

Review of Gravelle et al.:

The ULR-repro3 GPS data reanalysis and its estimates of vertical land motion at tide gauges for sea level science (essd-2022-235)

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.

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? 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).

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.

Minor Comments

Title

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

Abstract

Please define GNSS.

Main Text

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

L66: “that” → which

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).

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.

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.

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

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

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”?

L174. Suggest moving parenthetical information to a separate sentence.

L185: hydrologic?

L225: experimented analyst? Do the authors mean experienced?

L240: suggest a comma after “Overall”

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

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.”

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

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

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

L304: How many stations are not plotted?

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.

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

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

L378: should strict be strictly?

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

L401: product’s?

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

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.

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?

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.

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.

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.

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.

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.

Fig. 8

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