

Gravelle et al. present a new reanalysis of GNSS data, focusing on stations that are collocated with tide gauges. The authors first describe how the input dataset was chosen and then provide a detailed account of how the GNSS data was processed. The steps taken were in accordance with the international standards adopted by the IGS for the third reprocessing campaign. An analysis of the sources of uncertainty in the data products especially relevant to the sea level community (vertical positioning and vertical rates), and the geographic variability therein, is also presented. The authors conclude with a convincing demonstration that the reanalysis provides an improvement over the previous reanalysis campaign. It is clear that a great deal of effort went into the creation of this dataset, and it is a welcome addition. The authors should especially be applauded for their work in making the data accessible; the data products hosted at the SONEL scientific service are available free of charge and without barriers.

This is a timely paper, and in my opinion, it should proceed with minor revisions.

We appreciate this supportive summary.

Major comments:

The purpose of the paper is to present the GNSS data reanalysis of vertical land motion nearby tide gauges, and, quite correctly, the discussion primarily focuses on the GNSS analysis. Little information, however, is given about the tide gauge data. Could the authors indicate where the tide gauge data could be accessed? Will information available on the SONEL archive only relate to the GNSS and that on the GLOSS archive only relate to the tide gauges? When giving the GNSS station information, will an identifier for the nearby tide gauge be included?

As requested later on (Minor comments below) we now provide additional information on the GLOSS programme, which answers these questions. Briefly, GLOSS programme comprises five global data centres, SONEL being the one dedicated to the GNSS data, whereas the other four address different products from tide gauges. Efforts are undertaken to favour interoperability between these data centres, in particular we have succeeded to link the GNSS station information with that of its co-located tide gauge. For example, an identifier and associated URL link in the GNSS station information at SONEL is pointing to the tide gauge station at the PSMSL (GLOSS global data centre for mean sea levels), and vice-versa.

A map showing the spatial distribution of GNSS station distance to tide gauges could be useful, perhaps in supplementary material (in addition to the information presented in Figure 2).

We have added a panel (map) to Figure 2 as suggested with the spatial distribution of GNSS stations and their distance to tide gauges.

Section 2.2.3 Stochastic modelling and time-correlated noise

The equation for the station position is given on the About page of <https://www.sonel.org/-Vertical-land-movements-.html>. I suggest having this information in the paper as well.

The equation of the model has been added to the text in section 2.2.3

Minor Comments

Title

Is there a reason why GPS was chosen for the title? GNSS is used almost exclusively elsewhere in the main text.

The reason is explained in the first line of Section 2.1 "Input data", that is, the title underlines that only GPS data were used, other GNSS (Galileo, Beidou...) were not considered. We can add "GNSS (GPS)" in the title, if the reviewer or the editor finds worth adding a second abbreviation, but this (GNSS) is implicit as soon as GPS is mentioned.

Abstract

Please define GNSS.

Done. GNSS is now defined in the abstract.

Main Text

L56: use of semicolon is grammatically incorrect here; the clause starting with "that is" would not qualify as a stand-alone sentence.

Semicolon now replaced by a comma.

L66: "that" -> which

Done.

L66: Although the citation for the modelling and corrections adopted for repro3 is given, a short synopsis may also be useful here. Section 2.2.1 and Table 1 do cover this information, so perhaps a shortened version could be given.

One possible edit:

This paper describes the latest ULR solution in a series, complying with the modelling and corrections adopted for 'repro3' (Rebischung, 2021; <http://acc.igs.org/repro3/repro3.html>), which succeeds previous releases (Wöppelmann et al., 2009; Santamaria-Gomez et al., 2017).

->

This paper describes the latest ULR solution in a series, succeeding previous releases described in Wöppelmann et al., (2009) and Santamaria-Gomez et al. (2017). This solution complies with the modelling and corrections adopted for 'repro3' (Rebischung, 2021; <http://acc.igs.org/repro3/repro3.html>), for example, corrections are made for antenna phase center and solid Earth tides (see Section 2.2.1).

Done. Thanks for the suggestion.

L88: Could you clarify how near to a tide gauge a station must be to satisfy the selection criterion? I suspect it is ≤ 15 km, but this is not explicitly stated.

Correct (15 km). Now stated in the text.

L94 GLOSS is defined, but it would be useful to have additional information on this program, for example, what data products are made available by it.

We have added additional information on GLOSS, which should also answer the questions raised above in Major comments.

