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Unearthing the forgotten record of glacier change in southeast Greenland

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Prior to the satellite era (pre-1970s) knowledge of long-term glacier change is sparse. Although some glacier-wide mass balance datasets are available, few records extend beyond twenty years in length, or indeed, start prior to the 1980s; as such, identifying long-term trends between glacier change and global temperatures is difficult. As a result, extending the record of glacier change will not only help to identify such trends, but may also facilitate more robust understanding of future glacier response under a perturbed and varying climate.

Since the 'heroic age of Arctic (and Antarctic) exploration', many photographs of polar environments have been captured and stored for historic interest. These photographs, depicting images of past glaciers and ice sheet margins, have, as of yet, untapped potential to provide important insights into past glacier extent, and long-term behaviour.

Using computer-vision methodologies, we present a unique record of georeferenced 3-D elevation models using declassified aerial imagery dating from the 1930s—1980s at quasi-regular time steps. This study focusses upon two sections (ca. 190 km total length) of the southeast margin of the Greenland Ice Sheet (in the vicinity of Kangerlussuaq Glacier), capturing the history of both land- and marine-terminating outlet glaciers, and local glaciers. We examine quantitative information extracted from these reconstructions, allowing us to 'back extend' the record of glacial change in this region, by measuring changes in glacial extent, surface profiles and height (elevation), and calculating volume estimates.