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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Toward high-spatial resolution hydrological modeling for China: Calibrating the VIC model" *by* Bowen Zhu et al.

Anonymous Referee #2

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This study presents a long term high-resolution hydrological modeling over China by using a hydrological model called VIC. The VIC parameters were estimated by using high resolution land surface data (e.g., soil texture, LAI and land use category) and a manual calibration procedure to my understanding. A 6-km simulation was validated against in-situ streamflow, ET and soil moisture observations, as well as remote sensing products. While high-resolution modeling is important for addressing regional phenomena and fine-scale processes, this manuscript fails to present advances or advantages of such effort. Except for using an existing or widely used 1-km land surface data, there is no update on VIC model physical processes specifically for high-resolution simulation (e.g., lateral flow, urban model). It is not clear whether the 6-km simulation improves the modeling of water cycle. The English presentation also needs

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extensive edits. Therefore, I have to recommend for a rejection. A few comments are listed below.

Major comments: 1. Providing local relevantly information is the most important features of high resolution modeling. However, the current work does not provide the evidence for the improvement of high resolution against coarse resolution simulation. A comparison is needed to compare the 6-km simulation of streamflow, soil moisture and ET with those from a coarse resolution (e.g., 25 or 30 km). To make a fair comparison, the coarse resolution model should also be calibrated. Then, the advantages or add values of high-resolution hydrological modeling could be illustrated. This is one of the most important issues of the current manuscript.

2. Another major concern is whether VIC modeling outperforms other land surface models. This could be answered by comparing the VIC simulation with existing reanalysis data, including GLDAS, CLDAS etc. This could demonstrate whether current study does provide solid advances in high-resolution modeling.

3. The third major concern is whether the water-balance VIC model without any updates in representing local human interventions (e.g., reservoir operation, irrigation, groundwater pumping, urbanization) is valid at high resolution. If these local human-relevant phenomena are totally ignored, the science rationale of high-resolution modeling is questionable.

4. The English should be improved, perhaps with help from a native speaker. Many presentations are not professional for an international journal.

Minor comments: 5. L244-245: “It was performed via a trial and error procedure to match the simulations with the hydrograph observations.” As you have seven parameters, they would have too many combinations to calibrated manually. Which measure did you use to decide to stop the trial?

6. In section 3.1, the author tends to show the advantages of updating soil parameters

by comparing a simulation which uses coarse resolution soil parameters with those by using the high resolution results. But I think the obvious improvement at high resolution may be directly due to the calibration as you do not calibrate the model at coarse resolution.

7. Figure 1 shows about half of the soil moisture observation stations are located over the Yellow River basin, where the human influence is large (such as irrigation). Although the author says “Most basins were minimally affected by human activities, such as water extraction, irrigation, and water management”, the human water intervention cannot be ignored over the Yellow River, which is heavily managed.

8. The Beijing flood event of 2012 was used to show model ability of capturing flood events, but can the VIC model represent the urbanization effects on hydrological regimes? As shown in Line 425-426, “However, the central region of Beijing, which has the highest population and number of buildings, suffered the deepest runoff, > 100 mm/day. This may have been due to the effects of urbanization during recent years.” How is the urbanization represented in the model, by changing land use category or using other method? To my understanding, the urban model is missing in the publicly-used version of the VIC model.

9. The definition of flood and drought. The author used runoff depth anomaly and soil moisture anomaly to represent flood and drought respectively, but the detail definition is not given. Which anomaly threshold is taken as flood and drought?

10. Line 187-190. The soil dataset provided by Dai et al., (2013) has 10 layers which is the same as Common Land Model, how do you match the 10 layers to the 3 layers in VIC model, by simple average or other methods?

11. Line 230-232. Please give the information of which basins you used for the calibration and validation, as there are only 9 basins in Figure 1.

12. Figure 4 and Figure 7, Please give the R-square and p value of the results.

13. Section 4.3 As shown above, if you calibrated model manually, the limitations of the work should consider this. There are some automatically calibration method to find the optimal parameter combination, which will improve your streamflow simulations.

14. Line 423: “the runoff depth presented a SE–NE zonal distribution”, it seems to be “SW-NE” instead of “SE-NE”.

15. L37, L113 and many other places in the manuscript, CLDAS means CMA Land Data Assimilation System instead of “China Land Data Simulation System”.

16. L79. This is not true, many studies started to use the meteorological observations based on 2K+ stations.

17. L252, “observed and simulated” -> “simulated and observed”

18. Table 2. The streamflow calibration and validation results are not that favorable. Many coarse resolution simulations could have higher NSE values. A more robust calibration procedure is needed.

19. Figures 4, 5 and 7. The validation results should be compared with those from un-calibrated model, calibrated model at coarse resolution, as well as the state-of-the-art land reanalysis data.

20. Figure 9. This does not make sense since the version of VIC used in this study does not have urban component.

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