Why do Benguela Niños lead Atlantic Niños?

Serena Illig\textsuperscript{1,2}, Marie-Lou Bachèlery\textsuperscript{2,3}, and Joke Lübbecke\textsuperscript{4,5}

\textsuperscript{1}Laboratoire d'Etudes en Géophysique et Océanographie Spatiale (LEGOS), CNRS/IRD/UPS/CNES, Toulouse, France
\textsuperscript{2}Department of Oceanography, MARE Institute, LMI ICEMASA, University of Cape Town, Cape Town, Rondebosch, South Africa.
\textsuperscript{3}Nansen-Tutu Centre, Marine Research Institute, Department of Oceanography, University of Cape Town, Cape Town, Rondebosch, South Africa.
\textsuperscript{4}GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
\textsuperscript{5}Christian-Albrechts-Universität zu Kiel, Kiel, Germany

We investigate the lag between warm interannual Sea Surface Temperature (SST) events in the eastern equatorial Atlantic, the Atlantic Niños, and the occurrence of Benguela Niños along the southwestern Angolan coast. It is commonly agreed that both events are associated with equatorial and subsequent coastal-trapped wave propagations driven remotely by a relaxation of the trade-winds. Yet, we observe that coastal SST anomalies off Angola tend to precede the ones in the equatorial cold tongue region by \(~1\) month.

We explain this counter-intuitive behavior using experimentation with a tropical Atlantic Ocean model. Using idealized wind-stress perturbations from a composite analysis, we simulate warm equatorial and coastal events over a stationary and then, seasonally-varying ocean mean-state. Results show that when wind-stress perturbations are confined to the western central equatorial Atlantic, the model yields equatorial events leading the coastal variability, consistent with the propagation path of the waves. This implies that neither the differences in the ocean stratification between the two regions (thermocline depths or modal wave contributions) nor its seasonal variability controls the timing between events. Only if wind-stress anomalies are prescribed in the coastal fringe, the coastal warming precedes the eastern equatorial SST anomaly peak, emphasizing the role of the local forcing in the phenology of Benguela Niños.

Both warmings originate from a reduction in the strength of the South-Atlantic Anticyclone. Nevertheless, local processes initiate the coastal warming before the remotely-forced equatorial waves impact the eastern equatorial SST. Then, equatorward coastal wind anomalies, driven by a convergent anomalous circulation located on the warm Atlantic Niño, stop the remotely-forced coastal warming prematurely.

In conclusion, this study shows evidence that Atlantic and Benguela Niños are connected via an ocean teleconnection associated with equatorial and coastal wave propagations, but they are also tied by a large-scale atmospheric circulation and ocean-atmosphere interactions.