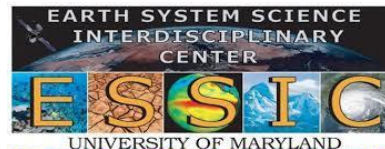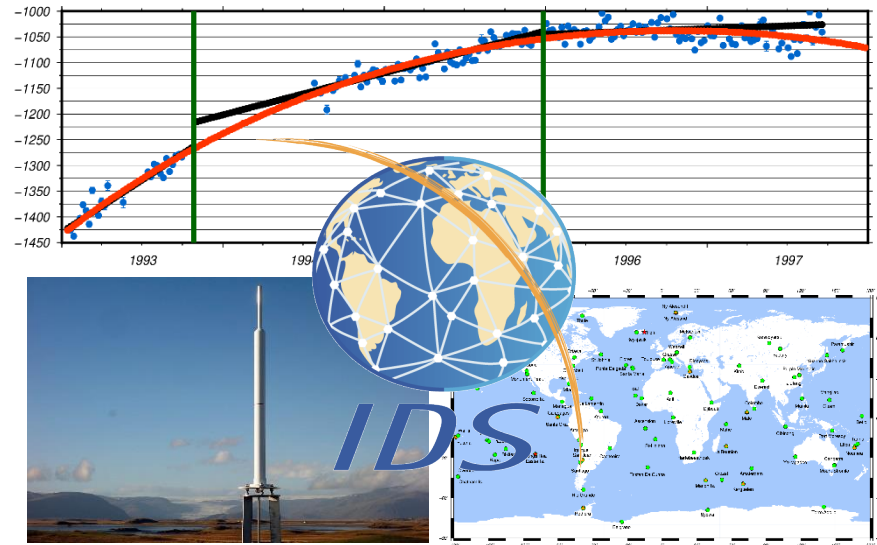# Impact of DORIS Post Seismic Deformation and Seasonal corrections on the DPOD2020 solution

