



Deconstructing southern African (multi) decadal summer rainfall variability through synoptic convection regimes

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Austral summer rainfall in Southern Africa is highly variable in time and space. Seasonal rainfall amounts archived in long-term observational databases have recently been shown to exhibit significant periodicities at the interannual timescale (with a 2-8 year peak materializing mostly the regional effects of El Niño Southern Oscillation, ENSO), the quasi-decadal (8-13 years) and inter-decadal (15-28 years) timescales, interpretable as the signature of the Pacific Decadal Oscillation and Interdecadal Pacific Oscillation over the region. Here, we attempt to deconstruct these rainfall signals into a limited number of coherent synoptic convective regimes, obtained by applying a k-means clustering on daily Outgoing Longwave Radiation (OLR) derived from the 20th Century Reanalysis (20CR), on the period 1901-2010 and on the 56 ensemble members individually.

Results show a time-increasing agreement between the ensemble members for capturing transient variability of large-scale atmospheric convection during the austral summer rainy season. Over the recent years, the results match well those obtained using satellite OLR measurements. The respective contribution of each regime to the three dominant timescales of rainfall variability has been assessed using multiple wavelet coherence analyses. The strong interannual teleconnections between the regional convective regimes and ENSO in the recent decades remain very robust throughout the 20th century. Synoptic convective regimes leading to wetter conditions in southern Africa are not systematically related to La Nina conditions. However, combinations of El Nino conditions at the interannual timescale with negative phases of the IPO and/or the PDO are likely to be associated with wetter conditions in southern Africa. At the quasi-decadal and inter-decadal timescales, analyses suggest a superposition of short-term anomalies associated with the various regimes and large-scale changes in convective activity. These interactions between synoptic and decadal timescales involve large-scale changes in the regional convective activity, in response to longitudinal shifts of the so-called South Indian Convergence Zone.