Role of analysis and reanalysis datasets on the prediction of extremely severe cyclonic storm Hudhud

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Introduction

- The frequency and intensity of the extremely severe cyclonic storms (ESCS) are increasing over the Bay of Bengal region (Singh et al., 2021)
- In this context numerical models play vital role to predict the tropical cyclone (TC) track, intensity and structure in advance with better accuracy (Mahapatra and Sharma 2021).
- The accuracy of model forecast is dependent on initial and boundary conditions (Kumar et al., 2017).
- Hence it is necessity to evaluate the performance of model on available different datasets with different spatial resolution to forecast of ESCS over the Bay of Bengal region.
- To bridge this gap, present study investigated a comparative study between global and regional reanalysis data sets to forecast the track and intensity of the Bay of Bengal cyclone Hudhud that developed in October 2014

Objective

To investigate the role of different datasets (ECMWF, FNL and NCMRWF (IMDAA)) on the prediction of the Hudhud cyclone over the Bay of Bengal region using high resolution modeling system

Methodology and data

- The WRF-ARW model version 4.2 is used in this study.
- The horizontal resolution of outer domain (D1) is considered 15 km and inner domain (D2) about 3 km.
- The initial and lateral boundary conditions for numerical simulations are taken from NCEP FNL with grid resolution of 1.0° x 1.0° and 26 vertical levels, ECMWF – ERA Interim with spatial resolution of 0.75° x 0.75° and 60 vertical levels, and NCMRWF - IMDAA Spatial resolution of 0.12° x 0.12° and 63 vertical levels.
- Model initialized at two different time 00UTC and 12UTC of 08 October 2014 and forecasted up to 00 UTC of 13 October 2014.
- Model results are compared with India Meteorological Department (IMD) best fit track and available Doppler Weather Radar (DWR).

Results and Discussions

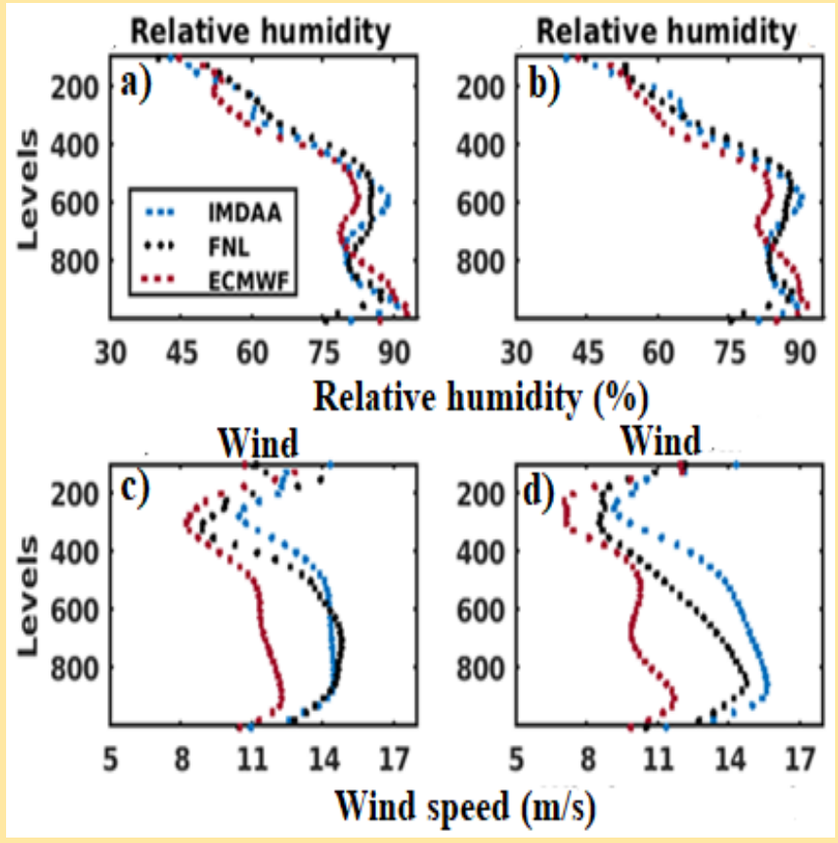

Fig 1: Vertical profile of (a & b) Relative humidity (c & d) wind from different datasets of cyclone Hudhud at 00UTC and 12UTC on 8 October 2014.

