Comment on hess-2022-25
Anonymous Referee #1
Referee comment on "Changes of Nonlinearity and Stability of Streamflow Recession Characteristics under Climate Warming in a Large Glaciated Basin of the Tibetan Plateau" by Jiarong Wang et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-25-RC1, 2022.

In cold alpine regions, climate warming has changed infiltration and hydraulic connectivity due to accelerated glacier melting and permafrost thawing as well as significant glacier and permafrost retreats. It should later the hydrograph pattern including the recession process. Authors analyzed the temporal changes of the recession parameters of a and b in the Brutsaert and Nieber equation in terms of the daily observed discharge during 1980–2015 in the Yarlung-Zangpo River basin (YRB). They obtained interesting results that *a* decreased and *b* increased with air temperature rise, meaning increase of nonlinearity and decrease of stability for the streamflow recessions in most sub-basins of YRB due to climate warming. This finding will benefit to establish a method for hydrological prediction and baseflow analysis in cold watersheds.

The manuscript was well-written and easy to follow. It is acceptable for publication after minor revisions.

Since changes of *a* and *b* values are highly related to the enlarged groundwater storage or soil active layer thickness, I suggested that authors to clearly state the physical bases of the changes of a and b. I also suggested to explain how the driving forces or changes of soil active layer thickness lead to the initially fast decline of recession (ascribed to the increased *b*) and finally slow decline of recession (ascribed to the decreased *a*). I believe these explanations could strengthen the manuscript quality.

Reply: We thank this anonymous reviewer for the valuable comments that helped us to improve our manuscript.

As shown in the observed hydrographs in Fig. r1 the streamflow recedes fast in the early phase of the recession and slows down in the later phase. In addition, Fig. r1 shows that the recession rate ($-dQ/dt$) is small (large) for small (large) streamflow in our study sub-basins.

We will revise the manuscript and add detail as follows: the accelerated glacier melting and permafrost thawing have increased the effective hydraulic properties (Lamontagne-Hallé et al., 2018) and the soil active layer thickness (ALT) for groundwater storage. The increase of hydraulic conductivities reduces the buffering effect of soils on streamflow variability and thereby increases the baseflow recession rate. This phenomenon can be identified in the observed hydrographs which show that the streamflow in the early phase of recession is faster in the warmer period of 1997-2015 in sub-basins NGS, YC, NX, and YBJ (Fig. r1). The warming-resulted increase of ALT strengthens aquifer regulations on groundwater flow so to slow down the recession rate as the warm season proceeds. This weakening of streamflow in the late phase of the recession is also shown in Fig. r1. So, the decrease of *a* (and a' which is a new coefficient related to *a* introduced in our revision and shown in document of Response to CC1) and the increase of *b* with the rise of temperature can illustrate a decrease in streamflow stability and increase of nonlinearity in time in the study basins.

