We would like to thank the reviewers for their insightful and constructive comments and efforts towards improving our manuscript. We present our point-to-point responses as follows:

Reviewer #2

The authors conducted a modelling study to evaluate impact of a landuse change on a watershed-scale discharge. The study uses relatively established hydrological model (CHRM) originally designed for cold regions settings and, thus, already incorporating many relevant processes. Different model elements were evaluated in the multiple previous publications.

Overall, the paper is well-structured and well-written, however, it suffers from few issues. The authors fail to follow up on the hydrological data referred to in Methods (L181-186). These data are neither presented in Results, nor in Discussion. The absence of the observed discharge from the results is particularly puzzling, given that authors present simulation data only for the years when streamflow observations are available.

Reply: The objective of the manuscript was to assess the impact of land-use conversion (i.e., annual crop to perennial forages) on the several components of the water budget. As observations are not available for most of those variables, the comparison was made between the baseline model (i.e., annual crop) to the falsified model (i.e., perennial forage). Therefore, the description of the hydrometric data in the methods section was an oversight and should not be included. However, the stream discharge and results of model calibration has been reported in Cordeiro et al. (2017) (Figure 3).

Furthermore, while utility of the CHRM in general was confirmed in the previous studies, authors changed the model to account for macropore development under perennial forages (L134-144). It is unclear from the article if adequacy of this change was properly evaluated. This is particularly important given that authors report higher simulated water content under perennial forages than under crops in most years – an observation contradicting numerous previous studies throughout semi-arid grasslands in North America and Eurasia (and acknowledged by authors in Discussion – L314-324). Therefore, there is a clear need to compare model outputs with observations to confirm that completed

model modification ('fallstat_correction') adequately captures effects of land use change.

Reply: We agree. In the current representation of CHRM, replacing annual crops with perennial forages would change the hydrological effect of the above-ground vegetation cover (e.g., snow trapping), but would cause no difference in the subsoil hydrology. In order to mimic the known subsoil alterations (i.e., prevention of ice lenses formation), the parameter "fallstat" was falsified. This parameter handles the infiltration into frozen soil for the following spring as determined from soil properties and soil moisture variables (Gray et al., 2001). As described in the manuscript, the approach to use the "fallstat" parameter was indented to *mimic the hydrological effect of macropore flow* (i.e., enhanced infiltration), not to represent macropore flow in fact. This representation was meant as a 'proof-of-concept' approach to assess the overall implications to different water balance components, but a more rigorous model representation of this process based on field research is warranted.

In fact, the other reviewer suggested to expand the "fallstat" parameter from "30-70%" to "0-70%". We have followed this advice and revised the results accordingly.

It must be noted that capturing observed discharge reduction may not be sufficient on its own, as it can be predicted based on the increased evapotranspiration after crop to grass conversion observed in the previous studies.

Reply: Indeed. While ET certainly impacts stream discharge, the final result depends on the interaction between ET, runoff, infiltration, and soil moisture, which are influenced by soil texture and weather. In the Canadian Prairies, discharge is mainly contributed by runoff during the snowmelt season. The objective of the study was to quantify alterations in those variables at larger spatial scales. We agree that decreased stream discharge can be predicted as an expected outcome, but the actual quantification can only be effectively achieved through a modelling exercise. We don't intend to claim that this study will answer all the questions, but it can certainly provide detailed insights about the hydrological contrasts between annual crops and perennial forages. It also provides evidence of processes that needs better representation in the model, such as soil moisture dynamics, which was mentioned by the reviewer.

I recommend this manuscript for publication after major revisions addressing the issues raised in the paragraph above.

Other notes:

L86 Typo: should be “Vertisols” instead of “Veritsols”

Reply: The word has been corrected.

L93 Please cite source of the shown land use file. Please add black line to the legend. Is it denoting borders of the 4 sub-basins referenced in L99?

Reply: Data source has been cited. Yes, it is the borders of the 4 sub-basins referenced in L99.

L99, L121 It is unclear why “four sub-basins” are mentioned. They are referred to just twice in the text and on Figure 1. Also, it adds confusion (there is a LS-05OG008 sub-basin that consists of four sub-basins).

Reply: The four subbasins are the result of the delineation of the watershed. We have rephrased the title of Figure 1 to improve clarity.

L105 Please consider spelling out most acronyms in the table (as was done at Cordeiro, 2017). Currently there are 22 acronyms in the making it nearly impossible to follow up.

Reply: The corrections have been made as suggested. It is not allowed to have landscape pages in the current version based on the journal requirements, we will make this change in the final typeset version.

References:

Cordeiro, M. R. C., Wilson, H. F., Vanrobaeys, J., Pomeroy, J. W., and Fang, X.: Simulating cold-region hydrology in an intensively drained agricultural watershed in Manitoba, Canada, using the Cold Regions Hydrological Model, Hydrol. Earth Syst. Sci., 21, 3483-3506, 10.5194/hess-21-3483-2017, 2017.

Gray, D.M., Toth, B., Zhao, L., Pomeroy, J. W., & Granger, R. J. Estimating areal snowmelt infiltration into frozen soils. Hydrological processes, 15(16), 3095-3111, 2001.