

Interactive comment on “Parameterizing sub-surface drainage with geology to improve modeling streamflow responses to climate in data limited environments” by C. L. Tague et al.

D. Wang (Referee)

dingbao.wang@ucf.edu

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This paper proposed an approach to transfer calibrated subsurface drainage parameters to ungaged watersheds based on geologic classifications (i.e., High Cascades and Western Cascades) in the US Oregon Cascades region. The method is based on the premise that soil drainage parameters and groundwater drainage characteristics are same for sub-watersheds with the same geologic class. The transferred parameter set is applied for assessing the impact of warming climate on streamflow, particularly the spring runoff fraction. The paper is interesting and well written. I suggest that this

C3896

paper is published with moderate revisions. I have some comments for this manuscript and hopefully the comments can improve the clarity of the paper.

1. The hypothesis or the parameters to be transferred (i.e., subsurface drainage characteristics) is presented in the last paragraph of Background section. It might be better to present this earlier part so that readers can grab the key research question of this research at the beginning. The authors may consider combine the Introduction and Background sections.
2. For the 6 calibrated parameters, gw1 and gw2 are for deep (slower) groundwater drainage. The other four parameters (k, m, po, and pa) are for soil transmissivity and holding capacity. It is understandable that gw1 and gw2 are dependent on the geologic classes. It will be helpful that the authors discuss the dependence of other 4 parameters on the geologic classes. This will explain the premise of the approach for transferring parameters.
3. What's parameter(s) for the drainage characteristics for the shallow groundwater storage in the WC systems? I guess they are related to the four parameters (k, m, po, and pa). The difference between the shallow and deep groundwater systems can be discussed based on the calibrated parameters between HC and WC, or parameters in HC (k versus gw2?).
4. For the deep groundwater, is linear storage-discharge relation used for modeling deep groundwater drainage?
5. For consistency among figures, the authors can choose the best parameter set (instead of randomly selected) from each watershed or HC/WC for demonstration of figures such as Figures 4-7.
6. It will be helpful that the authors explain the end-member parameter method in the texts. The end-member method is explicitly explained in the caption of Figure 5 (i.e., “parameters are varied spatially according to HC/WC geologic classification. . .”). I fully

C3897

understand this until I read Figure 5.

7. Line 14 in page 8674: exponential decay of saturated conductivity? Be specific in case the readers are not familiar with the RHESSys model.

8. Table 3: Please add units for the parameters if applicable.

9. Figure 6: add a 1:1 line?

10. The authors may explain the Figure 3. For example, the y-axis value corresponding to parameter $m=2.0$ for the watershed HORSE is around 0.2. What does that mean? Is the y-axis a cumulative probability?

11. Lines 25-26 on page 8678, "For W2, we selected parameters that met the . . ." I am confused with this sentence since parameters from W2 calibration are excluded (lines 23-25 on the same page).

12. Line 16 on page 8680: Editing may be needed since end-member method is used only for SF watershed. For other watersheds, the parameters are based on model calibration.

13. W2 may be removed from the study watersheds due to the limitation of streamflow observations. The special characteristic of W2 sometimes distracts the readers from more important discussions.

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