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Palaeoclimatic implications of small-scale glaciation in the Lesotho highlands, southern Africa

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In southern Africa, past climate data is sporadic, and is dominated by records from arid, coastal or semi-arid environments (Karoo, Kalahari & Namib deserts, Western Cape). There is a vast gap centred on Lesotho where there is currently no reliable temperature or rainfall proxy data for climate change prior to the present interglacial. The few studies of palaeoclimate in the more humid south eastern region of southern Africa provide only qualitative indications of climate shifts through the last glacial-interglacial cycle. Consequently, debate continues over the key issue of whether this region in southern Africa experienced increased precipitation or substantial aridification at and around the global Last Glacial Maximum (LGM). Geomorphic evidence of former glaciation in the high mountain region of southern Africa dated to the LGM implies that specific climatic conditions would have been required to sustain active glaciers. This paper presents results for various sites in the Lesotho highlands, which host linear ridges interpreted as glacial moraines. The application of a glacier reconstruction technique to determine whether these locations could have supported glaciers indicates a reconstructed glacier Equilibrium Line Altitudes (ELA) between 3071 and 3127 m a.s.l. and palaeoglacier mass-balance characteristics comparable with modern analogues, reflecting viable, if marginal glaciation. The reconstructed palaeoclimatic conditions during the LGM suggest that snow accumulation in the Drakensberg was significantly higher than considered by other studies, and has substantial relevance for tuning regional climate models for southern Africa during the last glacial cycle. The climate history of Lesotho is still uncertain due to an absence of any palaeoclimatological data from this region, in particular for the period spanning the LGM. The occurrence of glaciation in the Drakensberg suggests that precipitation was greater than at present, despite the general consensus that the summer rainfall region of southern Africa was drier during that time, suggesting that there was a major shift in rainfall zones across south eastern southern Africa during the last glacial cycle.