

Interactive comment on “Glacier Changes in the Chhombu Chhu Watershed of Tista basin between 1975 and 2018, Sikkim Himalaya, India” by Arindam Chowdhury et al. 2021

The authors express their gratitude to the editorial team and the reviewers for their insightful feedback and suggestions to upgrade our manuscript. The detailed specific responses to the reviewer's comments are given below. The responses of the comments and the revisions in the manuscript are given in blue colour.

Reviewer #1: 09 Mar 2021

In this manuscript, the background of research is well explained, and what is discussed using the obtained data seems to be appropriate in most cases. But I also think the current manuscript contains various problems, and major revision is needed.

Comment: The obtained data about glacier distribution look meaningful in that they are better than the crude data available before. However, it is unclear whether the quality of new data is high enough. More detailed info about data quality should be given - current descriptions in Sections 3.2 and 3.4 are insufficient. For example, orthorectified Sentinel SA images were used as the reference for geometric correction of other satellite images, but no info is given about the error of the orthorectification of the Sentinel images. Whether the presented data are accurate enough is crucial for publication in the journal Earth System Science Data.

Response: The data used here, Sentinel 2A, has a much better spatial resolution than any other freely available data sources (i.e., Landsat series) for glacier analysis (Paul et al., 2020). Suggestion has been corrected and incorporated accordingly (P4-L141 and L146-147) as per the analysis done.

Comment: A strange thing the authors did is computation of topographic parameters for various years (1975, 1988, 2000, 2010, and 2018) using the SRTM DEM which reflects the topography only in 2000. Therefore, some of computed parameters such as slope do not look meaningful. Please present and use only meaningful data such as the outline and area of each glacier.

Response: Thank you for pointing it out. The suggestion has been incorporated accordingly and only spatial changes have been presented using the different multispectral and panchromatic images over the timespan (P5-L175-176).

Comment: The quality of English writing is low, with numerous grammatical mistakes, awkward expressions, typing problems etc., although the meaning of sentences is mostly understandable. Three examples of such problems in the earlier half of the abstract are:

L11: “The CCW consists of 74 glaciers” – CCW is a watershed, so “consists of” should be “contains”.

L12: The sentence “The change of such glacier outlines obtained ... (2018)” does not have a verb. It is necessary to change “obtained” into “was obtained”.

L13: “and” or “but” should be inserted before “by 2018”.

Lots of similar problems with English writing can be found throughout the manuscript.

Response: English grammar and composition have been revised throughout the text.

Comment: Most figures look OK, but they also contain some problems. For example, use of subfigure labels “a1”, “a2”, and “b1” in Fig. 3 is unusual and strange. Also in its caption, explanation of labels such as IF and CI is written in a random order – please sort them alphabetically.

Response: For Fig. 3, suggestions have been incorporated accordingly. The revised Fig. 3 has been added in the manuscript (P28). Fig. 1 has also been revised according to the suggestions.

Added References

Paul, F., Rastner, P., Azzoni, R. S., Diolaiuti, G., Fugazza, D., Bris, R. Le, Nemec, J., Rabatel, A., Ramusovic, M., Schwaizer, G. and Smiraglia, C.: Glacier shrinkage in the Alps continues unabated as revealed by a new glacier inventory from Sentinel-2, *Earth Syst. Sci. Data*, 12(3), 1805–1821, doi:10.5194/essd-12-1805-2020, 2020.

Revised Figures:

Some minor changes in the figures and captions as per previous suggestions.