L105: Please indicate how many of the 601 stations are reference frame stations.

The number of reference stations (176) is now added.

L112: suggest not repeating "from GNSS measurements" twice in the sentence.

The repetition (second) is now removed.

L145-148: This sentence is difficult to parse at first read through; perhaps it could be split into two. What do the authors mean by “converted from relative to absolute”?

We agree, and have split the sentence into two. The relative aspect refers to an antenna calibration relative to an antenna with an absolute calibration. This is now clarified in the text.

L174. Suggest moving parenthetical information to a separate sentence.

It reads better indeed. Done.

L185: hydrologic?

Corrected.

L225: experimented analyst? Do the authors mean experienced?

Yes! It is corrected now.

L240: suggest a comma after “Overall”

Done.

L249-251: How many stations satisfy these conditions? How many were reference frame stations vs stations near tide gauges?

546 stations satisfy these conditions, among which 161 are reference stations and 457 are nearby a tide gauge.

L254-258: step is used four times in two sentences, and it is not clear at first read-through whether the authors are referring to a step in the overall procedure or referring to a previous iteration. One possible means of clarification: “a functional and a stochastic model were adjusted to each of the position time series from the previous step on a station by station basis.” -> “a functional and a stochastic model were adjusted to each of the position time series found using the procedure described in Section 2.2.1 on a station by station basis.”

Thanks for the suggestion. Done.

L286: should this be “of the vertical component”?

“velocity estimates on the vertical component” has been replaced by “vertical velocity estimates”

L300: suggest “America” changed to either “North America” or “Canada”

“America” changed to “North America”.

L303: Is there a reason the authors used GPS here rather than GNSS?

GPS changed to GNSS.

L304: How many stations are not plotted?

There are 8 stations with velocity discontinuities. It is now indicated in the text.

L321-329: Point of clarification, does the power-law and white noise discussed in this section correspond to the noise discussed in section 2.2.3? In general, more description on how to interpret Figure 5 and what details are included on the figure would be welcome.

Yes, the white noise and power-law noise presented here are those mentioned in Section 2.2.3. In practice, Figure 5 highlights deterministic and stochastic features that are accounted for by the functional and stochastic models adjusted to each position time series. We have extended this paragraph to specify this, and to better describe the figure.

L335: Perhaps this sentence could be split into two for clarity.

Yes, done.

L347: should this be “but are mostly non-zero”?

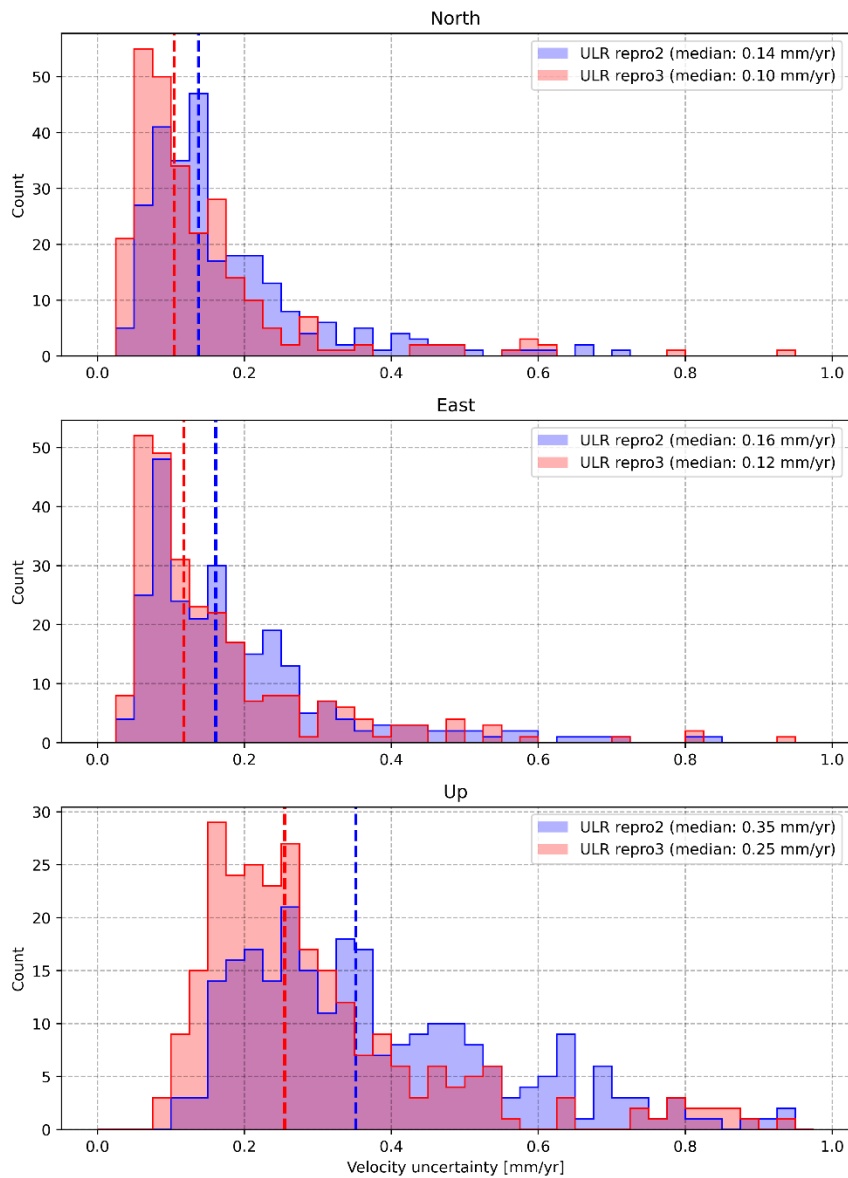
Yes, done.

