

Interactive comment on “Results from a full coupling of the HIRHAM regional climate model and the MIKE SHE hydrological model for a Danish catchment” by M. A. D. Larsen et al.

Anonymous Referee #1

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This study presents the results from a coupled regional climate model HIRHAM with MIKE SHE hydrological model, which also includes SWET land surface model. The coupling between the models are only done over the Skjern catchment, which is an interesting feature of this new tool. With this new tool, a series of real data numerical experiments with coupled and uncoupled models are presented to explore the influence of coupling frequency and internal variability of the atmospheric model. The study is quite interesting, and the multiple simulations along with comparisons to observations are comprehensive. However, at the same time, there are several shortcomings in the current version of the paper also, which needs to be addressed before being suitable

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for publication. In general, the manuscript is poorly written with lot of grammatical mistakes and not well organized. The authors conclude that the coupled simulations give poor results because the coupled model is not tuned or calibrated. However, there are no results presented in the current manuscript that supports their conclusion. It could also be potentially influenced by their limited area coupling. In their approach, they couple the two models over a small catchment only, which is less than 0.1% of the total atmospheric domain. So, does it create a very different patch of land surface over Skjern catchment compared to the adjacent cells, where HIRHAM uses its own land surface model? If there are significant differences in soil temperature due to difference in partitioning of surface energy fluxes by the new model, it can generate local circulations, which can influence the simulated variables. This needs to be discussed. Further, I have the following comments which should be addressed.

1. Pg. 3007, Line 10: The authors here can definitely not say that it is due to the calibration of the models alone. There could be many other reasons. This needs to be addressed.
2. Pg. 3007, Line 18: Change “ranges” to “spread”.
3. Pg. 3009: The introduction is poorly written, the authors discuss about future global climate predictions and importance of uncertainty in climate models, and then at the end, present what they do in this study. A more focused discussion on the scientific questions they want to answer with this new tool and the motivation behind this work, would strengthen this section.
4. Pg.3009, Line 6-16: These works were mostly related to short term simulations using mesoscale atmospheric models, not climate simulations. The spatio-temporal time scales of these studies compared to the preceding introduction are different. This needs to be rephrased.
5. Pg. 3009, Line 26-29: For example, read York et al. 2002, Jiang et al. (2009), Anyah et al. (2008).

6. Pg. 3011, Line 19: Clarify “the undercatch corrected precipitation”.
7. Pg. 3012, Line 9: Does it mean that the fluxes measured over forested area was used for agricultural site ? Explain the rationale behind it. Missing data alone does not justify this approach.
8. Pg. 3013, Line 20: Is this calibration done for every particular year?
9. Pg. 3015, Line 11: Clarify “safety regulations”. So, the coupling is based on reading and writing of output files?
10. Pg. 3015-3017: The description of the different simulations requires a Table with two sub-categories: “coupled and uncoupled simulations” followed by experiment name and description. Otherwise, it becomes too difficult for the readers to follow which experiment is which, and it is very annoying. The evaluations are performed in terms of RMSE and MAE. The results could be interpreted better by using MSE and examining the contribution of model bias, variance of the simulated variables and the correlations. And, the use of Taylor diagrams would be even more appropriate to present the results for comparison of different variables with multiple simulations, coupled or uncoupled.
11. Pg. 3020 - 3021: See above comments.
12. Pg. 3023 and Pg. 3030, Line 10: This needs to be rephrased. See above comments.
13. All figures have a very small font size which is not readable.

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