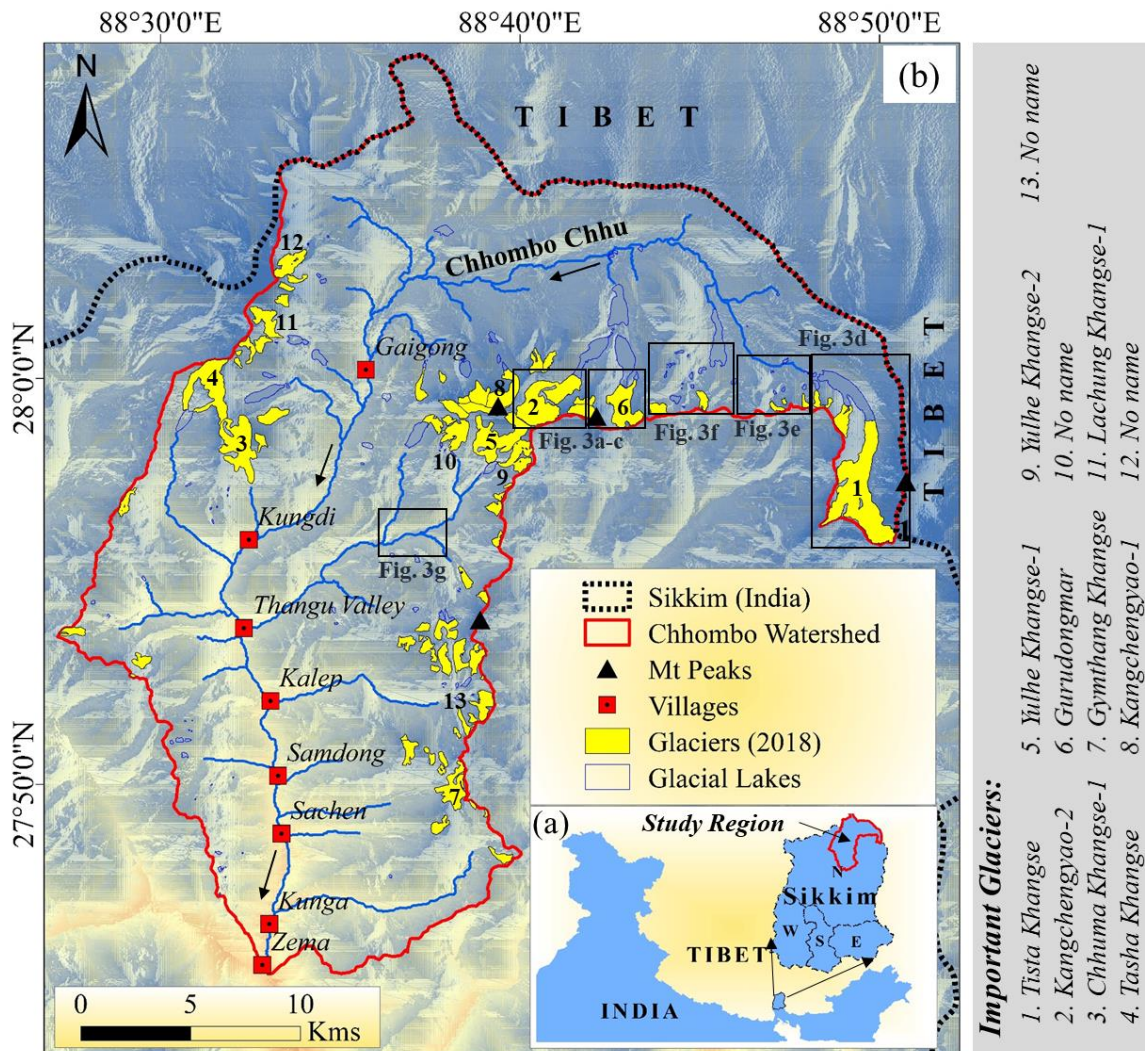


Figure 1. (a) Location of the Chhombu Chhu watershed in the Eastern Himalaya. The watershed boundary is marked in red in the inset within Sikkim, (b) Glacier and glacial lake distribution in the CCW in the Sikkim Himalaya. Inset in black boxes represent the field measurement sites in 2017–2018. The base map used here is SRTM DEM.

