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The representation of the South Tropical Atlantic teleconnection to the Indian Ocean in the AR4 coupled models

Rondrotiana Barimalala (1), Annalisa Bracco (1), and Fred Kucharski (2)

(2) Abdus Salam International Centre for Theoretical Physics, Earth System Physics Section, Trieste, Italy (kucharsk@ictp.it),
(1) EAS, Georgia Institute of Technology, 311 Ferst Drive, Atlanta, GA 30332, USA

A series of recent papers showed that sea surface temperature (SST) anomalies in the south equatorial tropical Atlantic modulate the interannual variability of the African and Indian monsoon rainfall. Physically this teleconnection can be explained by a simple Gill-Matsuno mechanism. In this work, the output from five different models chosen within the CMIP3 (Coupled Model Intercomparison Project version 3) ensemble of coupled general circulation models (CGCMs) are analyzed to investigate how state-of-the-art CGCMs represent the impact of the South Tropical Atlantic (STA) SSTs on the Indian and African region. Using a correlation-regression technique, it is found that four out of the five models display a teleconnection between STA and Indian region which is generally weaker than in the observations but in agreement in the rainfall field pattern. This teleconnection is also noticeable in the ensemble mean of the five models. Over Africa, however, the significant changes in rainfall displayed in the observation are properly caught by only one of the CGCMs. Additionally, none of the models reproduces the symmetric upper-level wind response around the Equator seen over the Indian Ocean in the observations and all have significant biases also in the surface pressure field response to the tropical Atlantic SSTs. Nonetheless the STA response, particularly over the southern hemisphere, is indicative of the Gill-Matsuno-type mechanism identified in previous studies using idealized experiments with atmospheric GCMs and observational data. With a suite of atmospheric-only GCM integrations it is shown that the differences in amplitude and pattern are not only due to the strong biases and reduced variabilities of the CGCMs over the tropical Atlantic but they are also caused by the different physical parameterizations used in models.