# High-mountain Asia Paleoglacier Inventory Beta.1

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## Introduction

The role of the monsoon and westerly moisture in driving glacial asynchrony during the last glacial cycle in high-mountain Asia (HMA) has received a lot of attention. This is because reconstructed past (paleo) glaciers provide an important paleoclimate proxy with broad spatial coverage. Previous studies have observed an out-of-phase behaviour in the timing and extent of the local Last Glacial Maximum (LGM)—regionally between glaciers in HMA—but also in comparison with the mid-latitude ice sheets. However, correlating glacial records across hemispheres or even locally can be a complex task. For example, not all ice sheet sectors culminated concordantly and similarly there are potentially large regional variability in both the timing and extent of glacier culminations across HMA. The variability in glacier culminations might also be obscured by a geographical sampling bias or the fact that data points (dated paleoglacier limits) have varying spatial and temporal uncertainties.

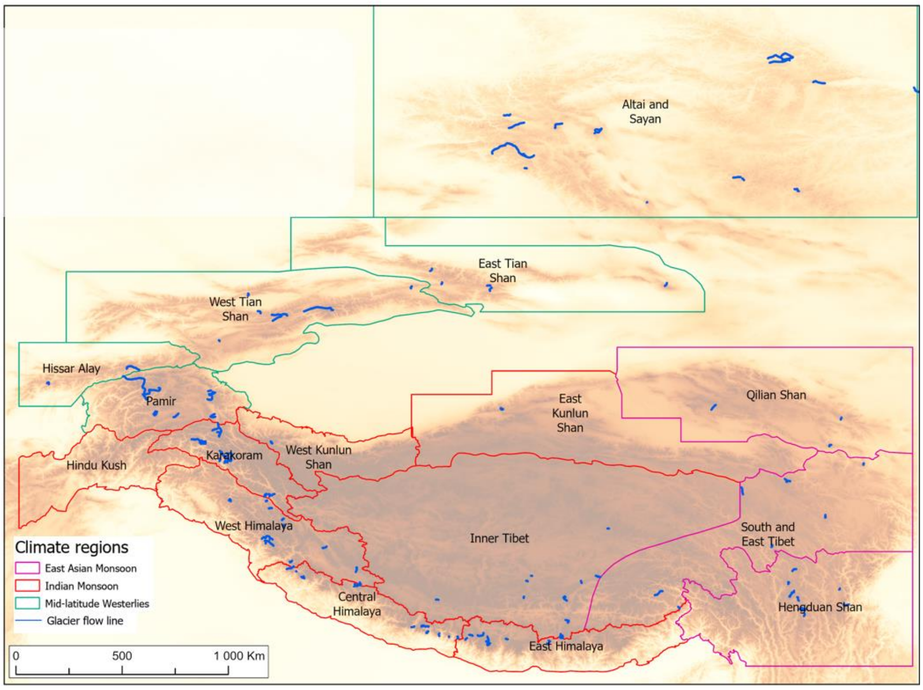



Fig. 1 Our HMA-wide paleoglacier database includes timing of glacier culminations, linked to glacier flow lines (Blomdin **et al**. in preparation).

To answer how competition between the monsoon and westerly moisture influenced glacial asynchrony across the region, we propose to evaluate which glacial records—sequences of glacial landforms dated using cosmogenic nuclides—track mid-latitude glaciation, and which track low-latitude monsoon dynamics. Towards this end, we present the first consistently generated reconstruction of glacier lengths for paleoglaciers and ice caps in HMA, based on published cosmogenic nuclide ($^{10}Be$ and $^{26}Al$) exposure age data and new mapping of ice margin limits from a range of satellite and elevation datasets. The High-mountain Asia Paleoglacier Inventory (HAPI) is an open access, high resolution database of glacier flowlines coupled with geochronological information, compiled from a meta-analysis of over 120 publications (http://hapi-data.org). By reconstructing individual glaciers, we can assess their spatial and temporal certainty, and compare their timing and relative size changes to both mid-latitude glacial records, and low-latitude monsoon records.