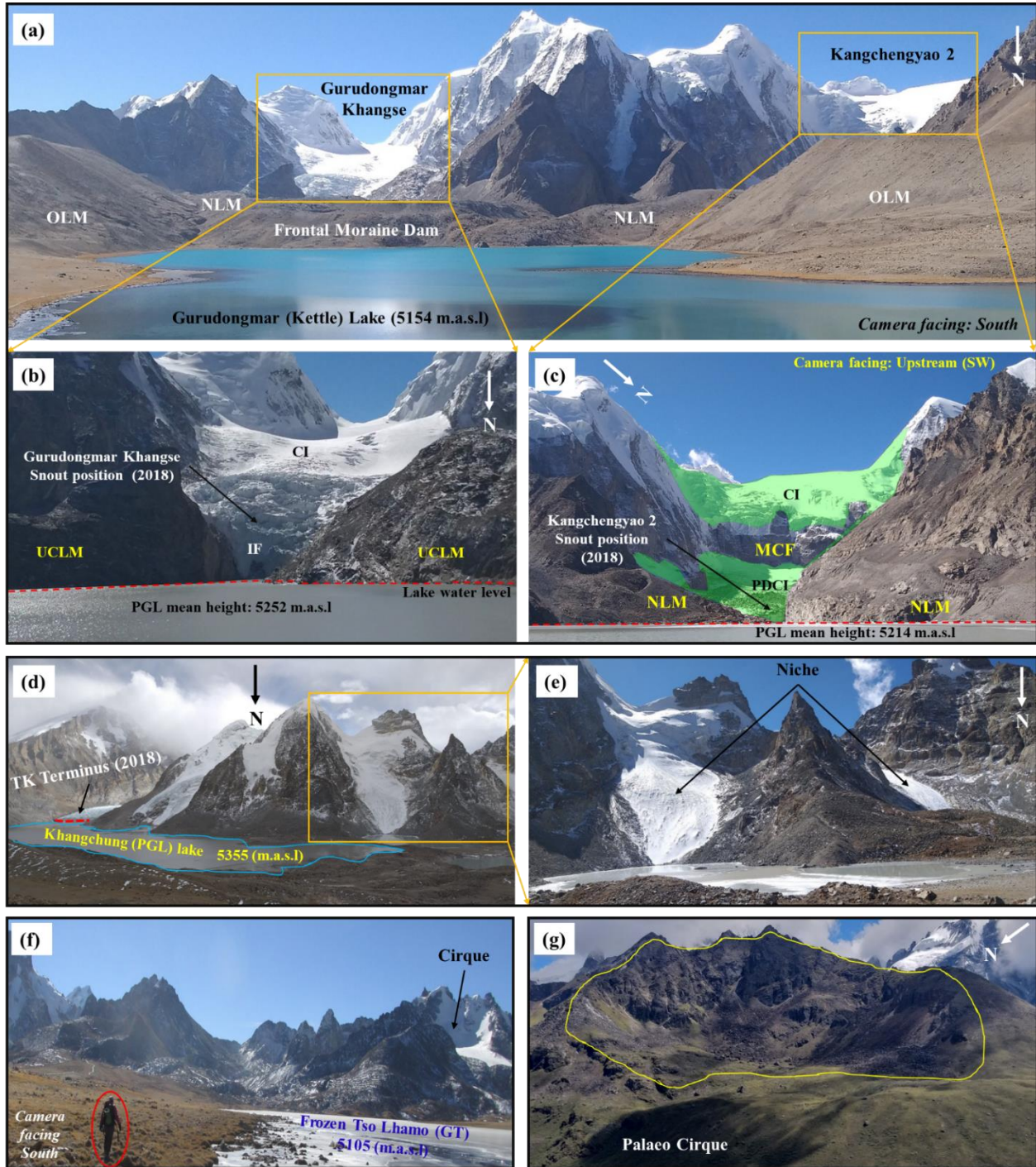


Figure 3. Field photographs (2017-18) showing different glaciers and associated geomorphological in the study region (see Fig. 1 for location). (a) Panoramic view of glaciers in the Gurudongmar region; (b-c) Closer view of Gurudongmar and Kangchengyao 2 glaciers; (d) Different morphological types of glaciers in the Tista Khangse region; (e) Closer view of some niche glaciers near Tista Khangse; (f) Tso Lhamo region; (g) Unknown Palaeo Cirque in the Lashar Valley, Thangu. Note: CI, clean ice; GT, glacial tarn; IF, icefall; MCF, Mountain Cliff Face; NLM, new lateral moraine; OLM, old lateral moraine; PDCI, partially debris-covered ice; PGL, proglacial lakes; TK, Tista Khangse; UCLM, unconsolidated Lateral Moraine. The red oval inset surrounding the person represents the scale of the image. (All Photo courtesy: Chowdhury, A. 2017-18).