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Devastating tornado of Kandi (9 April 1993) — A case study

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सार — 9 अप्रैल 1993 को पश्चिम बंगाल के मुर्शिदाबाद जिले में आए विध्वंसकारी बवंडर (टारनेडो) के विषय में इस अध्ययन में विस्तार से लिखा गया है। इस बवंडर से संबंधित सिनोप्टिक स्थिति और रडार संकेतों की चर्चा की गई है। इसके अतिरिक्त, यह भी बताया गया है कि इस बवंडर के कुछ लक्षण पश्चिम बंगाल में आए कुछ अन्य बवंडरों से किस तरह से मेल खाते हैं। इस बवंडर के संबंध में लोगों के कुछ अनुभवों का विवरण प्रस्तुत करने का इसमें प्रयास किया गया है।

ABSTRACT. A case study of the devastating tornado which occurred in Murshidabad district of West Bengal on 9 April 1993 is described. The synoptic situation and radar evidence in association with this tornado have been discussed. Also, how certain features of this tornado compared with some of tornadoes reported over West Bengal and attempt to provide an explanation regarding a burning sensation felt by people with passage of this tornado has been made.

Key words — Tornado, Radarscope, Convective activity, Thunderstorm, Hailstorm, Bounded weak echo region (BWER).

1. Introduction

Frequency of occurrence of tornado in India is rather very low and is mainly confined to north and northeast India. Some recorded cases of tornadoes from 1963 are indicated in Fig. 1 which is definitely not exhaustive.

On 9 April, 1993 a very devastating tornado ripped through five villages of Kandi sub-division of Murshidabad district in West Bengal.

In this paper the synoptic situation and radar evidence in association with this tornado have been discussed. It has also been discussed as to how certain features of this tornado compared with some of the tornadoes reported earlier over West Bengal and United States.

2. Description

On 9 April, 1993 between 1530 to 1600 IST, a tornado swept through five villages of Kandi subdivision of Murshidabad district in West Bengal. The affected villages were Sujapur under Khargram Police Station (P.S.) and Khosbaspur, Gokarna, Chhatra and Motra under Kandi P.S. (Fig. 2). The tornado was reported to have lasted for about 15 min with 3 to 5 min at places on its track. Apart from killing more than fifty people, the tornado caused widespread damage to houses, installations, trees etc. on its track.

As per the eye-witness reports collected by the touring officer, the dark, towering clouds started forming over "Patan Bil" — a big marshy land of area of about 12 sq km and situated about 5 km west of Sujapur village under Khargram Police Stations (near Lat. 24°N, Long. 88°E), (Fig. 2) around 1530 IST (Aajan time). The cloud became darker and bigger with red glow within the cloud. Suddenly, a funnel shaped cloud resembling the trunk of an elephant came down from the base of the cloud and started drawing water just like an elephant. The whole thing started revolving in an anti-clockwise sense with white smoke around red glow. It then advanced towards Sujapur village with a tremendous roaring sound as if a hundred aeroplanes were approaching. As the system approached Sujapur, the villagers felt very hot with burning sensation on their bodies.

Hailstorm with hails of weight 250/300 gm (some even estimated them to be of 500 gm) preceded the tornado. Agee *et al.* (1976) and some of the Indian authors had also observed that large hails often fall near the tornado just ahead of it. Within a few seconds of the hailstorm, the tornado lashed the Sujapur and other affected villages. The mud houses of these villages were completely devastated. High tension electric towers in the open field were razed to the ground. The roof of a double storeyed building (a factory, manufacturing cement pipes) lying by the road side in Sujapur was thrown about 60 m to the north. A big banyan

