

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

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The authors thank for these comments.

Several sections of the article were rewritten. As the referee suggests, changes were 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” was modified. This section now describes the revised sequence of analysis steps proposed by the referee. This is first considering separately

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the changes 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 leads to a better understanding of the impact of the statistical downscaling technique and clarifies the influence of the described local properties involved in the downscaled technique. It also gives 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 are based on: i. yearly and monthly magnitudes, ii. frequency of wet/dry events at daily time scale (for rainfall) and iii. events at different quantiles.

The changes made to section 2.6 lead to corresponding updates in the section 3, Results. This section was 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 is followed by a discussion of the results.

In addition, as the referee recommends, results were tested using absolute values instead of relative changes. This allows 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 was tested also in view of the concern by the referee, and commented on in the revised paper (see next). For temperature and rainfall, calculation of absolute changes is indeed a better option. Figures are now updated accordingly, as suggested by the referee.

For the analysis of rainfall changes, 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

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shows the impact of this procedure in terms of relative change (%)”, it is possible that when results are reported by relative changes (in percentages), sites with low rainfall can present higher relative changes. However, the use of the absolute changes does not affect high intensities (as the maximum rainfall intensities). The perturbation approach is based in a combined technique using absolute changes only for the low intensities. These absolute changes 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. This is now also tested. Showing rainfall change by absolute values, shows that higher changes are produced in regions where rainfall intensities are higher, during wetter periods.

The results section now includes a discussion on the spatiotemporal patterns observed in local precipitation and temperature by using the same impact indicator described in section 2.6.

In addition, section 2.5 and section 3 now omit the testing and conclusions related to the model performance and the testing of different calibration methodologies as this is part of a previous publication. See: Célleri, R., Willems, P., Feyen, J., 2010. Evaluation of a data-based hydrological model for simulating the runoff of medium sized Andean basins. *Maskana* Vol.1, No.1, ISSN No. 1390-6143, 61.

Special attention also was 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 were made to the paper, to improve the language and structure of the sentences.

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

p6447/15: "produce inappropriate results compared with GCMs": this is a rather liberal 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. Two available RCMs for the region were considered in the study, see Table 1. However, the sentence was 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 was 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 was changed to: "The catchments consist mainly of tropical alpine grasslands (páramo)."

p6451/21: to be add: to be added The change was 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. A discussion about this simplification was added to section 2.6, including a brief description on the potential impacts of this simple ET determination.

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

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

p6458/5: founded -> found The sentence was changed to: "As relations are found between..."

p6458/16: data feasibility: wrong word. Perhaps "data access"? The sentence was 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. For the model calibration and validation, reference is now made to a previous publication.

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