

Interactive comment on “Glacio-archaeological evidence of warmer climate during the Little Ice Age in the Miyar basin, Lahul Himalaya, India” by Rakesh Saini et al.

Anonymous Referee #1

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The manuscript presents a ^{14}C -based numerical dating case study at an archaeological site located in a proglacial environment in the Miyar Basin, Lahul Himalaya, India, which is an interesting and understudied region. According to the authors their data implies that the site was inhabited and used for agriculture during the ‘Little Ice Age’ (LIA). Basing on the configuration of modern settlements in the valley and a review of literature on Quaternary glaciations in High Asia, conclusions regarding the paleoclimatic conditions are drawn, i.e. that the region has experienced warmer and drier climate during the LIA. Since the LIA is widely considered to be a phenomenon of world-wide impact, ‘evidence’ for a local or even regional climatic optimum during this period –as suggested by the title– would be of outstanding relevance for both the glaciological and

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the paleoclimatic research communities. However, unfortunately the manuscript and data cannot meet such high expectations and are subject to range of substantial shortcomings as outlined below. As a consequence, I cannot recommend the manuscript for publication.

Specific comments

My criticism focuses on six points which I will explain in further detail below: (i) Lack of clear concept and study design (ii) Literature work does not fulfill basic standards (iii) Method set is too limited for the overall purpose, uncertainties are not discussed (iv) Large parts of the discussion are biased and/or speculative (v) Conclusions are not supported by data (vi) Figures are poor

In the following I will focus on the key shortcomings – not only to explain my recommendation to reject the manuscript but also to provide the authors as detailed information as possible on what I think would be necessary to improve future submissions. I did my best to present my criticism in a constructive way but am afraid much of it still won’t read nicely.

(i) Lack of clear concept and study design The introduction hardly points out the relevance of the topic. Furthermore, basics of scientific study design such as hypothesis, research questions and aims do not become clear. In consequence, much of the article, particularly the discussion, left an rather incoherent impression owing to a lack of focus (cf. iv) and, ultimately, lead to conclusions which are hardly supported by the data (cf. v).

The study mixes elements of a review with elements of a case study in a way which I find rather inappropriate. The actual data should be considered in far more detail, in my opinion. Specifically, the discussion of the dating results is very limited, uncertainties are missing completely, and not much information is provided regarding spatial distributions (cf. iii). On the other hand, review elements are mostly used to fill gaps in the manuscript’s dataset. Basically, there is nothing wrong with such an approach but it

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certainly requires humbleness, respect for and detailed consideration of other authors' work, particularly when challenging or even neglecting a widely accepted current state of research. This could all be done in this manuscript (cf. ii).

The title is misleading since the actual dataset is neither sufficient to constrain LIA glacier extents nor related paleoclimate in my opinion (cf. iv, v).

(ii) Literature work Many statements which obviously do not represent original research results of this manuscript are lacking references. In this respect, the chapters 2 (study area) and 3.1 (mapping methods) require specific highlighting, both not citing a single reference. Other statements which are either not the key focus of the paper (e.g. Pleistocene glaciations, P1L22ff, P7L9ff) or of limited informative value (e.g. P1L25ff) are supported by a wealth of literature. In these cases, the reader has hardly any added value and might get the impression that the citations are just to fill up the references list.

In general, I strongly suggest treating previous work with much more humbleness and respect. Particularly in contexts regarding the LIA in High Asia the manuscript tends to reject the current state of research; However, without treating any study in detail or providing a discussion that gets close to supporting such point of view. For example at P1L29ff eleven (!) studies, many of which presenting high quality original results, are jointly accused of falsely generalizing LIA conditions from other parts of the world over the Himalaya without going into any further detail. In my opinion, this is not justified skepticism against past studies or challenging paradigms but simply insufficient consideration of the current state of research. In this context, the treatment of a review paper by Ann Rowan (2016) needs to be highlighted: despite being up-to-date and focusing on key topics of this manuscript, the article gets only very limited attention and, whenever it is mentioned, there is always a negative annotation without explaining why. In my opinion, good scientific practice requires to work in detail with such literature, exactly covering the manuscript's topic and wider study region. Rejecting relevant studies certainly requires discussing them in detail and trying to falsify them basing on actual

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data – one by one.