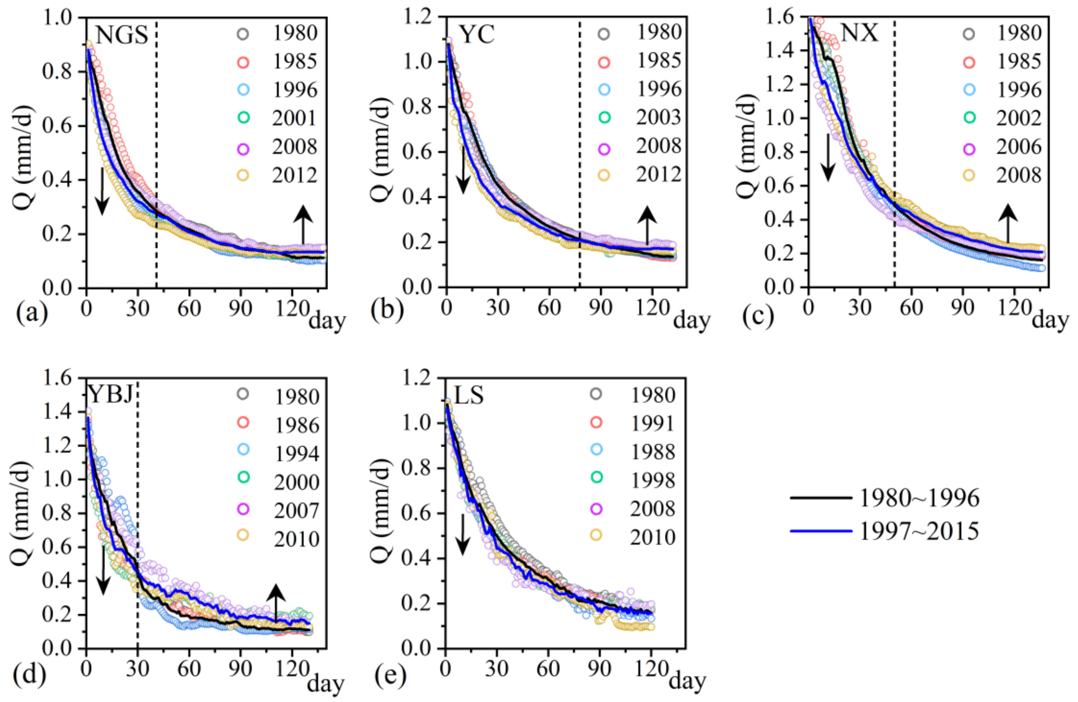

Figure r1: The discharge recession for the selected years with approximately the same initial discharge Q_0 in the study sub-basins.

Minors

1. The decrease of log(*a*) means the decrease of recession rate and thus increase of the streamflow stability, right?

Reply: Defined by Tashie et al. (2019), "an increase in the value of *a* increases rates of streamflow "decay", while the value of *b* is a measure of "nonlinearity" with greater nonlinearity enhancing the concavity of the hydrograph." A larger *a* value indicates a greater recession rate in the log (*a*)-*t* relationship (see Fig. 3 in Tashie et al. 2019). So, the decrease of log(*a*) means the decrease of recession rate and the streamflow stability.

2. Line 100. "…, mean annual temperature varies from -9.3 to 22.0 °C". Is it right the annual temperature could as high as 22.0 °C in the basin?

Reply: This is a spatial range of the mean annual temperature across the Yarlung-Zangpo River basin (YRB) from the west to the east. The mean annual temperature in the downstream valleys could be as high as 22°C.

3. Line 104. "Groundwater accounts for about 54% of the annual streamflow". References are needed.

Reply: The reference has been added. We will revise as "Groundwater accounts for about 55% of the annual streamflow in upstream and 27% in downstream of YRB (Yao et al., 2021)" from lines 103 to 104 in revision.

4. Fig 3. There is a mistake for the range of mean daily precipitation

Reply: The range of daily precipitation in Fig. 3 comes from the observed daily precipitation data in the two periods 1980-1996 and 1997-2015. There is a mistake that the lower bound of the daily precipitation was not shown in that figure. We have redrawn the figure shown below and included the revised figure in our revision.