**How was HAPI created?**

1. $^{10}Be$ and $^{26}Al$ cosmogenic nuclide data was first mined from https://expage.github.io/.
2. Available remote sensing data was then download for all catchments with available chronological data. This data includes SRTM 30, HMA DEM8 and TanDEM-X. Additionally, the "World Imagery" base map by ESRI was used, which consists of an amalgamation of TerraColor, SPOT, WorldView, GeoEye, IKONOS imagery.
3. By using sample locations, available geomorphological maps from respective publications, and the remote sensing data—ice margin positions (points) were visually mapped for dated moraine ridges, far-flung glacial erratic's, or samples within a drift sheet or ground moraine. Additionally, the maximum ice margin limit visible in the remote sensing data or interpreted in respective publications was mapped, as well as the modern glacier margin (if existing). If no modern glacier existed in a catchment the location of the break in slope of the headwall was mapped.
4. Once the ice margin locations where mapped, glacier flow lines were drawn between the ice margin points to reflect plausible ice flow patterns. Paleoglacier lengths and elevations could then be calculated for each flowline which represent a group of exposure ages, determined by the original publication. Paleoglacier lengths and elevations was also recorded for maximum stage flow lines even though they were not dated.
5. The exposure age groups where then used to calculate deglaciation ages and uncertainties using the methods of Blomdin **et al**. (2018). Reconstructed glaciers (paleoglacier flow lines) were also scaled to units of normalized length and elevation, along a hypothetical ice flow line, from 1 at their reconstructed maximum length, and 0 at their current terminus or cirque headwall.

6. All data is stored in the attribute tables of the paleoglacier flowlines.

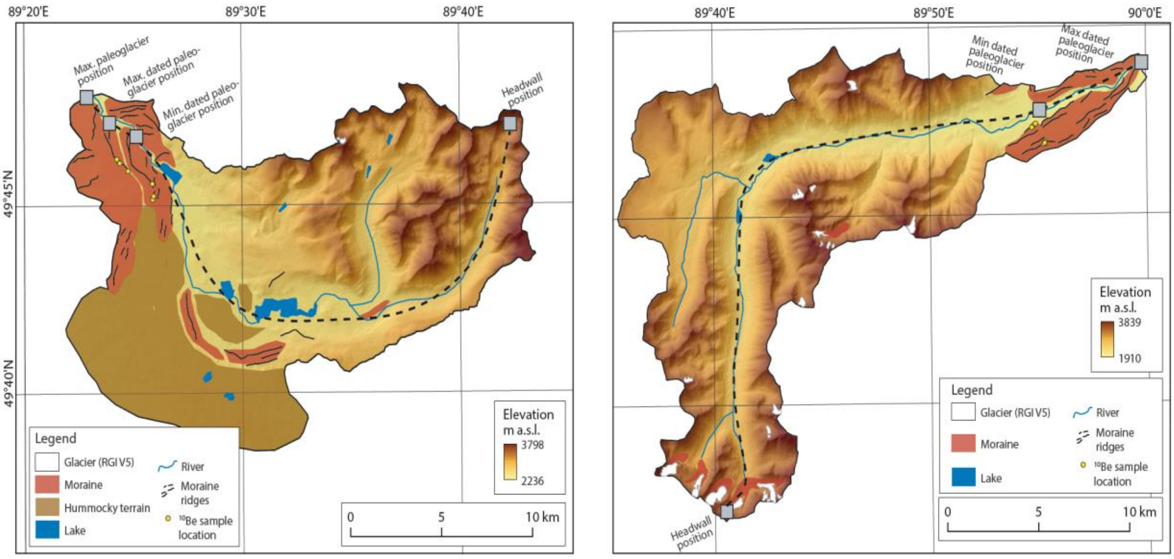
7. 


Fig. 2 Left: Ice-margin positions are recorded as points, at the maximum position regardless of whether it is dated or not and then at every dated deposit as well as at the headwall. A hypothetical flow line is then drawn to reflect plausible ice flow. If there is a glacier in the catchment, its flow line is also recorded. If the catchment is large and there are many modern glaciers: the potentially longest flow line is always considered.

## References

Blomdin, R., Stroeven, A. P., Harbor, J. M., Gribenski, N., Caffee, M. W., Heyman, J., Rogozhina, I., Ivanov, M. N., Petrakov, D. A., Walther, M., Rudoy, A. N., Zhang, W., Orkhonselenge, A., Hättestrand, C., Lifton, N. A., Jansson, K. N. (2018). Timing and dynamics of glaciation in the Ikh Turgen Mountains, Altai region, High Asia. Quaternary Geochronology 47, 54-71. https://doi.org/10.1016/j.quageo.2018.05.008