The Cryosphere Discuss., 6, C1507–C1515, 2012
www.the-cryosphere-discuss.net/6/C1507/2012/

The Cryosphere Discussions

Interactive comment on "The recent retreat of Mexican glaciers on Citlaltépetl Volcano detected using ASTER data" *by* J. Cortés-Ramos and H. Delgado-Granados

Anonymous Referee #1

Received and published: 12 September 2012

General comments: This paper deals with the evolution of Mexican glaciers on the Citlaltépetl volcano using ASTER images. The authors firstly document the areal and glacial front altitude changes of the glaciers over the 2001-2007 period and use the 1958 glaciers extension to evaluate the glacial retreat over the second half of the 20th century. Then, they present a methodology to compute the spatial distribution of the net radiation using ASTER images. They finally present the results and discuss them, trying to relate the glacier retreat with the distribution of the net radiation at the glacier surface.

To my point of view, it is always interesting to document glacier changes and glaciolog-

ical processes in region of the world where information is very rare. However a major problem I have with this paper is that the authors try to relate changes in surface-area through time with changes in net radiation at the glacier surface computed using satellite images for only 3 given dates! I can accept that the distribution of the net radiation at the glacier surface at a given date can give an idea of the ablation at this same date, but it cannot be representative of the ablation over the whole year (because of the seasonnal cycle of several terms of the radiative balance, and because of the changes of the glacier surface between snow and ice cover) and furthermore, the ablation is only one parameter of the mass balance whose changes over time govern the surface-area and length changes. Furthermore, the response of glaciers in terms of surface-area and front elevation changes is dependent of the dynamic (i.e. the glacier flow), which depends on the slope, size of the accumulation zone, thermal regime of the glaciers.... So that, the surface-area changes are not a direct response to fluctuations of climate parameters....

Finally, the paper is not free of errors and misunderstandings. As a consequence, errors need to be corrected and many points need to be improved to allow the paper to be published in TC, and it would take to much time to be done as revisions during the time left to the authors, so that, I think that the authors must be encouraged to consider the following comments and submit again the paper to TCD, as a new submission.

A number of points are not substantiated by the data and analyses presented in this study (i.e., the relation between surface changes and net radiation distribution, the relation between sublimation and net radiation and temperature, the representativity of the net radiation map derived from ASTER images in comparison with the seasonnal/annual cycle of net radiation, ...). Furthermore, many points mentionned by the authors as part of the presented work are general glaciological statements which are not demonstrated in the present paper (i.e., the role of the net radiation in the surface energy balance). The authors need to present with more details the data used in the study: the meteorological data, as well as the satellite images.

TCD

6, C1507–C1515, 2012

The paper would strongly gain from further analyses. Maybe the issue about glacier surface-area changes over the second half of the 20th century could be improved by analysing and reconstructing glacier surface-area changes from Landsat images (Landsat 5 available since the early 80s). Maybe some further analyses could be done concerning the meteorological data recorded by the two AWS (on and close to the glacier), to describe the seasonnal and annual cycle of the different energy fluxes. Maybe improving the linkage between the net radiation recorded on the glacier at the AWS and the one computed from the ASTER images could be done.

I recommend:

1) Realising a more extended study of glacier surface-area change using Landsat images, freely available on the USGS website, and analyse the results in relation with meteorological data available in the region, and/or reanalysis data, and/or climate indices like SOI, STT...

2) Adding a description of the climate seasonnality and the mass balance seasonnality in this region of the world.

3) Presenting in detail the seasonnal and annual cycle of the meteorological data measured at the AWS since 2006 on and close to the glacier (SWin SWout, LWin, LWref, albedo, Rnet, T°, humidity, accumulation, etc...) instead of quoting a Master tesis work (Ontiveros-Gonzalez, 2007), impossible to find for a foreign researcher.

4) Working on the net radiation maps computed from the ASTER images. The authors claim that their results of net radiation distribution on the glacier for a single date per year are representative of the energy balance in the rest of the year, but this point is doubtful when one sees the annual cycle of Rnet shown in Figure 4. One first thing to do is to compare the albedo and surface temperature values given by the satellite data with the values given by the AWS on and out of the glacier.

