

A radar study of the Gopalpur cyclone of 20 to 25 September 1972

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ABSTRACT. Some characteristic features of the Bay of Bengal cyclone of 20 to 25 September 1972, which crossed coast just south of Gopalpur in south Orissa on the afternoon of 22 September are presented in this paper.

1. Introduction

The Gopalpur cyclone of 22-25 September 1972 was tracked using satellite data and three aircraft reconnaissance missions from Guam, until the cyclone came within the range of the Visakhapatnam radar on the early morning of 22nd. The course of the cyclone was accurately followed by the radar after it came within its range.

2. Radar observations

A JMA-118A S-band radar with a peak power output of 600 kw is in operation at Dolphin's Nose, Visakhapatnam from April 1970. The initial echoes associated with the present cyclone were observed by the radar at 2320 IST on 21 September 1972. However, the band structure associated with the cyclone could be observed clearly from 0410 IST on the 22nd only. After the band structure was observed, the radar was operated as frequently as was feasible and the cyclone was tracked until 0520 IST on the 23rd, about 14 hrs after the cyclone had actually crossed the coast.

3. Analysis of data

The track of the cyclone as worked out on real time basis is shown by the dotted line in Fig. 1. For the present analysis the position of the centre of the system was determined by projecting the negatives on to a screen to the same size as on the PPI scope and fitting the appropriate spiral overlay. It was observed that for this cyclone the 15° spiral gave the best fit for the entire period. Since more than one picture was available for a particular time of observation in majority of the cases, the position of the centre of the system was determined with the help of two or three pictures for that particular time and the mean position was taken for the final plotting. Due caution was exercised whenever the centre was determined using

a photograph where signal attenuation was employed. The position of the centre of the cyclone on the basis of this analysis is given in Table 1 for the period 0410 IST of the 22nd to 0520 IST of the 23rd. The track of the cyclone based on this analysis is shown by the continuous line in Fig. 1.

4. Characteristics of the cyclone as observed by radar

4.1. Eye of the cyclone

PPI and RHI pictures of the cyclone at selected hours are shown in Figs. 3 and 4. The very first characteristic feature observed from the figures is that the eye of the cyclone remained open during the entire period. The eye wall could be identified clearly from 0305 to 1512 IST of the 22nd after which it has become indistinguishable from the band structure. This is just after the cyclone crossed the coast and moved inland. As observed by other workers in the field, the gyration of the eye wall could be clearly seen, indicating the oscillation of the axes of the eye of the cyclone. But the eye wall was not observed to shift to the northern side — far side of the radar — even for the duration of a single observation.

4.2. Band structure of the cyclone

During the entire period over which the cyclone was observed by the radar, only 90° to 120° spiral arcs of the bands were observed between the station and the eye of the cyclone. Not only the band structure beyond the eye away from the radar was never observed, but not a single echo was observed beyond the eye during the entire period of observation for over 24 hrs.

This could, perhaps, be due to either the system being not being not severe enough so that the bands on the farther side have not developed properly or to the system being just a pressure system with not

