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Climate response to ocean temperature variations along the South Atlantic coast of Africa

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Fully coupled General Circulation Models (CGCM) exhibit different kind of biases due to deficiencies in the physics, insufficient horizontal or vertical resolution of its component models and forcing errors. One of the most common errors affecting CGCMs is an anomalously warm sea surface temperature (SST) along the coast of south-western Africa, western South America and California. The bias is linked both to a poor representation of coastal winds and low clouds, and to difficulties in the representation of the coastal upwelling.
This study makes use of a CGCM, whose ocean temperature is relaxed to observations along the South Atlantic coast of Africa (SAA) to correct this warm bias. This region is known to be part of the strongest upwelling system known worldwide.
The relaxation is effective locally and the mean annual SST bias drops from about 6°C to almost zero in the region. The impact of changing SAA thermal profile spreads over the Southern tropical Atlantic, decreasing SSTs and freshwater input. On the other hand, the ocean warms up north of the Equator, from the Caribbean to the African coast, and the precipitation deficit reduces, reconstituting the intertropical convergence zone in the basin. Remote effects play a part in the entire tropical Pacific, which cools off in the west and warms in the eastern region, while freshwater influx follows variation of SST, and salinity patterns change accordingly. The impact of SAA temperature is remarkable, although at a lesser extent, in the Indian Ocean, whose western sector re-establishes seasonal upwelling activated by change in surface winds.
The local effect of coastal temperature variation is mostly evident at the beginning of boreal summer, characterized by the largest SST interannual variance, and the ocean cooling triggers El-Nino-like conditions in the following fall. An important increase of precipitation is noticeable in the Caribbean during the hurricane season. The freshwater plume released by the main rivers indicates that the SAA thermal relaxation has a remote effect on the precipitation/evaporation balance over lands overlooking the Atlantic.