CNES/CLS IGS Analysis Center 2022/2023 Activities

A. Mezerette[1], S. Loyer[1], E, Saquet[1], A. Banos Garcia[1], A. Santamaria Gomez[3], F. Mercier[2,3], F. Perosanz[2,3]

(1) CLS, Collecte Localisation Satellites, 11 rue Hermès, 31520 Ramonville Saint-Agne, France
(2) Centre National d'Etudes Spatiales, Toulouse, France
(3) GET, Université de Toulouse (CNES, CNRS, IRD, UPS), Toulouse, France

First-Author: amezerette@groupcls.com
CNES-CLS IGS Analysis Center: https://igsac-cnes.cls.fr

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G1.2

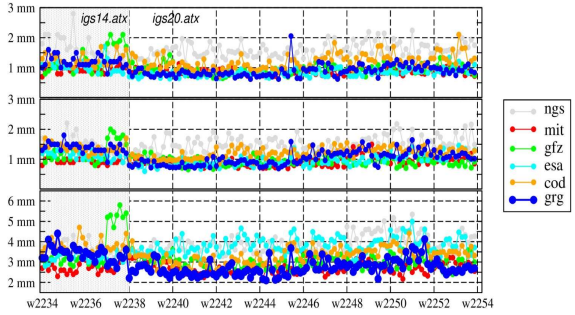
Introduction

We present in this contribution the main aspects of the efforts made at the CNES/CLS Analysis Center in 2022-2023. We summarize the main changes associated with the adoption of the IG20/IGS20.atx standards following the recently released International Terrestrial Reference Frame (ITRF2020) and following our participation to the third IGS reprocessing effort (REPRO3). We have also increased our participation to IGS with the delivery of rapid and ultra-rapid products: the quality and specificities of these products (orbit, clocks) are presented together with their availability and some details on the associated processing chain. Finally, we focus on the preliminary results of the processing of the satellites of the BEIDOU constellation that will be included soon in our products.

Switch to ITRF2020 standards for IGS products

Starting from the 27/11/2022 (GPS week 2238), we adopted, with the others IGS Analysis Center, the IG20/IGS20.atx standards relying on the recently released International Terrestrial Reference Frame (ITRF2020) and following our participation to the third IGS reprocessing campaign (REPRO3). The figure below illustrates these changes on the daily terrestrial coordinate quality relative to other IGS contributors. The GRG solution now reaches a vertical quality below 3 mm (~1 mm in horizontal directions). We recommend Precise Point Positioning users of our products to use coherent orbits, clocks, biases and attitude files all together to maintain the best quality of their solutions.

IGS20 standards	▪ Igs20.atx antenna PCV & PCO patterns ▪ Products alignment relative to IGS20 reference frame ([IGSMAIL-8238])
Increase contribution of Galileo data	Galileo measurements weight increased relatively to previous contribution (now ~equal to GPS measurements)
Troposphere modelling	VMF1 mapping function (Böhm et al. (2006)
Antenna Phase Center corrections applied for measurements biases	The WSB and Inter Frequency Differential CODE biases are computed WITH applying antenna PCOs according to (Banville et al, 2020, IGSMAIL-8113) - (This do matter if PCOs are not equals for each frequency).
Long-names	Long-names are used for the products files archived on IGS data centers
S/W upgrade	New version of our Gins S/W (22_1) including vmf1 modeling APC corrections and noticeable gains in CPU.



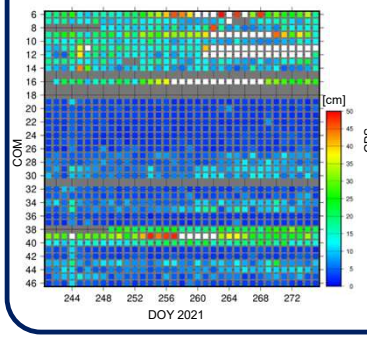
SINEX coordinates main combination statistics (values from the IGS-ACC P. Rebischung): ENU WRMS of different AC contributions relative to the combined solution

