Hydrol. Earth Syst. Sci. Discuss., 12, C6163–C6167, 2016
www.hydrol-earth-syst-sci-discuss.net/12/C6163/2016/

Hydrology and Earth System Sciences
Open Access
Discussions

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

T. Yoshida and P. A. Troch

takeoys@gmail.com

Received and published: 15 January 2016

The authors appreciate the review comments from the Referee. Our responses to each comment are shown below.

Comment 1: Are these catchments studied here at (dynamic) steady state?

- Line 21: How is it related to steady state? Is it implied here that for those basins whose drainage density does not change with age, they achieved steady state?

Response:

The study catchments are all located in dynamic landscapes with the tectonic uplift in the Quaternary Period of 250 – 1000 m (National Research Center for Disaster

Prevention, Japan, 1973). We assumed that all the catchments have reached steady states in which rates of tectonic uplift and erosion are equated when averaged over thousands of years. The fact that the catchments locate in the dynamic landscape is compatible with the assumption which we predicated on; that is the assumption that driving forces of catchment coevolution, or catchment forming factors, are climate, geology and tectonic (Troch et al., 2015).

Comment 2: It might be useful to compare, for e.g., slope-area relationship of catchments from Jefferson et al 2010 (Oregon) with catchments from this study. This may shed some more light to the discrepancy observed between Jefferson et al 2010 and this study, since except the oldest basin (HAZ) from this study all other catchments approximately fall in the range of ages studied in Jefferson et al. 2010. Also, drainage density alone may not be sufficient to characterize relationship between hydrology and geomorphology (which is the major goal of this study) for these catchments, and I think, slope-area relationship will be able to better characterize physical processes/ mechanisms governing the evolution of these landscapes.

Response:

We analyzed the slope area relationship for every catchment. The results indicated that the channels dominated by fluvial erosion emerged between 2 – 6 Ma since their formation, depending on the tectonic uplift rate, and extended towards the upper portion of the catchments until they become substantially eroded gentle hillslopes. It should also be noted that the contributing areas of the inflection points in mean slope area relationship are generally smaller than those of the channel heads defined by the digitized stream lines. The discrepancy between the inflection points and the channel heads implies that some portion of the fluvial channels is ephemeral rather than perennial. The extension of ephemeral streams in mature catchments supports the argument that the major flow pathways have changed over time from deep groundwater to shallow subsurface flow, even after the drainage density have reached equilibrium.

Comment 3: Do these volcanic landscapes have distinct slope-area relationships than other soil mantled landscapes?

Response:

We have not conducted slope area analysis for other soil mantled landscapes because interpretation of slope area relationship is not straightforward especially when climatic conditions and tectonic uplift rate are incorporated as described in the revised manuscript. We will continue working on this topic to shed more light on the interconnected nature of landscape evolution and hydrological properties by decoupling the effects of internal properties (e.g., soil hydraulics properties) and external forcing (e.g., climate) of catchments.

Comment 4: Line 219/Line 228: Not clear on what basis (R value) it is decided what is strong and what is weak. In Fig 4, R value is 0.5 and is termed as weak whereas in Fig 5 is 0.6 and is termed as strong correlation. Incremental increase of correlation magnitude of 0.1 changes the correlation from weak to strong?

Response:

We avoid ambiguous expression of weak/strong correlations in the revised manuscript. Instead, consistent description of significant based on the threshold, p-value of 0.05, was used to decide if the correlation is significant or not.

Comment 5: Line 241: For what scales these slopes were estimated?

Response:

The scale of the map is 1:25,000. This information was added to the revised manuscript.

Comment 6: Line 265: It might be worth discussing little bit more the implications of negative correlation here in terms of physical processes.

Response:

The interpretation of negative correlation was discussed in the section 5.2 of the revised manuscript as follows. Our results suggest two hypotheses to be tested in future studies on the evolution of drainage densities in mature volcanic catchments. One is that as catchment further evolve, hydrologically active channels retreat as less recharge leads to lower average aquifer levels and less baseflow; the other is that it does not significantly change after catchments reached maturity in terms of surface dissection.

Comment 7: Line 297: Is there a reason for why more intense surface dissection is expected?

Response:

We deleted ‘more’ in the revised manuscript, because the increase in the drainage density observed in the Oregon Cascades is at similar rate suggested by Jefferson et al. (2014).

Comment 8: Line 299: Please give more details on what additional mechanisms are referred to here.

Response:

We describe “the mechanism other than the one described in Jefferson et al. (2010)” in the following paragraphs. One is that as catchment continues to age, the hydrologically active channels retreat because of less groundwater recharge leads to lower average aquifer levels and less baseflow. The other hypothesis is that the active channels do not undergo much surface dissection after the catchments reach maturity.

Comment 9: Figure 15: Which order of channel does this stream profile belong to? If we take an average of several stream profiles and compare them with average of Oregon catchments’ (Jefferson et al 2010 study), the differences, if observed, may reveal observed differences between the two studies.

Response:

The channel illustrated in Figure 15 (in the previous manuscript), which is the longest channel in SNK, belongs to first to third order stream. With this figure, we aimed to illustrate the existence of knick point in SNK that may have influenced the anomalously high drainage density of the catchment. The comparison of geomorphology in the Oregon Cascades and Japanese catchments is beyond the scope of our study, which aimed to investigate the relation between landscape evolution and hydrologic responses.

Comment 10: Line 349-354: Are these river networks more dynamic than the river networks of Oregon cascades?

Response:

We have added the following description on how the tectonic uplift rate differ in both studies.

"*Studies addressing the tectonic uplift in the central and southern Oregon Coast Range suggests that the portions of the landscape are uplifted at a rate of 0.05 to 0.2 mm/yr (Heimsath et al., 2001; Reneau and Dietrich, 1989; Brown and Krygier, 1971; Beschta, 1978), which corresponds to 130 – 510 m in the Quaternary Period. The rates of tectonic uplift of our catchments, ranging from 250 – 1000 m, suggests some of the study catchments are more dynamic than the catchments in the Oregon Cascades. However, the significant correlation between the catchment age and baseflow index for the combined dataset implies that the difference in tectonic uplift rate does not exert significant influence on the rate of catchment co-evolution.*"

Minor:

Comment 11: Line 191: Calculated

Response:

This has been corrected.

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