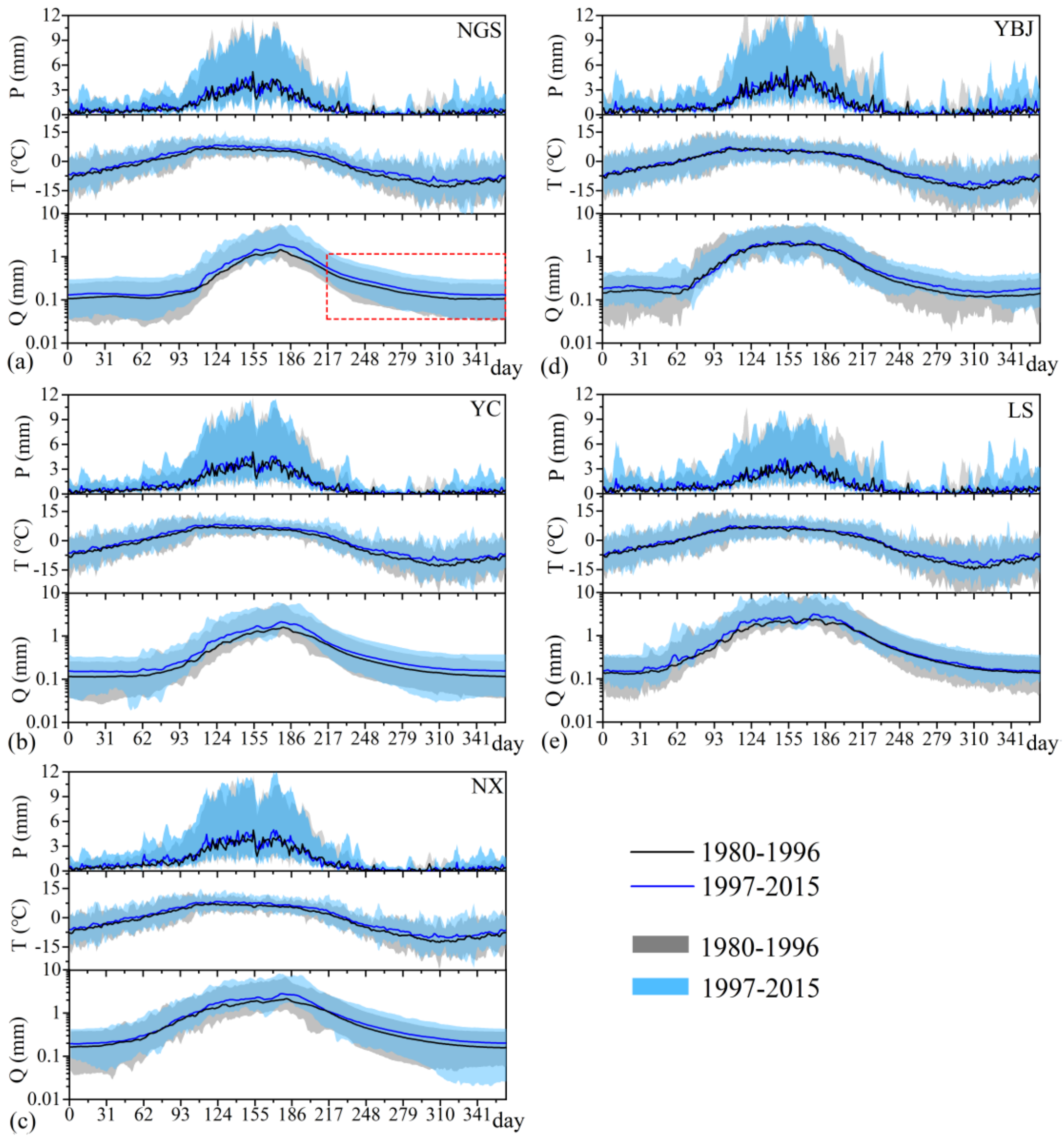

Figure 3: (a)-(e): Mean daily precipitation *P*, temperature *T*, and discharge *Q* in a hydrological year (from 1 March to 28 February of the following year) for the two periods in the five sub-basins. The red dashed rectangle in (a) shows the hydrograph recession from 1 October to 15 February of the following year, and the shading shows the range of the daily variation of *P*, *T*, and *Q* in each period.

References:

Lamontagne-Hallé, P., McKenzie, J. M., Kurylyk, B. L., and Zipper, S. C.: Changing groundwater discharge dynamics in permafrost regions, Environ. Res. Lett., 13, 084017, https://doi.org/10.1088/1748-9326/aad404, 2018.

Tashie, A. M., Scaife, C. I., & Band, L. E.: Transpiration and subsurface controls on streamflow recession characteristics. Hydrological Processes, 33(19), 2561–2575. https://doi.org/10.1002/hyp.13530, 2019.

Yao, Y., Zheng, C., Andrews, C. B., et al.: Role of groundwater in sustaining northern Himalayan Rivers. Geophysical Research Letters, 48, e2020GL092354. https://doi.org/10.1029/2020GL092354, 2021.