Low-frequency variability of the Indian Monsoon-ENSO relation and the Tropical Atlantic: The 'weakening' of the '80s and '90s.

by

F. Kucharski [1], A. Bracco [2], J. H. Yoo[1], F. Molteni[1]

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Corresponding author address:

Fred Kucharski
The Abdus Salam International Centre for Theoretical Physics
Earth System Physics Section
Strada Costiera 11
34014 Trieste, IT

e-mail: kucharsk@ictp.it

[1]The Abdus Salam International Centre for Theoretical Physics, Earth System Physics Section, Trieste, IT.

[2]Woods Hole Oceanographic Institution, Physical Oceanography Dept, MS21, Woods Hole, MA, 02543, USA

Abstract

The Indian Monsoon-El Nino Southern Oscillation (ENSO) relationship, according to which a drier than normal monsoon season precedes peak El Nino conditions, weakened significantly during the last two decades of the 20th century. In this work an ensemble of integrations of an Atmospherical General Circulation Model (AGCM) coupled to an ocean model in the Indian basin and forced with observed sea surface temperatures (SSTs) elsewhere is used to investigate the causes of such a weakening.

The observed interdecadal variability of the ENSO-Monsoon relationship during the period 1950-1999 is realistically simulated by the model and a dominant portion of the variability is associated to changes in the tropical Atlantic SSTs in boreal summer.

In correspondence to ENSO, the tropical Atlantic SSTs display negative anomalies south of the Equator in the last quarter of the 20th century and weakly positive anomalies in the previous period. Those anomalies in turn produce heating anomalies which excite a Rossby wave response in the Indian Ocean in both the model and in reanalysis data, impacting the time-mean monsoon circulation.

The proposed mechanism of remote response of the Indian rainfall to tropical Atlantic sea surface temperatures is further tested forcing the AGCM coupled to the ocean model in the Indian basin with climatological SSTs in the Atlantic Ocean and observed anomalies elsewhere. In this second ensemble the ENSO-Monsoon relation is characterized by a stable and strong anticorrelation through the whole second half of the XX century.

Furthermore, we investigate the role of tropical and south tropical Atlantic SSTs in forcing the Indian monsoon rainfall (IMR). For this purpose, we use two different observational data sets and ensembles of simulations with an atmospheric general circulation model (AGCM) coupled to an ocean model in the Indian Basin and forced with observed SST elsewhere. We show that the residual in the IMR time series for observed and modeled data, obtained by subtracting the ENSO-forced component of the IMR that is linearly related to the NINO34 index, is significantly correlated with south equatorial Atlantic SSTs.