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Subseasonal teleconnections South America - South Africa

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There is marked subseasonal variability over South America and southern Africa. Based on previous work showing that a teleconnection exists between the South American monsoon system and interannual summer rainfall variability over southern Africa, this study shows teleconnections between subseasonal variability over these landmasses. Observed daily gauge precipitation data for 1970-1999 are gridded to 1° resolution for South America and 2.5° for South Africa. At each grid point, anomalies of daily precipitation are calculated and submitted to a bandpass Lanczos filter to isolate subseasonal oscillations in the 20-90 day band. For each season, the filtered precipitation anomalies for the South African grid boxes are correlated with filtered precipitation anomalies in the grid boxes over South America. Lags from 0 up to 12 days are applied to the South African data, in order to investigate convection anomalies over South America that could produce atmospheric perturbations associated with South African precipitation anomalies. The significance of correlation between the filtered data takes autocorrelation into account and uses effective sample sizes. The results shown represent the best correlations for different climatic regimes such as the winter-rainfall dominated southwestern Cape, the all season rainfall South Coast and the summer-rainfall dominated Limpopo region. NCEP re-analyses are used to composite subseasonal anomalies in OLR, 200 hPa streamfunction, and vertically integrated moisture flux associated with precipitation anomaly above one standard deviation in the filtered series (positive phases) of the South African selected regions.

The possible origin of the atmospheric circulation anomalies associated with those positive phases is determined using influence functions (IFs) of a vorticity equation model with a divergence source. The model is linearized about a realistic basic state and includes the divergence of the basic state and the advection of vorticity by divergent wind. The IF for a given target point indicates the regions in which the anomalous upper-level divergence is most efficient in producing streamfunction anomalies around the target point. For action centers of circulation anomalies directly associated with precipitation anomalies in southern Africa, these regions with higher forcing efficiency coincide in South America with the indications of the precipitation correlation patterns with southern Africa. These results are confirmed by simulations.

It is shown that strong teleconnections exist between South African daily rainfall and that over various areas of South America, with the latter leading by four to five days, for both winter and summer, involving regions with strong rainfall in these seasons. During the summer, the mechanisms involve both a modulation of the local Walker cell as well as extra-tropical Rossby wave trains. For winter, the latter mechanism is more important. While in summer tropical convective anomalies over South America play an important role, in winter the subtropics become more important. In both cases, these modulations lead to regional changes in circulation over southern Africa that are favorable for the dominant synoptic rainfall-producing weather systems such as cut-off lows and tropical extratropical cloud bands.

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