Finally, the Abstract, Introduction and some other parts of the paper would gain of

TCD
6, C1507–C1515, 2012

being reviewed by an english native speaker.

Specific comments:

Abstract:

P. 3150, L. 2: replace “elimination” by “disappearance”.

P. 3150, L. 9-10: replace “would be gone” by “might have disappeared”.

P. 3150, L. 10-12: The sentence “The net radiation from ASTER images and the energy fluxes calculated via the meteorological data at the glacial surface show the close relationship between glacial shrinkage and surface energy balance”, is not demonstrated in the paper! There is no analysis of the surface energy balance, even if a AWS is apparently available on the glacier since many years...

P. 3150, L. 12-13: The last sentence “The magnitude of changes... glacial retreat in Mexico” can be removed from the abstract as this point is not demonstrated in the paper.

Introduction:

P. 3150, L. 20: replace “understanding” by “knowledge”.

P. 3150, L. 22: replace “Mexico” by “the surrounding areas”.

P. 3151, L. 1: replace “it is possible there could be water shortages” by “it is possible that water shortages may occur”.

P. 3152, L. 4: “algorithms were developed to”. The used equations already existed before the study was realised, so that you should write, “were used”.

P. 3152, L. 6: “in this work the relationship between net radiation and glacial retreat was established or the entire glacier surface”. I can’t see in this paper any relationship established between these parameters.

2 Glaciers of Citlaltépetl Volcano

TCD

6, C1507–C1515, 2012

P. 3152, L. 21-22: A reference is missing for the advances of the glaciers during the early Holocene, and furthermore how these advances were dated??

P. 3152, L. 23: remove the paranthesis (5000-100 yr before present). Do you consider these dates as the time limits of the Neoglacial? Were does it come from?

P. 3152, L. 26-27: "the LIA ended in Mexico during the mid 19th century". How the moraine were dated? I can't find the quoted references by Heine.

P. 3153, L. 7: replace "during" by "in". Last paragraph beginning P. 3153, L. 19: instead of quoting the work of Ontiveros-Gonzalez which is a student tesis, imposible to find for a foreign researcher, you should better describe the regional seasonnality of climate. And it is the same thing everywhere in the paper when you quote this reference to mention the works on surface energy balance realized on the glacier (see "general comments #3).

P. 3153, L. 21-22: "Furthermore, the net radiation on the surface impacts this seasonality". I assume "this" is used for "local weather" which appears in the former sentence. How can the net radiation at a glacier surface impacts the local weather?

P. 3153, L. 24-28: this sentence has to be re-written. It is because, the region of interest is far from pollution sources and because the volcanic activity is low, that you can assume that climate change is the main cause of glacial retreat.

3.1 Meteorological data

The location of the two AWS could be shown on the map (Fig. 1).

More details are needed about the NARR data (resolution of the grid, method of interpolation, coordintate of the grid cell(s) used in this study, etc....)

What about the meteorological data after the 15th of october 2009. The paper has been submitted in May 2012!

3.2 Glacier mapping from ASTER

TCD

6, C1507–C1515, 2012

Interactive Comment

What are the Path/raw of the used images?

What are the dates of the used images?

What is the accuracy on the ground control points?

What is the resultant error on the glacier surface-area computed?

3.3 Spatial distribution of the net radiation

P. 3156, L. 25: remove “it” after “were made”.

P. 3156, L. 27: replace “moment” by “date”.

P. 3156, L. 28: remove “it” after “is made”.

P. 3157, L. 2: remove “a” after “and”.

P. 3157, L. 11: replace “Stephan” by “Stefan” and write it like it: Stefan-Boltzmann. Stefan is not the first name of Boltzmann, his first name was Ludwig! But Stefan the family name of Jozef Stefan, the austrian physicist, thesis director of Ludwig Boltzmann.

P. 3157, L. 14: replace “Boltzmann constant” by “Stefan-Boltzmann constant”.

P. 3158, L. 15: remove the “s” for the word “regression”.

P. 3158, L. 23: replace “Stephan” by “Stefan”.

P. 3159, L. 11: replace “Stephan” by “Stefan”

4.2 Surface distribution of the net radiation

This part has to be completely changed, and reorganised, see general comments #3 and #4.

