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Hydrology and Earth System Sciences
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Discussions

Interactive comment on "Using the Storm Water Management Model to predict urban headwater stream hydrological response to climate and land cover change" *by* J. Y. Wu et al.

Anonymous Referee #2

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This study uses a rainfall-runoff model to examine the impact on hydrologic response of increasing rainfall (due to climate change) and increasing imperviousness in 5 headwater watersheds. Results suggest that the climate change scenario increases peak discharge, but hydrologic response is more significantly impacted by increases in impervious surface coverage. For the climate change scenario, the runoff ratio and RB-Index do not increase significantly. The percent increase in the RB-Index and runoff ratio is not significantly different between the land use and combined scenarios.

General Comments:

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Interactive Discussion
Discussion Paper

1. Better understanding the combined impacts on hydrologic response of land use changes and climate change is important. A National Research Council 2012 report, Challenges and Opportunities in the Hydrologic Sciences, argues that, "hydrologic science is now challenged to understand, quantify, and delineate the contribution of human land use change to flooding in comparison to those changes driven solely by anthropogenic changes in greenhouse gases."

   I believe this research could contribute to our understanding of the impact of land use changes versus climate change on hydrologic response, but these contributions are not clearly articulated. In the introduction, (p. 7095 lines 26-29), the authors write "To date, however, relatively few studies have been conducted in Midwest USA to quantify responses of multiple urban streams to potential changes in both climate and land cover using a hydrological model specifically designed for use in urban environments (e.g. SWMM) and to examine a suite of variables to describe stream responses." But how will examining the combined impacts of land use and climate changes in the Midwest further our understanding of these impacts on hydrologic response? Why might hydrologic response be different in these watersheds than in the studies that are cited? A better review of the literature examining combined impacts of land use and climate changes on hydrologic response is warranted. What are the outstanding questions this study will address?

2. The conclusions of the study are drawn on the results of modeling analyses alone. But if the goal of the study is to examine the impacts on hydrologic response of increasing imperviousness and increasing precipitation, why not also examine field observations of rainfall and runoff? The authors state that they've collected 16 months of data that could provide a catalog of real storms to examine. For these storms, what is the relationship between the runoff ratio, peak discharge, and RB-Index and watershed imperviousness? For a single watershed, how do these indices vary with increasing storm size? Perhaps through

analysis of field data, hypotheses could be developed that could then be tested using the SWMM model.

3. The relationships between imperviousness and runoff volumes and imperviousness and peak discharge are (theoretically) linear. As are the relationships between rainfall depth and runoff volume and rainfall depth and peak discharge. So we would expect that as imperviousness increases, so do runoff volumes and peaks and that as rainfall depths increase, so do runoff volumes and peaks. Thus the modeling results are not providing any new information about the impacts of increasing rainfall and increasing imperviousness.

   However, in reality, urbanization is much more complex and response is not necessarily linearly dependent on rainfall. Elements of the urban landscape such as stormwater pipes, stormwater management structures, as well as impervious surfaces combine with rainfall to produce hydrologic response that can be unexpected. A model like SWMM can be used to examine some of these complexities of the urban landscape to help us better understand and provide new information about hydrologic response in urban watersheds.

Specific Comments:

1. p. 7092 lines 25-28. This sentence is misleading. It makes it seem like the increases in all 3 indices for the combined scenario were significantly larger than the increases in indices for the land use scenario. But the increases in the R-B Index and runoff ratio are not significantly different between these two scenarios.
2. p. 7099 lines 23-24 Why was this event chosen for climate change modeling scenarios. Is it a typical event? Was this also the event chosen for the land use scenario? I assume so but this is not explicitly stated in Section 2.5.
3. Fig. 4 and Table 4 There appears to be a significant difference in the total runoff produced in each modeling scenario. Even though the runoff ratio does not sig-

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nificantly increase with the increases in precipitation, the runoff volume clearly does. It could be useful to also include percent changes to runoff volume.

4. Fig. 1 This figure is very difficult to interpret. The cross-hatching fill used for the watersheds makes it so one can not see the distribution of impervious surfaces within the watershed. At the scale and coloring used, it is also difficult to distinguish an impervious surface from a stream channel.

5. Fig. 5 and Table 5 and Conclusion 3. To me, it doesn't appear that the location of the impervious surfaces within the watershed makes much of a difference. For the % differences in Table 5, it would be more useful to show the % difference compared to the uniform scenario.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 7091, 2013.