Reply to Referee comment 1

Dear Editors and Reviewers:

We would like to thank the editor and all reviewers for their valuable suggestions and comments on the manuscript. These comments have not only improved the quality of the current manuscript, but also are beneficial to our future research in general. All point-by-point responses are presented as follows and we will carefully revise the manuscript based on these comments. For clarity, all comments are given in the original version, while responses are marked in blue.

Emma Daniels (Referee)

General comments:

In general, I think the paper has interesting results and could be published. However, the quality of English needs to be improved in some parts (mainly abstract, introduction and methods). Moreover, I miss details in your method such as your definition of summer (i.e. which months are analyzed) and details on the land use maps (e.g. a table with percentages) and how they are included. I think the paper would benefit from analysis of an additional parameter for extreme precipitation, such as rainfall above the 90th percent as with 10 years of data (i.e. 900 data points assuming a summer of 3 months) the 99th percentile alone might be misleading. Furthermore, I miss an explanation why precipitation is thought to increase with further reforestation but decreased between 1990 and 2010 though forest cover increased. Also, I wonder why Shrubland (USGS code 8) and Savanna (USGS code 10) are chosen as a type of forest? Judging from the LANDUSE.TBL these classes are much more similar to Cropland and Pasture than forest, so I wonder if expanding these makes a difference or if you are mainly looking at the effect of the additional Broadleaf forest. I think the figures need work and should become more informative than mainly barplots and spatial difference plots.

Thanks for the comments. We are sorry for the grammar problems in the manuscript. The manuscript will be proofread by a native English speaker. We have added the definition of summer in the introduction, and the summer defined in this manuscript is from June to August. Table 1 will be added in the revised manuscript to explain the percentages of different land use types in the whole basin. Moreover, the land use changes were included in the WRF model by modifying the geographical static data used in the model which further changed the simulation of subprocesses such as the vegetation phenology, canopy stomatal resistance, runoff and groundwater in the land surface model Noah-MP (Li et al. 2018). Many parameters were used in Noah-MP to describe the characteristics of different land use types, such as albedo, HVT (Top of canopy), LAI (Monthly leaf area index), and VCMX25 (Maximum rate of carboxylation at 25 °C). When the land use changed, these parameters changed accordingly which finally led to the changes in substance and energy exchanges between atmosphere and land surface. The

geographical static data we used in the WPS is *landuse_30s_with_lakes* which was download from the WRF website. The land use data of 1990 and 2010 scenarios were derived from the Landsat thematic mapper (TM) digital images. And then, in the YRB, we replaced the land use data from the *landuse_30s_with_lakes* with the land use data from the Landsat thematic mapper (TM) digital images. Finally, we randomly changed 20% and 50% of the croplands to be forests using the 2010 scenario as a baseline to produce 20% and 50% reforestation scenarios.

Given the comments from other reviewers, the 99.95th percent summer rainfall has been chosen to further analyze the extreme rainfall. Furthermore, the land use changes from 1990 to 2010 were not only involved the increase of forests, but also the change of other land uses, such as urbanization and grassland degradation. Therefore, although the forests increased between 1990 and 2010, the precipitation decreased with the joint impacts of all other land use changes.

Moreover, the land-use categories of the original land use data are defined by Liu et al. (2002, 2005), which are commonly used in China. In this category, there are four kinds of forests which are Forest (Liu code 21), Shrub (Liu code 22), Sparse woodland (Liu code 23) and Cut over land (Liu code 24). When converting the land use type from Liu categories to USGS categories, the four forest categories of Liu were converted to Deciduous broadleaf forest (USGS code 11), Shrubland (USGS code 8), Savanna (USGS code 10) and Savanna (USGS code 10), respectively. That was why Shrubland (USGS code 8) and Savanna (USGS code 10) were chosen as a type of forest. All above information and more clarifications will be added in the method section of the revised manuscript. The figures in the revised manuscript will be improved, and we will also add more informative figures such as qq-plot and significance test in the revised manuscript. We display the revised Fig. 5 as follows; other revised figures will be included in the revised manuscript.

