Relationship between sub-surface temperature in the South West Indian Ocean and southern African rainfall

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Relationship between an index of southern African summer rainfall (SARI) and upper ocean heat content in the South Indian Ocean at zero lag (January-February) was analyzed. A region just east of Madagascar termed as Box A showed the strongest positive correlation with SARI at zero lag. Another strong but negative correlation with SARI at zero season lag is found in the core of the Seychelles Chagos Thermocline Ridge region, termed as Box B. Higher correlation coefficients are observed between SARI and subsurface temperatures in Boxes A (r = 0.32) and B (r = -0.34) compared to SARI with large scale modes like El Nino (r = -0.26), PDO (r = -0.12) and IPO(r = -0.11), all statistically significant at 95%. These results suggest that changes in the subsurface temperature over box A and box B can be useful to monitor and potentially predict regional precipitation. Composite analysis (neutral with respect to ENSO) indicates that when positive (negative) subsurface temperature anomaly is enhanced (reduced) east of Madagascar between January and February, positive (negative) rainfall anomalies prevail over large parts of Mozambique and northern South Africa particularly over Limpopo basin. Wet years over Limpopo basin (22-24S, 26-33E) seem to be associated with enhanced westerly moisture transport from the Angola low or from the southeast Atlantic increasing the rate of low-level moisture convergence in the southeastern African interior. This implies favourable conditions for the development of cloudbands, tracking from western southern Africa towards the east bringing most of southeastern Africa's summer rainfall. On the contrary, composite rainfall for dry years that are neutral to ENSO indicate that at lower-level, although a strong anomalous low prevails over the entire southern African mainland, conditions favouring cloud band development are expected to occur. However, at higher-level, an even stronger anomalous low over southern Africa including Limpopo basin indicates upper-level convergence. In such cases, low-level convergence will not necessarily cause a deep layer of rising air in the atmosphere if convergence exists aloft. Therefore, such conditions suppress cloud band development and precipitation which explain negative rainfall anomalies over Limpopo basin. The study also looks at the frequency and intensity of tropical cyclones crossing the South West Indian Ocean during wet and dry (neutral with respect to ENSO) years.