

Review of the Paper:

The topic important and the paper is very useful for the sea level community. It gives a condensed overview about the new ULR GNSS(GPS) solution for sites at or near tide gauges as part of the IGS reprocessing effort. The paper is well written and easily to understand also for non GNSS-experts. The data is available at a data repository.

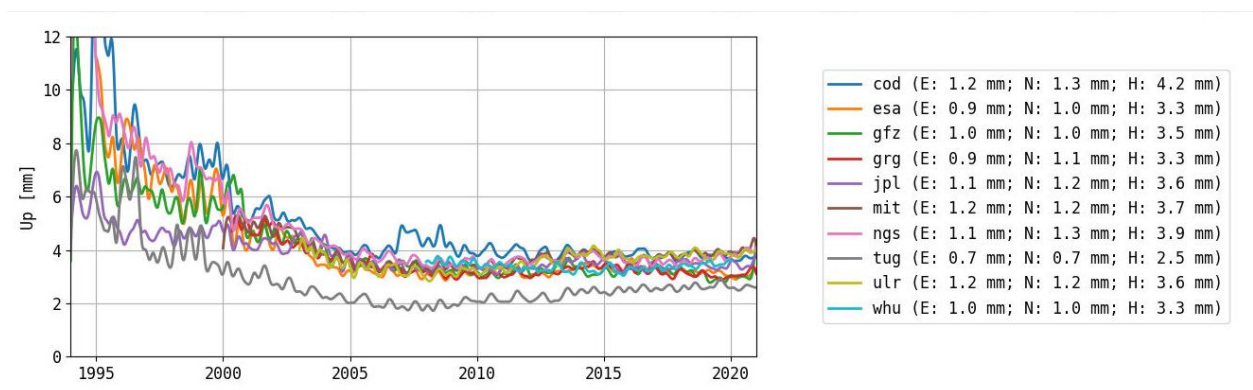
The positive review is appreciated. Thanks.

A shortfall of paper is the analysis of the results, which is only done against ULR's previous version. The latter has a different time span and short overlap. The comparison with own previous reprocessing is helpful but may not reveal problems associated with the general processing strategy or setup. Since ULR participated in the IGS reprocessing campaign, I assume there are more in-depth analyses of the ULR contribution against other contributors. Rebischung et al. 2021 (EGU and AGU) are slides of presentations and are less helpful to gain confidence in the new ULR solution. Years ago, Deng et al. (https://doi.org/10.1007/1345_2015_156, unfortunately not open access) did a comparison of their processing with the (older) ULR analysis providing, which may also be a way to evaluate this new data set. I strongly encourage the authors to perform similar studies using external solutions and provide results within the paper.

There are several reasons that raise some concern in following the suggestion:

- 1. As the reviewer mentioned, such a comparison has already been done and presented by Rebischung et al. (2021), and more recently again at AGU in 2021 and at the IGS workshop in 2022. The comparisons showed that the quality of the ULR-repro3 solution is in line with that of most of the other analysis centres (see Figure R1 below).*

Figure R1: Smoothed daily median formal errors of station positions (Rebischung et al. 2021). ULR solution is within the boundary of the best and “worst” solutions.



- 2. ULR-repro3 is the only solution formally (within IGS) dedicated to the analysis of coastal GNSS stations nearby tide gauges (GFZ was in repro2, but not in repro3,*

unfortunately). Consequently, its publication would be useful even though other solutions were proven to be less noisy.

Figure R1 above shows, however, that there are no obvious problems associated with the processing strategy or setup. In order to provide additional evidences that the ULR-repro3 solution does not suffer from any major processing issues, we compared it with the IGS-repro3 combined solution. In particular, we compared using the RMSE and the Lomb-Scargle periodogram (Figures R2 and R3). As expected, both the RMSE and Lomb-Scargle show that the repro3 combined solution is less noisy than the ULR-repro3 solution. However, the level of noise ULR-repro3 solution remains low (as most, Figure R1) and does not highlight any major estimation issue.

