Review comments for manuscript hess 2013-227, by P. Gagnon and A. N. Rousseau

General comments

The manuscript addresses relevant scientific issues, about the validation of a stochastic disaggregation model (developed by the authors), and its use for the assessment of the impacts of climate change on extreme precipitation events. Raw data simulated from the Canadian regional climate model (CRCM) are spatially disaggregated at a finer resolution (from 45 km to 4 km), over a small area located in the province of Quebec. Three different CRCM simulations are used (over the 1961-2099 period). The study concentrates on annual maximum daily precipitation (AMPD), occurring between in the months of May to October. Results show that: (1) realistic estimates of AMPDs can be obtained from the disaggregation model (reference period, 1961-2000), however AMPDs are positively biased; resolution bias issues are addressed but the CRCM simulation bias cannot be assessed precisely; (2) the climate change signal is slightly strengthened by disaggregation but not significantly; (3) the disaggregation model could be further enhanced, to better represent the convective precipitation events.

The subject of the manuscript is within the scope of HESS and I recommend it for publication, after the authors have taken into account the following issues.

Scientific issues

1. Disaggregation model calibration

In their conclusions, the authors mention that "the resolution of the observations might have a non-negligible impact" on disaggregation results (lines 21-23, p. 8184). Then, the ideas in the subsequent sentences (lines 23-27) are not clearly expressed. These sentences seem to suggest that the resolution of the observations have an impact on the calibration of disaggregation model parameters. This is an important issue, and it should be more explicitly addressed in the paper.

Going back to section 3.1 (p. 8175, lines 9-13), it is mentioned that the disaggregation model parameters were estimated based on high resolution data from south-eastern United States, and that the parameter values were kept the same for the study area after a comparison was carried for a small area in southern Quebec (near the study area). How was the comparison done? What dataset was used for southern Quebec, and what was the resolution? In section 4.1 (p. 8178, lines 18-20), the authors indicate that the calibration of the disaggregation model was performed using four years of data. This information should be moved to section 3.1, and should be further developed: how were the calibration period and length selected?

2. Increase in CRCM resolution

In the Introduction section of the paper, the authors mention that two main approaches exist to downscale simulated climate data: dynamical downscaling (which typically "requires intensive computational resources", p. 8170, line 24) and stochastic disaggregation models. The authors also mention that disaggregation models offer a simple and less computationally intensive alternative to dynamical downscaling, and that such models can also be applied after dynamical downscaling. In their

study, the authors have used 45km CRCM data. Considering that 15km CRCM data are becoming available for the province of Quebec, this increase in CRCM resolution and the potential use of this dataset (in future works, for example) should be briefly discussed.

<u>Technical corrections</u>

1. The paper is generally well written, but some sentences need to be revised/clarified by the authors:

- P. 8172, lines 26-28, I suggest: "However, resolution of the weather station network is relatively high in this area, improving confidence in the interpolation results".
- P. 8173, first sentence of section 2.3 (lines 1-3), please revise.
- P. 8177, lines 5-7: the sentence beginning with "The first use…", please revise.
- P. 8181, lines 18-20: the sentence beginning with "Figure 4…" should be revised.
- P. 8182, lines 7-11: The sentences beginning with "That being said…" and ending with "… of the CRCM simulation." should be clarified. A clear distinction between the bias terms and a more systematic reference to the terms of equation 6, <u>throughout section 5.1</u>, would help.

2. Some precisions need to be added, in the manuscript as well as in the figures and table:

- P. 8172, line 16: I suggest indicating the spatial resolution of the CEHQ grid in km, for consistency.
- P. 8173, line 19: Is CRCM tile (3, 4) the one represented in red in figure 1? This should be clarified.
- General comment about references to figure 1: When referring to this figure in the text, the color code should be more systematically mentioned so that the reader clearly understands which element of this figure is being discussed.
- In table 1, do the values shown refer to the most extreme precipitation event in the entire 1961-2000 period? This should be clarified in the table's title and in the text (p. 8181, lines 26-30).
- Figure 3: Why is the bias expressed as the difference between disaggregated and raw simulated data, and not the opposite (negative bias)? The opposite would be more consistent with the terms in equation 6.
- Figure 5: I suggest adding the symbols $\beta 0$ and $\beta 1$ in the X axis and Y axis labels, for better clarity.
- Figure 6 caption should clearly specify that the boxplots show the relative changes "in the highest daily precipitation between the future (2050-2099) and recent past periods (1961-2000)".
- Figure 3's caption: "maximum annual" should be replaced by "annual maximum value" for better clarity.

3. Some typing errors have been noted:

- P. 8177, line 5: replace the "," by "." at the end of the sentence.
- P. 8182, line 21: $\beta 0$ and $\beta 1$ were switched according to the notation used in equations 7 and 8. Please modify.
- P. 8185, line 3: "more work need to be done" should read "more work <u>needs</u> to be done".