The Eastern Cape drought

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Abstract

In recent years the Eastern Cape has experienced recurring drought with unfavourable impacts on agricultural production and water resources. Dam levels in early 1992 were 30% of capacity. Statistical analysis has demonstrated that drought recurs at intervals of 3,45 and 18,2 years, particularly when March rains fail to materialise. Regional analysis of cloudiness, surface and upper level winds, and sea surface temperatures exhibit distinctive patterns in drought years. Low-level winds sweep eastward bringing Karoo-like conditions to the Eastern Cape, in association with increased jet stream winds. Reduced cloudiness is noted in a NW-SE band extending from Namibia across the Eastern Cape watershed. To the south of Madagascar, the SW Indian Ocean anticyclone strengthens in drought years and increased trade winds cause the Agulhas Current to cool and recurve southwards near East London. Consequently sea surface temperatures to the south-west are 3°C cooler in dry years. The subtropical humid air mass over the Agulhas Current and north-eastern South Africa retreats eastward, and rainfall associated with cut-off lows and ridging anticyclones is limited over the Eastern Cape.

List of abbreviations

ECW - Eastern Cape Watershed
SST - Sea surface temperature
OLR - Outgoing longwave radiation
GIS - Geographic information system
SOI - Southern oscillation index

Introduction

The Eastern Cape Watershed (ECW, Fig. 1) has recently come under the influence of drought leading to a decline in the local economy through reduced agricultural productivity and a scarcity of water resources. The ECW is spread across a climatic transition zone: the west is dominated by mid-latitude, winter rainfall and the east by sub-tropical, summer rainfall. Mean annual rainfall ranges from 250 mm along the Karoo fringe at Jansenville to 450 mm in the east at Grahamstown (SA Weather Bureau, 1988). Mean annual evaporation (potential from class A-pan) is about 2 000 mm (SA Weather Bureau, 1986).

Following 18 months of below normal rainfall, dam levels at the end of 1991 were 30% of capacity (SA Weather Bureau Newsletter, 1991). Thus a study of the cycles of rainfall and the climatological mechanisms underlying drought in the ECW is overdue. Given the east-west gradient in the water deficit, it is hypothesised that drought results from an eastward encroachment of subsident dry air from the Karoo basin. Rainfall is dependent on instabilities in the mid-latitude westerlies in the transition seasons (Jackson and Tyson, 1971; Cowling, 1984; Preston-Whyte and Tyson, 1988). In drought years the meteorological processes sustaining cut-off low pressure systems (in autumn) and ridging anticyclones (in spring) over the southern escarpment are expected to be disrupted.

Climatic background

The ECW (Fig. 1) contains the Groot/Gamtoos, Sundays, Great Fish and Buffalo river systems, and extends from 31 to 34°S and 23 to 27°E. The coastline is convex and bends at an approximately 45° angle near Port Elizabeth. Alongshore winds which are characteristic of the area (Heydorn and Tinley, 1980; Hunter, 1987; Jury and Diab, 1990) diverge over the coastal plains. A feature of the adjacent SW Indian Ocean waters is the warm Agulhas Current which flows very near the coast at East London, but some 100 km seawards of Port Elizabeth (Jury et al., 1993). Subsident motions in the coastal zone which may dampen rainfall processes have been linked to atmospheric circulations off-shore over the Agulhas Current (Jury and Courtney, 1991). On the south-western flank of the ECW, a belt of steep coastal mountains to the east of George restricts the inland penetration of moisture.

The escarpment (indicated by the 1 000 m contour in Fig. 1) lies some 200 km from the coast near 22°E, creating the aforementioned Karoo basin where annual rainfall is less than 200 mm. In the east, the escarpment gradually converges towards the coast and is within 50 km at East London. There, the warm Agulhas Current supplies humid air which can be driven up the steep windward face of the escarpment, resulting in orographic rainfall with convective characteristics (maximum rate 90

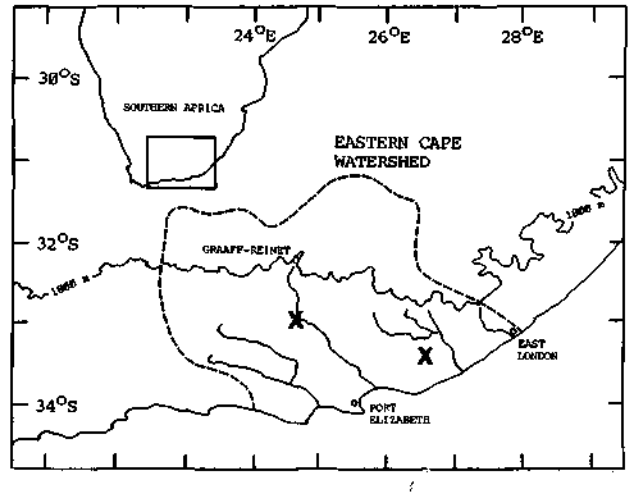

Figure 1
Location map of the Eastern Cape watershed (boundary dashed) showing rainfall stations with X symbols. The 1 000 m contour of the escarpment, major rivers and urban centres are shown

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