National Institute of Technology Rourkela

Defence Seminar

Seminar Title	: Oceanic and Atmospheric Characteristics Associated with Distinct Intensification Scenarios of North Indian Ocean Cyclonic Disturbances
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Venue	: Mining Engineering Seminar Hall
Date and Time	: 20 Nov 2024 (11:00 AM)
Abstract	: The study investigates the dynamics of highly intensified cyclonic storms (HICS) and concurrent cyclonic disturbances (CCDs) in the North Indian Ocean (NIO), highlighting their distinct behaviors and influencing factors. HICS frequency shows an upward trend with extended durations in both pre-monsoon and post-monsoon seasons. Accumulated Cyclone Energy (ACE) correlates positively with HICS frequency, and climatological analysis emphasizes the dominant role of mid-tropospheric relative humidity (MRH) in the Arabian Sea (AS). Genesis potential indices further underscore the contributions of MRH and vorticity. Super cyclonic storms (SuCS) are influenced by vertical wind shear (VWS), low-level vorticity, MRH, and phenomena like the Madden-Julian Oscillation (MJO) and Equatorial Rossby (ER) waves. Sea surface temperature (SST) and Tropical Cyclone Heat Potential drive SuCS genesis and intensification, with earlier one playing a primary role. Translational speed also impacts SuCS intensification through ocean interaction. The study evaluates the predictive performance of the MPAS-A model, initialized with ERA-5 data, which outperforms FNL in predicting HICS tracks. A comparison between GDAS and ERA-5 tracks shows GDAS performing better in later forecast periods. The model is able to predict well the wind patterns, moisture transport, and potential vorticity structures critical for cyclone development. In the exceptional 2019 cyclone season, elevated ACE, SST, and potential intensity (PI) anomalies, alongside reduced VWS, supported cyclone genesis and intensification. The Indian Ocean Dipole (IOD) and MJO created favorable thermodynamic conditions, enabling a record-breaking cyclone season in the year 2019. CCD genesis is linked to higher convection, low-level westerlies, and atmospheric waves like Tropical Depressions and Mixed Rossby-Gravity waves, with El Niño and positive IOD contributing significantly. This research provides comprehensive insights into HICS and CCD dynamics, highlighting the roles of atmospheric and oceanic factors, predictive modeling, and the unique conditions of 2019. The current findings enhance the understanding of cyclone behavior in the NIO and have implications for forecasting and risk mitigation.