Hydrol. Earth Syst. Sci. Discuss., 12, C5112–C5116, 2015
www.hydrol-earth-syst-sci-discuss.net/12/C5112/2015/


Hydrology and Earth System Sciences
Discussions

# *Interactive comment on* "Co-evolution of volcanic catchments in Japan" *by* T. Yoshida and P. A. Troch

**A. Jefferson (Referee)**

ajeffer9@kent.edu

Received and published: 25 November 2015

General Comments: The manuscript shows that 14 catchments, with primarily volcanic bedrock, show both landscape and hydrologic changes with bedrock age. Drainage density is used as the single metric of topography, while baseflow index and slope of the flow duration curve were used as the hydrologic metrics. The authors endeavor also to test climate as a correlate with catchment hydrology and landscape characteristics, but the fairly narrow range of climates represented in the study makes this section less compelling. Overall, I think the paper does a nice job of presenting a new dataset on hydrology in volcanic catchments, but that it tries to do much with too little in terms of making broad claims about coevolution. In particular, I think the climate section is weak and the topographic metrics are underdeveloped, but could be significantly



strengthened with some additional DEM analysis. I think with revision this paper could be a strong contribution to HESS, and I look forward to seeing it published.

Specific Comments: Slope-area analyses (such as used by Jefferson et al. 2010) are a powerful tool for inferring differences in process domains across catchments. Other DEM analyses that could be done include generation of hypsometric curves and more river long profiles and calculation of average slopes and ruggedness. Analyses such as these would a more robust way of showing that the landscapes are evolving over time and should help support or constrain the interpretation of processes that explain the drainage density trends. In reading the discussion, I noted that the authors inferred that the tentatively observed decrease in drainage density in older catchments might be due to lowering of the regional water table due to blocked recharge. Alternatively, perhaps the topography has been sufficiently eroded in these older catchments such that the slope-area space can't support such a high drainage density anymore. More geomorphological analysis might help support one of these hypotheses.

Section 4.2: In Figures 5 and 6 and related discussion in the text, the statistical fits seem highly dependent on the very youngest catchment to show a time trend. I was interested to see if the relationships are statistically significant if this catchments is removed from the dataset. Using the data provided in Table 3, I found that there is no statistically significant log-linear fit between age and drainage density ($p=0.28$) or age and slope of the flow duration curve ($p=0.30$) without the youngest catchment. In the discussion, the authors do describe how the geology of the youngest catchment may result in an anomalously high drainage density (relative to the age), but I think it would be worthwhile to point out the effect of the youngest catchment within the results section.

Section 4.3: In this section, the authors introduce another dataset, that of MOPEX catchments as discussed in Wang and Wu (2013). This dataset is described sometimes as MOPEX catchments and sometimes as the Wang and Wu dataset, and unless the reader has also read Wang and Wu, this will be confusingly inconsistent. More

significantly, I think the main result highlighted by graphing the MOPEX data along with the Japanese catchments is how climatically similarly the Japanese catchments are. Given that, it is unsurprising that the authors find no significant trends with aridity index. Based on this, the authors conclude that catchment age is "the strongest candidate as a predictor of the variability in baseflow index." This seems like a rather strong conclusion to draw from a sample over a narrow range of variability for one climatic metric.

Technical Comments: p. 9962, line 20: This sentence seems to require citation demonstrating the rigorous validation.

p. 9963, line 12: What scale were the maps?

p. 9965, line 10: You call this a weak correlation, but with a standard p-value cutoff of 0.05, I would call this no significant correlation. Examination of Figure 4 suggests that any inference of a relationship between catchment age and aridity index seems heavily dependent on the two outlier age catchments.

p. 9965, line 23: I think there is a typo in this sentence and something other than age is meant. This was also picked up by another reviewer.

p. 9667, line 5: I'm not convinced that is fair to conclude that catchment age is the dominant descriptor of hydrologic variability, if the authors explicitly framed your paper as testing age versus climate but then couldn't really test climate. That said, the finding that age is a strong control on hydrologic response is in agreement with previous research in volcanic catchments.

p. 9667, line 17: "They" is unclear.

p. 9668, line 24: Citation needed for the statement abut flowpaths changing from vertical to shallow subsurface over time.

p. 9668, line 27-28: It's not clear why disconnection of the channel network from aquifers would result in a decrease in drainage density, unless it is specified that it is a



decrease in the extent of the perennial stream network.

p. 9669, line 5-6: Here "western US", previously "Oregon Cascades."

p. 9669, line 8-9: How much difference in drainage density between Oregon and Japan could be due to differences in mapping standards?

p. 9669, line 25: Awkward construction of the last phrase in the sentence.

p. 9670, line 9: Are there any citations to support the assertion that acidic water dissects the landscape faster anywhere in the world?

p. 9670, line 10: Ending the discussion with this rather drawn out and speculative discussion of a single watershed seems weak. I think the last paragraph of the conclusions is an appropriate and much stronger way to end the discussion (especially since it is not really conclusions).

p. 9670, line 14: e.g., is unnecessary since the authors have listed all of the variables examined and not just given examples.

p. 9670, line 16: This is the first mention of intra-annual or seasonal water balance. I suppose the slope of the flow duration curve and the baseflow index tell you something about the overall water balance, but I didn't see anything broken out seasonally.

p. 9670, line 20-21. Alternatively drainage density has stayed constant in mature catchments.

p. 9670, line 21-22: DD is controlled by aridity index for a large array of diverse watersheds (Wang and Wu), but that assertion has not been convincingly supported in the Japanese catchments.

p. 9671, lines 1-3: This sentence doesn't really say anything.

Table 2: It would be lovely to organize the catchments in this table in the same order they are presented in Tables 1 and 3.

Figure 7: What was the 0.35 to 0.45 range in aridity index chosen for presentation?

Figure 8: The caption describes weak relationships, but in fact they are non-significant if the p-value cutoff is 0.05 as usual.

Figure 9: The inset of Figure 9 is the same as Figure 8. I think these two figures out to be combined.

Figure 10: Are the MOPEX catchments the same as the Wang and Wu catchments used in the previous figure? Consistent labeling would nice.

Figure 11: I don't think that the BFI in Jefferson et al. (2010) is calculated in quite the same way as in this study. Did the authors evaluate what difference that might make on the reported BFI values? If there is an effect of the methodology, how can the authors justify fitting a line through the combined datasets?

Figure 12: Why switch to baseflow coefficient here when baseflow index is used elsewhere? This doesn't seem to be justified or explained in the text.

Figure 12: In the caption, the authors report a correlation coefficient (0.74) but no associated p-value. Also, their reported correlation coefficient is for the Wang and Wu catchments and not the ones in the present study. It seems like it would be more relevant to report the relationship for the present study or the combined datasets.

Figure 14: Unclear what the northing and easting are relative to, so some latitude/longitude coordinates would be nice. Also, in the lower watershed the blue elevation colors make it difficult to pick out the channel network. Finally, there's no units on the color scale.

---

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 9655, 2015.