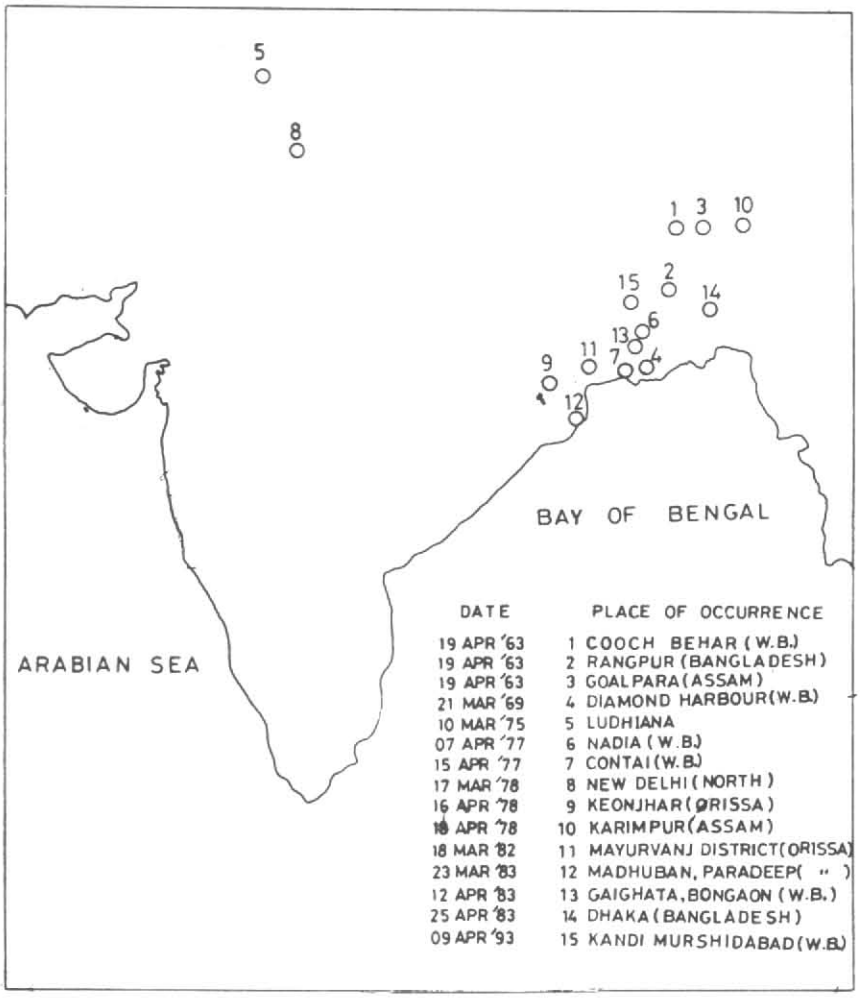

Fig. 1. Location and dates of tornadoes in India (1963-93)

tree with circumference measuring 5 m and situated about 50 m to the northeast of the factory was uprooted. According to the villagers, the tree had fallen first to the north and then the wind force turned it to the west and finally to the southwest. Here, a bus with 50-55 passengers was lifted to about 20-25 feet high, rotated a few times in the anticlockwise sense and then the broken parts were thrown to the eastern side of the road at a distance of about 50 m. A telephone pillar with its cemented base in Gokarna village was uprooted and thrown on to the broken roof of a building at a distance of about 50 ft.

3. Synoptic situation over northeast India

On 8th morning, a trough of low pressure extended from east Uttar Pradesh to northwest Bay of Bengal across south Orissa with upper air cyclonic circulation over Bihar Plateau and adjoining Madhya Pradesh extending upto 0.9 km asl which became less marked on 9 April 1993. The other trough of low pressure extending from east Uttar Pradesh to Nagaland across Bihar plains and Sub-Himalayan West Bengal on 8 April, however, passed through central Bihar and Gangetic West Bengal on 9 April, 1993.

A cold trough, which extended from Sub-Himalayan West Bengal to coastal Orissa across Gangetic West Bengal between 1.5 and 3.1 km asl on 8 April, was not visible on 9 April, 1993.

Westerly jet stream core, however, passed through Bihar Plateau, central West Bengal, north Bangladesh, Assam and Meghalaya on both 8 and 9 April, 1993. These could have been responsible for the subdued thunderstorm activities over Gangetic West Bengal on 9 compared to 8 April

