Influence of the Equatorial Atlantic Cold Tongue and Angola Current on Atlantic Basin Climate Variability

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The long term goal of this project is to utilize available high resolution NASA observations, atmospheric and oceanic reanalyses, along with a high-resolution uncoupled mixed-layer ocean model with Ekman dynamics and a coupled mixed-layer ocean/atmosphere/land surface regional climate system model to advance our understanding of the role of ocean/atmosphere interactions in the tropical and subtropical southeastern Atlantic in forcing regional and remote Atlantic climate variability. Specific objectives include a) understand the roles local and/or regional wind stress and thermodynamic processes over the southeastern Atlantic play in the development of sea surface temperature (SST) variability and coastal upwelling in the region, b) elucidate the influence of ocean/atmosphere feedback processes on regional and remote Atlantic variability of both the ocean and the atmosphere, and c) understand whether resolving small-scale oceanic structures, using a state-of-the-art coupled mixed-layer ocean/atmosphere regional climate model, can improve our predictive capabilities of the regional climate.

Research efforts in 2013 involved using available observational and reanalysis datasets to better understand decadal variations in the southeastern Atlantic climate. Our results reveal a significant warming trend in SSTs (~ over 2 K over the 32-yr period) along the Guinean and Angola/Namibian coasts and a weaker cooling trend over the sub-tropical south Atlantic (~ -0.25 K per 32-yr) over the past 32 years (1982 – 2013). These SST trends are shown to have distinct seasonality, with the most significant changes occurring during November – January. Investigation of the surface heating budget and atmospheric circulation changes during this period reveal that the austral summer SST trends are associated with a southward shift of the South Atlantic sub-tropical anticyclone as well as changes in heating over continental Africa that affect the Angola continental thermal low's position and influence the low-level circulation along the southwestern African coast. Together these atmospheric circulation changes are found to be associated with a weakening of the coastal and equatorial South Atlantic wind stress, a decrease in the coastal and equatorial upwelling, and an increase in coastal sea surface temperatures. These results are relevant for improving our understanding regional climate variability associated with global warming over this area, as the land is likely to warm faster than the ocean in the future.