

Limited glacier advances and modest glacial cooling on the Tibetan Plateau revealed by glacial geology and glacier modeling

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Glaciers on the Tibetan Plateau have experienced multiple advances and retreats during the past few glacial cycles, but they have remained restricted to the highest mountain areas in the form of valley glaciers and ice-fields. In an effort to quantify the climate during past glaciations, we have combined the glacial geological record of eight mountain regions across the Tibetan Plateau with a numerical glacier model. Based on detailed remote sensing landform mapping we have defined present-day and past glacier maximum outlines. Using a high resolution (250 m) higher order glacier model, calibrated against present-day glaciers, we have quantified the climate perturbations required to expand the present-day glaciers to their past maximum extents. We find that a modest cooling of 2-6°C during a few thousand years is enough to expand present-day glaciers to their past maximum extents, even with significant (25-75%) precipitation reduction. This limited glacial cooling indicates that the Tibetan Plateau temperature may have remained relatively stable during the Quaternary glacial cycles. Further, for the three mountain regions with largest present-day glaciers we have run the model forward with a warming climate until year 2300 and the outcome is dramatic ice volume losses for all three regions.