Guilhem Moreaux (CLS), Frank Lemoine (NASA), Nikita Zelensky (UMD), Alexandre Couhert (CNES), John Moyard (CNES) and Hugues Capdeville (CLS)
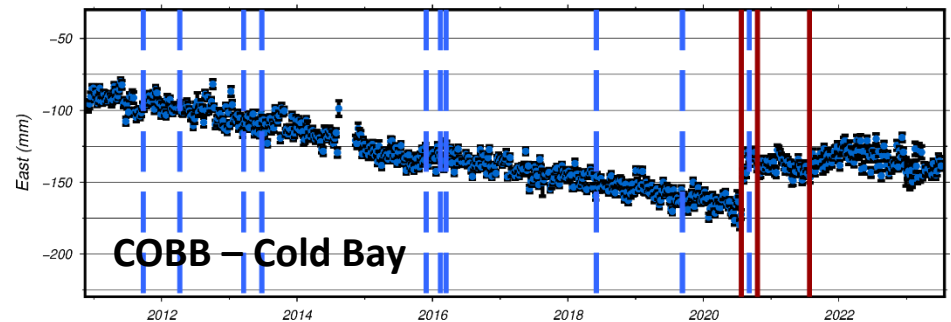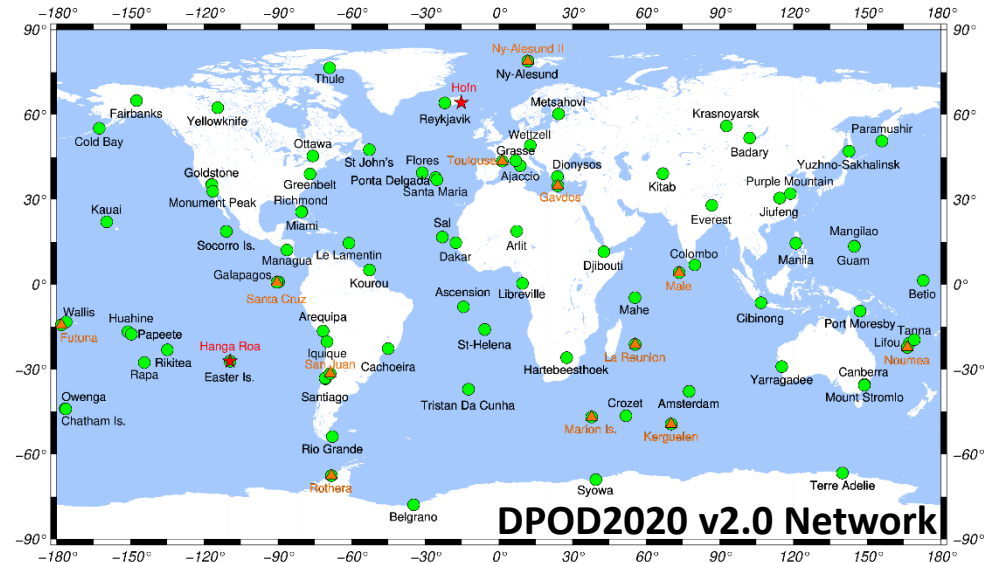
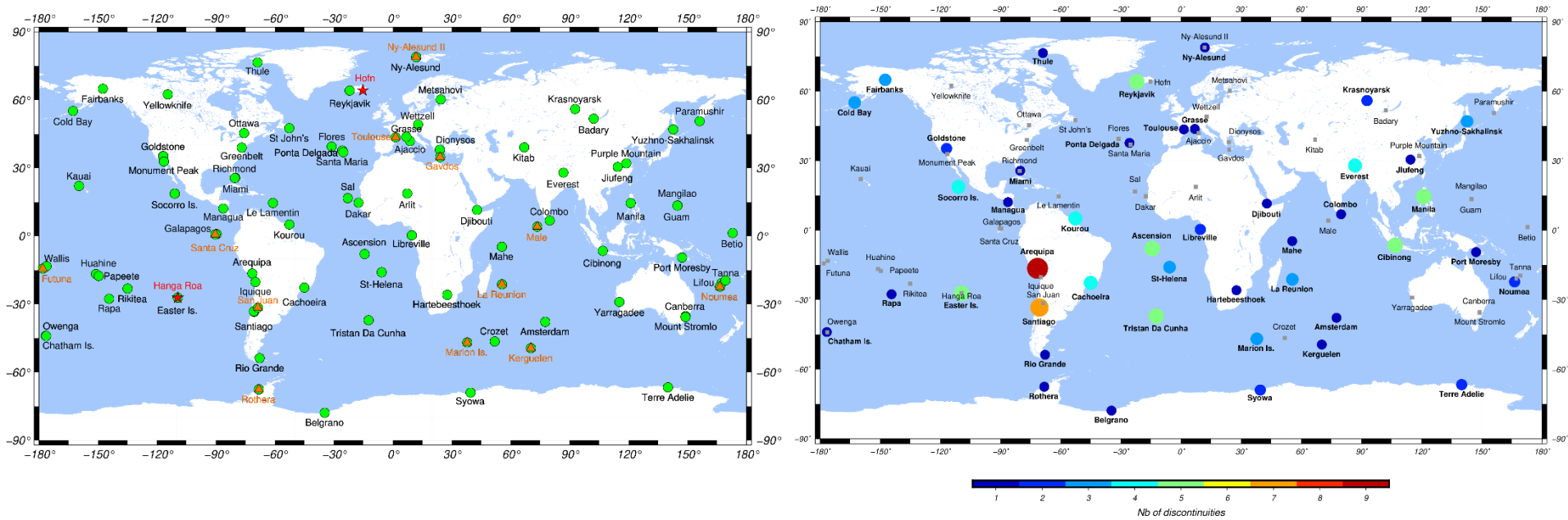# DORIS terrestrial reference frame for POD

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

- ❑ **New stations**
  (ex: Hanga-Roa, Höfn, Ny-Ålesund).

