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First-order mapping of rock-glacier distribution in the Hindu Kush Himalayan region based on Google Earth

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Extensive – but barely studied – areas of permafrost exist in the Hindu Kush Himalayan (HKH) region. Many people live on or near this permafrost and their regional livelihoods and economies may come to face effects of widespread permafrost thaw induced by climate change during the decades to come. This is because permafrost thaw influences a broad range of systems including hydrology, vegetation, sediment loads in torrents and rivers, debris flows, rock fall, water quality, and the stability of engineered structures.

Approximate relationships between topo-climatic variables and permafrost occurrence are known from other mountain ranges. Their application to the HKH region, however, is subject to a large uncertainty in the driving large-scale climate variables such as air temperature. To provide a first-order estimate of permafrost distribution, we conduct a systematic randomized mapping of rock glaciers on Google Earth and in this presentation share the first results.

The strong topographic heterogeneity requires sampling a high number of locations. For this, we randomly distributed 2000 mapping squares (0.05 degrees slide length) in the entire HKH region. In order to reduce subjective error, guidelines and training for mapping have been developed, and every square was mapped by two people independently. In addition to rock glacier outlines and a subjective measure of mapping confidence, also snow and cloud cover, image date, image quality have been recorded.

Preliminary results show that the proposed method works well and can be used as a tool to assess the distribution of mountain permafrost in remote areas with sparse to nonexistent ground data and to inform further steps in research.