Non-ENSO control on southern Africa precipitation variability

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The objective of this study is to quantify the nature of the mechanisms of southern Africa rainfall variability, unrelated to the El Niño Southern Oscillation, by means of a simple empirical composite analysis, as a baseline for a more detailed study.

Keywords: non-ENSO; southern Africa; precipitation; interannual variability

1. Introduction

Although the El Niño Southern Oscillation (ENSO) forms a key component of many seasonal forecasting schemes for the climate of southern Africa (SA), controlling 25% of wet season January–March (JFM) rainfall variability (Camberlin 2001), a considerable part of the dry/wet rainfall anomalies is determined by Indian Ocean and Atlantic Ocean teleconnections (Mason & Jury 1997; Washington et al. 2003). This paper gives an overview of a simple composite analysis approach to the non ENSO-related mechanisms.

2. Methodology

The methodology applied consists of calculating composite mean anomalies based on a sampling of JFM seasons which are wet/dry over SA and ENSO neutral. The leading empirical orthogonal function (EOF1) of JFM season rainfall anomalies, obtained over SA domain, and the Niño 3 index (N3) are indicators used to select composite years. Thus, wet (dry) years are defined by EOF1 values greater (less) than EOF1 time-series standard deviation, and ENSO neutrality is fixed by an N3 absolute value lower than 0.5. The resulting selected years are 1960, 1964, 1968, 1979, 1982 and 1994 for the dry composites and 1953, 1963, 1967, 1972, 1979, 1981 and 1997 for wet composites. Figure 1b shows the precipitation anomalies for these years, indicating that the largest anomalies are over eastern SA.

3. Results

Composite mean anomalies of sea-surface temperature for ENSO-neutral SA wet/dry years show a north–south structure centred over the Southwest Indian Ocean (figure 1c). Wet (dry) SA anomalies are enhanced by cold (warm) SST anomalies centred

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on 80° E and 25° S. The atmospheric response is characterized by an anticyclonic (cyclonic) circulation (figure 1d) during wet (dry) years resulting in moisture flux anomalies. A planetary wave 3 structure is detected from the wind anomalies field (figure 1d) over the Atlantic and Indian Oceans.

4. Discussion

SA ENSO-independent rainfall modulation has been analysed. As indicated in previous studies (Washington et al. 2003) there is a consistent Western Indian Ocean sea-surface temperature pattern acting on SA precipitation. Anyway, from the results neither the underlying mechanism nor the role of the Atlantic Ocean are clear. A deeper analysis including model experiments is required to clarify these aspects.

References


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