- ❑ **New discontinuities**
  (ex: COBB – M8.2 EQ in 2021/07/29).

- ❑ **Longer time series.**

- ❑ **New data processing.**

- ❑ **New models…**

DPOD2020 v2.0 Network

COBB – Cold Bay

DPOD2020 v2.0
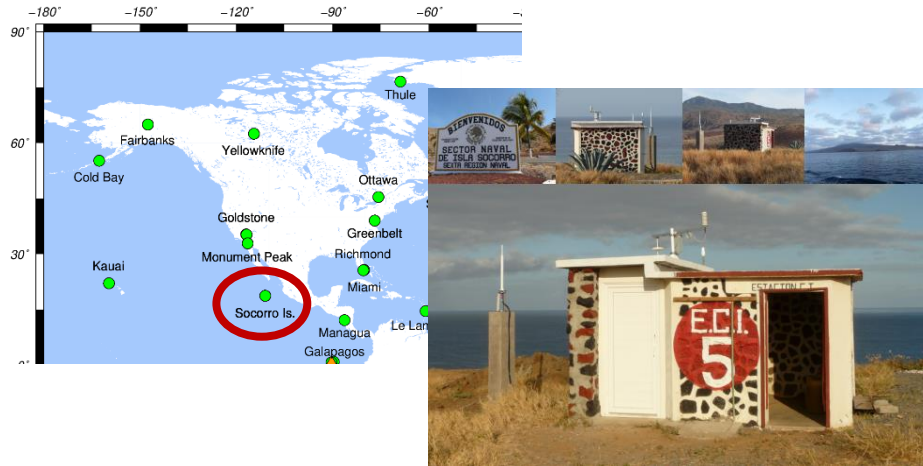

DPOD2020 v2.0 = stacking of IDS 20 (1993.0-2023.0), aligned onto ITRF2020.

DPOD2020 v2.0 includes 216 stations @ 89 sites (+14 stations vs ITRF2020).

Half of the sites are free of any discontinuity.
Half of the discontinuities have geophysical origin.

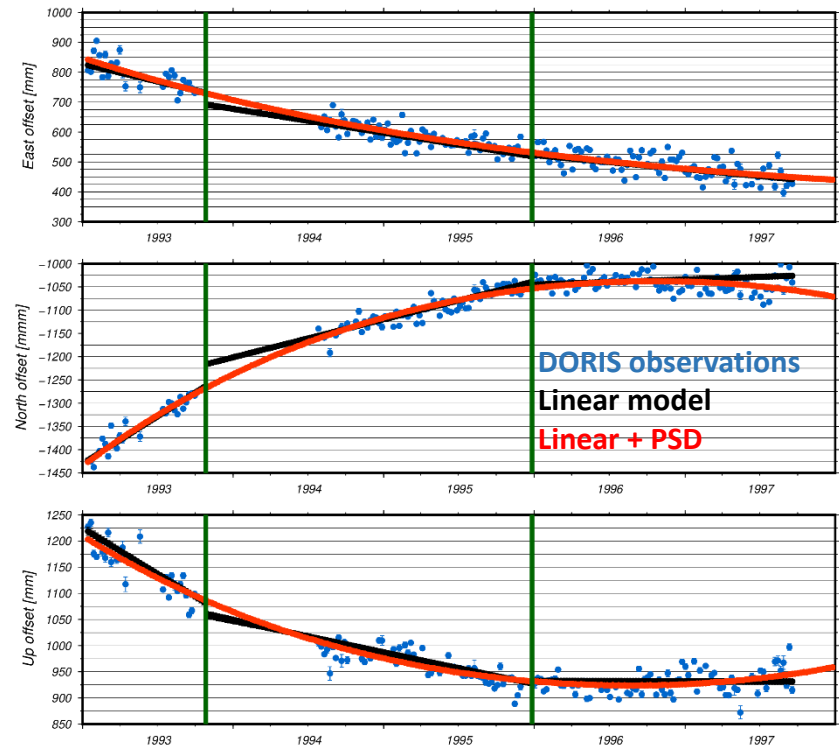Estimation of annual, semi-annual, 118 and 59-day periodic signals.