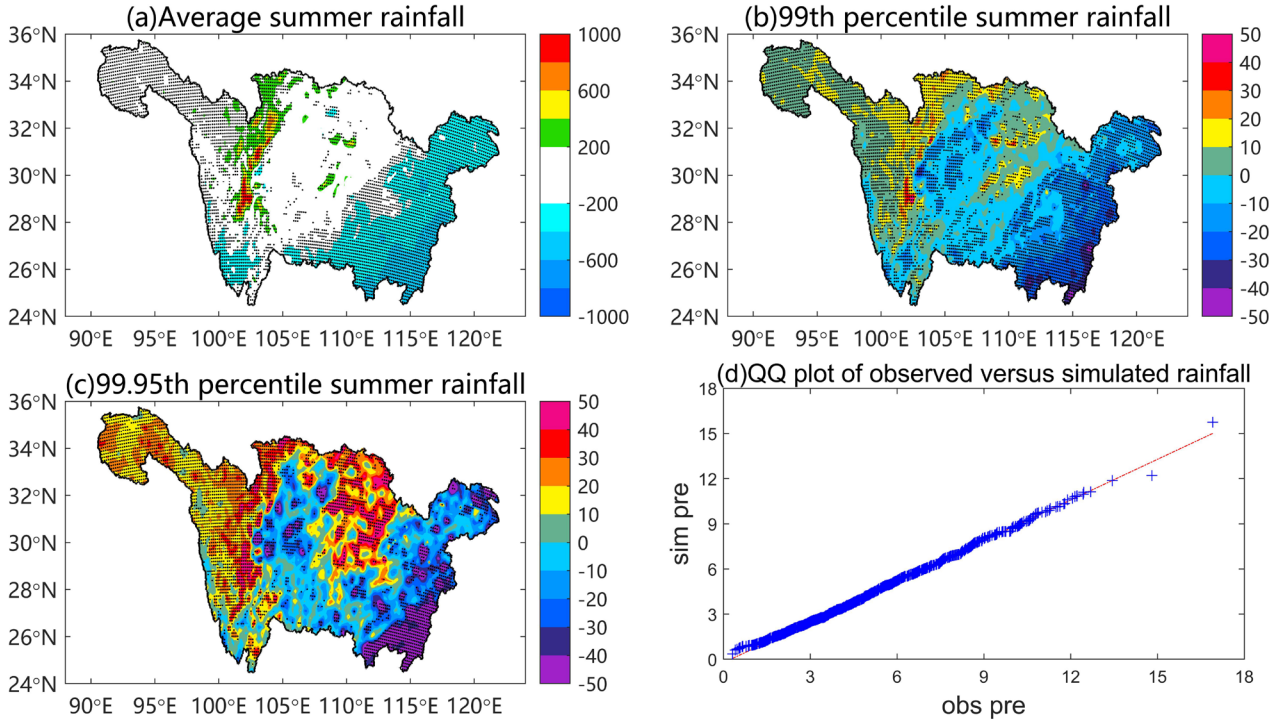

Figure 5. The bias of (a) average summer rainfall (mm), (b) 99th percentile summer rainfall (mm/day) and (c) 50th percentile summer rainfall (mm/day) between the observed data and 2010 scenario, and (d) the qq-plot of observed rainfall versus simulated rainfall. The stippling regions show statistically significance of bias identified by t-test at a 5% significance level.

Table 1. The percentages of land use and cover under four scenarios.

Scenarios	Cropland	Forest	Grassland	Water and wetland	Urban	Unused land
1990 scenario	29.15	42.82	23.50	1.65	0.19	2.69
2010 scenario	28.48	43.60	23.13	1.79	0.86	2.14
20% scenario	22.80	49.28	23.13	1.79	0.86	2.14
50% scenario	14.58	57.50	23.13	1.79	0.86	2.14

Reference:

Li, J., Chen, F., Zhang, G., Barlage, M., Gan, Y., Xin, Y., and Wang, C.: Impacts of Land Cover and Soil Texture Uncertainty on Land Model Simulations Over the Central Tibetan Plateau, Journal of Advances in Modeling Earth Systems, 10, 2121-2146, https://doi.org/10.1029/2018ms001377, 2018.

