

# Compatibility between the preliminary ITRF2020 solution and GNSS antenna phase center offsets

A. Villiger<sup>1</sup>, R. Dach<sup>1</sup>, L. Prange<sup>1</sup>, D. Arnold<sup>1</sup>, M. Kalarus<sup>1</sup>, S. Schaer<sup>1,2</sup>, P. Stebler<sup>1</sup>, A. Jäggi<sup>1</sup>

<sup>1</sup>*Astronomical Institute, University of Bern, Bern, Switzerland*

<sup>2</sup>*swisstopo, Wabern, Switzerland*

*e-mail: [arturo.villiger@aiub.unibe.ch](mailto:arturo.villiger@aiub.unibe.ch)*

EGU 2022, 23. May 2022

# Introduction / Motivation

---

## Introduction/Motivation

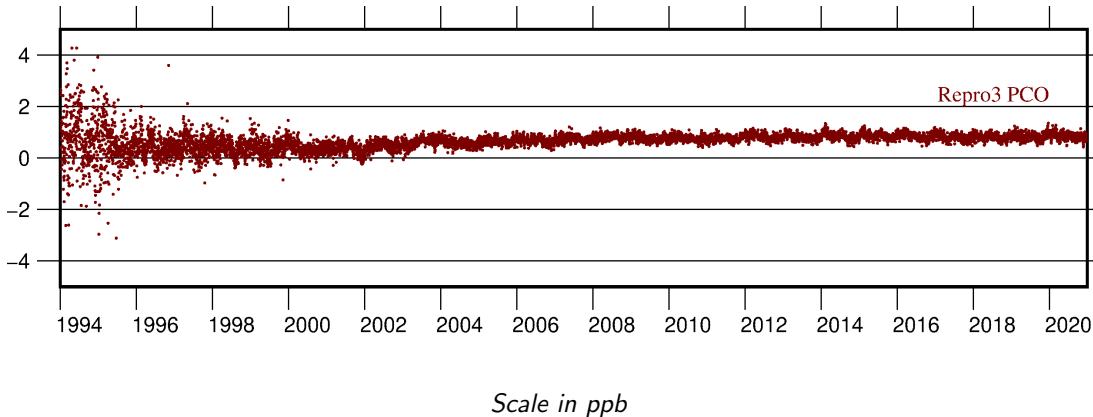
- ITRF 2020 was published
- SLR and VLBI define ITRF scale
- GNSS has an intrinsic scale defined by the satellite phase center offsets
- Disclosed Galileo (and GPS BLOCK IIIA) satellite PCOs allow to align GNSS scale
- Studies based on CODE Repro3 products

## Analyzed tests

- Repro3 scale (based on Galileo) w.r.t. ITRF2020
- Redefined GNSS intrinsic scale (based on Galileo) w.r.t. ITRF2020
- Conclusion / how to continue

# Scale comparison

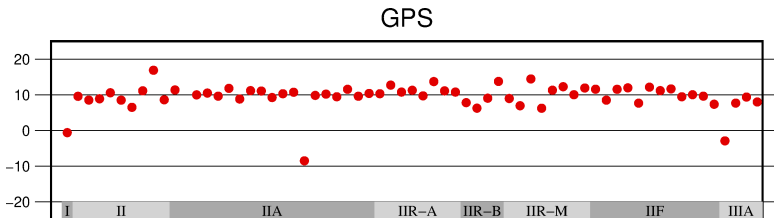
Repro3 scale: Repro3 PCOs used (constrained)



# Aligning CODE Repro3 based PCOs to ITRF 2020

## Estimation of system-wise offset

System	Offset [cm]	Processed	2019	Orbit height
GALILEO	+18.7	2016–2020	+16.7	29'000
GPS	+13.2	1994–2020	+11.6	26'000
GLONASS	+9.5	2002–2020	+10.8	25'000

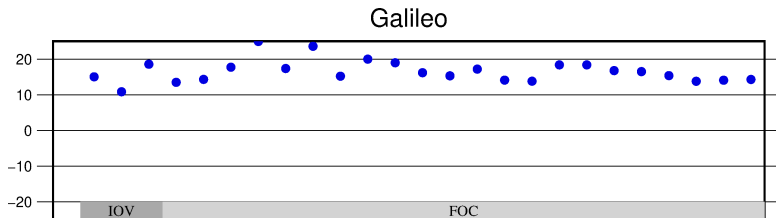


Note: BLOCK III-A according to Repro3 ANTEX (not disclosed values)

# Aligning CODE Repro3 based PCOs to ITRF 2020

## Estimation of system-wise offset

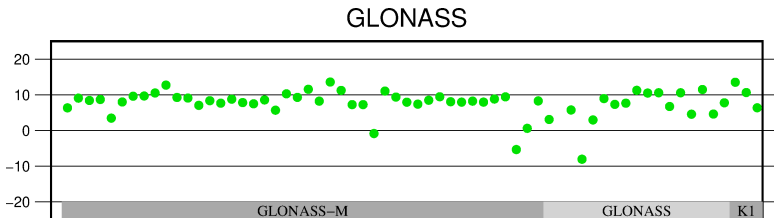
System	Offset [cm]	Processed	2019	Orbit height
GALILEO	+18.7	2016–2020	+16.7	29'000
GPS	+13.2	1994–2020	+11.6	26'000
GLONASS	+9.5	2002–2020	+10.8	25'000



# Aligning CODE Repro3 based PCOs to ITRF 2020

## Estimation of system-wise offset

System	Offset [cm]	Processed	2019	Orbit height
GALILEO	+18.7	2016–2020	+16.7	29'000
GPS	+13.2	1994–2020	+11.6	26'000
GLONASS	+9.5	2002–2020	+10.8	25'000



*Note: GLONASS including time-dependent x/y-PCO*

# Disclosed BLOCK IIIA PCOs vs. Galileo vs. ITRF2020

SVN	launch	cal.	ITRF2020	Gal.
74	Dec. 2018	1.851	1.964	1.853
75	Aug. 2019	1.851	1.933	1.820
76	Jun. 2020	1.831	1.951	1.839
77	Nov. 2020	1.850	1.951	1.842
78	Jun. 2021	1.876	–	–
Diff. to cal.:			<b>-0.104</b>	0.007

## Legend

cal.: Disclosed PCO values

Gal.: Galileo induced scale (PCO constr.)

## Conclusion

- Galileo and GPS scale differ from ITRF 2020 scale
- Galileo and GPS BLOCK IIIA are consistent

## Open issues:

- Presented study based on L1/L2 and E1/E5a
- GPS: L5 for newer satellites

# Conclusion and outlook

---

- Intrinsic GNSS scale is given following the assumption of constant satellite PCOs
- Galileo-based scale are shifted w.r.t. ITRF2020
- Alignment of the intrinsic GNSS scale drift can be done either by Galileo or external scale definition (ITRF2020) ← IGS realization by IGS RF-WG
- BLOCK IIIA satellite PCOs are inline with Galileo induced scale
- Still a long way to go ...