

## ***Interactive comment on “Climate changes of hydrometeorological and hydrological extremes in the Paute basin, Ecuadorean Andes” by D. E. Mora et al.***

**D. E. Mora et al.**

diego.mora@ucuenca.edu.ec

Received and published: 23 August 2013

The authors thank for these comments.

Several sections of the article will be rewritten. As the referee suggests, changes will be made to the structure of the article and to the concepts within it, especially in the methodology to evaluate the impacts of climate change, and therefore, in the reporting of results and conclusions.

Section 2.6 “Impact indicators” will be modified. This section will describe the proposed concepts given by the referee. This is first considering separately the changes

C4347

obtained from the GCM-RCM simulation results without downscaling, then describing the spatial and temporal variability on observed series, and finally comparing the changes obtained directly from GCM-RCM outputs with the changes resulting from the perturbed observed series. This comparison will lead to a better understanding of the impact of the statistical downscaling technique and will clarify the influence of the described local properties involved in the downscaled technique. It also will give a clearer interpretation of results in the analysis of the spatio-temporal patterns. The impact indicators and the description of the local properties of observed series will be based on: i. yearly and monthly magnitudes, ii. frequency of wet/dry events (for rainfall) and iii. events at different quantiles.

The changes made to section 2.6, will lead to corresponding updates in the section 3, “Results”. This section will be divided in three subsections: i. Spatio-temporal patterns in observed series, ii. Impact indicators obtained directly from the GCM-RCM outputs, and iii. Impact indicators obtained from the downscaled series. This will be followed by a discussion of the results.

In addition, as the referee recommends, results will be tested using absolute values instead of relative changes. This will allow us to check whether the results are disturbed when comparing changes at different locations along the study area, especially the ones related to temperature. The reason why we plotted relative changes is because these are more constant/independent of intensity values (mainly holds for rainfall). However, this will be further tested also in view of the concern by the referee, and commented on in the revised paper. For temperature absolute changes will be plotted as suggested by the referee.

According to the referee’s comment “it seems that much of the obtained results are a direct consequence of assumptions made in the precipitation downscaling routine. For instance, one of the downscaling methods uses a combination of absolute and relative changes, as visualized in Fig. 3. Fig. 5 then shows the impact of this procedure in terms of relative change (%)”, for the analysis of rainfall changes, it is possible that

C4348

when results are reported by relative changes (in percentages), sites with low rainfall can present higher relative changes. However, the use of the absolute delta does not affect high intensities (as the maxima rainfall intensities). The perturbation approach is based in a combined technique using absolute deltas only for the low intensities. These absolute deltas only affect low intensities (not the high intensities). And it is expected that these are not reflected in the yearly, monthly neither daily rainfall average changes. The method in fact aims to avoid that the low intensities will increase to unrealistic high intensities. However, this now will be tested and a better explanation will be included in the article to explain the methodology in a more clear way.

Results will include a discussion of the spatiotemporal patterns observed in local precipitation and temperature stations by using the same impact indicator described in section 2.6.

In addition, section 2.5 and section 3 will omit the testing and conclusions related to the model performance and the testing of different calibration methodologies. Instead section 2.5 will be modified and will include a brief description of the rainfall-runoff model approach.

Special attention also will be given to the revision of the conclusions, based on the new analysis and results.

Specific comments:

“Lastly, the paper needs a further revision on language and accuracy of the description of the procedures. While not exhaustive, here are some specific comments: Several modifications will be made to the paper, to improve the language and structure of the sentences.

p6446/1: "despicably": whatever word may be meant here, this surely is not the correct one. The word will change to "noticeably"

p6447/15: "produce inappropriate results compared with GCMs": this is a rather liberal

C4349

interpretation of the citation. Buytaert et al. (2010) showed that RCMs do not necessarily give better simulations of precipitation during the historical run, especially in complex regions such as the Andes. But that definitely is not a reason to simply discard them as inappropriate. The use of two available RCMs for the region were considered in the study, see Table 1. However, the sentence will be changed to: "Buytaert et al. (2010) showed that RCMs do not necessarily give better simulations of precipitation during the historical run, especially in complex regions such as the Andes. However, two available RCM runs were considered in this study: the PRECIS HADLEY and the PRECIS ECHAM, see Table 1."

p6448/21: interspersed: wrong word? The sentence will be changed to: "The downstream part of the basin ends in a buffered region between the Andes and the Amazon forest."

p6449/1: páramo: explain, for instance as "tropical alpine grasslands (páramo)" The sentence will be changed to: "The catchments consist mainly of tropical alpine grasslands (páramo)."

p6451/21: to be add: to be added The change will be performed

p6452/22 - 23: this needs more elaboration: what data were used to calculate ET? From what and how many stations? Where future ETs calculated by keeping all these data constant except T? While I think this is a reasonable simplification, it is often criticized because it is relatively straightforward to extract changes of other factors (e.g. humidity) from GCMs too. Perhaps the potential impacts of this simplification should be discussed briefly. We will add a discussion on the simplification, including a brief description on the potential impacts of this simple ET determination, to section 2.6 and to the conclusions.

p6456/10: "in unitary runoffs, this is relative to its area.": typically referred to as runoff depth. The sentence will be changed to: "but after a conversion of discharges to runoff depth."

C4350

p6457/13: experimenting -> experiencing The sentence will be changed to: "...the highest monthly temperature values are experiencing lower changes than the average ones"

p6458/5: founded -> found The sentences will be changed to: "As relations are found between..."

p6458/16: data feasibility: wrong word. Perhaps "data access"? The sentence will be changed to: "...for the support in research activities and data access."

p6465: explain the abbreviations for the performance measures: NS eff Ob, NS eff BF etc. The abbreviations will be explained

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 6445, 2013.