Liu, J., Liu, M., Deng, X., Zhuang, D., Zhang, Z., and Luo, D.: The land use and land cover change database and its relative studies in China, Journal of Geographical Sciences, 12, 275-282, https://doi.org/10.1007/BF02837545, 2002.

Liu, J., Liu, M., Tian, H., Zhuang, D., Zhang, Z., Zhang, W., Tang, X., and Deng, X.: Spatial and temporal patterns of China's cropland during 1990–2000: An analysis based on Landsat TM data, Remote Sensing of Environment, 98, 442-456, https://doi.org/10.1016/j.rse.2005.08.012, 2005.

Specific comments:

The number and quality of references in the first section of the Introduction is poor. I am sure there is more work done on LUCC changes that is more relevant to your work than done in Burkina Faso and Scandinavia. You can also leave these out as you mention more relevant ones later on.

Thanks for the comment. We have removed these two references and added two more relevant references in the first section of the introduction: Furthermore, Yu et al. (2020) found that the recent greening in China inferred a country-averaged surface cooling of 0.11 ℃. The study of Lin et al. (2020) showed that the urbanization tended to weak extreme precipitation events in urban agglomerations over coastal regions and intensify the influences on those in central/west China.

References:

Yu, L., Liu, Y., Liu, T., and Yan, F.: Impact of recent vegetation greening on temperature and precipitation over China, Agricultural and Forest Meteorology, 295, 10.1016/j.agrformet.2020.108197, 2020.

Lin, L., Gao, T., Luo, M., Ge, E., Yang, Y., Liu, Z., Zhao, Y., and Ning, G.: Contribution of urbanization to the changes in extreme climate events in urban agglomerations across China, Sci Total Environ, 744, 140264, https://doi.org/10.1016/j.scitotenv.2020.140264, 2020.

Adding a table to figure 4 with the percentages of LU classes would be more informative.

We agree with this comment and have added a table to figure 4 with the percentages of land use classes:

Table 1. The percentages of land use and cover under four scenarios.

Scenarios	Cropland	Forest	Grassland	Water and wetland	Urban	Unused land
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How are the 32 vertical levels of the model spread? Are there enough layers near the bottom to trust the surface values you are evaluating such as skin surface temperature and 2-m relative humidity?

There were 32 eta levels of the model, and the top was at 50 hpa. We acknowledged that we did not test whether there were enough layers near the bottom to trust the surface values. However, there were many relevant studies which used similar or less vertical levels to study the changes of these surface variables (Hu et al., 2015; Yu et al., 2020). Moreover, Gallus et al. (2009) found that doubling the number of vertical levels from 31 to 62 did not result in a consistent improvement in the precipitation forecasts and the skill might not be improved much by refining the number of levels. On the other hand, we acknowledge that the finding from Gallus's study may be different for different cases. However, refining/adding the number of levels will need much more computing resources and time to finish the simulations of such a big and nested domain in the study, which limits what we can achieve regarding it. So, we decided to leave this out in this study but may look at it in the future work. At the meantime, we will clarify it in the discussion part of the revised manuscript.

References:

