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Interactive comment on "Technical note: A low-cost albedometer for snow and ice measurements – Theoretical results and application on a tropical mountain in Bolivia" *by* Thomas Condom et al.

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We are grateful to the anonymous reviewer for his positive feedbacks. We present below our detailed answer to each of their points. The reviewer's comments appear in black Times font and our responses appear in brown Arial font. Page 7.L120. (also Page 14.L 243). Can you comment on the possible applicability of this instrument on calculating the same index in other regions where "hours" associated with these angles may be a little bit different? My impression is that the light sensor, although advertised as deployable in outdoors, was conceived for light measurements on more controlled

environments, where the light source is between the limits described in the paper. I know that the authors suggest more studies at the end of the manuscript and I am not asking for a complete calculation of hours and days where this application would be ideal, but some notion of ranges could be good.

The angle of view of the sensor is 55°; which limits where and when it can be used. To determine these limits, we calculated what the solar angle is at noon for different latitudes throughout the year. Considering the LCA is operational when the solar angle is greater than 55° at noon, it may be used all year long at latitudes between 12°N and 12°S, from March to October between 12°N and 30°N, and from September to March between 12°S and 30°S. The sensor cannot be used at latitudes higher than 60°N or 60°S at any time throughout the year. Between 45°N and 45°S the sensors can be operated during the ablation season when the glacier surface changes are the most important.

We specify the applicability of the LCA in terms of latitudes and periods of the year in the revised version of our manuscript ('Abstract' and 'Discussion and conclusion' sections).

In the abstract you can now read: 'Despite the limits imposed by the angle view restrictions, the LCA can be used between 45°N and 45°S during the ablation season (spring and summer) when the melt rate related to the albedo is the most important.'

In the Discussion and conclusion we specify the applicability of the LCA as follows: 'The angle of view of the sensor is 55°; which limits where and when it can be used. To determine these limits, we calculated what the solar angle is at noon for different latitudes throughout the year. Considering the LCA is operational when the solar angle is greater than 55° at noon, it may be used all year long at latitudes between 12°N and 12°S, from March to October between 12°N and 30°N, and from September to March between 12°S and 30°S. The sensor cannot be used at latitudes higher than 60°N or 60°S at any time throughout the year. Between 45°N and 45°S the sensors can be operated during the ablation season when the glacier surface changes are the most important.'

Table 1.- The same applies for the minimum operating range. There might be many locations where the -20_C is simply too high, as for example at the accumulation zones of mountain glaciers or whole glaciers in those located in sub-antarctic regions. This is true and might be a limitation for the application of the LCA in very cold regions. Therefore, we added a sentence that indicates this in the revised version as follows: 'Due to its operating temperature range (see table 1), the use of the LCA is limited at very cold locations where the temperature falls continuously below -20°C for long periods of time. However, this may not be too critical since the main purpose of the device is to document albedo surface changes during melt periods when such low temperature conditions are not typical.'

Page 14.L249 to Page 16.L283. and Fig 6. I wonder if it is possible to show the linear models for the individual land surfaces studies, i.e., bare soil and snow. My point here is that in 6A the cluster at the bottom (mostly bare soil?) might be influencing the slope for snow, which is the aim of the paper. In fact, reading the abstract (L.32) gives me the impression that this method works best for non-glacierized areas (rËĘ2 0.83 versus 0.92). Another thing is perhaps including the error term in the equations of each plot; 6B seems to show a fairly consistent bias so perhaps in this case (for different snow conditions) a bias correction can improve the signal the authors are finding. We made a new version of figure 6 according to your comments: we included different regression lines considering all of the data; under cloudy and sunny conditions. The caption of the Figure 6 now reads: "Figure 6: A Comparison of the daily measured albedo at the ORE site using the CNR1 radiometer and the LCA for the period from 07/11/2012 to 06/03/2013 – daily data calculated from 11AM to 3PM – ORE; RMSD = 0.1; n = 247. B Comparison of the daily measured albedo at the SAMA site on the Zongo Glacier using the CM3 sensor and LCA for the period from 01/12/2012 to 9/10/2013 – daily data calculated from 11AM to 3PM; RMSD = 0.08; n = 175. The red dots are for cloudy

conditions and the white dots are for sunny conditions, as per the classification given by Sicart et al. (2016). The calculated regression lines are shown in red for cloudy conditions, blue for sunny conditions, and black for all conditions. The dotted lines represent the bisectors."