Also, much key literature is missing, e.g. regarding dendrochronological studies of LIA glaciations and Holocene climate, the heterogeneity in climatic forcing of glacier dynamics over High Asia, existing morphostratigraphies, etc. (cf. literature recommendations at the end of this text).

(iii) Method set and uncertainties CRN and OSL dating have made great progress during the last years, CRN is certainly the most promising technique for LIA moraines without tree stands today. The literature used to support the weak and vague argument that these methods have "limitations" (P2L15ff) seem either outdated or inappropriate for the context of LIA glaciers.

By contrast, a critical assessment of the 14C method or discussion of uncertainties is lacking. The plateau in the 14C calibration curve, one of the main reasons why 14C is used so scarcely in LIA studies because it renders calibration almost impossible, is not even mentioned.

Dendro methods are key for both paleoclimate and glacier characterization in the LIA context. These are also not even mentioned in the manuscript.

The assumption that the area was used for agriculture should be supported by sedimentological and pedological analyses.

(iv) Lack of focus as well as biased and/or speculative discussion Even though the manuscript is quite short, much text is used for off-topic statements. A prominent example is the first paragraph of the results (P4L27-P5L2) which basically presents no results at all. Instead, again the LGM configuration is highlighted (without citing adequate literature or indicating how this is relevant for the study at hand). The next paragraph (P5L3-P5L12) presents "middle Holocene" moraines without providing any dating evidence (and so on).

The data actually presented is restricted to 14C dating results which are accompanied

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by some archaeological interpretations of landforms and landform mapping. Paleoclimatic datasets from the study area are not part of this paper.

The discussion is extremely speculative in my opinion, in some parts completely losing the connection to the data and/or the literature which is actually available in the study region, at times even to the topic of the paper.

The author's conception of the term "Little Ice Age" is not congruent with widely accepted definitions from the literature. Despite the typical fuzziness regarding the determination of starting and end points of certain periods (mostly originating from different events and/or dating methods used for definition) I would say that the LIA is generally used for a climatic pessimum lasting from ~ 1300 until ~1900 CE. Glacier advances in the 19th century glacier advances would thus be considered (late) LIA by most authors. The term 'historical glacier advance' which the authors use instead is typically used when referring to glacier fluctuations for which actual observational data exists. Despite different local dynamics and timings, the LIA cooling signal is regarded to be world-wide owing to the global character of predominant forcing, i.e. solar and volcanic. As such, supporting the hypothesis of a warming during LIA must be substantiated by outstandingly solid data.

On the other hand, the 'Medieval Warm Period' (MWP, also referred to as 'Medieval Climate Anomaly') lasted ~1000-1300 CE. The oldest sample (UBA-30075) is thus definitely MWP/pre-LIA, the second oldest (UBA-30064) may arguably be considered MWP as well but that will depend on actual data on late Holocene climate in the study area.

Figure 2 shows a clear LIA moraine in my opinion (lobate structure just left below the center of the Google Earth image) – with both tributaries of Tharang Glacier united as indicated in the historical map. The historical map, on the other hand, has a much too coarse resolution to use it as a basis to constrain the actual terminal position. CRN dating of this moraine will probably be the only way to assess the timing.

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(v) Conclusions are not supported by data I certainly agree that the mapped structures and archaeological findings indicate certain farming usage. However, to me much evidence (horns, cow dung) seems to point toward pastures rather than agriculture. Pasturing has yet much less climatic implications since pasturing has been the predominant type of land usage in High Asia for thousands of years despite climate fluctuations. In order to support the argument that actual agricultural activities were conducted at the sites more evidence needs to be presented, e.g. soil profiles with substantial portions of humic matter, drill furrows, pollen records.

(vi) Figures Complex, confusing and cluttered figures that are neither self explaining nor being explained in figure captions. Linkages between different figures (e.g. marking locations of photos and map in overview) as well as figures and text are weak or do not exist.

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