Geoscientific
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comment

Interactive comment on "Simulating climate warming scenarios with intentionally biased bootstrapping and its implications for precipitation" *by* Taesam Lee

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Author response to the reviews of the paper "Simulating warming climate scenarios with intentionally biased bootstrapping and its implications for precipitation" (Manuscript # gmd-2016-188) Taesam Lee Reviewer #2 D. Defrance (Referee) This article presents a statistical method to determine local climate change from global observations. With this approach, the Intentionaly Biased Bootstrapping (IBB) and some hypothesis, the author estimates the future temperature and precipitation at a local point. The article is clearly divided into several parts: a good description of the method, the complete procedure to permit to everyone to use easily it and a good application on the South Korea to validate the method with a good description of the results. The methodology

is precisely described but some information will permit to improve the comprehension. I suggest to publish this article in GMD with minor revision. The different remarks and suggestions are described below. Reply: The author appreciates this reviewer's generous comment. The author tried his best efforts to improve the manuscript. Hope this improvement is satisfactory to this reviewer.

Some questions Line 31: To specify that the temperature from GCM is relatively accurate as you mention in the conclusion Line 54: In some places, such as the Sahel, the increasing in temperature results from global warming but also from feedback related to the reduction of precipitations. It is perhaps too generalist to assert that everywhere the increasing in temperature will be followed by an increasing in precipitation with the self-order of magnitude. Can this depend on the type of precipitation or the origin (e.g. monsoon system or stratiform precipitation) ? Reply: The author appreciate this reviewer's detailed comment. The proposed IBB method does not postulate that the temperature increase implies the increase of precipitation. The method employs the empirical relation between temperature and precipitation. When an observed temperature increases and an observed precipitation decreases, the same reverse relation can be reproduced through the proposed IBB method. The author considers that the proposed method is not physical-based method so that the type of precipitation cannot be taken into consideration. This limitation is mentioned at the end of the conclusion section from the comment of this reviewer below.

Line 78: In the methodology, some hypothesis must be mentioned: - The method is only based on the temperature mean. If in the future the extremes of temperature increases (warmest and coldest), the method does not take this into consideration. - For the precipitation, the evolution is in relation with only the temperature evolution in the methodology and the meso-scale change is not supported. The author really appreciates this reviewer's insightful comment. No physical mechanisms can be included. This limitation was discussed at the conclusion section.

"The proposed IBB method is not a physical-based method but a statistical simulation

approach in which a physical mechanism of precipitation cannot be taken into consideration. Substantial modification might be required to accommodate this mechanism."

Line 160: for the block bootstrapping technique to simulate the temperature, I would like a better description of the method with one or two sentences because it is easier to read the entire method rather than reading into the references. Reply: The author totally agrees with this reviewer's comment. Simple sentences were added accordingly as follows:

"Bootstrapping is a random sampling with replacement and block bootstrapping is to resample blocks. Each block contains a set of predictor and predictand like a regression. Here, temperature and precipitation can be set as a block and they act as predictor and predictand, respectively."

The author hopes that this modification is satisfactory to this reviewer

Line 191: Data description, you describe the available data (74 locations) and you give 1283 mm a year but you select 54 datasets with a good hypothesis (> 30 years available data). Is the precipitation mean the same with the only 54 datasets? I suggest to insert directly the selected datasets in the beginning of the paragraph with the hypothesis and the annual mean. Reply: The author appreciate this reviewer's detailed comment. Official annual mean precipitation of South Korea (1283mm) is announced by KMA, not calculated from the current study. The sentence was modified accordingly as follows:

"In the current study, 54 weather stations that record temperature and precipitation in South Korea with more than 30 years of record length and that are managed by the Korea Meteorological Administration (KMA) were employed. South Korea is located in Far East Asia and has a mean annual precipitation of 1283 mm from KMA."

The author hopes that this modification is satisfactory to this reviewer

Line 250: you very accurately write that the test period is relatively short and not

enough of high values of annual temperature. Did you tested a longer test period with a short validation period e. g. 20 years test period 1976-1997 and validation period 1998-2008 ? Reply: The author really appreciates this reviewer's pinpointing comment. 20 years was also tested with no difference from the current test. 15 years (the test period that has been used in the current study) and 20 years are not much different from 15 years in analyzing the long-term change.

Line 335: In the conclusion, the limits of the method in terms of variability of extremes should be recreated. This limit associated with IBB can still be disturbing for some applications such as extreme floods. Figure 3 and 4, there are many data on it and it is not easy to analyse it for the reader. Maybe to classify the stations by order of error could permit to better interpret the results. I am not a good example to suggest to you a good representation of the results. Reply: The author really appreciates this reviewer's insightful comment. The authors consider that long-term variability of hydrological extremes can be derived from the IBB method when it is related with other variables such as precipitation. But no physical mechanisms can be included as this reviewer pointed in the previous comment. This limitation and possible extension were discussed at the conclusion as follows:

"The proposed IBB method is not a physical-based method but a statistical simulation approach in which a physical mechanism of precipitation cannot be taken into consideration. Substantial modification might be required to accommodate this mechanism. Also, a possible extension of the current study must be on analyzing the future variation of hydrological extreme events (e.g. extreme floods). If a long-term variation of hydrological extreme events is related with precipitation, one can derive the variation from the IBB method."

In Figure 3 and 4, the classification of the station by order of error is not easy since the magnitude of error varies all times and it is not good to change the order of stations every time. The temperature and precipitation behave differently for their changes at each station. Therefore, the author consider that it is better to stand the station order

as is.

Hope this reviewer satisfactory to this modification.

Technical notes Line 58: 1 hour intensity Reply: It was modified as 'the intensity of hourly precipitation'. Hope this modification is satisfactory to this reviewer.

Line 64: for this paragraph, a reference could be appreciated Reply: A reference is added accordingly.

Line 98: local linear smoothing (Cai, 2001) Reply: It was modified as 'local linear regression'.

Line 208: but employed in comparison ? Can you use validation ? Reply: The author appreciates this reviewer's detailed comment. 'validation' was used now according to this reviewer's comment.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/gmd-2016-188/gmd-2016-188-AC3-supplement.pdf

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