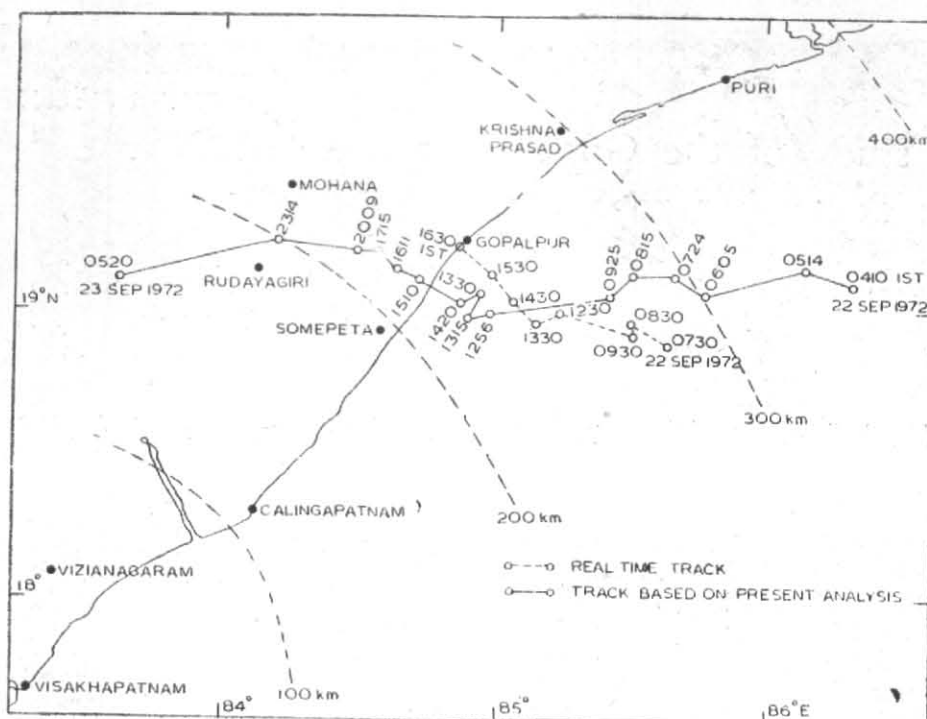


Fig. 1. Radar track of the cyclone during 21-23 September 1972

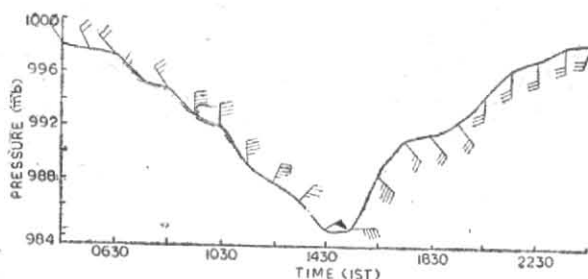


Fig. 2. Hourly observations of wind and pressure at Gopalpur on 22 September 1972

TABLE 1

Time (IST)	Azimuth of centre from north	Distance of centre from station km (n. Miles)	Time (IST)	Azimuth of centre from north	Distance of centre from station km. (n. Miles)
22 September 1972			1330	050	230 (124)
0410	065	350 (189)	1420	050	222 (120)
0514	063	337 (182)	1510	046	215 (116)
0605	060	300 (162)	1611	043	215 (116)
0724	058	295 (159)	1715	040	215 (116)
0815	056	280 (151)	2009	039	210 (113)
0925	057	270 (146)	2314	032	200 (108)
1256	052	227 (123)	23 September 1972		
1315	051	220 (119)	0520	016	160 (087)

much rainfall associated with it. The hourly values of pressure and wind at Gopalpur about 20 km to the south of which (as per the track of the cyclone obtained on the basis of the present analysis) the system crossed the coast are shown in Fig. 2.

According to Das *et al.* (1973) wind speeds of 50 kt were actually recorded at two different places in the storm field both to the right and left of its track on the 22nd and ship *ATBE* reported the lowest pressure of 975 mb (at 19°22'N and

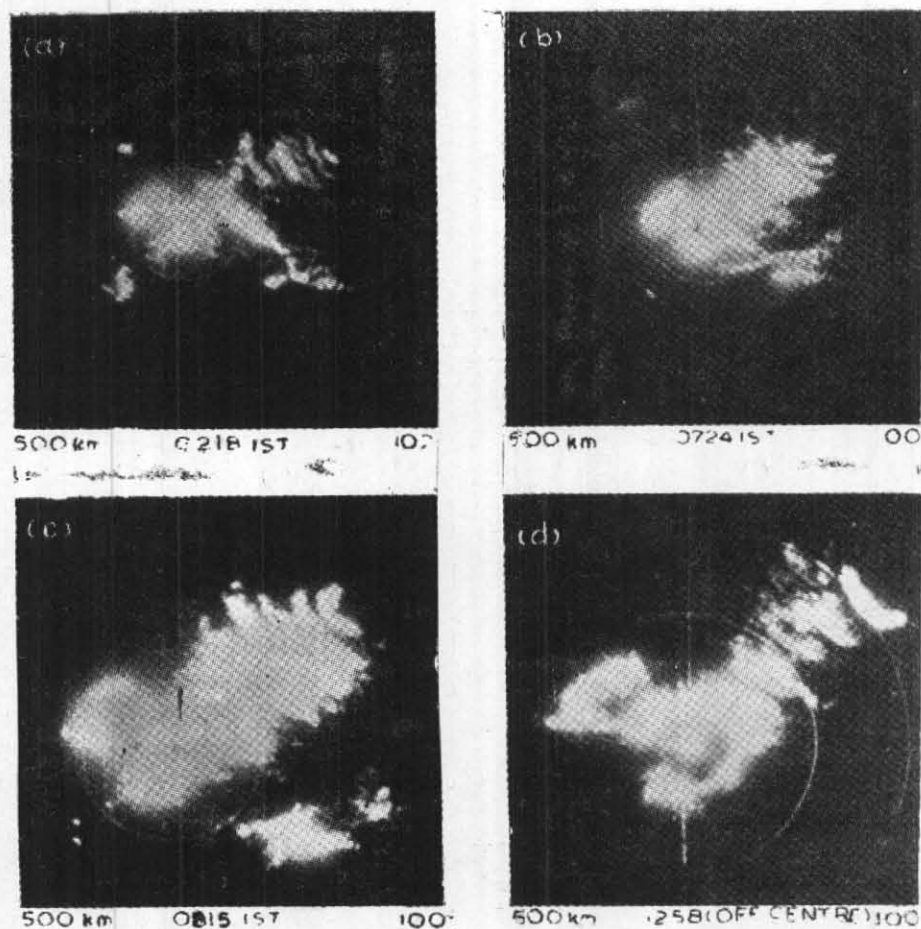


Fig. 3. Radarscope pictures taken at Visakhapatnam on 22 Sep 1972. Figures at left hand corner gives range (km), at centre time (in IST) and at right hand corner distance between range rings. For RHI, azimuth is also indicated.

