

## Restricted glaciations on the Tibetan Plateau and palaeoclimatic implications

Jakob Heyman<sup>1,2</sup>, Arjen P. Stroeven<sup>1</sup>, Alun Hubbard<sup>3</sup>, Jon Harbor<sup>2</sup>, Marc W. Caffee<sup>4</sup>, Clas Hättestrand<sup>1</sup>, Helena Alexanderson<sup>5</sup>, Yingkui Li<sup>6</sup>, Liping Zhou<sup>7</sup>, Ping Fu<sup>1,2</sup>, Björn Morén<sup>1</sup>

<sup>1</sup> Department of Physical Geography and Quaternary Geology, Stockholm University

<sup>2</sup> Department of Earth and Atmospheric Sciences, Purdue University

<sup>3</sup> Institute of Geography and Earth Sciences, Aberystwyth University

<sup>4</sup> Department of Physics, PRIME Lab, Purdue University

<sup>5</sup> Department of Earth and Ecosystem Sciences, Lund University

<sup>6</sup> Department of Geography, University of Tennessee

<sup>7</sup> Department of Geography, Peking University

The Tibetan Plateau is a unique topographic feature and it houses the majority of present-day glaciers located outside the polar regions. The glacial geology of the Tibetan Plateau has attracted much recent interest with main focus on the extent and timing of, and driving forces behind, past glacier advances. Field studies and satellite image based landform mapping have revealed a common pattern where glacial landforms and sediments are distributed in and around mountain groups, but where extensive regions of the plateau are lacking evidence of past glaciation. Cosmogenic exposure and luminescence dating of glacial deposits have helped define the timing of mountain-based glaciations up to several hundred thousand years old. We use the glacial geological record, with alpine style glaciers restricted to mountain regions, to quantify past climate variation. Using a high resolution (<500x500 m) higher-order glacier model, the present-day climate is perturbed to force glacier expansion to mapped ice marginal limits. We apply the model for several mountain regions across the Tibetan Plateau and thus quantify past climatic limits for Tibetan glacier expansion. Our modeling indicates that glaciers expand beyond their late Quaternary margins under the influence of modest cooling, indicating that they might have experienced only limited climate shifts during the last few hundred thousand years, or that temperature depressions were offset by extreme aridity.

Keywords: *Tibetan Plateau, glaciation, glacier model, palaeoclimate*