

Interactive comment on “Hydrological impacts of climate change on small ungauged catchments-results from a GCM-RCM-hydrologic model chain” by Aynalem T. Tsegaw et al.

Anonymous Referee #1

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In the manuscript the regionalized DDD model with dynamic river network was used to study climate change impacts on hydrology by 2070-2100 in ungauged catchments in the Bergen area in western Norway. Six ungauged small rural catchments are modeled with a single high-resolution downscaled climate scenario.

The manuscript is well structured and well written and bring new knowledge on estimation of climate change impacts on small ungauged basins with sub-daily time steps. However, to improve the manuscript, the results, which use input from one climate model, should be given more context in regard to other climate scenarios and some key uncertainties should be better presented.

C1

Detailed comments

Abstract: The abstract should clearly state the climate scenario (especially rcp) for which the results are based since this affects the likelihood of the proposed changes (ie. these are apparently with the rcp8.5 and are therefore likely to be the upper end of the proposed changes). The uncertainties due to use of only one climate scenario should be shortly acknowledged also in the abstract and the percentage changes of the results should be provided with less accuracy (ie. not well 256.3 % but with e.g. 260 %).

Data and methods

More background information from the Bergen area floods and the mechanism (snow or rain or both) could be provided. In discussions the results could be reflected with this.

Section 2.2

Section 2.2 includes information of the climate change input data used. However the climate change input data should be described in more detail -The climate scenario used should be more clearly stated (Global climate model, regional climate model, rcp) (NORESM-M, WSF, but the rcp is not mentioned here, apparently rcp8.5) - the corrections made to the data should be provided with more details. Is only the GCM corrected and for which variables? Is there any bias correction on the RCM data? How well do the temperatures and precipitation compare to observations? -the use of only one scenario just be better justified (since the common approach these days in to use several scenarios to enable uncertainties to be included). Why this particular model and why only one?

Discussion

Since only one climate scenario is used, the influence of this decision on the results should be discussed. Å Table 4 states the temperature and precipitation changes

C2

with the used climate scenario (the GCM-RCM and rcp of the scenario should be added to the table header) and on page 2 the range for rcp8.5 is stated. However these should be compared more clearly in the discussion or elsewhere (how does the chosen scenario compare to others, is it e.g. wetter than average). Also the range of temperature and precipitation with other rcps than just 8.5 should be provided for context. The results are currently only been compared to the rcp8.5 results of e.g. NCCS report, also some comparison with the rcp4.5 could be provided for more context. How does the use of only one scenario influence the results and what are the likely results with other scenarios (e.g. are these likely to be the top end of changes in floods which can be used as worst case scenario). Currently the results, which are stated with high accuracy, can provide false sense of certainty while this major uncertainty is not well established. (The emissions used in RCP8.5 pathway are nowadays considered by some scientists as rather unlikely due to the ongoing mitigation efforts and the sinking prices of renewables. Therefore there has been arguments against the use of this scenario as a “business as usual” scenario).

The results showed large increase in flood risk due to climate change. Other studies are referred to but the main differences between these studies explaining the differences in the results (the inclusion of different types of catchments with more snow dominated flooding and the use of several different climate scenarios) should be analyzed.

The changes in max SWE (table 4) are very large, any comment on this? What is the influence of the snow model type used?

There is also big increase in evapotranspiration in the climate change scenario (table 4). What could explain this? And what is the influence of the relatively simple evaporation model, which is correlated to temperature and influenced by precipitation through soil moisture but does not use other input from the climate model such as changes in wind speed, cloudiness or humidity? The changes in evapotranspiration only have a limited effect the flood discharges, but the low discharges are more sensitive to these

C3

changes.

4.4. Limitations Rcps should be added to GCMs and RCMS as source of uncertainty or limitation to the study.

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C4