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Interactive comment on "Multi-scale temporal variability in meltwater contributions in a tropical glacierized watershed" *by* Leila Saberi et al.

Anonymous Referee #2

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This paper is an excellent, in-depth exploration of multiple methods to constrain the role of meltwater in downstream hydrology, granted at a very small scale. The innovative contribution is the use of different time scales to demonstrate the interplay between melt regimes, precipitation patterns, and groundwater dynamics. There is tremendous opportunity to expand the relevance of this work in the future by applying a similar suite of methods to data from further downstream, or nested catchments.

A few overarching issues that should be more clearly addressed in the discussion/conclusions:

1. The 7.5 kmˆ2 basin study area has offered valuable insights because of the data collection and monitoring that can be done at this scale, but it is important to acknowledge how your insights and results may translate downstream, given that your interpre-

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Discussion paper

tations of the hydrology and implications of glacier recessions on discharge are being presented for an area in immediate proximity to the glacier terminus.

2. The differentiation, or lack thereof, between snow and glacier melt should be more explicitly discussed. How big a role does snow (melt) play in the catchment, and what data to you have that informs this? To explore this, and relevant to many of your interpretations, a cursory estimate of the precipitation partition in the catchment could be interesting - what percent of precip falls as snow vs. rain based on your temperature and precip data? Given that information and your discharge measurements, do you have a sense of relative contribution of snowmelt vs. glacier ice melt, or even how much of the discharge from the glacier terminus could also be liquid precip routed through that pour point?

Specific comments:

P3 L23-24: which 4 major river systems?

P5 L5: Do you know if historically any other glaciers generated perennial surface discharge?

P6 L10-12: Lack of any rainy/wet season samples is a limitation.

Section 3.2.2: Having run same analytes in different labs in different years potentially introduces error or uncertainty. How confident are you in comparing different lab results? E.g. were detection limits the same, were any lab comparisons done?

Figure 2: 2(a) and 2(c) read like results.

P8 L20: grammar – 'is be unique'

P10 L10: how were T, P, and RH interpolated?

P11 L4-7: unclear here how you ultimately selected tracers for the mixing model. E.g. were thresholds applied to bivariate plots?

P11 L13-17: Any hypothesis on why groundwater discharge was so low in Feb 2017? Are there temps or precip events that inform this anomaly?

Figure 4 caption, line 4: “corresponding to the”

P14 L13-15: how do these melt factors compare to the literature?

P14 L24: reference for historic geodetic mass balance estimates?

P14 L30: missing close parentheses - “full details).”

Figure 5(d): y-axis label typo – “Contribution”

Figure 5 caption: clarification on “(a) average air temp below ELA (5050 m.a.s.l.) and over glaciers and simulated melt inputs” – does this mean T is averaged over ablation zone plus snow covered area?

Figure 5 caption, L4: ‘distribution’ should be ‘contribution’

P20 L10-11: what you suggest here is a buffer against lower extreme low flows during drought times, which somewhat contradicts your repeated assertion (e.g. P20 L14) that melt does not necessarily provide the buffer often credited to it. Reconciling these, perhaps with a clear acknowledgement in the conclusions that the buffer does exist for extreme low flow scenarios, but the modulating effect in other flow scenarios may not be as strong of a control on streamflow as other studies suggest.

P20 L26-27: these longer periods controlled by melt inputs are via infiltration and groundwater recharge, right?

Figure 8 caption, lines 1-2: reference here to glacial meltwater is misleading, since what you’ve characterized is glacier outflow that is a combo of ice and snow melt, right?

P22 L9: “Recharge by meltwater”

P22 L22-23: Unclear what justifies the assertion that discharge could be reduced by

half. Equilibrium discharge with glacier melt contributions and equilibrium discharge post-glaciers should be the same if precip is the same, barring other changes (e.g. increased ET). The peak water period in the middle is a different story, but this claim seems unsupported.

P22 L24-25 Related to the previous comment and as mentioned at the beginning, the other huge caveat is that you are looking at a point 2 km from a glacier terminus, so results absolutely cannot be implied to inform understanding of vulnerability of water resources. Extrapolating further downstream is a logical next step and I think expanding your methods downstream would be an incredibly valuable contribution to this understanding!!!

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