Page 2 L.26 and 31 (and other places where this word shows up), perhaps replace "Classical" for "Traditional"? We agree and replaced "Classical" with "Traditional".

Page 2 L.29 and Page 13 L.235. To me "right hand side" is not a good way to refer to a location for the reader, because the point is actually located at the bottom of the map. I suggest "the southern slope of the moraine arc (Fig 5)" or something along these lines. In order to be more explicit, the text has been modified according to your remark as follows: "on the crest of the lateral moraine".

Page 2. L.38. please reword "images showing the surface state of the glacier" (surface conditions?) We reworded "images showing the surface state of the glacier (i.e snow or ice)" by "images showing the surface conditions of the glacier (i.e. snow or ice)."

Page 5.L88, I suggest deleting the word "classical" We changed the word "classical" to "traditional".

Fig. 1: I really don't see the black arrows. You are right. We modified the figure by adding the black arrows.

Page 6.L112, the abstract says 0.26 instead of 0.3 We changed the value in the text from 0.3 to 0.26.

Page 6.L115 "Figure 2" twice (even with a dot in between) difficults the flow of the document to me. I suggest changing the second "Figure 2" for "In that figure" or something similar. As the referee suggested, we changed "Figure 2" to "This figure".

Page 8. L142. I don't think "repartition" is the right word, perhaps "distribution" We changed the word "repartition" to "distribution".

Page 10.L166. I don't see where this parenthesis closes. We closed the parenthesis.

Page 10. L169-170. Suggest replacing "a cloud optical depth equal to 64" for "an optical depth of 64". As suggested, we changed the wording "a cloud optical depth equal to 64" to "an optical depth of 64".

Page 10. L173-178, Wouldn't this explanation be clearer using equations instead? We agree with this comment and added equations in order to be clearer. In the revised version you can now read: "The theoretical broadband albedo and LCA albedo indexes are calculated over the 0.205-3.9 μm range using the theoretical solar irradiance, the LCA spectral response from Figure 2, and the semi-infinite diffuse beam albedo from Figure 3. The total incident radiation flux for LCA, Sinc (in W m-2), is obtained by summing the theoretical incident radiation fluxes, Sinc-th(λ) (in W m-2 μm-1), weighted by the LCA response, Rλ (-), at each spectral increment of 5 μm for both cloudy and clear sky conditions (Eq. 1). S_inc=∑_(λ=0.205)ˆ3.9âŰŠãĂŰS_(inc-th) (λ) R_λ dλãĂŮ (Eq. 1) Similarly, the reflected radiation flux for the LCA, Sref (in W m-2), is obtained by summing the theoretical reflected radiation fluxes, Sref-th(λ) (in W m-2 μm-1), weighted by the LCA response, Rλ (-), at each spectral increment of 5 μm for each snow or ice class considered (Eq. 2). S_ref=∑_(λ=0.205)ˆ3.9âŰŠãĂŰS_(ref-th) (λ) R_λ dλãĂŮ (Eq. 2) Then, the LCA albedo index, Albedoindex (-),is the ratio between the reflected and incident LCA radiation fluxes for each type of snow and ice surface, and cloudy or clear sky conditions (Eq. 3). ãĂŰAlbedoãĂŮ_index=S_ref/S_inc (Eq. 3)."

Figure 4. It says theoritical instead of theoretical. Also, I think this figure is too small. We changed "theoritical" to "theoretical" and enlarged the two figures.

Page 20. L336-346. I feel this paragraph is a bit disconnected from all the previous text. I see no previous reference on snowline elevation or to precipitation behavior. Perhaps they need to reference figure 8 in this paragraph. We agree with this comment and described the dynamic of the snowline elevation in section 3. You can now read: 'For the whole glacier, the main precipitation type is solid and the albedo increases after

each snowfall with a snowline that could reach the front of the glacier. After that, during dry consecutive days the snowline rises up due to the snow melting processes.' We added the following sentence to give the logical chain between the two sections: 'Using this threshold, it is possible to plot the evolution of the glacier cover (even ice or snow) over time for different altitudes ranging from 4929 m a.s.l. to 5184 m a.s.l. (figure 8).'

You will find the revised manuscript in supplement.

Please also note the supplement to this comment:
https://www.geosci-instrum-method-data-syst-discuss.net/gi-2017-55/gi-2017-55-AC1-supplement.pdf

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