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Radar study of the cyclonic storm of 21 September 1962 in the Bay of Bengal

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ABSTRACT. Radar observations of the cyclonic storm of 21 September 1962, taken at Dum Dum Airport, Calcutta with the help of a 3-cm Japanese (Type NMD-451A) radar have been reported in this communication. Movement of the storm and associated observed echoes in the form of spirals or bands have been shown. Characteristics of the storm and distribution of rainfall have also been described.

1. Introduction

In an earlier communication De and Sen (1959) reported appearance of the 'Eye' of a tropical cyclone with the help of a 3-cm high powered radar installed at Dum Dum Airport, Calcutta. It was a fortuitous occasion that even with a storm of slight to moderate intensity, the eye "was well defined and appeared on the radarscope with remarkable clear definition in the form of a hook at one stage and a circular echo around the eye at another". Since then many attempts were made to locate the eye of the cyclonic storms with the help of the above mentioned radar. But these were not successful because the storm tracks were not very near the radar site and also the radar beam was attenuated by associated precipitation in the forward sector of the storms. The present communication is meant for reporting the radar observations of the cyclonic storm of 21 September 1962. The storm track was within about 50 km of Dum Dum Airport (Calcutta). The radar observations showed the location of the storm and associated rain belts in the form of spirals or bands converging to the centre.

2. Details about the storm

The cyclonic storm had its origin as a depression in the head Bay of Bengal at 00 GMT of 20 September 1962. Later it developed into a deep depression and showed movement towards northwest. Its northwesterly movement continued while it developed into a cyclonic storm and it crossed the Sunderbans, about 120 km to the ESE of Dum Dum Airport at about 0300 GMT of 21st. Saugar Island located within about 100 km from the storm track, reported a maximum speed of 80 km/hr (44 kt) southwesterly wind at 0802 GMT. The anemograph record of Alipore Observatory also showed gusty westerly winds steadily increasing and reaching to a maximum speed of 78 km/hr (42 kt) in the evening of 21st, while the maximum wind recorded at Dum Dum Airport was southerly 92 km/hr (50 kt) at 1610 GMT of 21st.

The cyclonic storm caused widespread damage in and around Calcutta. Several houses collapsed in Howrah district. It also caused considerable damage in the districts of 24 Parganas and Hooghly. It completely dislocated train and air services of Calcutta.

The cyclone after crossing the coast changed its course to N, NE, W and from evening of 21st its movement was mainly northwesterly. On the afternoon of 22nd, it weakened into a depression. The track of the storm is shown in Fig. 1.

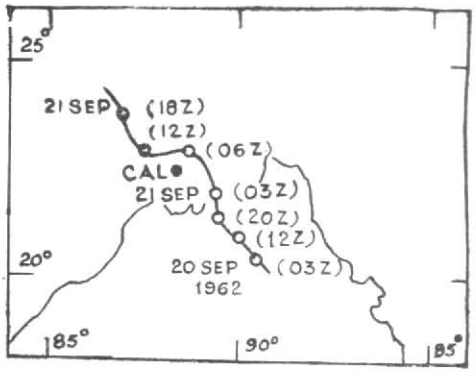

Fig. 1. Track of the cyclonic storm of 20-21 September 1962

3. Radar observations

The radar observations were taken with a 3-cm (Japanese Type NMD-451A) radar. It has a peak power of 250 km, the beam width being 1·2° in both vertical and horizontal between half power points. The aerial is located at a height of 50 ft above ground. The maximum range is 300 km.