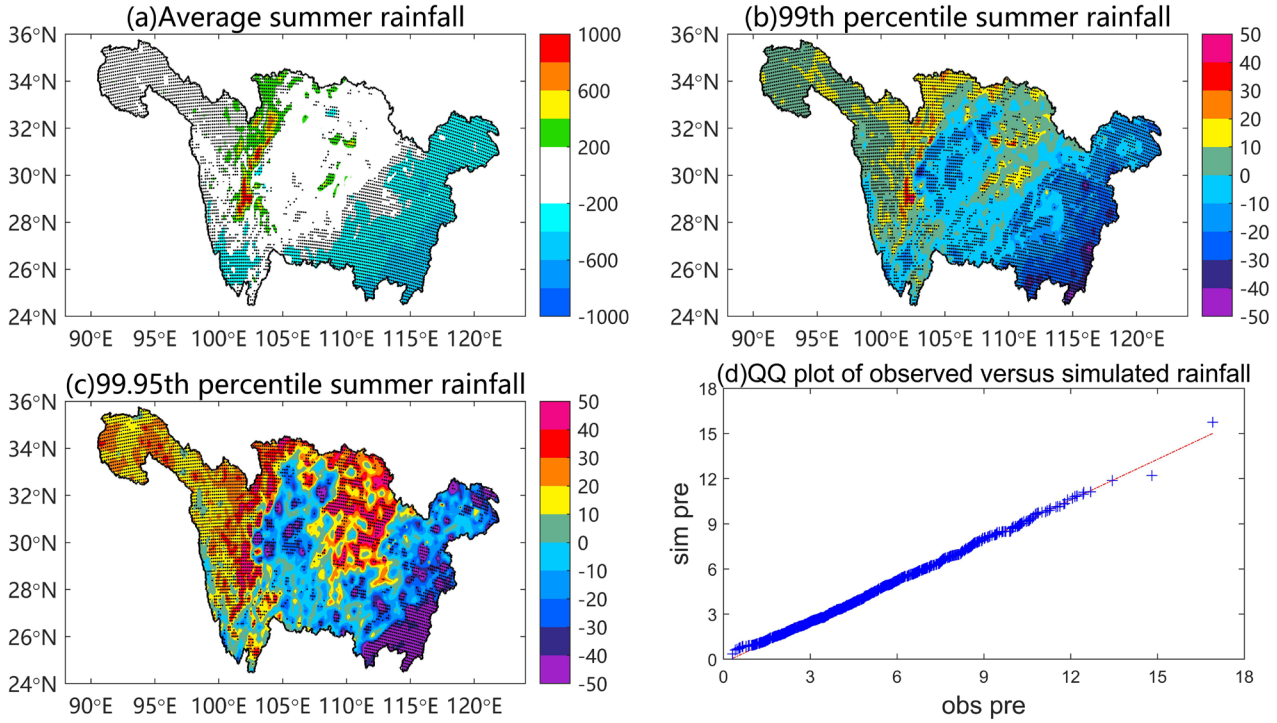
Hu, Y., Zhang, X.-Z., Mao, R., Gong, D.-Y., Liu, H.-b., and Yang, J.: Modeled responses of summer climate to realistic land use/cover changes from the 1980s to the 2000s over eastern China, Journal of Geophysical Research: Atmospheres, 120, 167-179, https://doi.org/10.1002/2014jd022288, 2015.

Yu, L., Liu, Y., Liu, T., and Yan, F.: Impact of recent vegetation greening on temperature and precipitation over China, Agricultural and Forest Meteorology, 295, 10.1016/j.agrformet.2020.108197, 2020.

Gallus, W. A., Aligo, E. A., and Segal, M.: On the Impact of WRF Model Vertical Grid Resolution on Midwest Summer Rainfall Forecasts, Weather and Forecasting, 24, 575-594, 10.1175/2008waf2007101.1, 2009.

In Figure 5c (and others), why not show a qq-plot of model and observed rainfall instead? 50th percentile is not interesting to show and analyze.

Thanks for the comment. In the revised manuscript, we will show a qq-plot of observed and simulated rainfall instead of the 50th percentile rainfall (as shown as follows). We will also add the analysis of 99.95th percentile rainfall to further analyze the changes of extreme rainfall.



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It seems urbanizations plays a role in the precipitation decrease between 1990 and 2010. Please consider using an urban scheme in WRF.

We acknowledge that the urbanization scheme may play a role in the WRF simulation for investigating the rainfall changes. However, it is difficult to re-run the simulation with urban scheme for this study, because it is very computing expensive and the time for running long-term simulations of such a big and nested domain is quite long. We will add this in the discussion of the revised manuscript and will take the urban scheme into consideration in future researches.

Why are the two areas (ALL-YRB) and (CTF-YRB) analyzed separately? Is there a rational in being interested in the converted areas specifically? Is analyzing more populated areas separately more interesting perhaps? As that is where the impact will be felt, not in the new forests.

Thanks for the comment. The reason we analyzed the two areas (ALL-YRB) and (CTF-YRB) separately was to investigate whether the land use changes at local scale influenced climate among the whole basin. We agree that analysing more populated areas separately is more interesting and will add the relevant results in revised manuscript.

Line 275-277 please reconsider/rewrite.

Thanks for the comment. We will revise the results according to all reviewers' comments and then rewrite Line 275-277.