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A wave mechanism for optimal excitation of Tropical Atlantic SST anomalies

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The role of the non-normal ocean dynamics in exciting tropical sea surface temperature (SST) anomalies in the Atlantic was investigated using an idealized ocean general circulation model. Optimal perturbations of temperature and salinity, characterized by relatively strong deep salinity anomalies near the western boundary, are found to generate a transient amplification of equatorial SST anomalies in less than 4 years.

The associated growth mechanism is a consequence of the excitation of coastal and equatorial Kelvin waves in the western boundary following a rapid geostrophic adjustment due to the optimal initial perturbations of temperature and salinity. The results suggest that non-normal growth may efficiently create large tropical SST variability on interannual timescales in the Atlantic. More specifically, an initial salinity perturbation of $0.1\,ppt$ in the deep western boundary can result in a sea surface temperature anomaly of 0.4 $^{\circ}C$ in the tropical Atlantic after about four years due to non-normal growth, assuming the dynamics are linear. The transient amplification of the tropical SST anomalies is due to a significant non-normality of the stable linearized dynamical operator.