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Solid Earth Discussions

Interactive comment on "Reprocessed height time series of GPS stations at tide gauges" *by* S. Rudenko et al.

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General comments

This is a paper on an important topic such as the estimation of vertical land motion of tide gauges for sea level research. The data processing and analysis presented constitute a great effort by the authors to provide an independent GPS solution within the framework of the IGS reprocessing and the IGS TIGA project. The authors also provide discussion on some specific case studies of co-located GPS and tide gauge stations. However, the paper is generally not well written and some parts of the methodology and discussion must be clarified. Also, verify that all the figures are referred in the right order and that are provided with appropriate captions describing (not discussing) the content of the figure.

Specific comments

P1026

L7: provide some numerical values on the quality of the estimated velocities (e.g., error bars, comparison).

L10: provide the number of tide gauges for which the vertical land motion was estimated by GPS.

L23: the authors should specify who requires the stated accuracies.

P1027

L17: add here origin rate errors too

L21: define what is meant by "near". Did the authors apply a distance threshold?

L24: how many velocities with >2.5 yr of data were estimated? How many near a TG?

P1028

L8: there are only 107 GPS stations officially committed to TIGA. Please clarify.

L10: the authors should clarify how the sub-networks solutions were combined. Was each sub-network aligned to the ITRF2005 by fixing the coordinates of the reference stations of were the sub-networks aligned to each other? What was the minimum number of reference stations used? Was their global distribution considered? Furthermore, it is not clear which set of reference coordinates was used (IGS05/ITRF2005). If it was ITRF2005, the authors should comment on the impact of the PCV inconsistency, especially on the vertical component (station coordinates in ITRF2005 were estimated using a relative PCV).

L18-21: the authors should clarify how the terrestrial frame of the solution was realised. Only information on the a priori station coordinates and velocities are provided. How was the terrestrial frame aligned? Where and how the constraints were applied?

L22: “few hundred” is too vague.

P1029

L25: any reference to support this statement?

L26-27: only the station coordinate residuals are assessed, not the absolute station coordinate differences, nor the accuracy, nor the realisation of the reference frame. The transformation parameters must be shown. Additionally, if the authors want to show the level of agreement of the estimated coordinates with respect to the IGS repro1, a direct comparison of the stations coordinates at a common epoch would be helpful. Only IGS reference frame station coordinates should be used since the GT1 solution have less weight than for other stations. Vertical velocities should also be compared to IGS repro1.

P1030

L13-15: this sentence needs explanation. How can be transformed the vertical coordinates only into longitude, latitude and height?

L17-19: this sentence needs explanation. Did the authors apply any constraint between the estimated trends of the same time series (between breakpoints) to obtain a unique station velocity?

L24: please clarify to which trend signal refers this statement.

P1031

L6: does the 2.5 yr threshold include breackpoints or does it represent breackpoint-free 2.5 yr data?

L16-20: vertical land motion estimated with GPS is consistent with that derived from TG data at Neah Bay assuming an absolute sea level change of 2 mm/yr (assumed by the cited Verdonck paper). This absolute sea level rise is completely in disagreement with the estimated altimetry sea level trend of 4 mm/yr (or it is -4.3 mm/yr ?). In addition,

it is not clear what the altimetry value has to do here (the relative sea level trend is missing). An explanation is needed here.

L21-23: this sentence is wrong or it needs rewording. Do the authors state that since the NA plate is subject to uplift so does geocentric sea level on a TOPEX grid point?

P1032

L9: does this trend refer to the relative sea level or to the absolute vertical land motion? Note that the relative sea level trend provided by the PSMSL is about -8 mm/yr. The authors must explain how this value was estimated and provide the data period. Also the source of the tide gauge data should be included.

L10: the tide gauge trend changes by 64% when the annual signal is not removed. Can the authors explain this discrepancy?

L11-13: This is wrong. Adding the GPS-derived vertical land motion and the relative sea level trend up, it should lead to the absolute sea level trend from satellite altimetry. See for instance equation in Santamaría-Gómez et al., 2012, Global and Planetary Change.

L13: sea level change from geoid variations is also sensed by the tide gauge. Can the authors really explain the trend differences by local geoid changes?

L18: Nedre Gavle relative sea level trend is estimated by the PSMSL in -5.6 mm/yr for the same period. The authors should explain how this value was estimated.

L19-22: This sentence needs be revisited since the GPS-derived vertical land motion of 7.6 mm/yr does not seem to be in satisfactory accordance with the tide gauge trend (6 mm/yr) and the absolute altimetry trend of 4 mm/yr (see my comment on L11-13 above).

P1033

L21: the Churchill relative sea level trend provided by the PSMSL for the 1940-2009

period is about -9.5 mm/yr. The authors should again explain what this trend represents and how it was estimated.

L26: the authors should include some reference for such construction fault or remove it. For instance, the cited Kaniuth et al. paper assumes it is due to sediment subsidence.

P1034

L1-3: from the vertical time series of fig. 13 it is not clear if the vertical trend has more than doubled since 2001. Do you have an estimate for this period or it is a comparison with Kaniuth et al results which were estimated with only 48 days?

L22-24: the authors should explain how the vertical land motion was estimated from the relative tide gauge sea level record. Following my comment on L11-13 (page 1032), in order to extract land motion from a tide gauge we need a hypothesis/observation/model for the absolute sea level signal recorded by the tide gauge.

P1037

L12: the authors should specify the percentage of stations with discrepancies below 1 mm/yr with respect to ULR solution.

L13: the ULR solution from Bouin and Wöppelmann 2010 is rather obsolete (the data processing described by Wöppelmann et al., 2009 was performed in 2007). Note that since 2007, two improved ULR solutions have been published by Santamaría-Gómez et al., 2011 and 2012, respectively. These solutions have significantly increased the GPS-near-TG network. A comparison of the vertical velocities with the last ULR solution would be far more interesting since this has never been done yet (even within the TIGA project).

Technical corrections

P1026

L10: add “correcting the vertical land motion in tide gauge records”. Remove “regional

and global”.

L12: methods -> techniques

L13: The former one -> Satellite altimetry

L17: totally -> some

L21: remove GPS. Pilot Proyect -> Working Group

L24: reserch -> research

L26: older -> obsolete

P1027

L3: remove “and made possible”

L9: GPS -> IGS

L13: estimates -> observations

P1028

L5: the global -> a global

L8: GPS near tide gauges

L17: remove reference

L24: remove X, Y, Z. Remove “of all stations”

P1029

L26: remove absolute

P1030

L2: accuracy -> precision

L4: accuracies are-> accuracy is

L22: at -> near

P1031

L14: add a comma after Washington

P1032

L8: CGPS -> GPS

P1036

L15: hit this region

P1037

L13: the recent -> a

L19: the global -> a global.

P1038

L1: the recent -> a

Interactive comment on Solid Earth Discuss., 4, 1025, 2012.