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Interactive comment on "The cumulative effects of forest disturbance and climate variability on baseflow in a large watershed in British Columbia, Canada" *by* Qiang Li et al.

Anonymous Referee #1

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General comments:

The main aim of the paper is to reveal or distinguish the individual contributions of forest disturbance and climate variability on baseflow in a forest catchment. However, the manuscript was poorly organized that so many uncertainties are in their methods and discussions.

The authors adopted several distinct methods in their study just like the baseflow separation method which seems to be critical in their study, and the MDMC method for quantifying the relative contributions of forest disturbance and climate variability and even Budyko method has also been adopted in this study. However, the discussions for each method were not enough, which lead to many uncertainties and questions to

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the readers. For example, the baseflow separation method, CMB developed based on Pinder and Jones [1969], was firstly proposed to investigate the variation in the runoff composition in three small drainage basins which are relatively simplex in flow path and components compared with larger catchments. As to the MDMC method, it needs a logistic flow chart to describe the whole processes, and more details should be provided on how you calculate ΔQf and ΔQc.

Another important issue is that how climate has changed in this catchment based on the observations and has climate changes impacted the forest itself about the coverage rate, beetle infestation?

The figures and tables are in poor quality.

Based on above considerations, especially the poor organization and insufficiency of discussions on various adopted methods, I have to recommend "major revisions", would like to encourage resubmission.

Specific Comments:

P means page, and L means lines

P1L14: what is the different between baseflow and groundwater discharge.

P1L17: how do you define a catchment a large one?

P1L17-23: As you have mentioned “However, studying this topic is challenging as it requires explicit inclusion of climate into assessment due to their interactions at any large watersheds.” How do you think that CMB method can solve this problem?

P2L11: ‘Introduction’ is poorly written for that the method seems not to satisfy your main work and there so many uncertainties in your study. For instance, larger catchments tend to be disturbed by human activities in their wide downstream alluvial plain, and the hydrological responses seem to be lagged by drainage network and inapparent compared with small catchments. As we know, CMB was developed based on

scientific studies on smaller catchment, how do your upscale the method for applying in large scale catchment?

P3L8: ". . .. . .but had reached nearly 50% of the pre-cut level. . .. . ." of WHAT?

P4L4-7: "Although there are . . .. . . annual streamflow. . . .. . .in large watersheds." What do you mean here? What is the logistic relation? I have expected as "There are many studies on annual streamflow but no study on monthly or daily streamflow". Anyway, critical comments in Introduction should be better if supported by data and comments of other colleagues.

P4L10: "there are no commonly-accepted " As there are no commonly-accepted methods for baseflow separation, how do you verify that your adopted method is suitable for the study catchment.

P6L12: ". . .. . .Manning Park drains to Okanogon River in U.S.A." I found that the river drains to Canada in figure 1?

P6L16-18: "The bedrock types are generally resistant to water erosion, and form uplands and mountain ranges, which may contain bedrock aquifers, where are highly fractured." It seems to be inconsistent!! As it hard to be eroded, why is fractured and contains aquifers?

P8L1: how long have the forest disturbance databases been recorded?

P8L20: ". . .. . .a total of 823. . .. . ." Is the water quality data measured per month?

P9L11: how about the distribution of forest disturbance? Is it changed every year? How to evaluation the change of position of forest disturbance on baseflow?

P11L8: CMB was developed based on scientific studies on smaller catchments. While applying in large catchments, other factors and processes, e.g., effects of exchange between riparian and river, storage and lag in river network, shall be considered. So CMB method in equation (1) may have to be improved before applying in large catch-

ments.

P12L12-18: all the variables should be in italic.

P13L12-16: this paragraph is difficult to be understood and need to be re-written.

P13L19: As you only use one equation (Equation (1)) for baseflow separations, I could not figure out why will Cro play so different effects on baseflow in small and large catchments? As the smaller or larger value of Cro will impact the value of BF no matter what values of Q is adopted in terms of the scale of catchment areas. It is worth to note that Cro determines the ratio of BF ad Q.

P14L15: Add a flow chart about MDMC.

P15L6-9: shall equation (3) be placed in individual line? How do you calculate Ge and BFa in equation (3)?

P16L5-14: what is the relationship between PET and MDMC?

P16L11: Budydo should be Budyko. w is ω?

P16L16: how do you determine the values of Cro and Cbf in Section 4.1? As you defined them as constant, thus how do you derive their values?

P18L14: in figure 9, I really can hardly figure out the breaking point at 1972. The authors need to display more data in figures or tables. What is the difference between the baseflow and groundwater discharge in the vertical and horizontal axis in figure 9?

P23L2-3: in table 3, cross-correlation results revealed that forest disturbance has altered the baseflow regimes, specifically, increased spring baseflow while decreased summer baseflow in our watershed? I also cannot find the trends.

P24L1: provide a figure to show how the climate changes or fluctuates.

P25L15: conclusions is too short and a deepen summary and perspective are needed.

The references should be carefully revised according to requirements of HESS. Some

of the references are lack of Doi (e.g., Weijs et al., 2013 and Winkler et al., 2014) and others may use wrong symbols (e.g., Power et al., 1999).

Figure 1 should be revised by adding a complete map about the catchment though it belongs to two countries. Land cover map also needs to be added to show the forest distributions.

Figure 5, in this figure, I find that CECA in some curves have little decreases as a function of year. Please try to explain why this happens.

Figure 7, it is lack of BFI in the legend.

Figure 9, what is the difference between baseflow and groundwater discharge?

Figure 10, how do you compute ΔBFf ? why not add ΔBFc in the same figure? Is ΔBF a bias between 1973 to 2013 and the reference period (before 1972)? There are not logging or beetle infestations in the reference period, are there? If no, how do you define it as the reference period?

References: Pinder and Jones [1969], Determination of the Ground-Water Component of Peak Discharge from the Chemistry of Total Runoff, Water Resources Research, 5(2), 438-445.

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