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On the climate of the Drakensberg: rainfall and surface-temperature attributes, and associated geomorphic effects

by

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ABSTRACT

The Drakensberg range is the highest landscape zone in southern Africa, is a World Heritage site and an important source of surface runoff. General climatic evaluations covering the area, however, date from the 1970's. Remarkably, few contemporary studies detail rainfall attributes and limited surface-climate data has been collected describing the sub-periglacial summit regions. This thesis presents an evaluation of rainfall and surface-temperature attributes in the mountains and, where possible, related geomorphic implications are described. The assessment is partly based on analysis of historical rainfall data measured by the South African Weather Services during the 20th Century, and partly on new rainfall, air and soil temperature data collected by the author over a five year period. Historical rainfall records show, when a spatial approach is taken, that altitude and distance from the escarpment eastward influence annual rainfall totals. Latitude plays no significant role in influencing rainfall totals, but is the single important factor influencing inter- and intra-annual rainfall variability. Rainfall variability increases from the southern Drakensberg to the north where important water transfer schemes operate. When a temporal approach is taken, historical records indicate no change in mean annual rainfall during the last half of the 20th century. Intra-annual rainfall variability has increased and this is illustrated by a statistically significant decrease of rainfall during the autumn season. A contemporaneous as well as a lagged correlation exists between the El Niño/Southern Oscillation and summer rainfall in the

Drakensberg. An increase in the frequency and intensity of ENSO should decrease summer rainfall and the lagged correlation could be used for summer rainfall forecasting.

Using temporary field stations, analysis of rainfall and air, soil and rock temperatures contribute to an improved understanding of the characteristics and structure of rainfall events, surface conditions and effect on rock weathering and soil erosional processes. With respect to rainfall attributes, totals recorded on the escarpment summit are considerably less than anticipated. Individual erosive storm events at all altitudes are found to have the ability to detach soil, but at high altitude less rain falls as erosive storms, and the total erosivity generated by rainfall events is less on the escarpment than in the foothills. Five-minute intensity data indicate that extreme rainfall events generate peak rainfall intensity, within the first half of the storm duration. Mean annual air temperature (MAAT) measured on the escarpment falls within the range previously estimated, but is higher than the MAAT suggested by other authors for the plateau peaks behind the escarpment. No long-duration, or seasonal freeze was found on the soil surface and soil temperatures are generally higher than air temperatures. Rock temperature and rainfall frequency recorded below the escarpment imply an environment conducive to rock weathering processes such as wetting and drying and thermal fatigue with the possibility of frost action. Contrasting air, rock and soil surface temperatures measured in the Drakensberg, emphasises the dissimilarity in micro-environmental conditions experienced by different natural mediums in the landscape. Overall, the data confirm the marginal-periglacial nature of the summit region but earlier estimates for rainfall totals at the escarpment appear to be notably high. Extrapolation towards, for example, palaeo-precipitation scenarios using earlier estimates, should thus be made with caution.

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