Comment on essd-2022-60
Marcus Nüsser (Referee)

Referee comment on "Multitemporal glacier inventory revealing four decades of glacier changes in the Ladakh region" by Mohd Soheb et al., Earth Syst. Sci. Data Discuss., https://doi.org/10.5194/essd-2022-60-RC1, 2022

Multitemporal glacier inventory revealing four decades of glacier changes in the Ladakh region

The study presents a multitemporal glacier inventory of Ladakh based on Landsat data for the years 1977, 1994, 2009 and 2019. The manuscript follows a clear structure, and most sections are well written. The study deals with large parts of the Upper Indus Basin (UIB) and three internal drainage basins (Tsomoriri, Tsokar and Pangong Tso) located in eastern Ladakh. The article is appropriate to support the publication of a useful and plausible data set. The data set solely contains Landsat data that can be used in future interpretations. However, I must mention several queries and specific comments.

Abstract

The sentence “Glacier inventories, and changes therein, play an important role in understanding glacier dynamics and water resources over larger regions” (line 11-12) should be modified. The expression “changes therein” is not precise and it is obvious that glacier changes are important to understand glacier dynamics. The study deals with 2257 glaciers larger than 0.5 km² covering 7923 ± 212 km². It is not clear what is meant by “equivalent to ~30 % of the glaciers and ~89 % of the glacierised area” (line 14-15). The term “deglaciation” is used two times in line 19 and could be replaced by area loss. In the last part of the abstract (line 20-23) the authors should inform about the type of climate data used and the length of the observation period.

Introduction
Many articles on Himalayan glaciers begin with this kind of introduction like ... third pole, water tower for large populations in adjoining lowlands, and so forth. However, the specific characteristic of glaciers in the cold-arid region of Ladakh should be highlighted in this context. Some of the urban agglomerations (Dhaka, Kolkata, Karachi) are less or not at all dependent on the glaciers of Ladakh. It might be more important to refer to basic studies on socio-hydrological interactions in Ladakh and the direct problems of water scarcity for irrigated cultivation (e.g. Nüsser et al. 2012 in Mountain Research and Development).

Line 27: What is the meaning of hydro-economy. This term is a bit vague and can mean different things including hydropower generation and irrigated crop cultivation. Here the authors

Line 28 it should read "Himalayan cryosphere"

Line 40 it should read ", not all regions of Ladakh". In this context the authors should mention glacier studies that have been conducted in Ladakh. Maybe at the end of this paragraph (line 43).

Line 47-48 The inventories by GSI and SAC are manually demarcated. "among others" needs references.

Line 50: why necessitated?

Line 52: it should read "entire Ladakh region"

Line 62: it should read images or imagery

Line 65-67. This sentence is important and should come earlier in the introduction.

Line 67: instead of arid season, lean or dry season might be more appropriate.

Line 68: it should read “can be viewed and downloaded from...”
**Study area**

The main problem is the unclear use of the terms UIB, Ladakh and study area. This should be consistent from the title and abstract to the conclusions. The study focuses on the upper part of the UIB above Skardu. The title focuses on the Ladakh region. In some section of the article spatial denominations are not consistent. Do the authors refer to entire UIB in line 83? In a later section (line 132) the authors state “...the entire UIB, upstream of Skardu, was investigated.”

Figure 1: It might be informative to point out the location of the three endorheic basins (Tsomoriri, Tsokar and Pangong Tso) for those who are not familiar with the region. Pangong and Tsokar can be detailed in the same way as Tsomoriri. In Figure 2a this information is presented. In the figure caption it should read stars (line 77) because it is plural.

Line 94-95: Census of India 2011 and Census of China cannot be found in the reference list

**Data and methods**

Line 106 it should read ASTER GDEM

Table 1: it would be informative to add a last column “Number of Images” in the table. How many MSS, TM, OLI images have been used in this study. The details are presented in the supplement, but the reader should get this basic information in Table 1.

Line 165 to 166: Which DEM was used?

Line 170: misleading might not be the appropriate word in this context.

Line 183: Kanda et al. (2020) with brackets

Line 194 to 203: Some grids have no ground stations for corrections. What is the range of bias?
Results

The section should not begin with a table and a figure.

Figure 3: Although one has to expect the majority of glaciers on northern aspects, the complete absence of southern aspects needs to be checked. What is with the large valley glaciers like the Siachen glacier and some glaciers on the southern faces of Nun and Kun in western Ladakh?

Figure 4: in the figure the term “glaciated area” is used and the figure caption uses “glacierized area”. This must be consistent.

In several parts (line 237, line 248, line 258) the authors use the term “Deglaciation”. Area loss might be more appropriate. (later again in lines 350 and 360)

Lines 271 and 276: It should read “...between XXX and XXX%”

Discussion

The heading “Description ...” is unusual in the discussion.

Line 316: It should read “open-source file format”

Line 321: “Jawaharlal Nehru University and University of Aberdeen glacier IDs” is not clear.

In the comparison with recent studies (section 5.4), the authors should also refer to the study by Bhambri et al. 2013: Heterogeneity in glacier response in the upper Shyok valley, northeast Karakoram.

Some brackets are needed in lines 404, 408, 422
Conclusions

Line 448: What are "more favorable climatic conditions"? For agriculture or for plant growth?

References

L 510: Reference Frey et al. 2014 title needs to be corrected