

Review of Climate of the Past manuscript number: 2011-64 entitled “Degree-day melt models for paleoclimate reconstruction from tropical glaciers: calibration from mass balance and meteorological data of the Zongo glacier (Bolivia, 16° S)”

Overall impression:

This paper gives a thorough comparison of the application of various kinds of temperature index models on a single tropical glacier in the Bolivian Andes. It utilizes a very complete data set of mass balance and meteorological observations to calculate mass balance profiles for average conditions as well as individual years. This alone makes this paper unique enough for publication. The motivation for the research is clearly stated as being for the purpose of using such models for reconstructing temperature and/or precipitation conditions at locales where paleoglaciers existed. However, much of the material to that end seems added on as an afterthought or is less well developed than the rest of the paper. A more thorough study would apply this work to a couple of test glaciers for the purpose of reconstructing climate and for revealing the potential uncertainties in doing so.

My evaluation based on the CP criteria is:

Scientific Significance: 3

Scientific Quality: 2

Presentation Quality: 2

1. Does the paper address relevant scientific questions within the scope of CP?
The paper addresses relevant questions which are somewhat outside the scope of CP
2. Does the paper present novel concepts, ideas, tools, or data?
The paper combines existing techniques and explores their application in a novel way
3. Are substantial conclusions reached?
The conclusions are strong but not necessarily substantial. I would like to see a more thorough application to paleo glaciers.
4. Are the scientific methods and assumptions valid and clearly outlined?
Yes.
5. Are the results sufficient to support the interpretations and conclusions?
Yes.
6. Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?
Yes
7. Do the authors give proper credit to related work and clearly indicate their own new/original contribution?
Yes
8. Does the title clearly reflect the contents of the paper?
Yes

9. Does the abstract provide a concise and complete summary?

Yes

10. Is the overall presentation well structured and clear?

Yes

11. Is the language fluent and precise?

There are many grammatical errors in this paper. I've suggested fixes for many of those, but I'm sure there are a lot more. This paper needs a very careful reading by a native English speaker.

12. Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

Yes

13. Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

No

14. Are the number and quality of references appropriate?

Yes

15. Is the amount and quality of supplementary material appropriate?

NA

Overall, I think this paper is acceptable with major revisions. If a re-review is needed, I would be happy to provide one.

Major Issues

--It appears that the comparisons are made against what look like smoother mass balance profiles rather than the much more variable stake data distributed across the glacier surface. It's not clear whether the models are run in a fully distributed fashion. but, if they are, then it might make sense to analyze the mass balance at every stake rather than against the smoother, average balance profile for a given year. Judging the model comparison based on the mass balance profiles may not allow the more complex models incorporating solar radiation to perform as well as they otherwise would.

--In the abstract, the author refers to the technique of obtaining a temperature and precipitation change from a glacier area as an "inversion". While inversion techniques could be applied, the methods used here and for most other similar studies are not formal inversions. Thus this terminology needs to be changed.

--There are very many typographical and grammar errors in this paper that need to be fixed before publication. I outline some of them below, but there are surely more.

Minor Issues:

Page 2122, lines 7-10. It is stated here that "computation of accumulation is generally quite straight

forward". This idea is reflected in the treatment of accumulation in this paper wherein a uniform value is applied everywhere in the accumulation area. I think the assumption and the treatment of precipitation is far more complex and this needs to be addressed in the paper. When the authors finally get around to looking at T vs Pre curves, the temperature variability for a given precipitation amount is analyzed, but the precipitation variability is not discussed.

Page 2125, line 4: What exactly does "characteristics of a temperate glacier" mean here? Are you discussing the climate? The ice temperature? The accumulation/ablation seasonality?

Page 2125, line around 22: I think you are referring to temperatures measured within the glacier's boundary layer versus those measured away from the boundary layer. please change the wording to reflect this.

Page 2126, line 15: Aren't the lapse rates also governed by precipitation amount and rate? Aren't latent heating effects important here?

Page 2132, Model 3: Although it's discussed later, I'm not sure why you use a different formulation than Hock (1999)? For comparison, wouldn't it be more useful to a wider audience to maintain her original formulation?