As mentioned earlier, the cyclonic storm had its origin in the head Bay of Bengal about 250 km to the southeast of Dum Dum Airport. Radar observations were taken during the entire life cycle of the storm. The radarscope picture at 0915 GMT of 20th showed a prominent "spiral" located about 180 km to the south extending to about 160 km to the northeast through 60 km to the west. Apart from this band, there were also scattered echoes in the south, southeast, east and northeast sectors. The entire pattern of echoes was found to move in the northwesterly direction as seen from the subsequent radarscope pictures. About two hours later, as many as three spirals could be located, one from 200°/240 km through 270°/150 km to 355°/140 km, the second from 170°/80 km through 340°/60 km to 020°/120 km and the third from 140°/90 km to 060°/180 km. The centre of the deep depression at that time was beyond the range of radar and hence could not be seen on the radarscope. It is apparent that these spirals formed part of a large circulation system around the centre. The radarscope picture in the early morning of 21st was very interesting. At 0045 GMT the orientation of the spirals showed that the centre of the storm was located near about 120 km to the southeast of Dum Dum. The spiral nearest to the radar station was very prominent while the remote spirals were not so distinct probably due to attenuation of the radar beam. The storm crossed the coast near Sunderbans at about 0300 GMT on the 21st. At 0507 GMT the storm entered sufficiently inlands and became weak. The height of the top of the echoes as could be estimated from the Range Elevation Indicator (REI) pictures was only about 5 km. With the advance of the day the depression penetrated further inlands and the pattern of echoes was also diffused.

Though the storm was of a moderate intensity it retained its activity even 12 hours after crossing the coast as was seen from the radarscope pictures. The REI picture at 1126 GMT showed the formation of Bright Band.

4. Characteristics of the storm

Several authors (Deppermann 1939) have studied the structure of cyclonic storms reaching the stages of hurricane and typhoon and found the minimum pressure at the centre as low as 973·6 mb. In the case referred to earlier (De and Sen 1959) the minimum pressure at the centre was inferred to be as low as 988 mb, with a pressure departure of the order of 15 mb. In this particular case, as stated earlier, no 'hook' or 'eye' could be detected with the help of the radar. That means that the storm was of moderate intensity. The minimum pressure recorded by Alipore observatory was 988·6 mb at 0930 GMT on 21st when the centre of the depression was about 65 km away from the station and the corresponding pressure departure from the normal was about 14·5 mb. The pressure recorded at Dum Dum Observatory was 987 mb between 0700 and 0930 GMT on the 21st.

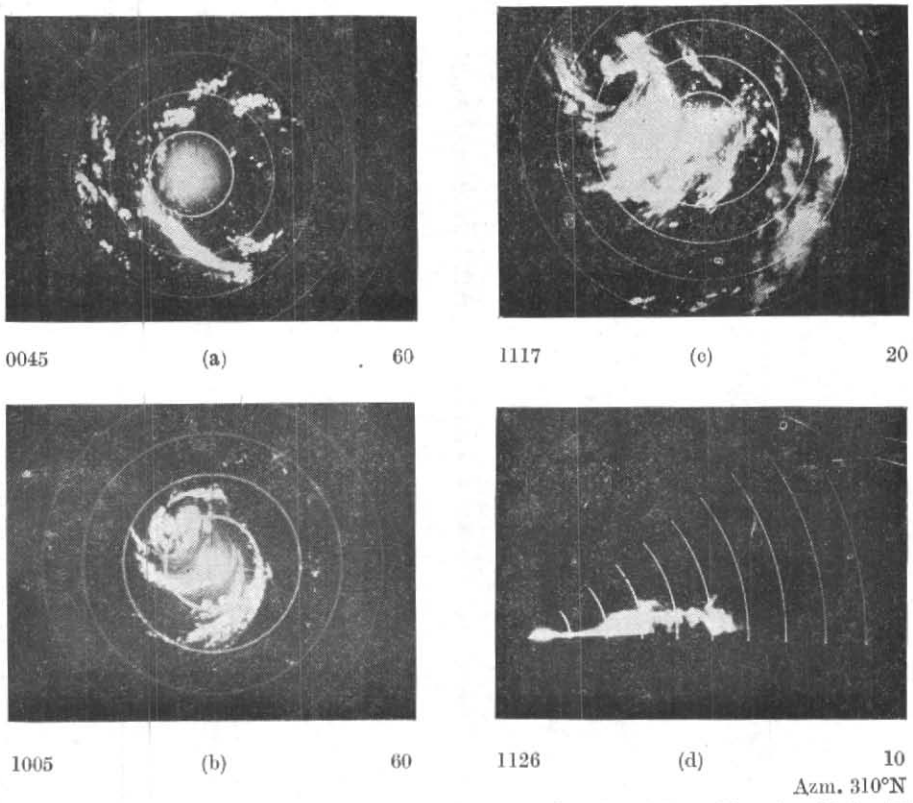

Fig. 2. PPI and REI presentations of the Storm Detecting Radar at Dum Dum Airport on 21 Sep 1962

