals are smaller than 23 mm.



DPOD2020 v01 vs DORIS-to-DORIS surveyed ties

Coordinate differences estimated at the date of the surveyed ties.



Alcatel-Starec

Starec-Starec

Larger Alcatel–Starec vs Starec-Starec residuals. No Alcatel–Starec residual below 6 mm. No evidence of a main direction for the largest Alcatel–Starec residuals.



DPOD2020 v01 vs DPOD2014

Validation based on CNES DORIS CRYOSAT-2 Reduced Dynamic orbits The plos show the differences of weighted DORIS RMS between both DPOD versions.

DPOD2020 - DPOD2014, weighted RMS by day (cm)





DPOD2020 DORIS GSC std2006 residuals over five missions and DPOD2014 - DPOD2020 residual differences (green, scale is the right vertical axis). We show a 120-day moving average for the residual differences.



An improvement with DPOD2020 can be seen for TOPEX, Jason-1/3 and Sentinel-6A. Jason-2 degradation is under investigation.



DPOD2020 v01 vs DPOD2014



Transition from DPOD2014 to DPOD2020 will have only negligible systematic altimeter satellite radial orbit impact.



DPOD2020 v01 vs DPOD2020 v01P

DPOD2020 v01P stands for DPOD2020 v01 with estimation of periodic signals (annual, semi-annual, two first Jason's draconitics) in the stacking process

Periodic signals over the entire time span of each site

Periodic signals before and after adding Jason-2 (2008.5)



Largest differences are for sites with strongest periodic signals and short time span. 80% of the position (resp. velocity) differences are smaller than 2.5 mm (resp. 0.8 mm/yr).



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□ DPOD2020 is a DORIS cumulative position/velocity solution aligned to ITRF2020.

DPOD2020 Version 1.0:

- \checkmark Is based on the IDS combined solution from 1993.0 to 2022.0.
- ✓ Shows good level of agreement with ITRF2020 as well as with DORIS-to-DORIS and DORIS-to-GNSS surveyed ties.
- ✓ Shows slight better POD performance compared to DPOD2014 and ITRF2020.
- \checkmark Is available for download from the IDS DCs since late January.



Realization of the version 2 (1993.0-2023.0) has been initiated.

□ IDS products will start to be aligned/expressed in ITRF2020 with the processing of the 2023 observations.