Post-Seismic Deformation Corrections

SODA – Socorro Island

DORIS is at Socorro since 1991/02/08.
Host agency: INEGI & Armada de Mexico.
Tide gauge (Gloss nb 162) @ 370m.
No GNSS, no SLR, no VLBI.

Submarine eruption on 1993/01/29 @ 4km.

DORIS observations
Linear model
Linear + PSD

DPOD2020 2.0 is the first DPOD solution with DORIS only PSD corrections.
DPOD2020 2.0 gives PSD corrections for SODA only.
Other stations affected by earthquakes or ice melting are under investigation.
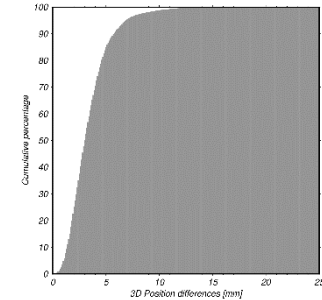
Impact of Estimating Seasonal Terms

Impact of the estimation of the seasonal terms on the weekly DORIS station coordinates. DPOD2020 v2.0 vs Stacking without estimation of periodic terms.

RMS of 3D weekly differences
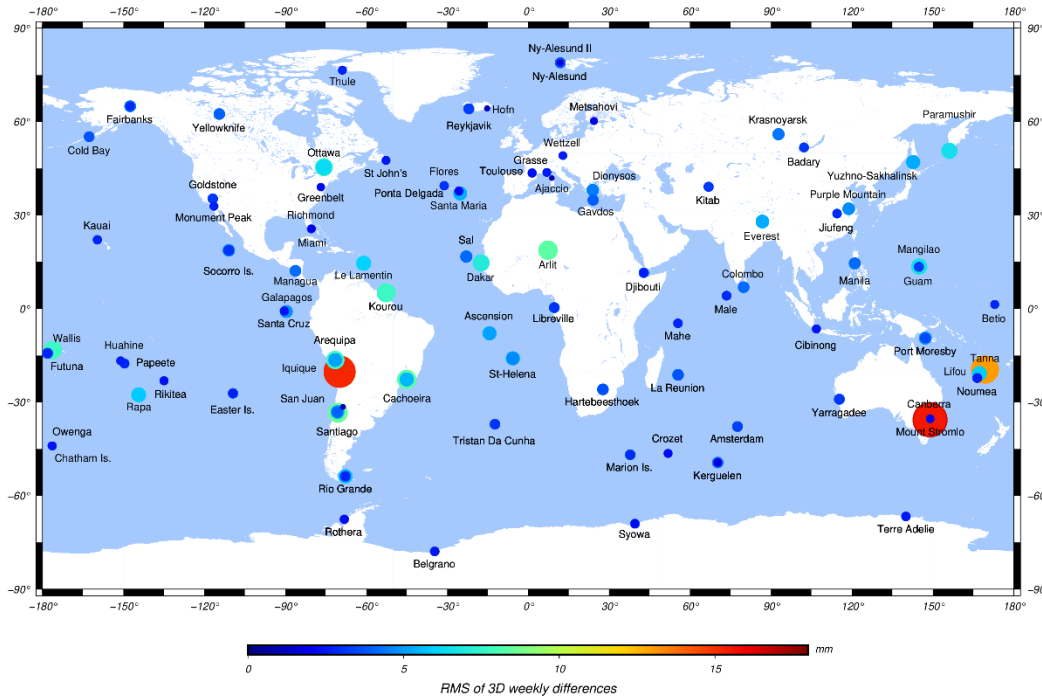
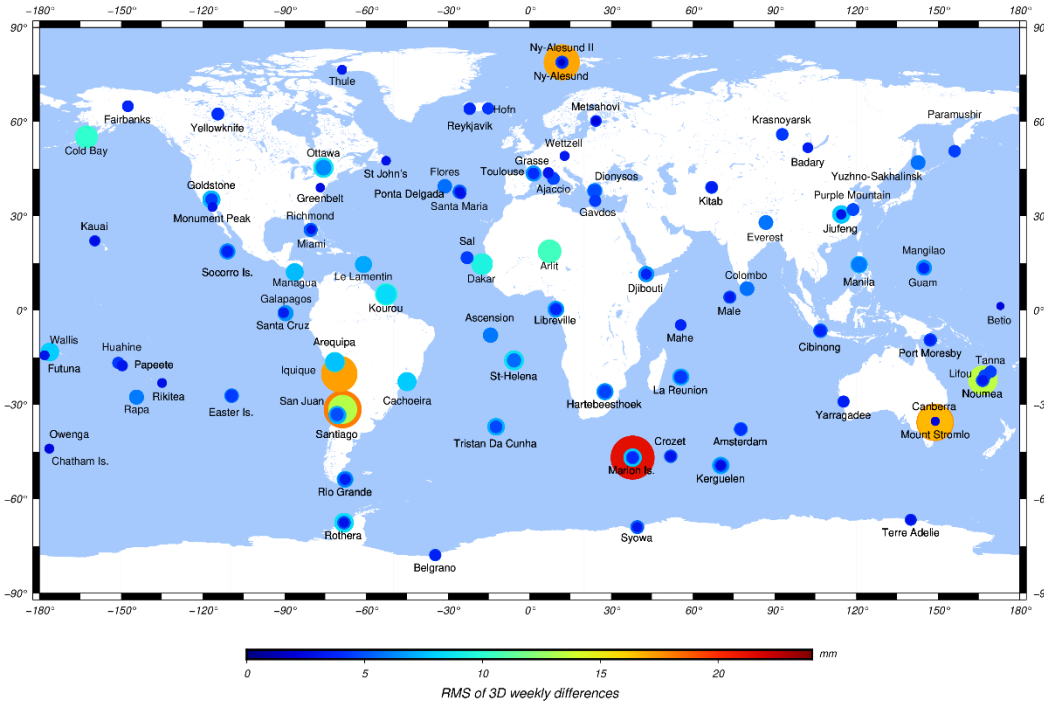| 1993.0-2023.0	[mm]
Max	31.8
Median	3.0
RMS	4.0
Mean	3.4
STD	2.0

2D Position differences [mm]

Small impact of the seasonal terms on the station positions.
85% of the weekly 3D differences are smaller than 5mm.
Largest differences are for sites with either
- ✓ **strong periodic terms (Canberra), or**
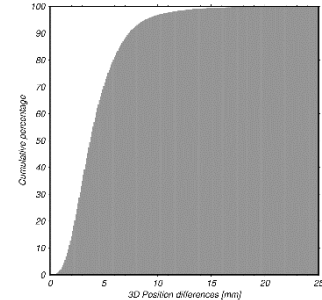- ✓ **with very short time span (Iquique, Tanna).**

DPOD2020 v2.0 vs DPOD2020 v1.0

Weekly station coordinate differences between DPOD2020 v2.0 and DPOD2020 v1.0. DPOD2020 v2.0 includes annual and semi-annual corrections.

