# Abstract

Tropical Cyclones (TCs) are atmosphere-ocean coupled weather systems, wherein complex coupled atmosphere-ocean interactions occur in terms of energy transfer at various timescales. The large scale atmosphere-ocean variability are observed to cause significant changes in TC activity over major tropical basins like North Atlantic and Western North Pacific at inter-annual and inter-decadal time scales. Also, atmosphere-ocean feedback system that occur during the lifetime of TCs modulates their intensity. The present work addresses the role of large scale atmosphere-ocean coupled variability on TCs through analysis of TC activity over NIO basins based on historical datasets and investigates atmosphere-ocean coupled feedback system using Mesoscale Coupled Modeling System (MCMS).

TC activity over NIO basins is analyzed using an energy metric called Accumulated Cyclone Energy (ACE). ACE indicates a clear increasing trend in NIO owing to observed increase in frequency and duration of intense cyclones (wind speed >64 knots). The statistical change-point analysis reveals the shift in mean ACE from 1997, with twofold increase observed in ACE for the recent epoch (1997-2014). The mean genesis location of intense cyclones exposes a longitudinal eastwards shift of 2.3° in Bay of Bengal (BOB) during the recent epoch, which potentially increased the TC duration. Total column water vapor and sea surface temperature show good agreement with TC variability. Analysis of large scale variability reveals that increase in frequency of intense storms post 1997 concur with the cold phase of Pacific decadal oscillation (PDO). The co-existence in cold phase of Pacific decadal oscillation with strong La-Nina, negative Indian ocean dipole and negative phase of tropical intra-seasonal oscillation are the deciding factors for strong TC activity over NIO basins. Evaluation of MCMS indicates the significant improvement in the prediction of cyclone intensity through implementation of air-sea coupling. The peak intensity, landfall position and time are accurately predicted by MCMS, whereas the uncoupled simulation over predicted the storm intensity. A numerical study of BoB cyclone Phailin (2008) shows the significance of two-way atmosphere-ocean feedback system. The model study reveals the formation of stable boundary layer over the cold wake, which cut-down convection over and downstream to the cold wake.

***Keywords***: Accumulated Cyclone Energy, Mesoscale Coupled Modeling System, Air-sea interactions and Stable Boundary Layer.