Dear Dr. Storrar,

Thank you very much for the time and effort devoted to reviewing our manuscript and we are grateful for your insightful and constructive comments. Below, we provide a point-by-point reply to each comment.

This paper presents the results of a detailed UAV survey of Qiyi glacier, with the intention of taking morphometric measurements of supraglacial channels that can, in turn, be used to estimate runoff. The analysis reveals relationships between sinuosity and lateral deviation (similar metrics), gradient and discharge. This relationship is promising as a means of deriving runoff information from parameters that are measurable by high-resolution satellite remote sensing. Other parameters (height/width) also showed strong(er) relationships, though these are dependent on UAV data and so less widely applicable to satellite remote sensing methods.

This is a neatly conceptualized and well-executed study and the manuscript is well-written. The model has the potential to be very useful for estimating runoff across many glaciers, subject to some caveats. The data and methods appear sound, although some of the morphometric data requires more explanation. The discussion should explain more about exactly how applicable this method is to other glaciers, since I think this is over-stated a bit in the text. I expand on these points below, but otherwise I think this paper is a very useful contribution and I enjoyed reading it.

Reply: We really appreciate your positive evaluation of our work and are pleased that the study was found to be useful and enjoyable to read. To make the content more rigorous, the applicability of this method to other glaciers has been revised in the discussion. Details will be mentioned in the reply to the fifth paragraph of your comments.

More information is needed on how exactly some of the morphometric data were calculated. Channel height and width is not straightforward to measure due to the topographic complexity of glacier surfaces, and so it is important that a consistent method is used to represent this (which I am guessing is what was done). How were the points h1 and h2 derived? This has a very significant implication for the measurement of both height and width. Please add some explanation of this to the methods section (2.3).

Reply: Thank you for pointing this out. We have revised the description in Section 2.3 to ensure readers can follow our definitions and emphasized that this method is consistent throughout this study. Specifically, supraglacial channels are continually eroded by rapid water flow, which creates relatively distinct inflection points in the cross-sectional slope. The two points with the maximum slope are designated as h1 and h2. A representative cross-section (channel A at 4350 m) has been included, showing the positions of h1 and h2 (Fig. A1). The following clarification has been added to line 115: “Since the supraglacial channel is continuously eroded by rapid water flow, there are relatively distinct inflection points in the slope of the cross-section. To ensure consistency in defining channel geometry, we applied a standardized approach to determine channel width and depth: first, the two points on the cross-section with the steepest slope gradients are taken as h1 and h2. Channel depth is defined as the average vertical distance from these two points to the lowest point of the channel, whereas channel width is defined as the horizontal distance between h1 and h2.”

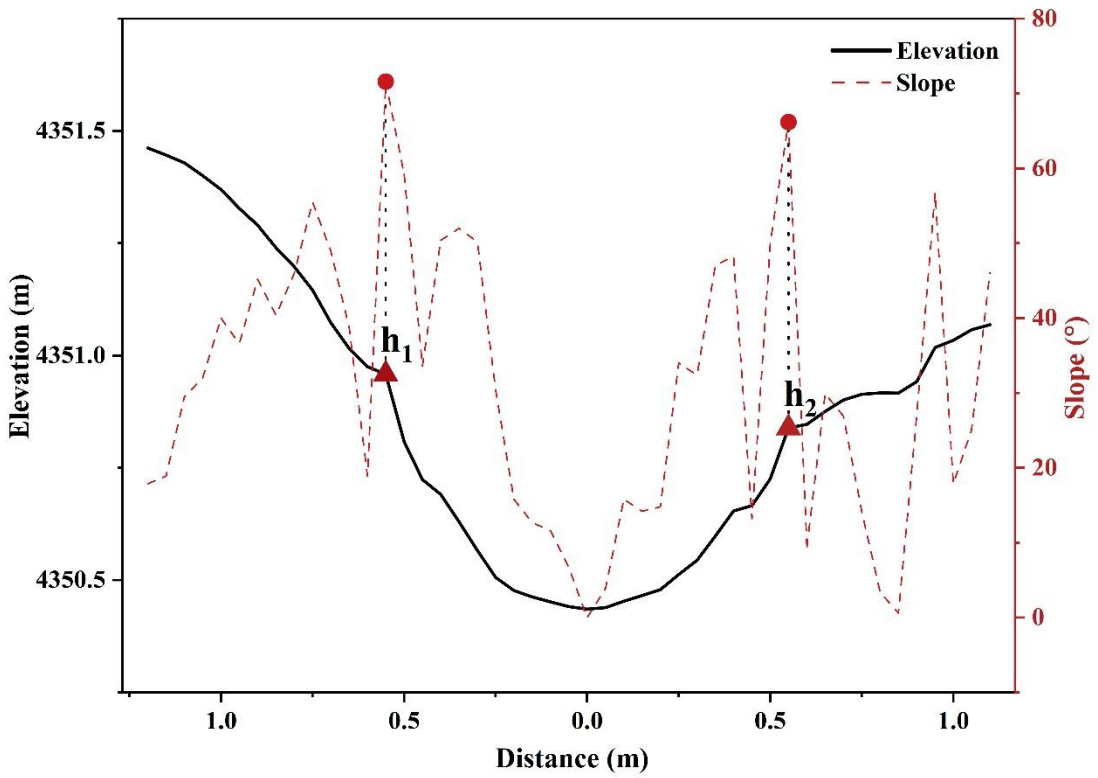

Figure A1. Cross-section of River A at 4350m elevation, the red dashed line represents the profile's slope.