1993.0-2023.0	[mm]
Max	65.1
Median	3.8
RMS	5.3
Mean	4.4
STD	2.9

RMS of 3D weekly differences

85% of the weekly 3D differences are smaller than 7mm.
Largest differences are for sites with either
- ✓ new discontinuities (Marion Island), or
- ✓ strong periodic terms (Canberra), or
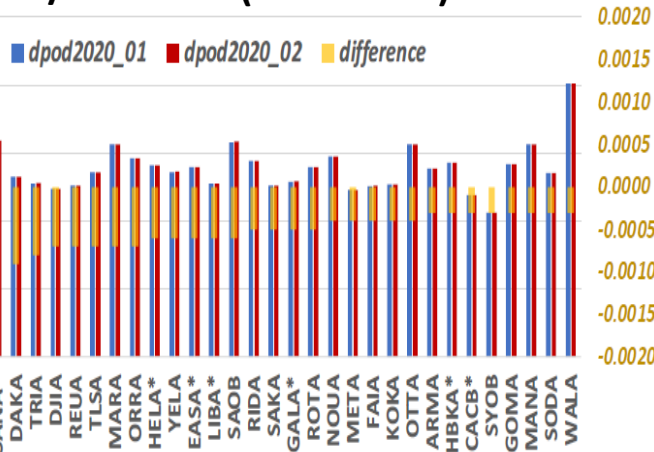- ✓ very short time span (Iquique, Ny Ålesund II, San Juan, Tanna).
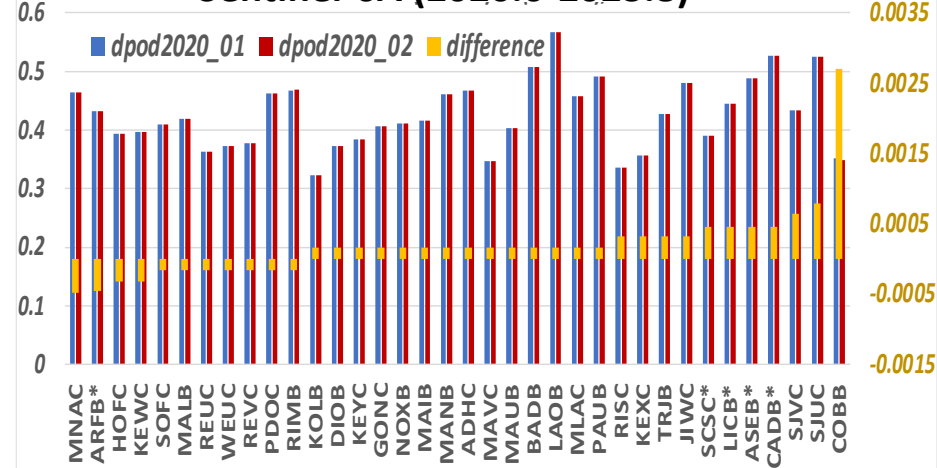
DPOD2020 v2.0 vs DPOD2020 v1.0

GSFC POD results
positive difference => improvement for DPOD2020 v2.0

TOPEX/Poseidon (1993-1998)

Sentinel-6A (2020.0-2023.8)

