

Possibilities to forecast early summer rainfall in the Lesotho Lowlands from the El-Niño/Southern Oscillation

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Abstract

Lesotho is located approximately at latitude 30°S in the interior of Southern Africa. The mesocale climate is complicated and governed by various weather systems. The inter-annual rainfall variability is great, resulting in low food security, since the growing of crops is almost exclusively rain-fed. Reliable forecasts of austral summer rainfall, especially early summer rainfall (October-December), are thus valuable. Earlier research has shown that the El Niño/Southern Oscillation signal from the Pacific can be discerned in Southern Africa. In general the signal from the El Niño/Southern Oscillation is strongest in the later part of the early summer. October, November and early summer rainfall are significantly correlated with certain preceding values of the Southern Oscillation Index (SOI), but weakly so. December rainfall and aggregate November-December rainfall are significantly correlated fairly strongly ($r = 0.5$ approximately) with certain preceding SOI values. Lead times of four months seem to be attainable. A contingency analysis basically yields similar results, working on the assumption that the response is non-linear in the sense that a certain threshold of the strength of the Southern Oscillation has to be surpassed to "trigger" a rainfall response in Lesotho. For wet Decembers the average monthly SOI for the preceding months May to November is positive during all months. For dry Decembers it is negative.

Introduction

The Lesotho Lowlands are located in western Lesotho and encompass 5 000 km². The Lowlands have a north-south extension of 200 km and a width of 25 km. They border the plains of the eastern Free State and have an approximate elevation of 1 750 m above sea level. To the east the foothills rise into the Lesotho mountains, which rise to elevations higher than 3 000 m. It is in comparison with these elevations that western Lesotho is called lowlands (Fig. 1). The 1886/87-1992/93 mean annual precipitation over the Lowlands is 735 mm (Hydén, 1996a). However, the mean annual precipitation varies considerably between years, the lowest being 426 mm and the highest 1 097 mm in the mentioned 107-year series.

A majority of the Basotho live in the Lowlands from rain-fed agriculture. Rainfall variability is thus of great importance for food security. The ability to forecast rainfall in the austral summer would contribute to improving food security. This is especially true, if droughts could be forecast so much in advance that farmers could switch to more drought resistant crops and adjust the planted acreage to expected rainfall. It is against this background that meteorological droughts and rainfall variability in Lesotho have been studied by this author (Hydén, 1996a, b, c, 1998) and others (De Baulny, 1977, 1979, 1981; Eckert, 1980; Elderidge, 1987, 1993; Jayamaha, undated (after 1979); Makhoalibe, 1985; Molapi and Sekoli, 1989; Sekoli, 1981; Sharma and Makhoalibe, 1988; Sharma and Makhoalibe, undated (after 1984); SWECO, 1977; World Bank, 1990; Zinyowera, 1978).

Since the 1930s, when Walker analysed the correlation between Indian rainfall and air pressure differences over the Pacific, the so-called Southern Oscillation has been believed to influence the rainfall variability of the southern hemisphere as well.

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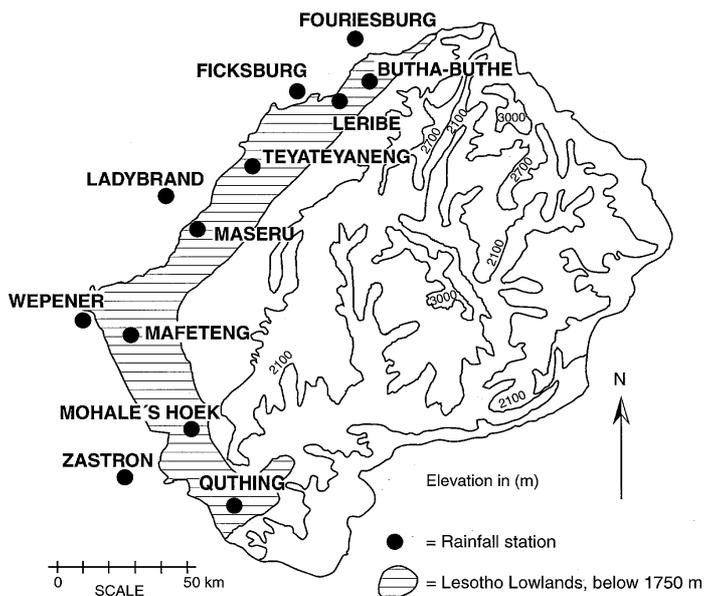


Figure 1
Topographic map of Lesotho and location of rainfall stations

Research has shown that the Southern Oscillation in turn is connected to the El Niño/La Nina phenomenon, i.e. the anomalous warming and cooling of the Pacific off the coast of Peru. Many authors have investigated the influence of the El Niño/Southern Oscillation (ENSO) on rainfall in Southern Africa (Harrison, 1983; Janowiak, 1988; Jury et al., 1994; Van Heerden et al., 1988; Lindsay et al., 1986; Lindsay, 1988; Lindsay and Vogel, 1990; Mason and Lindsay, 1993; Matarira and Unganai, undated (after 1994); Ropelewski and Halpert, 1987, 1989, 1996; Walker and Bliss, 1932) (Table 1).