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Reply on RC1

Saúl Arciniega-Esparza et al.

Author comment on "Remote sensing-aided rainfall–runoff modeling in the tropics of Costa Rica" by Saúl Arciniega-Esparza et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-428-AC1, 2021

Thanks for your suggestions and your comments. We attached our responses to each point starting the line with "*R:*".

After reading the title, I expected to be presented with a modelling study covering larger areas of the humid tropics. I was thus surprised to find that the manuscript only discusses the case study of Costa Rica when reading the abstract. Thus, I suggest to change the title and exchange "humid tropics" with "Costa Rica".

R: We are agree with this statement that Costa Rica is a limited geographical space, but we would argue that the many tropical climates from seasonally-dry, high-elevation temperate to very humid all covered within the territory of Costa Rica allows a more general reference to the tropics already in the title. Therefore, we will change the title of the revised paper to "Remote sensing-aided large-scale rainfall-runoff modelling in the tropics of Costa Rica".

Line 121 states that delineation of the catchments was performed using "the terrain analysis toolset from SAGA GIS". Were the standard settings used?

R: Thank you for this comment. In the revision, we will fully describe the corresponding settings used with SAGA tools as they deviate from the default due to the strong topographical gradient that influences channel initiation.

The description of the 4 calibration strategies and the associated schematic in Figure 3 left me somewhat confused. Looking at the figure, I assumed that M2 was a stepwise calibration in which a first iteration calibrated against monthly streamflow, followed by a second calibration against daily streamflow. I thus wonder what the "first streamflow" in line 307 refers to. Furthermore, the color coding in Figure 3 left me wondering how M2 and M4 differ from each other and why M4 was similar to M3. The schematic would be clearer if a 4th row could be added, so that each row represents one calibration scheme.

R: Thanks for this comment. In the revised paper, we will modify Figure 4 to add a new row clarifying the different model setups used. We will also modify the color scheme using a colorblind palette as in nature communications (https://www.nature.com/articles/s41467-020-19160-7).

Both NSE and KGE values are presented for comparing the performance of the 4 calibration strategies with each other. In line 437 a values of KGE < 0 are deemed to be poor and in lines 474 and 476, values of KGE > 0.6 are said to be acceptable. How is the choice of these ranges justified? As Knoben et al. (2019) show, even negative KGE values could present an improvement over using the mean flow as a predictor. At the same time, there is no guarantee that KGE > 0.6 is linked to an improvement over a specific benchmark. While the given values clearly show which of the methods provides an improvement over the other, it remains unclear how good the performance actually is. This is particularly relevant in lines 516-521 where an acceptable performance of KGE > 0.5 is linked to both underestimated high and low flows. I would thus like to see a prupose-based KGE benchmark specified against which the results can be compared.

R: Thank you for raising this important point. In the revised paper, we will clarify our choice in using the single discharge metric KGE from Kling et al. (2012) to evaluate the performance of the different HYPE model setups as opposed to multi-criteria calibration. We will refer to the work by Garcia et al (2016), that showed that the KGE is a relatively balanced metric with slightly more focus on high flow. However, Santos et al. (2018) advice against the use of log-transformed discharge with the KGE for low flow evaluation due to potential numerical issues. The latter points against a multi-criteria evaluation, but as Ding (2018) shows this issue is an ongoing scientific debate in the community. Nevertheless, we will implement a clearer description and discussion on this issue and also show other performance metrics (KGE, Pearson Correlation Coefficient, MAE, NSE) for comparison purposes in the supplementary material.

The second issue of a benchmark evaluation will be addressed using the %-deviation from the model calibrated with daily streamflow data (M1), which usually is common practice. These %-deviation values will be added to Figure 8 in the revised paper.

References:

Kling, H., Fuchs, M., and Paulin, M.: Runoff conditions in the upper Danube basin under ensemble of climate change scenarios, J. Hydrol., 424–425, 264–277, https://doi.org/10.1016/j.jhydrol.2012.01.011, 2012. a, b, c

Garcia, F., Folton, N., and Oudin, L.: Which objective function to calibrate rainfall–runoff models for low-flow index simulations?, Hydrol. Sci. J., 62, 1149–1166, https://doi.org/10.1080/02626667.2017.1308511, 2016.

Santos, L., Thirel, G., and Perrin, C.: Technical note: Pitfalls in using log-transformed flows within the KGE criterion, Hydrol. Earth Syst. Sci., 22, 4583–4591, https://doi.org/10.5194/hess-22-4583-2018, 2018.

Ding, J.: Interactive comment on "Technical note: Pitfalls in using log-transformed flows within the KGE criterion" by Léonard Santos et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2018-298-SC2, 2018

Technical corrections

Line 274: The abbreviation IDW needs to be defined.

R: In the revised paper, we will spell out the Inverse Distance Weighted (IDW) interpolation at first mention.

Figure 5: Please extend the y-axis so that the values for Rancho Ray M1 become visible as well.

R: Thanks, we will modify the figure to improve the visualization of the Rancho Rey M1 metrics.

All figures: Unfortunately, the colour scheme used is often not colour-blind friendly. Particularly the lines in Figures 8 and 9 are barely distinguishable. Also, the colour gradient green-yellow-red (e.g. in Figure 1f) or the multicolour gradient (e.g. Figures 4a, 6) generate maps which are very hard to read. I thus suggest switching to a different colour scheme and to use different line shapes (dotted, dashed) to further improve the readability.

R: Thank you for this suggestion. In the revised paper, we will modify the figures to improve the visualization using different color schemes more friendly for color-blind readers using the colorblind palette as in nature communications (https://www.nature.com/articles/s41467-020-19160-7).