87.15° E) at 1730 GMT of 21st. Thus the system was actually a severe cyclone.

24-hr rainfall figures ending at 0830 IST of 21st, 22nd and 23rd of stations in north Andhra and south Orissa coasts were examined. It is seen that exceptionally heavy rainfalls have been recorded on 22nd and 23rd, particularly along the path of the cyclone and on its right forward sector, as is generally known to occur synoptically.

On the RHI, it was observed that the echo heights through the bands to the eye wall were never more than 6 km. On occasions the height of the first band after the eye wall was found to be slightly more than the eye wall itself. Fig 4(a) is typical of the RHI presentation for this cyclone. The structure of the bands is also clearly seen. It is indeed difficult to believe that within 20 to 30 km of the last observed band, the system suddenly gets lowered to such an extent that it becomes totally undetectable, particularly when such heavy rainfalls are associated with the system.

Somewhat similar observations have been made by Raghavan (1974) in the case of the Cuddalore cyclone of 1 to 8 December 1972. In the case of tropical cyclones ADA and ALTHEA of the southern hemisphere that struck the Queensland coast during Jan 70 and Dec 71 respectively, Barclay (1972) has observed nearly similar characteristics of non-observance of the band structure beyond the centre of the cyclone away from the radar site and ALTHEA within 75 km. But in the case of the Cuddalore cyclone as well as ADA and ALTHEA, the shifting of the eye wall to the farther side of the eye was clearly observed, whereas in the case of the Gopalpur cyclone, the eye remained always open only. This clearly indicates the suppression of the reflected radar signals from the bands and other rainfall regions in the direction beyond the centre of these cyclones on account of probable changes in the microwave propagation conditions brought about by the cyclones themselves due to the presence of significant gradients

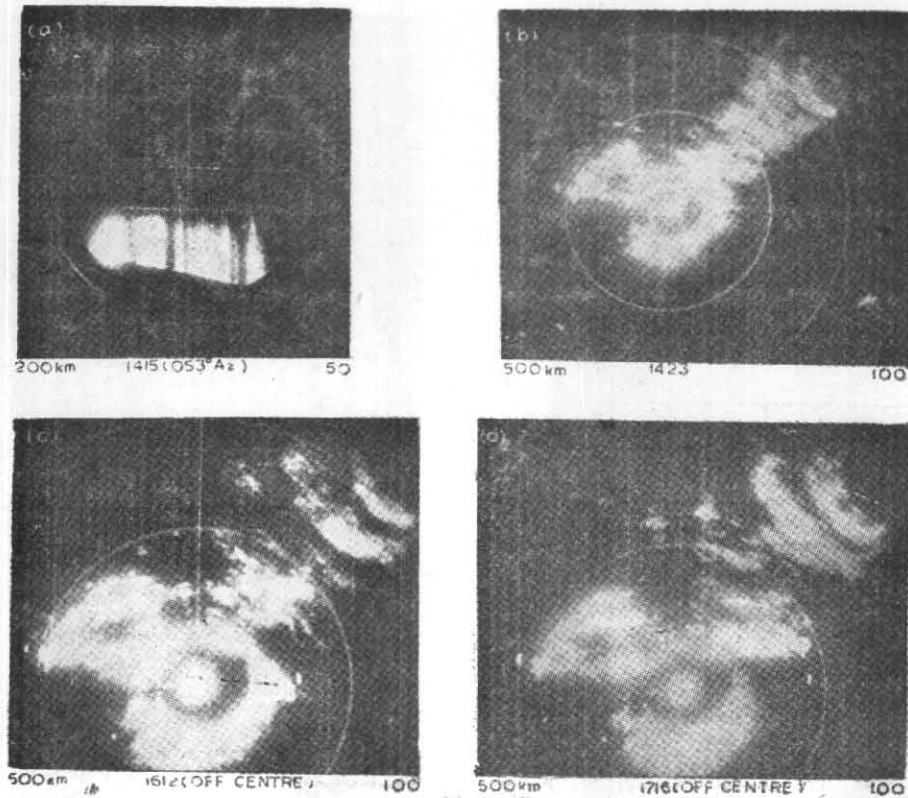


Fig.

of temperature and density at and in the vicinity of their centres.

4.3. Track of the cyclone

Compared to the features regarding the eye and the band structure, the track of this cyclone has only shown the often observed jumpy nature — but within a frog leap type envelop — both in the real time track and the track on the basis of the present analysis. Quite sudden fluctuations in the movement of the cyclone are observed between 1230 and 1430 IST of the 22nd in both the tracks,

This is just prior to the system crossed the coast. The system has moved nearly towards west during the period when it was being tracked by the radar. The order of discrepancy of about 20 to 25 km in the different fixes between the real time track and that of the present analysis compares favourably with those obtained by other workers in the field.

Acknowledgement

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