Figure R2: RMSE Comparison of the ULR-repro3 and IGS-repro3 combined solutions

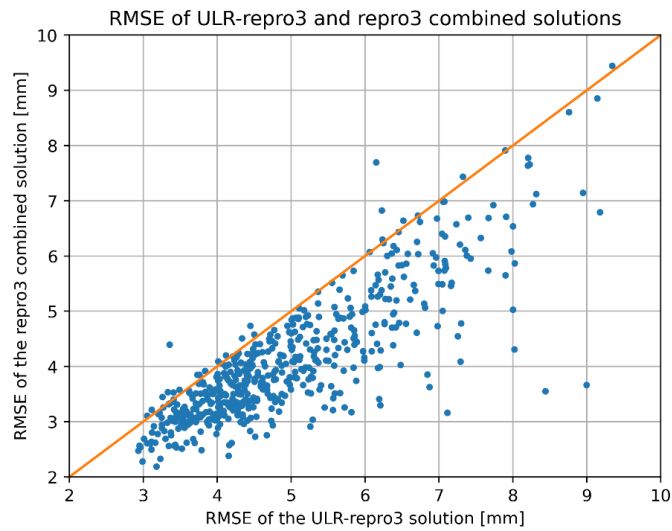
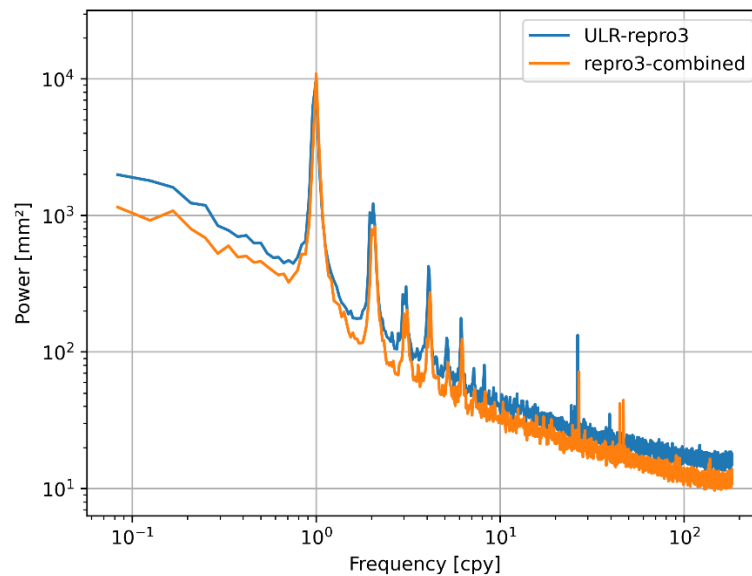


Figure R3: Lomb-Scargle periodograms of the ULR-repro3 and IGS-repro3 combined solutions



Considering our comments above and that a dedicated article is in preparation by the leaders of the IGS-repro3 combination and comparison campaign, we have followed the suggestion with a short summary paragraph at the end of Section 3.4.

In general, I recommend to publish the paper with minor corrections.

Comments which may help the authors to further improve the paper:

Title: the term GPS is used, but later consequently GNSS, better have consistent naming

The term GPS in the title is intended to make clear what type of GNSS data was analysed. The text then uses GNSS consistently, except to specify the GNSS-type (Section 2.1) or where a GPS-technique feature is specifically addressed.

Line 46: I assume the GNSS orbit estimate is CoM, but is this also true for GNSS derived coordinates and velocities?

Once the alignment to the ITRF2014 is done, GNSS positions and velocities are expressed relative to the origin of the ITRF2014, which follows the CoM (as observed by Satellite Laser Ranging or SLR) over long-term time scales, but at short time scales it corresponds to the Centre of Figure (CoF). Thus, velocities (long-term by definition) are expressed relative to the CoM. However, daily positions are relative to CoF. See details in Dong et al. (2003) in JGR (Origin of the International Terrestrial Reference Frame) and Altamimi et al. (2014) in JGR for the case study of ITRF2014.

Line 89: Although the authors using “continuous” only here and Fig.4, most of the Geoscientist may understand this term as the opposite to “campaign” GNSS. Also, the two citations using this term refer to it as long-term. I suggest another wording.

True that some geodesists may understand “continuous” as permanent station observations in contrast to “campaign” as episodic observations. We did not find a better wording. This is why we clarify the term right after using it, and we do not use it anymore, but in Figure 4 which asks the reader to refer to the text. If you have a better suggestion, we will be happy to consider it.

Line 98: is 3 months correct? For me this sounds contrary to the statements in line 86ff.

The short record length (3 months) stations correspond to French stations, whose GNSS was recently installed to fulfil the requirements of the GLOSS program. This is clarified in the text just before introducing the GLOSS programme, and providing additional information requested by Reviewer #2.

Line 99: Santamaria-Gomez et al., 2017: the supplementary material says 757 stations with data between 1995.0 and 2015.0

- here the authors wrote 2013.

There was a typo in Santamaria-Gomez et al. We confirm that the last year processed was 2013 (in other words, from 1995.0 to 2014.0).

- any statement, why the authors processed less stations
- any statement, why this solution starts later than their previous reprocessing effort?

The main reason was to cope with the deadlines of the IGS-repro3. We did not have the resources to extend back in time before 2000 (CPU cluster access was challenging), nor was this a requirement for the IGS reanalysis campaign. For instance, the WHU group solution extends back to 2008, and the MIT or GRG groups back to 2000, as we ultimately did. The manual editing of the time series was also a long time-consuming step as we did it carefully (carried out on the three components).

We therefore were stricter in the station selection criteria, rejecting more stations than in the previous reprocessing effort. Hopefully, this will change for the next reanalysis campaign (new cluster, increased automation in quality check procedures...).

Line 113: could you specify the terminus “many corrections”, likely for the supplementary material

For clarity, we have changed this with the explicit section number, where the details can be found. We have prepared a Table with rather technical details for GPS specialists. However, we consider this of little use for the vast majority of the readers/users of the data paper. We attach the Table to our response, and if the reviewer or editor insist, we will add it as supplemental material to the paper.

