



Late-Quaternary niche glaciation in the Lesotho highlands, southern Africa

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Records of past climate data for southern Africa are predominantly restricted to arid, coastal or semi-arid environments (Karoo, Kalahari & Namib deserts, Western Cape). There is currently no reliable temperature or rainfall proxy data for climate change prior to the present interglacial for Lesotho. Consequently, there has been continued debate over the issue of whether this region in southern Africa experienced increased or reduced precipitation at and around the global Last Glacial Maximum (LGM). Recent published work has applied a geomorphological, micromorphological and glaciological approach to demonstrate a glacial origin for various 'moraine like' deposits in south-eastern Lesotho. This geomorphic evidence, dated to the LGM, implies that specific climatic conditions would have been required to sustain active glaciers. This paper presents results from two sites in the Lesotho highlands, which host linear ridges interpreted as glacial moraines. The application of a glacier reconstruction technique to determine whether these sites could have supported glaciers permits the calculation of palaeoglacier mass balance, total velocity and basal slip, which in turn may be compared to modern analogues. Reconstructed equilibrium line altitudes (ELAs) range from 3071 to 3074 m a.s.l. and palaeotemperatures during the summer months would have been around 2.7°C, whilst palaeoprecipitation would have approximated 1500 mm per annum. The results indicate that the mass balance characteristics for the palaeoglaciers are comparable with modern analogues, reflecting viable, if marginal glaciation. The importance of topographic shading on determining the location of the glaciers is reflected through insolation mapping and the potential of this shading on glacier mass balance is quantified from energy balance model calculations. The occurrence of small-scale glaciation in the Drakensberg during the LGM implies 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.