Assessment of remote sensing-based environmental features of severe cyclonic storm 'Dana' over the Bay of Bengal in October 2024

Sunil Kumar[1,2,*], Shashi Kant[1], Amrit Kumar[2] and Satya Prakash[1]

[1]India Meteorological Department, Ministry of Earth Sciences, New Delhi 110 003, India
[2]Amity Centre of Excellence in Ocean-Atmospheric Science and Technology, Amity, University Haryana Gurugram 122 413, India

The present study investigates the structural, dynamic and thermodynamic characteristics of severe cyclonic storm, 'Dana', the first post-monsoon tropical cyclone over the North Indian Ocean in 2024. Using synoptic data and satellite imageries, we have analysed the evolution of storm, intensity changes and atmospheric interactions. The structural analysis reveals that 'Dana' predominantly exhibited an irregular central dense overcast pattern with a mean diameter of 173 km throughout its lifecycle. Dynamically, the development and movement of the cyclone were influenced by wind profiles, sea-surface temperature (SST), upper-level divergence, lower-level convergence and atmospheric pressure patterns. The average vertical wind shear was 16 knots, increasing to 20 knots during cyclone strengthening. Regarding thermodynamics, SST ranged from 29°C to 30°C over the central and northern Bay of Bengal and the north Andaman Sea, with tropical cyclone heat potential between 100 and 112 kJ/cm^2. This study integrates satellite-based observations with traditional meteorological data, providing valuable insights into the internal dynamics of the cyclone and contributing to improved forecasting and understanding of factors influencing tropical cyclone intensity and track in the region.

Keywords: Bay of Bengal, dynamic features, satellite imagery, structural analysis, thermodynamic processes, tropical cyclone.

TROPICAL cyclones (TCs) are the most catastrophic [illegible] high relative humidity from low- to mid-level of troposphere, sufficient amount of Coriolis force, minimum threshold value of convergence, divergence and vorticity[7–10].

The tropical disturbances over the North Indian Ocean (NIO) are classified based on different criteria for better understanding. For example, classifications are made based on the number of closed isobars in surface charts, wind speed, T numbers, etc. As operational forecasters, we usually plot the surface charts in the India Meteorological Department (IMD) and detect the TC centre. These charts are handy when the system is over land after landfall. In fact, we give the most weight to surface charts over land when T numbers are not classified. These classifications help meteorologists predict the behaviour of the disturbances and issue warnings accordingly. Based on the T number and the maximum sustained wind speed, the classification of tropical disturbances over the NIO was adopted by IMD[3].

Based on long-term mean TC occurrences, the frequency of occurrence of TCs over the NIO is higher during the post-monsoon season than pre-monsoon season[3]. In addition, more TC formation over the Bay of Bengal (BoB) than in the Arabian Sea was also observed. If we look at the previous records of landfalling TCs near the Odisha coast, 5 TCs crossed near the Odisha coast during 1891–2023 in the month of October (Table 1). The present study is also concerned with the most recent severe cyclonic storm (SCS), 'Dana', that crossed Odisha coast in October 2024. Due to the improvement of forecasting techniques