Earth Syst. Sci. Data Discuss.,
https://doi.org/10.5194/essd-2017-30-RC1, 2017

Earth System Science Data Discussions

Interactive comment on "A 14 year dataset of in situ glacier surface velocities for a tidewater and a land-terminating glacier in Livingston Island, Antarctica" *by* Francisco Machío et al.

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Received and published: 19 June 2017

Dear Authors, it was my task to read your paper and to review it. I found your data set very interesting and valuable. I was an enormous effort to collect these data over 14 years in order to estimate the velocities from the positions. Nevertheless, I have some comments and suggestions, which I hope will improve the paper.

General comments:

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I would recommend to provide - with the data - an additional file (e.g. Readme) that

describes the content of the Zip-archive. As a non-GIS user I found it a bit complicated to access the data. After installing an open source GIS on my Linux PC I was able to read the data and to visualize them, which was helpful but took some time. Therefore, providing a simple ASCII file that contains the data of the shape file would be very useful. It makes the access to non-GIS users easier. Nevertheless, I have understood the advantages of a GIS environment.

The authors have provided a complete data set open to any potential users. The large advantage is also that every user can derive its own velocity field using a different approach. But in order to do so, the authors should add some additional information. For example, the provided data file contains additional stations, which are present in the available table and the appendix A. The reason is unknown.

Specific comments:

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[P: page; L: Line]

P3/L16-20: Considering the standard deviations of the mass balance I would prefer a formulation like "... are not significant different from zero..". Therefore a discussion like " ... a slightly more negative balance because of" can be misleading based on the data. Can you add in a short sentence how the mass balances were estimated?

P4/top (3. Methods): In this context, you should speak about differential GNSS methods, since you used two GNSS-receiver: one as a base at JCI and one as the rover in the network of stakes. This should be clear for the reader from the beginning of this section. Please mention the distance between the base station and the rover. Since the base station operates permanently, I would have expected an accuracy better than 1 cm for the horizontal components. You should also be able to derive plate tectonics. Well, this does not matter so much for the local estimation of the velocity field.

Concerning the applied "fast static mode" with a site of 10 seconds only. I believe that

this is a very short occupation time. I wonder if you were able to resolve the ambiguities and estimate a precise position. Is it possible that the “fast static” sites do not fit well with the second-degree polynomial approximation? Can you comment on this fact?

I would also mention here that the estimated coordinates of the stakes were projected into the UTM-System using Zone 20S.

P4/L16: My first impression was that the variable t with the index n represents any possible time. While reading the paper, equation (2) and equation (4) imply that “n” stands for the last observation in time.

In this context, I also do not understand the purpose of equation (1). For the derivation of the second-degree polynomial approximation there is no need to form any delta x (or delta y etc.). To keep it clear I would simply remove it. It continues with equation (2), which in my eyes is rather the vector of observations (reduced to one component (e.g. X or Y)) containing all the positions of one stake for the entire period. Is it not the case that X(t_n) (eq. 2) is the same as the vector X in equation (4)? I find this mathematical presentation confusing and recommend a simplified form.

Page 5 (top): You have decided to use a least squares approach treating all the observations with equal weight. On the previous page you write that the accuracy ranges between 0.07 to 0.6 m. I wonder now why you have decided to use equal weights. Would it not be possible to improve the results by using different weights? Can you comment on this?

Page 6 (equation (6)): The term Sigma_X0 is not explained. I suppose it is the a priori unit weight. In the same context I would consider e_x to be the “estimated variance of unit weight” a posteriori. In the next section you treat it as the root-mean-square error in position. I do not understand this expression and would rename it. The value of e_x rather indicates how well the approximation fits the positions of the stakes, as you say in the following sentences (P5/L11-L12). You could estimate the accuracy of the coefficients with (e_x**2)*inv(N). The elements on the diagonal of this matrix are the

variances of the coefficients.

Page (6) equation (7) and (8): I do not understand the origin of these two equations. My approach would be based on the following relation based on error propagation.

Velocity is given by two positions X2 and X1 and the time difference delta t [t2-t1] (assuming the error in time can be neglected):

V=(X2-X1)/(delta t)

Error propagation:

(S_v)**2= (-S_x1/(delta t))**2+(S_x2/delta t)**2

Assuming equal precision for the coordinates X1 and X2 gives:

Standard deviation of velocity: S_v= sqrt(2)/(delta t)*S_x => e_v=sqrt(2)/(delta t)*e_x

Therefore, I cannot see that the error of the velocity component is dependent on the size of the velocity or the distance between the two positions. It is dependent on the precision of the estimated positions and the time between the reoccupation.

