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Teleconnections between South American monsoon, Benguela Niño and southern Africa rainfall

Alice Grimm (1) and Christopher Reason (2)

(1) Federal University of Parana, Physics, Curitiba, Brazil (grimm@fisica.ufpr.br), (2) University of Cape Town, Oceanography, Cape Town, South Africa (Chris.Reason@uct.ac.za)

Benguela Niño (Niña), a climate mode which causes anomalous sea surface temperature (SST) in the tropical southeastern Atlantic, is known to influence southern Africa rainfall. The present study shows that this mode and its associated precipitation are connected to the South American monsoon variability, since substantial summer rainfall anomalies exist over central South America preceding the peak of Benguela Niño (Niña) events. These rainfall anomalies can influence the evolution of this climate mode and the associated African precipitation, which reach their maximum in austral late summer-early autumn. Analysis of the temporal evolution of South American and African rainfall prior and during the Benguela Niño (Niña) events, as well as of the Atlantic SST anomalies, shows that the strongest South American rainfall anomalies precede the strongest Atlantic SST anomalies and the strongest African rainfall anomalies. The evolution of the associated streamfunction anomalies shows a tropics-extratropics wave-train propagating southeastward from central South America towards the extratropical Atlantic in peak summer. There are also rotational and divergent circulation anomalies over the tropics between South America and Africa that suggest a tropics-tropics teleconnection between the two continents. The rotational and divergent anomalies associated with these teleconnections are able to enhance the Benguela Niño (Niña) SST anomalies off the western African coast and furthermore, are able to directly influence the African rainfall.

Influence Functions of a vorticity equation model with a divergence source are calculated for the action centers of the streamfunction anomalies, to indicate the regions in which the anomalous upper-level divergence (associated with tropical tropospheric heat source) is most efficient at producing streamfunction anomalies around these centers. 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. It is applied at 200 hPa, near the level of maximum divergence associated with convective outflow in the tropics and an equivalent barotropic level in the extratropics. The Influence Function analysis shows that the anomalous convection over South America is the most probable source of the observed streamfunction anomalies. Besides, simulations with this model forced with anomalous divergence patterns observed during the Benguela Niño (Niña) events show that anomalies of the South American monsoon convection produce the main circulation anomalies observed during the Benguela Niño events and hence influence circulation patterns and rainfall over Angola and other southern Africa regions.

The joint observational and modeling analyses during Benguela Niño (Niña) events show that the anomalous convection over South America is the most probable source of the observed circulation anomalies. The results suggest that the rainfall anomalies over South America and Africa do not simply have a common forcing, but that those over South America influence the anomalies over Africa directly, because of their influence on circulation anomalies over Africa, and indirectly, via the effect of induced circulation anomalies on the SST over southeastern Atlantic.

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