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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Impacts of land use/cover change and reforestation on summer rainfall for the Yangtze River Basin" *by* Wei Li et al.

Anonymous Referee #3

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The authors of the manuscript "Impacts of land use/cover change and reforestation on summer rainfall for the Yangtze River Basin" present work that show the effects of land use and land cover change on regional climate processes including summer rainfall. The manuscript shows the importance of better understanding these effects and has some interesting discussion points. These types of studies are difficult to do and this is a great start. However, In my opinion, the points outlined in this review need to be addressed for this work to have scientific merit.

General:

1. The methods used to change land cover need to be discussed further as other reviewers have mentioned. The land surface model (Noah-MP) is complex and offers many options to better represent land surface processes. The land surface model is

only mentioned once in the text. Noah-MP contains too many options that need to be carefully chosen for this to be glossed over. Additionally, Noah-MP uses only the dominant land use category when calculating surface fluxes, so at 15km an increase in forest will not matter if it doesn't become the dominant category. This may help explain the inconsistent results between the 20% and 50% reforestation but without more information, it's hard to say.

2. The limitations of using a convective parameterization when investigating rainfall extremes needs to be discussed. In a region with large vertical relief, the choice to use a course resolution for this study should be justified. Convection permitting scales (<4km) not only allow for better representation of precipitation processes, but also better land surface representation (including topography).

3. The model validation is insufficient. Look to Liu et al., 2017, for an example of full model validation. To be specific, I would like to see the figures reworked to show the spatial patterns of rainfall on a seasonal and annual basis in the observations and in the control simulations. Furthermore, the figures should include a representation of percent change in rainfall. A bias of 600mm of rainfall during the summer months is a lot if the average summer rainfall is only 1000mm. This information isn't shown so it's hard to know if the bias is significant. Statistical testing should also be included where appropriate. Additionally, validation of other climatic components that contribute to rainfall (such as the vertical structure of the atmosphere, PBLH, CAPE, CIN) would aid this study. Validation of surface fluxes would also help build a better picture of how well the model can represent this region. There are several eddy-covariance towers in the eastern part of the domain and a comparison of sensible and latent heat flux to those towers would be interesting. Any change that is presented should have an accompanying discussion of validation for that component. Showing Figure 10 but compared to observations would be necessary to see if WRF can capture extreme rainfall.

4. The taylor diagrams are honestly pretty confusing, I would remove them and provide

a table of biases instead. The correlation coefficients are rather low for temperature (the easiest for the model to accurately capture) and lower for rainfall when compared to observations. This leads me to believe that the model isn't configured properly for this region. If the above issues were tackled, then this opinion might change. One way to show that the model is well validated is to show that the temperature and rainfall falls within the spread of observations. Comparison to not only the station data but to an independent gridded dataset (such as ERA5, CRU, etc.) would strengthen this point.

5.The percentiles of rainfall need to be defined better. What does 99th percentile mean in this case? Is it the 99th percentile of rainfall events over the 11 years? Without sub-daily rainfall, I'm not sure that this qualifies as extreme per se. A common extreme rainfall metric is the 99th percentile of daily maximum rainfall (requires sub daily rainfall to properly calculate). In my country, the storms that produce flash flooding often last only a few hours, vs a monsoon type rain that produces flooding from many, many hours of low intensity rainfall. More discussion of rainfall in this region would put this information into context. I would remove the figures that show changes to median rainfall and instead discuss some other metric of interest.

6. All the figures showing change between simulations need to have statistical testing. The figures all look very noisy and some of the changes to precipitation could be because the storms moved, not because more rain fell.

7. Instead of bar graphs, boxplots or violin plots should be shown. This will capture the distribution of the change.

Minor specific points:

The convention I have seen for abbreviating land use and land cover change is LULCC not LUCC.

There are some English language errors in the text, but these don't bother me that much and have been covered by other reviewers.

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