Page 2137, lines 9-10: What does "such a smooth definition of the best R^2 mean?"

Page 2138, line 9 or so: You are comparing the performance of the various models within the accumulation area but your model for snow accumulation seems blatantly wrong to me. I understand your choice of a fixed accumulation rate up there based on limited measurements, but maybe a better approach would be to compare the actual measured accumulation with the modeled rather than the curve based on smoothed data.

Page 2143 line 24: The statement that temperature can be constrained within a degree may only be true if the precipitation is known exactly! This will rarely be the case, so the actual constraint will be much looser and will involve uncertainty in temperature and precipitation. This needs to be clarified in the text.

Editorial:

The constructs many sentences by beginning with Indeed,... These can mostly be simplified by concisely stating the the sentence without the lead-in.

2121-4: the ablation models aren't "laws" they are parameterizations or relationships

2121-10: change topographic to topography

2121-12: depluralize timescales and strike "The performed"

2121-22: change relative to relatively

2121-24: insert "the" between in and main

2122-3: use nonexistent rather than inexistent

2122-8: remove the mass balance equation

2122-14: depluralize days

2123-2: replace several with "the" and insert "that govern melt" after processes.

2123-12: change "in" to "to", change "reproducing" to reproduce, and change "day-night" to diurnal.

2123-23: change play to plays.

2124-5: depluralize "radiations" (here and throughout the text) and change "are" to is.

2124-12: depluralize “folds”
2126-12: strike “this parameter indeed” and replace with which.
2126-14: depluralize “covers”
2126-25: strike “the gauge to properly collect” and replace with measuring
2127-16: strike “Indeed”.
2127-26: depluralize “balances”.
2128-23: change “particularity” to capability.
2130-5: change “is” to as
2132-1: change “tan” to than
2133-9 to 10: Make read “These types of models (i.e. models 3 and 4) take into account...”
2133-11: Change “beams” to radiation.
2133-17: depluralize “temperatures”
2133-17: Make read “This model has the characteristic of allowing ablatiojn even when temperature is...”
2134-9: make sentence read “Parameter optimization was realized...”
2134-10 depluralize “years”
2134-14: strike “permitted to obtain” and replace with “results in selection of”
2137-12: Switch the order of “improve significantly” to “significantly improve”
2137-14: strike “a”
2137-15: Change “dispersion” to scatter and “belong to” to “are of”
2137-25: Change “a specificity” to “specific to”
2137-29: change “in” to “to”
2138-1: change “reproducing” to reproduce.
2138-6: strike “are” and change “efficient” to “efficiently”
2138-27: change “possibility to take into account” to “ability to account for.”
2139-1: change “next” to future
2139-2: pluralize model
2139-2: Which models are you referring to here?
2139-9: make read “... permits the incorporation of geometrical...”
2139-16: pluralize “glacier”
2139-16: change “inexistent” to “nonexistent”
2139-17: switch order of wording make read “directly compare”
2140-11: change “larger than” to “as large as”
2140-13: strike “by”
2140-20: change “in” to “of”
2140-21: change “than” to “as”
2140-24: using word “factors” after MF is redundant. Strike second instance.
2141-7: change “than” to “as”
2141-11 to 12: change “have not a good ability in catching” to “are not capable of capturing”
2141-15: change “valid” to validate.
2141-16: move “as low as possible” after “input data”
2141-28: depluralize “precipitations”
2142-10 insert “required to maintain the present ELA” after “input data”
2142-11: word “paramaters” is misspelled.
2142-13: change “contrasted” to “the contrasting”
2142-15: strike “or”
2142-19: depluralize “parameters”
2142-22: strike “obtained”
Sentence starting on 2142-28: Insert “However” at the beginning and strike however later in the

sentence.

2143-2: remove double negative to read “our approach yielded realistic results.”

2143-11: change “precise and accurate” to in-depth.

2143-23: change “able to fit” to “capable of fitting”

In table 4, remove the equations describing each model. These are already presented in the text and in table 3.