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Interactive comment on "A range correction for ICESat and its potential impact on ice sheet mass balance studies" *by* A. A. Borsa et al.

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This manuscript chronicles the discovery of a previously unrecognized error of elevations derived from ICESat satellite laser altimetry observations. The authors also examine the impact of this error on regional and ice sheet-wide elevation change rate reconstructions. The error, called G-C offset, is caused by different processing of the transmitter and receiver waveforms (centroid of the transmitted pulse vs. peak of the fitted Gaussian of the received pulse). The G-C offset comprises both a random component and a time-varying bias. Correcting this error and analyzing its impact on published mass balance estimates is critically important, as due to the vast size of the ice sheets, even a small trend can result in large mass balance errors.

The manuscript is well-written, provides sufficient details and easy to follow. However,

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there a few changes could improve the presentation of the results.

Developing the G-C correction and analyzing the spatial and temporal evolution of this offset requires information extracted from different ICESat products. The authors assume that the readers are familiar with the different products, their relationships and with the different approaches used for range-estimations for different landcover types. A paragraph summarizing the relationship (hierarchy) between the different products as it pertains to waveform processing the G-C offset correction would be very useful. The G-C error is intimately linked to the waveform shapes. Therefore, providing details about the different waveform shapes assumed for different products would be beneficial for the readers. For example, instead of saying "G-C timing was not intended to be used for range determination of simple ICESat return waveforms", one should rather explain that it was not intended to use for surface types for which the return waveform can be estimated by single Gaussian peaks, such as land ice (GLA12). Also, GLA14 is mentioned, but without explaining why it was not corrupted by the G-C error.

I was disappointed that the impact of the correction on the results for the Uyuni site was not presented in detail. Did the correlation between the waveform shape parameters and the ICESat elevation errors decrease after the correction? If yes, how much? How about the temporal trend of the ICESat elevation errors (misfits) – we only learn that the previously positive trend turned into negative, but no details are given.

Finally, as Figure 5a shows, the bias trend caused by the G-C correction is not linear. While approximating it with a linear trend provides a means to examine the impact of the G-C error on published average elevation change rates, large uncertainties remain. The authors use the example of determining Antarctic ice shelf thinning rates to compare the performance of different G-C correction methods. They demonstrate a good agreement between thinning rates obtained by a rigorous G-C correction of individual observations, and by the application of a linear global G-C correction. While these results are interesting, they might or might not be applicable for other cases, due to the simple averaging scheme used for estimating thinning rates and the simple geom-

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etry of the flat, smooth ice shelves. In my opinion, it is very difficult (or impossible) to assess the accuracy of elevation/volume/mass change estimates derived obtained by applying a global, linear G-C correction or a set of inter-campaign biases. Therefore, this practice should be discouraged.

Specific comments:

Abstract: while the magnitude of the G-C offset indeed increases with decreasing energy for Laser 3, Laser 2, especially L2A doesn't exhibit this behavior.

Page 3, line 6: according to the Zwally et al., 2002 ICESat't target accuracy was 1.5 cm/yr, not 2 cm/yr

Salar Uyuni DEM: what is the accuracy of the GPS derived DEM? What was the justification for using linear interpolation between the different dates? What is a hybrid DEM?

Page 5, lines 22 and later: I believe that calling waveform shape parameters "metadata" is misleading. The expression "metadata" is commonly used to refer to data about the data, for example who, where, when collected the data.

Page 7, equation 1: it should be mentioned that the notation uses the original ICESat parameter names. For example d_parmTr(2) looks complicated, but it is simply the second component of the Gaussian fit used to characterize the transmitted waveform.

Interactive comment on The Cryosphere Discuss., 7, 4287, 2013.