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Modern glacier variability at South Georgia in a long-term perspective

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Glaciers located along the Antarctic Peninsula and also on the islands lying in the fringes of the Antarctic continent are currently in a state of demise. This shared pattern of retreat suggests that climate are significantly changing in the Southern Hemisphere, but how unique is this change in the context of the past 10 000 years? Because instrumental and historical data from this region is scant, and also that climate models struggle capture the dynamic features of the region, longer dataseries are required in order to address scientific questions such as: What is the scale expression of natural variability for glaciers occupying the Antarctic fringe and on longer timescales, and to what extent can the observed glacier retreats be explained by natural climate variability? We wanted to provide answers to these fundamental questions by producing terrestrial glacier records from the remote island South Georgia (54-55°S, 36-38°W) covering the last 13 000 years. Alpine glaciers mass balance is determined by the relative importance of summer temperature versus winter precipitation as well as wind direction. The alpine glaciers of South Georgia are especially sensitive to changes in winter precipitation and they have–in terms of frontal advances–varied significantly during the time interval of interest. Our results, based on detailed analysis of both lake and fjord sediment records as well as moraine sequences, suggests that we are able to track glacier activity at sub-decadal time scales. This has been possible due to a novel integration of exposure dating with radiocarbon dating of lake and fjord sediments, including bedrock knobs and moraines, which in sum have facilitated the construction of highly accurate age-depth models for the sedimentary archives. Soft sediments obtained from both short and long cores have been analyzed by a suite of methods, including geochemical elements (XRF), rock magnetic properties, dry bulk density and Loss-on-ignition. Lake sediment distribution was surveyed and mapped prior to coring by the use of ground penetrating radar. The integrated dataset forms the basis from which the glacier reconstructions were carried out.