Line 138/Table1: which IONEX files are used, IGS combined?

Yes, indeed, the IGS combined IONEX files are used. It is now stated in Table 1.

Line 138/Table1: FES2014b also contains Ssa and Sa.

- Are you truncating this model, and if yes, to which tides; what leakage do you expect?
- How (if) does Ssa & Sa map to the spectral behavior of your orbits (and coordinates). Since a correction for tides are sensed by both, satellites and tide gauges, this would help the user to understand possible side effects.

We did not truncate FES2014b model, neither for the station displacements nor for the variations in the gravity field. The effects of the ocean tides are thus corrected the best it can using the state-of-the-art, including Sa and Ssa.

FES2014b modelling errors can indeed exist and propagate into ULR solutions (and likely contribute peaks at ~14 days). The question of whether possible errors in Sa and Ssa in

FES2014b model yield significant errors in ULR7 solution, and which are these errors, is out of the scope of our data paper.

Line 195: pls specify "several" and supply plots with the subnetworks in supplementary material.

Several is up to 10. Now added in parenthesis. Figure S1 (added as Supplemental Material) illustrates the subnetworks distribution for a given (random) day 2018-01-01.

Line 195: The subnetworks are fixed though 2000.0 till 2021.0? or vary day by day?

The subnetworks vary day by day. It is now specified in the text.

Lines 198 to 205: This section needs some more explanations. For those not familiar with GNSS processing it is interesting to understand how the alignment and transformation of the sub-networks is performed, but I failed to understand the concept.

These lines and paragraph refer to a practical aspect of computational efficiency. The Figure S1 now added in the Supplemental Material (suggested above) will likely help illustrating this aspect of station distribution into sub-networks.

The combination of the sub-networks and alignment are explained in the next paragraph, and the very last of the section. They refer to the literature for the daily combination (Herring et al., 2015) and then for the frame alignment / transformation to Altamimi et al. (2018). We provide information on the choices that we adopted for our specific case study that may help the reader with geodetic background. Further details on the geodetic concepts can be found in those manuals. Therein, the reader can find additional references. For instance, the GLOBK algorithms for network combinations are explained in Dong D., T. A. Herring, and R. W. King, Estimating Regional Deformation from a Combination of Space and Terrestrial Geodetic Data, J. Geodesy, 72, 200–214, 1998. There are two concepts: You can estimate the rotation and translation with least-squares fitting of the coordinates of the common stations or you can construct the site coordinate covariance matrix that allows for rotation and translation of the network and simply combining the networks allows the systems to re-orient without any explicit rotation and translation parameters. The latter is a more advanced concept in estimation theory but one which is used in GLOBK extensively.

Line 230ff: pls give some more information about the handling at earthquake sites. - How many days are used to estimate offsets; - any outlier control of the daily solutions, - how you handle postseismic deformation; - what, if new earthquakes occur within your fitting period?

The offsets are estimated during the stacking process with CATREF software. The offset dates are given by the user in a specific file. The software then estimates the amplitude as the difference between the average of the detrended positions before and after the offset. Post-seismic signals were first detected visually, then corrected using the IGS estimates, before a new stacking iteration is performed.

Line 292: The data doi web site say 554 stations, while here only 546 are mentioned

It is now corrected in the doi web page, thanks for pointing this out.

Line 330/Fig.5: what causes the peak near $7 \cdot 10^1$ cpy

We do not see any peak at this frequency (70 cpy). Note that we see a peak at 40 cpy, which was already present in the previous (repro2) ULR solution as well in MIT solution. The peak is still present in ULR and MIT repro3 solutions. Its origin remains unknown, it does not correspond to a tidal aliasing or to another known process. Further research will be needed to identify its origin.

Line 368ff: Did you perform the comparison for 2000.0 – 2013(15).0?

No, we compared the results obtained by considering the entire span of each dataset so that the resulting differences highlight the progress that a user can expect by using the new ULR-repro3 solution, whatever its origin (record length or advanced corrections and modelling).

Some (likely) typos

Line 23: university -> University

Corrected

Line 83: RINEX: any link to or citation of?

A link is now added (<https://igs.org/wg/rinex/>)

Line 213: Herring et al., 2021 is missing in the reference list

The year is corrected as in Ref 24 adding the online link to whole documentation.

Line 225: experimented or experienced?

Experiences (corrected now).

Line 240: per decade and station?

Yes, per decade and per station, it is specified now

Line 265: is Gobron et al. in press: Gobron, K., Rebischung, P., de Viron, O. et al. Impact of offsets on assessing the low-frequency stochastic properties of geodetic time series. J Geod **96**, 46 (2022). <https://doi.org/10.1007/s00190-022-01634-9>? Or a different paper?

Updated.

Line 269: correct research center for geosciences -> Research Center for Geo...

Done.

Line 408: CMSLT should all be upper case letters

Done.