TOPEX/Poseidon residuals are slightly smaller using DPOD2020 v1.0. Adding the periodic corrections slightly increases the TOPEX residuals.
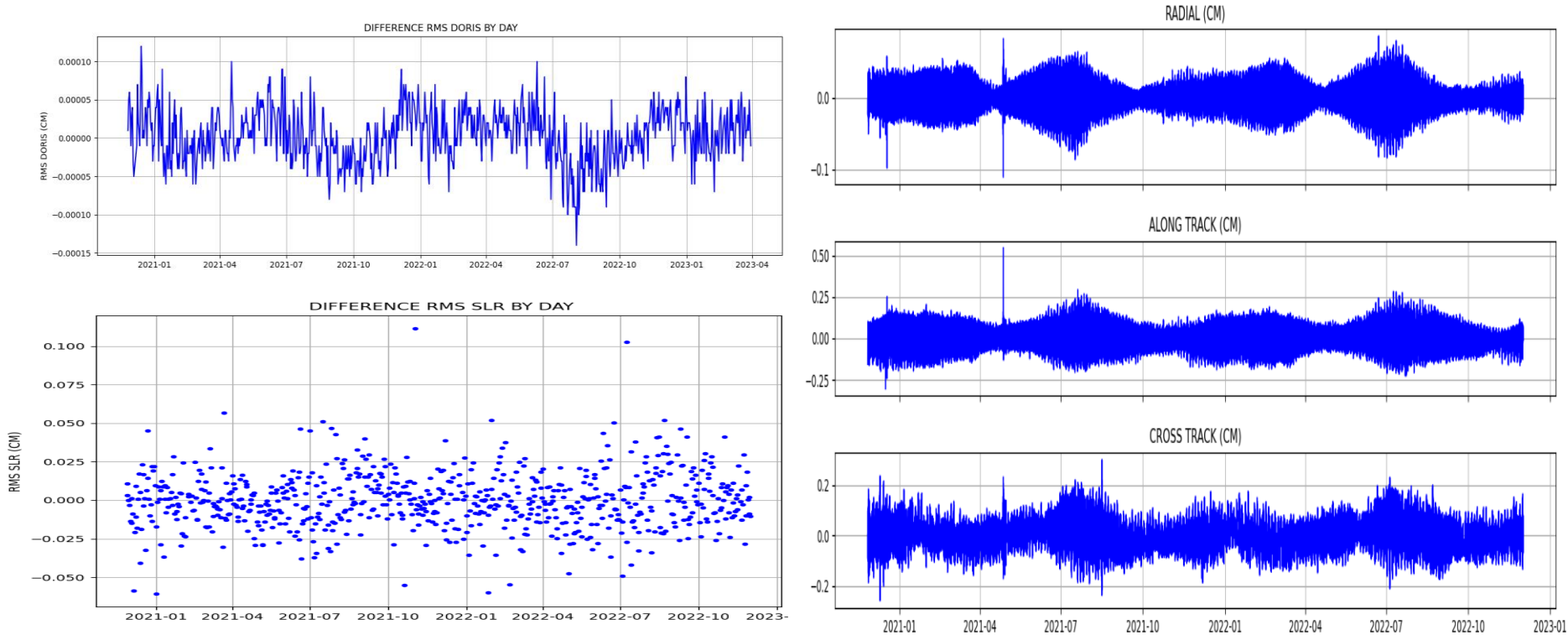
The Sentinel-6A DPOD2020 v2.0 residuals with or without the seasonal corrections are slightly smaller than for DPOD2020 v1.0.

The RMS radial orbit differences are below 1mm.

DPOD2020 v2.0 vs ITRF2020

Sentinel-6A CNES DORIS reduced dynamic orbits in POE-G preliminary standard. 2020/11-2022/11