BEIDOU

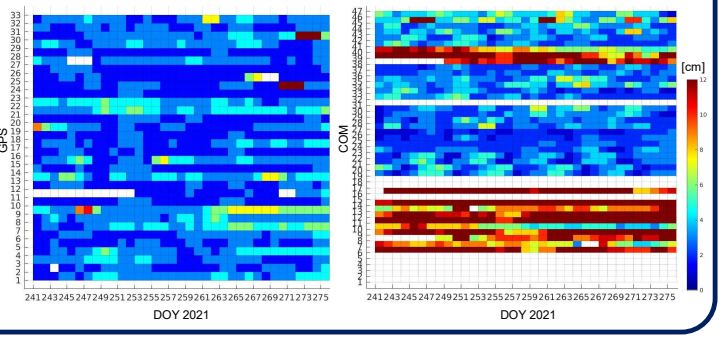
The CNES/CLS analysis center currently processes the GPS/GALILEO and GLONASS constellations. For Multi-GNSS experiment (IGS-MGEX), we plan to include BEIDOU products (BDS-2/3), as several Analysis Centers have already done.
In 2022 we included the BDS constellation in our GNSS tools (preprocessing and orbitography software with Wide-Lane & Narrow-Lane ambiguity fixing capabilities). Our first results are presented here. The figures below show the RMS3D orbit differences for BDS-2/3 with regard to the GFZ analysis center solution (2-10 cm for BDS-3 MEO) and the BDS overlaps we achieve as of today (less than 4 cm for BDS-3 MEO) compared to the GPS ones. Note that we let the ambiguities unfixed for BDS-2 satellites.

Constellations	GPS GALILEO BEIDOU
Reference observations used (RINEX3)	C2I/C6I
Fixed Ambiguities	GPS/GALILEO/BEIDOU (only BDS3-MEO)
Mean % of fixed ambiguities	96% / 98% / 87%
Attitude	BDS-2: Strasser et al. (2021) BDS-3: Yang et al. (2023)

BDS-2/3 orbit differences vs GFZ



GPS and BDS overlaps (GPS week 2173 to 2177)

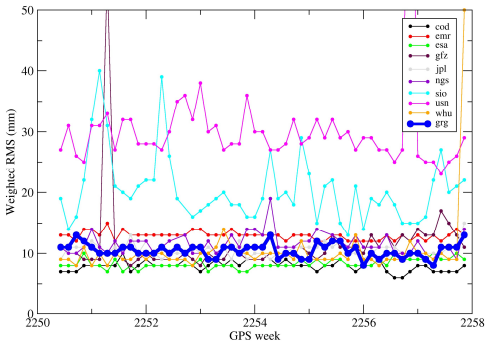


RAPID & ULTRA-RAPID PRODUCTS

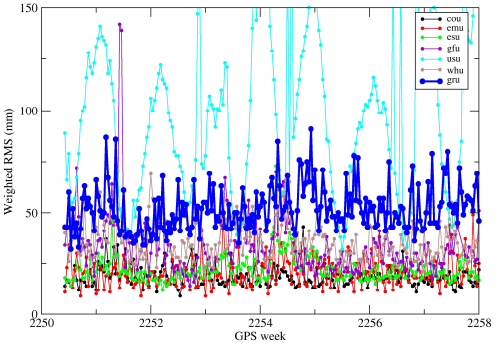
Since the beginning of the year 2023, the CNES/CLS analysis center delivers rapid and ultra-rapid products to IGS. Our participation to the combined rapid/ultra IGS products is under evaluation by the IGS coordinator. The processing consists of 3 stages : floating solution, ambiguity resolution and then fixed solution. This processing is executed on a dedicated 8-core virtual machine and lasts approximately 50 minutes from the end of the data retrieval to the delivery of products. Several modifications have been made compared to the classical final products processing to maintain this time below one hour (data sampling, modelling, number of stations …) The processing differences relatively to our final products and the quality of these new rapid products (data from the combination summary files [IGS coordinator S. Masoumi]) are shown below.

	FINAL	RAPID	ULTRA-RAPID
Delivery	1/week	1/day	every 6H
Constellations	GPS+GAL+GLO	GPS+GAL	
Network	nearly 120 stations	nearly 90 stations	
Orbites	300 sec	900 sec	
Horloges	30 sec	300 sec	
ERP (XY + LOD)	1/day	1/day	every 6H
Treatment	24H observed	24H observed	24H observed + 24H predicted
2nd order ionospheric correction	Yes	No	

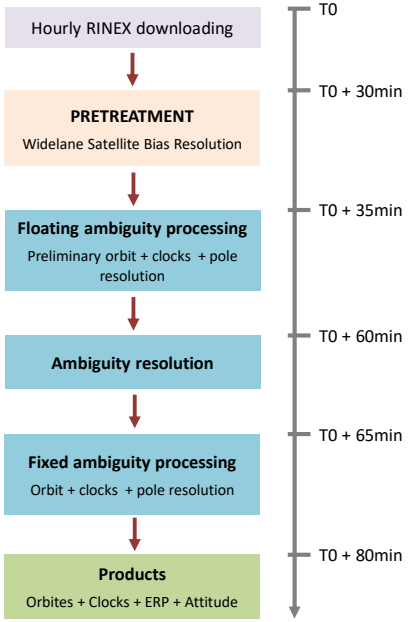
RAPID Orbit (AC solutions compared to IGR)



ULTRA-RAPID Orbit (AC solutions compared to IGU)



RAPID & ULTRA-RAPID processing



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