Since the premise of this study is that supraglacial channel morphometry may be a better way of estimating runoff than existing modelling techniques, it would be good to see some comparison of the data generated here with modelled runoff data. This is hinted at in the conclusions (line 365). I don't know how feasible this is, but if possible would be a useful addition.

Reply: Thank you for your suggestions. First, runoff estimated from in situ ablation stakes and precipitation measurements is commonly used as a verification for glacier runoff models. For this reason, we did not perform a comparison with other modelled runoff results. Second, while modeling methods have the advantage of being applicable to other glaciers, our study area is limited to Qiyi Glacier. Although we currently have in situ ablation stake and precipitation data, other meteorological data required to drive runoff models are lacking; therefore, we did not conduct additional runoff model simulations in the present work. In our future research, we plan to install additional meteorological instruments, which will allow us to compare field measurements, runoff model simulations, and channel geometry methods in a systematic way. Thank you again for your valuable feedback.

The discussion of applicability (section 4.4) should be extended to discuss further exactly how typical this glacier is, and other types of glacier to which this model probably does not apply besides tidewater glaciers. For example, temperate glaciers, glaciers with strong surface structures (e.g. crevasses) and debris-covered glaciers, all of which will be very common, are likely too complex to be represented by this model. This section should also note that to derive similar relationships for other glaciers requires mass balance data at the very least (because the scaling relationships are

likely different for each glacier), so unless I am mistaken it can't be applied using remote sensing alone.

Reply: We fully agree with your suggestions. Following your advice, we have reorganized the discussion in Section 4.4 to further emphasize the representativeness of the Qiyi Glacier, and we have expanded our description of glacier types where this model may be difficult to apply or may require substantial adjustments, including temperate glaciers, debris-covered glaciers, and glaciers with strong surface structures. In addition, although channel geometric parameters can be derived from remote sensing alone, the establishment of this method still requires mass balance data to calibrate the coefficients for runoff estimation, due to scaling differences among glaciers. We have therefore explicitly stated that this method requires mass balance data.

I suggest rewording the title to make it clearer to something like: "Estimation of annual runoff using supraglacial channel geometry derived from UAV surveys of Qiyi Glacier, northern Tibetan Plateau"

Reply: The authors all agree that your suggested title more precisely and fully reflects the research content of the article. We have revised the title accordingly.

Line 14-15: Re-order words (novel remote sensing method)

Reply: Change to "a novel remote sensing method".

Line 15: Not sure what is meant by 'discharge volume'? I think you just mean discharge here?

Reply: We acknowledge that this was an incorrect statement, and the term "volume" has been removed.

Lines 24-25: I don't understand the point here. We don't have centimetre-resolution satellite imagery?

Reply: We sincerely apologize for the lack of clarity in our previous wording. What we intended to convey is that if the remote sensing imagery and DEM for a specific glacier study area reach meter-level resolution, our method can serve as an effective solution for analyzing glacial runoff changes. The original sentence has been revised to: "If satellite remote sensing data with meter-level spatial resolution are available for a specific glacier research area, our regression models, based solely on the UAV-derived supraglacial channel network, will be a promising solution for monitoring changes in annual glacier discharge."

Line 59: Suggest 'uncrewed' instead of 'unmanned' to remove gender bias.

Reply: We have made the suggested changes.

Lines 68-71: Are these findings published? If so, please provide a reference.

Reply: The reason we did not include citations to our field investigation results is that these findings are

currently based on observational experience and data that have not yet been formally published. The research in this paper also confirms that our field observations are reliable.

Line 72: Discharge?

Reply: Change "discharge volume" to "annual discharge".

Line 129: I assume from the equation that mass balance is expressed with negative values indicating mass *loss* specifically? It would be good to clarify this in the text below the equation (as well as stating the units).

Reply: Thank you for pointing this out. We have added clarification under Equation 1: "mass balance is expressed in millimeters water equivalent (mm w.e.), with negative values indicating mass loss."

Line 155: Pre-existing ice structure (e.g. fractures) also exerts a strong influence on channel morphology (e.g. Rippin et al. 2015: https://onlinelibrary.wiley.com/doi/full/10.1002/esp.3719?casa_token=5KxM3AvAxIYAAAAA%3AAODpVkdle62Mntm4D44VdOLPP_C7as8R1utImLL7u3vRhY6XGGyBfY0zhIDLpP5UlRx0olELoZHKRCU)

Reply: This is a very valid point. We have integrated this concept into the Discussion (Section 4.1)

Line 185: Median and *mean*?

Reply: The term "mean" is used to denote the average value. We have replaced "averages" in the text (including other incorrect usages).

Line 292: 'especially for mountain glaciers' needs to be in a separate sentence because it is not what Smith said.

Reply: We have restructured the sentence to separate the phrase "especially for mountain glaciers" into a new sentence.

Line 296-7: Change glaciers to glacier (it has only been done at one!).

Reply: We have made the suggested changes.

Line 308-9: Yes, sinuosity and lateral deviation could be determined from high-resolution satellite imagery, but you also need gradient, which can be taken from DEMs, which will be at significantly lower resolution where no UAV data are available. That is not to say that it is not useable, but perhaps worth stating.

Reply: Your suggestions have helped us make the manuscript more rigorous. We have clarified that

gradient must be derived from DEM data, and that in regions without UAV data, gradient extracted from lower-resolution DEMs (e.g., 30 m GDEM, SRTM) still requires further evaluation regarding their applicability. Nevertheless, such datasets can provide valuable scientific reference for future research.