Figures in the left and right hand bottom corners indicate time in GMT and range rings in km respectively

The track of the storm based on official bulletins (issued by the India met. Dep. Offices) has been shown in Fig. 1. It is seen that the rate of movement is not uniform all throughout the course of the track. Over sea, the speed of movement of the deep depression was very small, being of the order of 6-10 km/hr. But when it developed into a cyclonic storm, its movement was very rapid, being of the order of 48-50 km/hr. Later (between 1200 and 1800 GMT of 21st), its speed of movement decreased to about 13 km/hr. It is thus seen that the average speed of movement of the deep depression over sea was about 8 km/hr and of the cyclonic storm near land 37 km/hr. It is seen that the average speed of movement of the cyclonic storm between 0455 and 1150 GMT of 21st was 29 km/hr.

A few interesting radarscope pictures as obtained at Dum Dum Airport are presented in Fig. 2. The Plan Position Indicator (PPI) presentation were taken with 0° elevation of the radar antenna. As stated earlier, except for a few hours on 21 September 1962, the cyclonic storm was more than 50 miles away most of the time. Thus the radarscope pictures generally corresponded to a level higher than the surface level. The radar is, therefore, not expected to indicate the centre of the cyclonic storm on the surface. As such the radar observations could not be utilised for confirming the track of the storm indicated by the official bulletins which referred to the positions on the surface.

Earlier workers (Kessler 1958) have studied vertical structure above the storm centre.

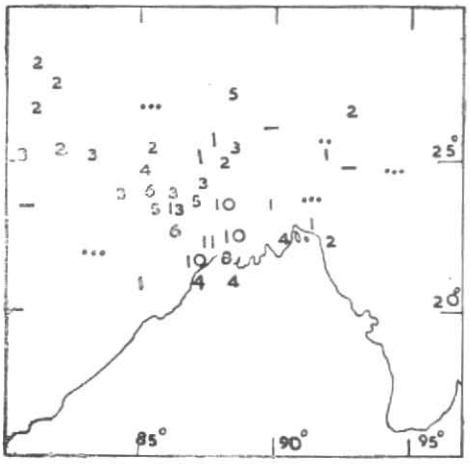

Fig. 3. Rainfall (in cm) during 24 hr ending 0300 GMT on 22 Sep 1962

Similar attempt was made in this particular case by vertically scanning the radar antenna. It has been found that the cloud tops did not generally reach more than 5 km. Kessler (1958) observed the appearance of thick layer cloud which, according to him, was derived from the wall cloud surrounding the eye of the hurricane Edna of 1954. Several attempts were made in this particular case to verify his finding. But the appearance of any such layer cloud over the centre of the storm could not be detected in spite of best efforts made.

5. Rainfall associated with the cyclone

The cyclonic storm had its origin in the form of a depression in head Bay on the early morning of 20 September 1962. At 0300 GMT, the centre of depression was located at 20°N, 90·5°E. Widespread rain associated with isolated thunderstorm occurred in the coastal areas of Arakan, East Pakistan and West Bengal. By 1800 GMT, the depression intensified and moved NW, its centre being located at 21 5°N, 89·5°E. Widespread rain accompanied with thunderstorm continued to occur over Gangetic West Bengal, Bihar and Orissa. At 0300 GMT of 21st, the deep depression further intensified into a cyclonic storm with centre located at about 22·0°N and 89·5°E and crossed the coast at Sunderbans. The rainfall recorded at 0300 GMT of 22nd during past 24 hours is shown in Fig. 3. It is seen that appreciable amount of rainfall was recorded in the SW and W sectors. This is in agreement with the pattern of distribution of rainfall generally observed in monsoon depressions. Stations located to the east and northeast of the storm track also were under the influence of the storm and recorded rainfall amounting to 2 to 4 cm.

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