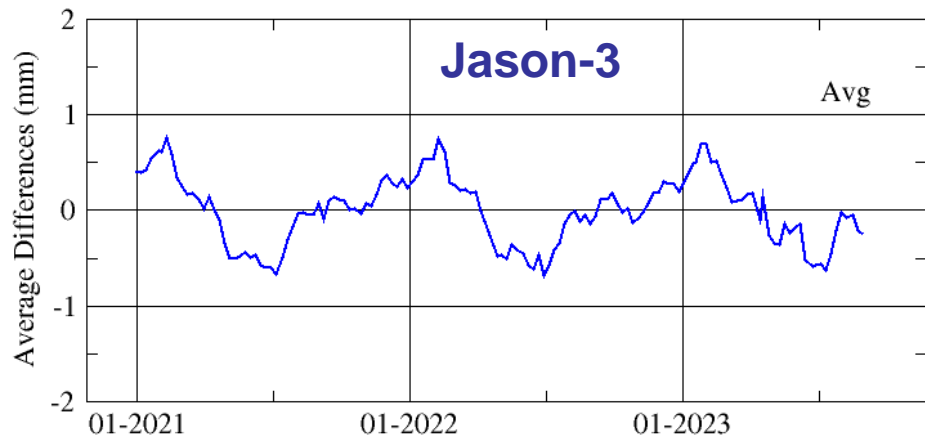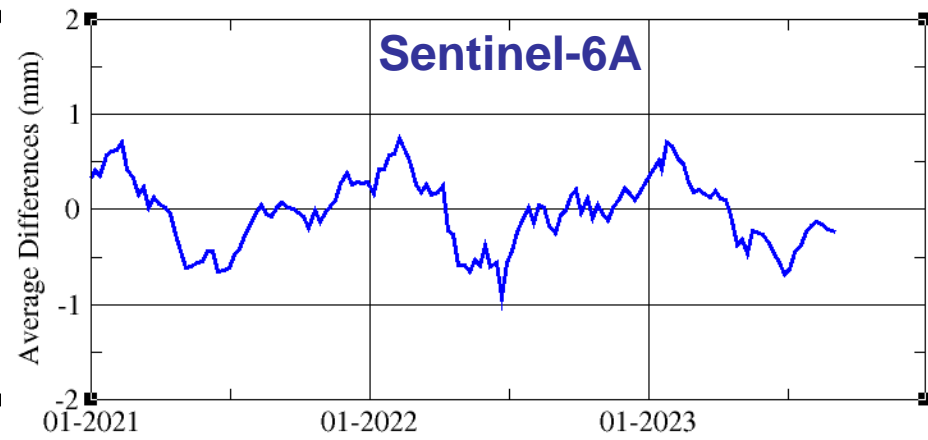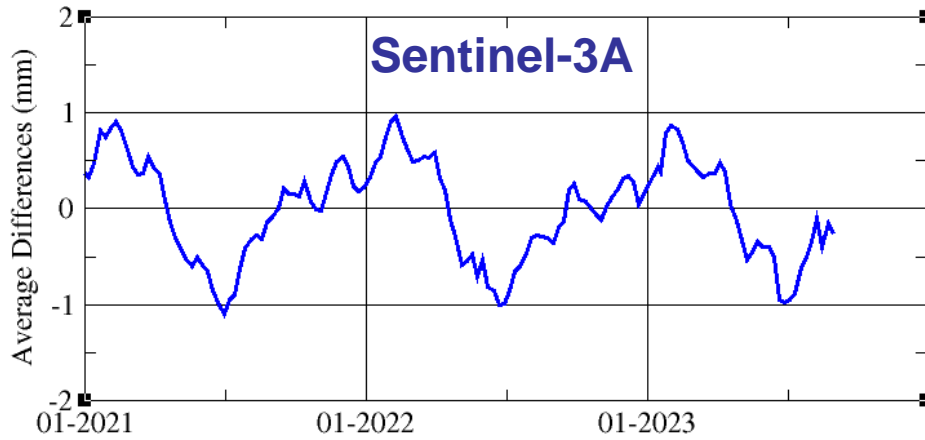**Comparable RMS of DORIS and SLR residuals for both solutions.**

Submillimetric impact in the radial direction, around 2mm in the along track and cross track directions.

Impact of Seasonal Terms on mean-Z Orbit Differences

DPOD2020 v2.0 with seasonal terms vs DPOD2020 v2.0 without seasonal terms.

Millimetric impact on the mean-Z orbit differences.

DPOD2020: a DORIS extension of ITRF2020 for Precise Orbit Determination

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

❑ **DPOD2020 Version 2.0:**

✓ **Is based on the IDS combined solution from 1993.0 to 2023.0.**

✓ **Is the first DPOD solution with estimation of periodic terms.**

✓ **Is the first DPOD solution with DORIS only post-seismic deformation corrections (SODA@Socorro).**

❑ **Estimation of seasonal terms has a**

✓ **Tiny impact on the DORIS and SLR residuals.**

✓ **Submillimetric impact on the radial orbit differences.**

✓ **Millimetric impact on the mean-Z orbit differences.**