P. 3160, L. 10: It would be more usefull to describe the energy balance at the glacier surface than given the reference of a Master Thesis (Ontiveros-Gonzalez, 2007) impossible to find.

TCD

6, C1507–C1515, 2012

P. 3160, L. 12: “Those values ... lead us to calculate” Why “lead us”... Where these results are presented in the current paper??? There should be!

P. 3160, L. 16 and 18 and 21: replace “on” by “at”.

P. 3160, L. 20: replace “where” by “when”.

P. 3160, L. 20-21: “This period is accompanied by an increasing of net radiation values on the glacial surface”. Due to what?? Explain.

P. 3160, L. 24-25: “A strong sublimation occurs due to the intense radiation in spite of the prevailing cold temperatures of this season”. Where does it come from? The sublimation is not a consequence of the radiation but of the turbulent fluxes and so of the temperature and humidity gradient between the glacier surface and the air. Furthermore, there is no relationship between cold temperature and sublimation. You can have sublimation with negative temperature! In other words, cold temperature do not prevent sublimation to occur.

P. 3161, L. 1-2: “That means an absence of sublimation that may enhance the effects of radiation making the mass balance more negative.” How can the absence of sublimation that enhance the effects of radiation?? What does it mean?

P. 3161, L. 6-7: “the more vulnerable zones for glacial shrinkage (mass loss) are those where the net radiation has the highest differences”. What does “the highest differences” mean??? Differences with what? Are you talking about spatial variability?

P. 3161, L. 10: remove the “s” at “decrease”

P. 3161, L. 15: replace “difference between” by “higher from”

P. 3161, L. 16-18: “Since the images were selected into the driest month of the year in Mexico, this could be considered as representative of the ablation season in a balance year.” How can you say that!! This has to be demonstrated!

P. 3161, L. 18-19: “net radiation is then the controlling factor for ablation on the glacial

TCD

6, C1507–C1515, 2012

surface". This point is largely known for tropical glaciers... you should almost quoted a reference, which are not missing, see the papers of Kaser, Wagnon, Favier, Sicart, Molg, etc...

P. 3161, L. 19-20: "The net radiation values for 2007 are in agreement with the values measured on the same day of the year by the Glaciar AWS". Interesting to read, but you have to mention the values given by both the AWS and the satellite!

5 Discussion and 6 Conclusions

The discussion session has to be completely changed. This part is full of inaccuracies, generalizations not supported by the results, inconsistencies, etc. ...

Just one exemple: the authors mention that March 2007 was the highest values of Rnet, they conclude that a strong ablation was occuring on the glacier, but this same year, they mention that the retreat was very reduced... this is inconsistent with their hypotesis that the glacier retreat is linked to the distribution of Rnet (which is a wrong hypothesis because of the time-lag in the response of the glacier surface-area changes to the changes in mass balance).

The conclusion has also to be changed!

Figures

Figure 1: The map showing the glaciers extension in 1958 could be in color and adding the contour line of the glaciers in 2007 to show the retreat over the 50 yrs. What is the source of the DEM used in the background?

Figure 3: The X-axis should be changed to be proportional to time.

Figure 4: The authors say P. 3155, L. 1., that the data are available over the period from 2006/09/17 to 2009/10/15, but only present the data for the period Sept 2006 to July 2007. The analysis of the seasonnal and annual variation of Rnet at the glacier surface would gain by presenting all the data. Also, what about the data after 2009?

TCD

6, C1507–C1515, 2012

We are in 2012.

Another important point: the peak in early March 2007 reaching about 500 m/w2 looks more like an error of measurements! Apparently, the data presented on this graph are daily average (it should be mentioned). And reaching such a value for a daily average of Rnet is impossible.

Figure 5: The scale must have intermediate graduation (not only the min and max values), to help the reader to better understand the spatial distribution of Rnet.

Figure 6: As for Fig. 3, the X-axis should be proportional to time. Also, where does the values for 1945, 1971/1975, 1988 and 1994 come from?? The used data to obtain these values should be presented in the text. Also, what is the dating of the LIA maximal extent, and how the dating was made?

Interactive comment on The Cryosphere Discuss., 6, 3149, 2012.