Description of the datasets:

I found in the shape file four more fields addressed with dias, prevista_x, prevista_y and movxy. They are probably not necessary. But could you please describe their purpose or remove it? Could you also add information on the fields ”t38_max_x” and “t38_may_y”. How did you obtain the maximum error? I believe it is absolute value of the maximum residual (Rx/Ry).

I used the data of the shapefile and converted them into an ASCII readable text file. Based on that I re-computed some of your coefficients and velocities using Octave/Matlab. Testing it on EJ14 I was able to recover your results with small differences. Xa(tn)= -8.31294e-06*tn*tn+5.62765e-03*tn + 635350.468 Ya(tn)=1.90564e-05*tn*tn+-1.11635e-02*tn+3048898.201 Ex: 1.68 ey: 4.45 Vmax: 57.31 Azi: 336.68

But for some others like EJ35 I could not get the same results. Is it possible that you have removed outliers that were ignore during estimation? In the same context I noticed that some stations were called EJ14r or EJ14R. First, what is the difference between EJ14 and EJ14R? Is there a difference or are these stations identical? Also, I find in the list more stations than shown in the table (e.g. EH14, EH16, EH18, EH23, EH26 etc.). Is there a specific reason to remove those? It might be necessary to revise the table and explain the reason for removing those stations from the table.

Technical comments:

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Please consider most of my remarks as suggestions. I do not insist on a complete implementation. Since I myself do not speak English as a mother tongue, some corrections have to be treated carefully. [P: page; L: Line]

P1/L14: . . . repeated GNSS measurements in a dense network of 52 stakes ..

P1/L16: . . . 2000-2013 and were “performed/carried out” at the . . .

P1/L18: . . . . This dataset “is” useful as input . . .

P1/L20: D-InSAR (not D-inSAR)

P1/L24: . . . source of information for “the study of glacier dynamics”.

P1/L31: . . . commonly used as input data “for” numerical models.

P1/L33: . . . are used instead for tuning “the” model’s free . . .

P1/L36: . . . more and more “common” to establish ..

P1/L44: are still of “large” interest, since . . .

P1/L48: , “the” GoLive project . . .. . . and “the” ENVEO CyroPortal

P2/L2: . . .measurements “in” a dense “network” of stakes . . .

P2/L5: .. in the late 1990s “on” Johnsons . . .

P2/L26: .. (Fig. 1c)

P3/L26: Fig. 2. Network of stakes on . . .

P4/L2: The glacier surface velocities were estimated based on repeated differential GNSS measurements in a network of stakes deployed . . ..

P4/L3: . . . .The “network” of stakes consisted (as of the end of the reported measurement period) . . .

P4/L5. The GNSS measurements were “carried out/performed” using a Trimble 5700 system, with “d”ata “c”ontroller TSC2. The observations were “performed/carried out” either in ..

P4/L7: for the latter, an occupation time of 10 s”econds” was “used”. . . .

P4/L9: e.g. The GNSS base station was located at the neighbouring Juan Carlos Station I (Fig.1) ”in a distance of 2-5 km from the two glaciers”.

P4/L14: From the collected positions of the stakes at different epochs, a surface velocity map . . ..

P4/L27: .. by “least squares fitting method”, minimizing . . .

P5/L3: X). For a least squares “approximation, assuming observations of equal weight,” these equations are:

P5/L6: This first sentence can be removed.

P6/Table1: Please define e_xy in the description of the table 1. It is not given in the text. I have checked it for EJ14 and there it is probably sqrt(ex*ex+ey*ey).

P8/ Figure 3: I find it very difficult to read the legend in the Quickbird map of this figure. Please make sure that the final print is showing the legend.

P9/ Figure 4 and 5: Same problem, I cannot read in the provided pdf-file the legend of the left map. The upper right map is not really necessary and also not readable. Both upper right maps of figure 4 and 5 show the same glacier (Johnsons).

P10/L2: . . . value of the velocity for the same date “(13/02/2013)”. . . .

P10/Figure 6+7: Again, the legend is too small. I could imagine that a wider color spectrum makes it easier to identifier different zones. The here used spectrum from yellow to red makes it difficult to separate different zones.

P11/L5-10: Can you support your findings with numbers. Give values for the velocities and support terms like “decreasing pattern” or “high-velocity zone”. What are the velocities for these?

P11/L11: . . ., which has extremely “steep” slopes. (?)

P11/L21: As mentioned before, I would not consider this as “root-mean-square position error”.

P14/Appendix A: EJ14 and others are missing in the table! Also I would avoid the the error term in this table as long as it estimated based on formular (7) and (8),

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