Observed Structure of Cyclonic Storms over Bay of Bengal and Arabian Sea Using Satellite Data

Kusuma G Rao and Manjusha Chourasia
Atmospheric Science Programme, Indian Space Research Programme

Among the extreme weather systems of Indian region, Cyclonic storms of Bay of Bengal and Arabian Sea are complex in their dynamical and thermodynamical structure. Since cyclone genesis and intensification occurs over the oceans, only satellite data will be resourceful to under stand the structure of cyclones. Here an attempt has been made to understand the cloud, rain, wind, temperature and humidity structure of the cyclones that occurred over the Indian seas during the period 2006-2009 using METEOSAT, TRMM and COSMIC data. Satellite data has been analysed for 8 cyclones that prevailed during 2006-2009, with 3 cyclones, Bijili, Nargis and Mala in the months of April-May, 4 cyclones Nisha, Khaimuk, Rashmi, SIDR in months of October-November and Gonu cyclone in the month of June. Spatial evolution of cloud systems for 8 cyclones has been studied based on METEOSAT IR Brightness Temperatures (IRBRT). In case of 'SIDR' cyclone, METEOSAT IRBRT plotted at 10 km x10 km resolution indicated that deep cloud systems prevailed in the eye region through out the cyclonic phase of 'SIDR', that is during 12-17 Nov, 2007. However, high resolution TRMM IRBRTs at 4 km x 4 km resolution clearly showed the formation of eye region indicated in increasing IRBRTs observed when the storm reached Severe Cyclonic phase. But, during the Very Severe Cyclonic phase (VSCS) of the storm, even with increase in IRBRTs in the eye region by 50 K from 190 K, the eye region was cloudy with deep clouds prevailing.

Analysis of TRMM 3B42 rainfall measurements for all the 8 cyclones revealed that maximum rainfall always occurred around the cyclone location in the front quadrants. For the cyclone 'SIDR', the maximum rainfall shifted from the front left (290.83 mm/hr) to the front right quadrant (510.91 mm/hr) as the cyclone reached the phase of Severe Cyclonic Storm. It is found that the total average rain in the front right quadrant is ~10.4% higher then that for the rare left quadrant. Continuous increase in rainfall with the phase change has been observed with the average rainfall increasing by ~36.1% in the VSCS phase in comparison with its Depression Phase.

Indication of direction of propagation of cyclone ~24-27 hrs in advance is the striking result inferred from analysis of Upper level METEOSAT Cloud Motion vectors (100-250 mb) for five cyclones. COSMIC vertical profiles of temperature in close proximity of cyclone (for 3 cyclones) indicate the common feature of double tropopause. Humidity profiles indicate sharp vertical variations at around ~6 km height. The observational analysis carried out here provide deeper insights and suggest underlying mechanisms of great importance in modelling the cyclonic storms.