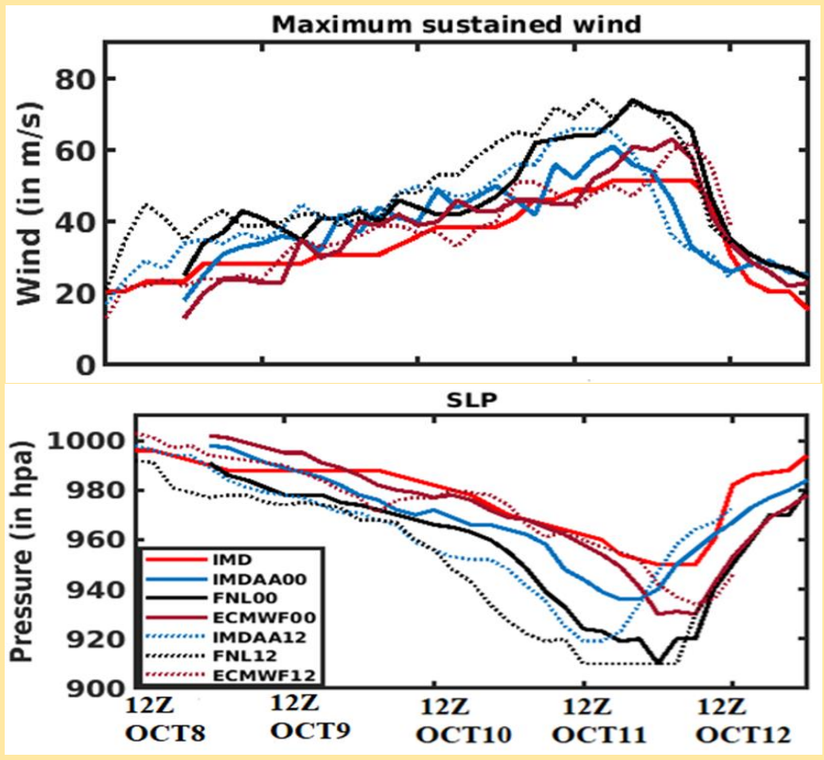

Fig 2: Model predicted MSW and SLP along with IMD best fit-track datasets

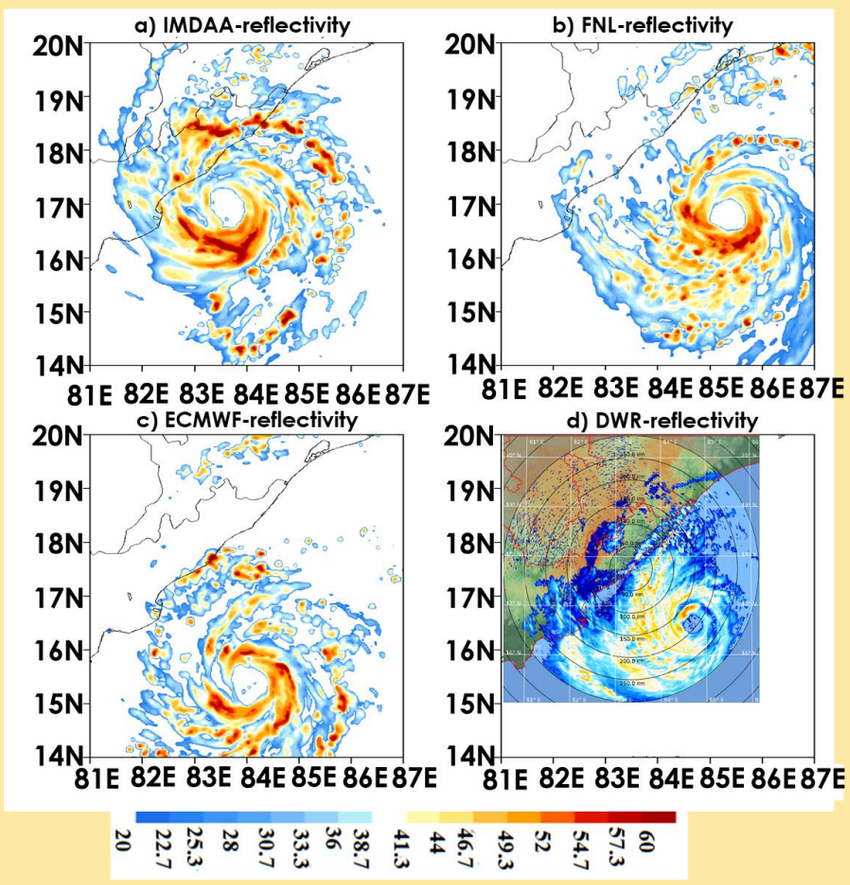

Fig 3: Comparison of maximum reflectivity (in dBZ) between model simulations and Vishakhapatnam DWR image for Hudhud at 1800 UTC on 11 October 2014

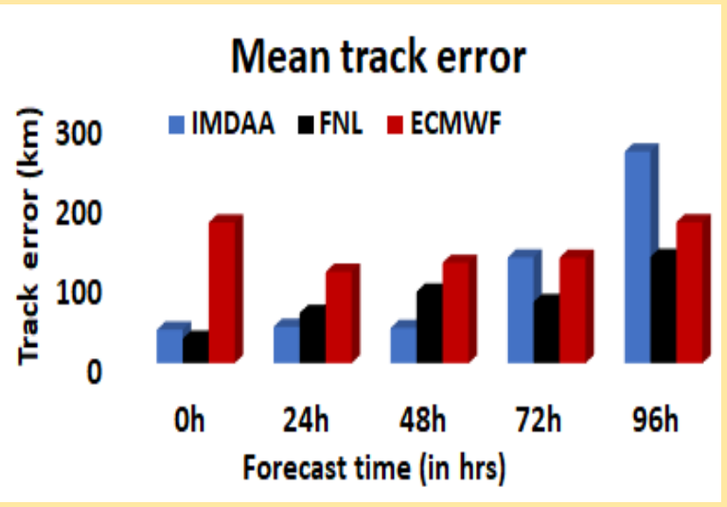

Fig 4: Average track errors for Hudhud cyclone from different data sets

Conclusions

- The initial state of relative humidity at 600 hPa plays an important role in the prediction of the intensity of the cyclonic storm Hudhud and suggested that higher humidity at 600 hPa provided maximum intensity of the storm.
- Model predicted MSW and SLP are better using the ECMWF dataset than FNL and IMDAA data sets.
- Maximum reflectivity predicted using the IMDAA data comparatively matched with DWR reflectivity.
- Less initial position error in FNL provided better forecast of track compared to other data sets.
- Simulations should be carried out with more number of cyclones to identity the better data set for tropical cyclones predictions over the Bay of Bengal region.

References

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