L378: should strict be strictly?

Yes, “strict” now changed to “strictly”.

L388: Was there also improvement seen in the North & East components? If so, by how much?

Yes, the figure below shows two panels that supplement Figure 8 in the manuscript. It shows improved results in the horizontal components too. However, we decided not to show these components to focus on the vertical component only, as the scope of the data paper is the vertical. If the reviewer or the editor insists, we can add the two panels below in the paper.



L401: product's?

"products" changed to "product".

L402: suggest stating that it is the vertical velocity that experienced the reduction in uncertainty.

"vertical" is added.

Tables

Table 1

In the second column suggest writing out Earth Orientation Parameters tide model from Desai and Sibois (2016) as opposed to just the reference.

Done.

Figures

Fig. 1

Why are some station circles different sizes? If size as well as color corresponds to station duration, a key would be useful. Why does the record length range from 3 months to 21 years, wasn't there a selection cutoff of >3years? Are these shorter duration stations all French GNSS stations and/or reference frame stations?

The issue of the circle size is fixed: now all circles have the same size. Yes, the stations shorter than 3 yrs correspond to some French stations.

It may be useful to have subpanels with regions of higher concentration of stations, e.g. Europe, Western North America, Eastern North America. Or showing the regional subnetworks mentioned in the main text.

The subpanels of Europe and North America have been added to Figure 1. The figure S1 showing the subnetworks distribution for the day 2018-01-01 has been added to the supplemental material.

Fig. 2

Please label the x axis.

Suggest having the label for all be "ALL GPS" or "ALL GNSS" to make it clear that the GLOSS tide gauges are not included in the tally.

"Date" is now added as x label. "ALL" is changed to "ALL GPS" and "GLOSS" changed to "GPS@GLOSS" for clarification

Fig. 3

Could you increase the text size for the piechart labels? Perhaps change the color corresponding to the unknown category from red to purple to increase the color contrast for colorblind readers. Would also be useful to have a title for the piechart (e.g., "Offsets origin") to avoid needing to reference the caption.

Thanks for these suggestions that improve the clarity of the Figure. The font size has been increased, the red has been changed to white, and black edge colour has been set for more contrast. A title has also been added.

Fig. 4

Panel a -

Are there values in excess of 3 mm/yr? If so, please add triangles to the colorbar to indicate saturation at +/- 3mm/yr.

The stations with vertical velocities near 0 mm/yr are difficult to see. Stations could be outlined in black, or the colormap could be blue yellow red instead.

Panel b -

suggest switching colormaps to a sequential rather than diverging map. In particular, having the same red to blue colormap as in the above panel risks the reader thinking the panels are on the same scale.

Thanks for these suggestions (adopted).

Fig. 7

The colorbar for panel a might be better placed below the figure to avoid mistaking "record length [yr]" for the title of the panel.

Changed, thank you.

Fig. 8

It might be easier to read the histogram if the bar graph is filled in with transparent colors.

Changed. Looks indeed better to some of us.