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Recent, rapid and profound changes to glacier morphology and dynamics, Juneau Icefield, Alaska

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The Alaskan region (comprising glaciers in Alaska, British Columbia and Yukon) contains the third largest ice volume outside of the Greenland and Antarctic ice sheets, and contributes more to global sea level rise than any other glacierised region defined by the Randolph Glacier Inventory. However, ice loss in this area is not linear, but in part controlled by glacier hypsometry as valley and outlet glaciers are at risk of becoming detached from their accumulation areas during thinning. Plateau icefields, such as Juneau Icefield in Alaska, are very sensitive to changes in Equilibrium Line Altitude (ELA) as this can result in rapidly shrinking accumulation areas. Here, we present detailed geomorphological mapping around Juneau Icefield and use this data to reconstruct the icefield during the “Little Ice Age”. We use topographic maps, archival aerial photographs, high-resolution satellite imagery and digital elevation models to map glacier lake and glacier area and volume change from the Little Ice Age to the present day (1770, 1948, 1979, 1990, 2005, 2015 and 2019 AD). Structural glaciological mapping (1979 and 2019) highlights structural and topographic controls on non-linear glacier recession. Our data shows pronounced glacier thinning and recession in response to widespread detachment of outlet glaciers from their plateau accumulation areas. Glacier detachments became common after 2005, and occurred with increasing frequency since then. Total summed rates of area change increased eightfold from 1770-1948 (-6.14 km^2 a^{-1}) to 2015-2019 (-45.23 km^2 a^{-1}). Total rates of recession were consistent from 1770 to 1990 AD, and grew increasingly rapid after 2005, in line with regional warming.