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Discussions

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Interactive comment on "Exploration of virtual catchments approach for runoff predictions of ungauged catchments" *by* Jun Zhang et al.

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We appreciate the helpful and constructive comments and the responses to the comments are as follows:

(1) The regressions were fitted with ordinary least squares, which will be added in the methodology section in the revised manuscript. The fitted curve in Figure 3 and line 161 was derived from hourly data to be consistent with the Flood Estimation Handbook (FEH), which is possible to bring some uncertainty. An example is shown here to demonstrate the difference between the fitted curve and FEH equation in line 161. Using the average slope in the Brue catchment, which is 29.12 m/km, T_p is 9.04 h from the fitted curve and is 5.38 h from the FEH equation, with the relative error of 40.4%,

which indicates the difference is significant. More detailed analysis on the difference about all the fitted curves will be discussed in the revised manuscript.

(2) As demonstrated in the comments, the curves for 15 h and 20 h with 10 mm/h in Figure 5(b) did not capture the trends well especially when the drainage length is large. Further details of the curves including R^2 and residuals, and more analysis on the limitations of curves will be further discussed in the revised manuscript.

(3) Many thanks for the useful suggestions and we agree that there are still gaps between the hydrologic model and the reality. As the hydrologic model is a simplification of the real system, it is impossible for the model to exactly represent the reality. In this study, the model is able to capture the main hydrologic characteristics of the catchment, which is useful in studying the catchment geomorphology and runoff production. With more available data and a wider exploration of the virtual catchment method, more understanding on the gaps between the model and the reality will be gained in order to reduce them in the future. More discussions about the possible limitations will be illustrated in the Discussion section.

(4) The baseline model was calibrated because the required data of the model were not all available such as land use and soil depth. The purpose of the study is to investigate the reliability of using the virtual catchment approach to simulate the catchment response to the changing geomorphology. To apply the approach to ungauged catchments, the geomorphological characteristics, e.g. slope, drainage length, area, etc., of the baseline model are to be modified according to the ungauged catchment, which results in a new representation for the ungauged catchment. As the model is fully physical-based and demonstrated its reliability in runoff generation, the new model can be treated as a reasonable representation of the ungauged catchment. Therefore, the runoff generated from the target model is a simulation of the ungauged catchment. The application of the virtual catchment approach will be further explored with more available catchments data. We will add this discussion in the revised manuscript.

(5) The descriptions of the virtual catchment approach will be added in the methodology section. A more comprehensive description of the fitted curves will be provided in the revised manuscript.

(6) Line 62: Yes, 'because' is an extra word and will be removed. Apologies for the mistake.

Line 118: Yes, it will be changed to 'pattern'.

Line 177: Yes, it should be 'fluctuation'.

Line 185: Yes, as discussed before, a statistical test will be performed to define the significance of the difference to obtain more precise discussions.

Line 232: As the relationship between Qp and L was shown in Figure 9 (a) and (b), it was discussed before the discussion of the relationship between Qp and Tp. Apologies for the insufficiently clear statements. The section title will be changed to 'Relationship between Qp with L and Tp'.

Line 236: Yes, the sentence will be re-organized as 'The effect of geomorphological characteristics on peak flows is more significant for small catchments as Qp varies more significantly with different slopes in the small catchments (with shorter drainage length)'.

A thorough check the spelling and grammar will be carried out in the revised manuscript.