Abstract

Tropical cyclones (TCs) that form over the North Indian Ocean (NIO) region is an extreme weather event that results in loss of human life, destruction to property and infrastructure in the coastal regions. This study indicates that NIO TC activity (genesis frequency and intensity) show an increasing trend and has an inter-basin teleconnection with the Pacific Ocean basin. Case studies for both pre- and post-monsoon cyclones were investigated using the Oceanic Nino Index (ONI) and its inter-relationship with NIO Sea Surface Temperature (SST) and Ocean Heat Content (OHC) anomalies. The study also showed an in-phase relationship between maximum cyclonic wind speed (V_{max}) and SST for the Bay of Bengal basin and also with OHC variability. This study also investigated the genesis mechanism of TCs in higher atmospheric levels which is a challenge for NIO TC forecasting. The study devised a novel method using the Eddy detection technique applying the key indicative parameter of Okubo-Weiss (OW) to investigate the formative stages and advance detection time ≈90 hours for tropical cyclogenesis before satellite detection in the North Indian Ocean region. Further, the study also formulated a suitable OW threshold value for both the rotational and shear components that needs to sustain for sufficient duration in order to trigger and initiate cyclogenesis in the upper atmosphere. In addition, the study also identified an optimum grid size using the Weather Research and Forecasting (WRF) that can be effectively used for the detection scheme. Study was also carried out to understand the role and influence of key atmospheric parameters on large-scale environmental flow and ENSO (El Niño Southern Oscillation) on tropical cyclone activity over the NIO basin. Detailed analysis was conducted on parameters influencing cyclogenesis formation and the study established a correlation between tropical cyclogenesis and Genesis Potential Index. Notable findings from the study indicates that strong mid-level Relative Humidity (RH_{600}), positive low-level Relative Vorticity (RV_{850}), weak Vertical Wind Shear (VWS), warm Sea Surface Temperature (SST), and suppressed Outgoing Longwave Radiation (OLR_{500}) are the responsible factors leading to increased tropical cyclone activity in the North Indian Ocean. Study signifies that RH_{600}, RV_{850}, and OLR_{500} are distinct during pre-monsoon seasons of La Niña and that favors the genesis of severe cyclone formation over this region.

Key Words: Eddy Detection Technique, Okubo Weiss Parameter, WRF, La Niña