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Interactive comment on "Variations of future precipitations in Poyang Lake Watershed under the global warming using a spatiotemporally distributed downscaling model" *by* Ling Zhang et al.

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We are very grateful to the reviewer for reading the manuscript extremely carefully and forwarding the valuable suggestions for improvement. Point-by-point responses to the reviewers' comments are listed below.

The reviewer's comment 1: The authors use MRI-CGCM3 data to estimate the future precipitation changes. Why do you choose MRI-CGCM3 data, not other Global Climate Models?

Authors' response: Thank you very much for the suggestions. Compared to the other CGMs of CMIP5, the MRI-CGCM3 (Meteorological Research Institute Coupled Ocean-Atmosphere General Circulation Model3) performs better in simulating diurnal rainfall over subtropical China (Yuan et al. 2013) and has the finest resolution of $1.121^{\circ} \times 1.125^{\circ}$, thus being applied in Poyang Lake Watershed. And MRI-CGCM model is just a study case to examine the performance of STDDM. Other single-model is also ok to test the applicability of STDDM. The references: Yuan, W.: Diurnal cycles of precipitation over subtropical China in IPCC AR5 AMIP simulations, Adv. Atmos. Sci., 30(6), 1679–1694, doi:10.1007/s00376-013-2250-9, 2013. The content will be added in the manuscript.

The reviewer's comment 2: The authors use precipitation simulations in RCP8.5 scenario from MRI-CGCMs to estimate precipitation changes under future climate warming. Why do you choose only RCP8.5 scenario, instead of other scenarios?

Authors' response: Thank you very much for the suggestions. The future data includes simulations of the Representative Concentration Pathways (RCPs) of 8.5, 6.0, 4.5 and 2.6. Compared to the other RCPs, temperature increases the most in the RCP8.5 scenario, which corresponds to a highest greenhouse gas emission, leading to a radiative forcing of 8.5 W/m2 and temperature increment of 7.14 °C at the end of 21st century. The research is to detect obvious changes of precipitations under climate warming. What we should do is to display the significant change of precipitations in a scenario where temperature increment is large enough. Precipitation changes can be detected the most obviously under the climate warming scenario with temperature increasing the most. Compared to the other RCPs, the temperature in RCP8.5 scenario increased the most. So we select future simulations in the RCP8.5 scenario. The related content will be revised in Section 2.2 of the manuscript.

The reviewer's comment 3: The authors analyze the future precipitation changes in the Poyang Lake watershed using a Global Climate Model. The Poyang Lake watershed is a small area; while the Global Climate Model is coarse with resolution larger than 1° x

1°, which is difficult to be applied in a local scale such as the Poyang Lake watershed. The application could be reconsidered.

Authors' response: Thank you very much for the suggestions. The Poyang Lake watershed is one of the major grain producing areas of China. In the south of the watershed, there is an internationally important habitat for migratory birds, abundant of biodiversity and regarded as Natural Reserve. The watershed is also a vital part of Yangtze River Economic Belt. However, floods and droughts occurs fluently in the Poyang Lake watershed, which cannot be immune to climate warming. As an important economic and ecological zones, what the precipitations changes in spatiotemporal distribution will be under the climate worming is a concern. GCMs is a basic tool to analyze the future climate changes. As the resolution of GCMs is coarse unable to applied in small scale such as Poyang Lake Watershed, we downscaled the climate variables in the watershed with resolution of 20 km x 20 km. The uncertainty is $\leq$ 4.9%, demonstrating that the downscaled data can be applied in the Poyang Lake watershed. The related content will be revised in the manuscript.

The reviewer's comment 4: In the methodology section, there is some confusions. What is the relationship between the STDDM and linear-scale algorithm? That should be explained more clearly.

