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Discussions

Interactive comment on "Evaluating seasonal hydrological extremes in mesoscale (pre-)Alpine basins at coarse 0.5° and fine hyperresolution" *by* Joost Buitink et al.

Anonymous Referee #2

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The manuscript "Evaluating seasonal hydrological extremes in mesoscale pre-Alpine basins at coarse 0.5 deg and fine hyperresolution" by Buitink et al. provides an interesting excursion into the effects of spatial resolution in hydrological modelling. Two grid resolutions, 500x500 m and 40,000x40,000 m are used in the STAHY model to simulate hydrological processes, and the results are compared in 5 mesoscale basins in the Swiss Alps. The main message is that the coarse resolution model fails to capture the "diverse and contrasting response" from the high resolution model, because topography and land cover are not accurately represented. This is found to be especially true for extremes, where anomalies in climate and their effect on runoff and ET were quantified.

It has to be said that these conclusions are not suprising, in fact are to be expected, and there are numerous studies published in hydrological literature that report the same or similar findings. In this sense, the potential innovation of the paper is rather limited, and would have to be found in the details and/or implications that are specific to the study cathments, climates, model used, etc. To highlight what is really innovative and make the relevance of the paper more clear I suggest to focus in the revision on the following points and questions.

1. What is the real aim of the paper? In the introduction (p2, 10-15) the authors claim that many studies have explored the effect of spatial resolution, but few (none) have explored the "effect of the modelling approach". It should be clarified from the start what is meant by this, because the authors in my opinion also only show the effect of spatial resolution and not modelling approach. They use the same conceptual model, same parameterisations, only the input data differ.

2. The studied catchments are all smaller than one coarse pixel in the analysis. This is quite clearly stated in Section 2.4. The input data are resampled to the 500x500 grid and averaged to a 40,000x40,000 m grid for the coarse application. So this sounds to me like comparing a spatially distributed model to a point model, not to a coarse resolution model. This also means that all elevation dependencies in hydrological processes in the point application are gone. Is this correct?

3. I would have liked to see at least a table with the values of the key parameters that were calibrated, i.e. something that gives more credibility to the SPHY model application. It seems in Section 2.4 that the model was calibrated for both the spatial application and the point application separately. I assume it is the high resolution application shown in Figure 5. How different were the parameter values? What do the differences (if any) mean for the results of the simulations, e.g. temperature dependencies, etc.

4. The results were compared on seasonal anomalies of runoff and ET, summed over the catchment areas. There are no supporting data and plots to actually show how

the model performed for spatially distributed variables, beyond Figure 6. For example, snow cover could have easily been compared with data to show how snow accumulation and melt processes are simulated. There is little confidence given to the spatial predictions of the model,on which the entire analysis is based.

5. A new metric DWD is proposed to show the place of the point model value in the spatial distribution of the spatially resolved values. This is an interesting metric. I appreciate the effort to illustrate its use in Figure 3.

6. The relation of the seasonal anomalies in ET and runoff to temperature across the basins in Figure 7 is interesting. I have one concern that the results here are probably strongly dependent on the parameterisations and structure of the model. Some of these relations, e.g. between runoff and temperature can be gleaned directly from observations. Will you get the same sensitivities? In Figure 8 the anomalies are plotted for every grid cell as a function of land cover. What about soil depth? Does SPHY assume that soil depth and soil properties are constant in space?

7. Overall, I find the physical relations between the results and hydrological processes in Section 3.1 nicely covered, the arguments are logical, especially the elevation effect is coming out strongly. I suggest also looking at the paper by Fatichi et al. (2015) “High-resolution distributed analysis of climate and anthropogenic changes on the hydrology of an Alpine catchment” in Journal of Hydrology for another demonstraiton of this effect with a physically-based model.

8. As mentioned above, the resolution effects are less instructive than the explanation of the anomalies. I am not sure what to take out of Figure 9, other than the point model lies within the range of the cells of the distributed model. This was for an extreme year, what about the entire simulation? Probably the results are the same. The message simply seems to be that lumping in space averages hydrological response, which is something very well known. Is there more to it than that? If yes, this has to be brought to the forefront more clearly.

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