Authors' response: Thank you very much for the suggestions. STDDM is a logical frame, including three parts: up-sampling GCMs simulations, constructing relations between the GCMs simulations and local observations, and correcting the GCMs simulations. In the part 2 constructing relations, a transform model were built between the simulations and the local observations to transform simulations to no-bias data. The transform function could be any bias corrected model, including linear scaling, local intensity scaling, power transformation, distribution mapping models (Teutschbein et al. 2012) and so on. The transform model can be linear or no-linear regressions model. That is the relationship between the simulations and observations. In the study, the linear scaling algorithm was used as a transform model (also called as bias-corrected

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model), as a case study. The references: Teutschbein C, Seibert J. Bias correction of regional climate model simulations for hydrological climate-change impact studies: Review and evaluation of different methods [J]. Journal of Hydrology, 2012, 456: 12-29. The related content will be revised in the manuscript.

The reviewer's comment 5: By STDDM, you calculate the precipitation of each grid separately and get the downscaled precipitations. The downscaled precipitation is grid data. There may be some outstanding grid in which the precipitation is far different from the adjacent grids. According to first law of geography, near things are more related than distant things. So I suggest that the downscaled precipitation should be smoothed by smoothing filter.

Authors' response: Thank you very much for the suggestions. The downscaled climate data is calculated based on the relationships between the up-sampled simulations and observations. The up-sampled simulations and observations are grid data. The relationships are the transform function between the match-ups of the simulation and observation. The transform function is constructed separately for match-ups in different grids. The grid data, including the simulations and observations, follows the first law of geography that the climate variable value is more related than distant grids. So the transform function based on the match-ups in nearer grids is more related than distant grids. Consequently, the climate variables calculated by the transform function should also follows the first low of geography. Besides, the downscaled results (precipitations in Fig. 9) shows almost no outstanding grid, which demonstrates that the results follows the first low of geography. On the contrary, smoothing may lead to information missing of the climate variables. So I think there may be no need to do smoothing.

The reviewer's comment 6: In 4.1 section, the validation period is from 1986 to 2005. However the observation data is from 1961 to 2005. Why not validate the downscaled precipitation in the same period from 1961 to 2005?

Authors' response: Thank you very much for the suggestions. To avoid model overfitting, there should be calibrations and validations. In the study, the calibration and validation periods are from 1961 to 1985 and 1986 to 2005, separately. The down-scaled model is constructed based on the data in calibration period. We should also need to know whether the model could be applied in the data of different time. So the validation period is different from the calibrations. The model could be more correctly base on more data. So at last, we used all data from 1961 to 2005 to reconstruct the downscaling model.

The reviewer's comment 7: Line199: The sentence missed a comma.

Authors' response: Thank you very much for the suggestions. It will be revised in the manuscript.

The reviewer's comment 8: There are 69 references. Please provide the reference number for each reference. Is every reference useful to the research? If not, please delete some.

Authors' response: Thank you very much for the suggestions. There is no need to add references number in the manuscript. All the references are useful to the study.

The reviewer's comment 9: Line197-200: Monthly precipitations, > 75% percentile of the 12 monthly precipitations, were classified as the extreme wet monthly precipitations for each year of the 103 years; monthly precipitations, $\leq$ 25% percentile were classified as the extreme dry monthly precipitation. The monthly precipitation of 25%-50% and 50%-75% quantiles are classified as normal dry and wet monthly precipitations. Why do the author classify the monthly precipitation into 4 categories, not 5 or 7? Why choose 25%, 50%, 50% and 75% quantiles as the classified boundary?

Authors' response: Thank you very much for the suggestions. As the extreme wet and dry months cause floods and droughts more frequently, we pay more attention to the precipitations changes in extreme wet or dry months. So the months are differentiated as extreme and normal ones. The precipitation changes in wet and dry months also could show different condition, so the precipitation months in dry and wet should be separated. Here, we differentiate the months as the extreme wet, extreme dry, normal wet and normal dry ones. As for the classified boundary, it is more flexible. Several tries showed that 25%, 50%, 50% and 75% quantiles is appropriate classified standard. However, other classified standard is also OK, only if the precipitation changes of extreme wet, extreme dry, normal wet and normal dry months could be differentiated.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2018-286/hess-2018-286-AC1-supplement.pdf

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