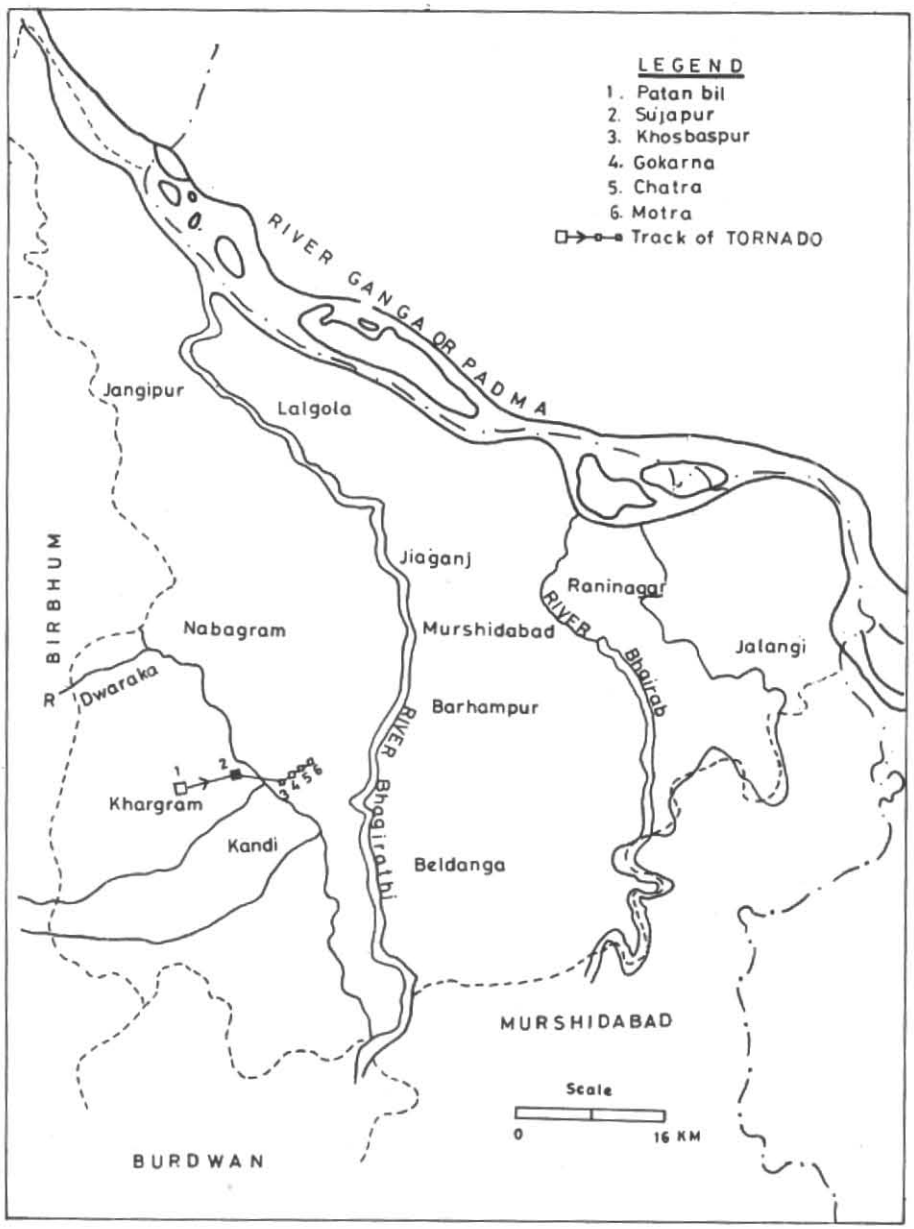

Fig. 2. Track of the Kandi tornado of 9 April 1993

as evident from radar observations of Cyclone Detection Radar (CDR), at Calcutta (Figs. 3 & 4).

It was also found that moisture had increased over Bihar Plateau and adjoining Gangetic West Bengal but decreased over coastal areas of West Bengal and Orissa on the morning of 9 as compared to that on 8 April, thereby, increasing the moisture contrast.

4. Radar observations at CDR Calcutta

The radarscope observations on 8 April, 1993 were taken at 1130, 1430 IST and on 9 April, 1993 at 1130 and 1600 IST by the S-Band Cyclone Detection Radar installed at the New Secretariat Building, Calcutta. It has a peak power of 500 KW and its receiver sensitivity is −110 dbm. It has a maximum range of 500 km and beam width 1.8 degree.

From the radarscope observation on 8 April, 1993 lot of thunder cloud developments were observed right from 1130 IST within 300 km of radar range all around except to the northeast sector. Height of cloud tops was around 8 to 9 km (Fig. 3). However, on 9 April, 1993, the day when tornado occurred, there was no significant radar

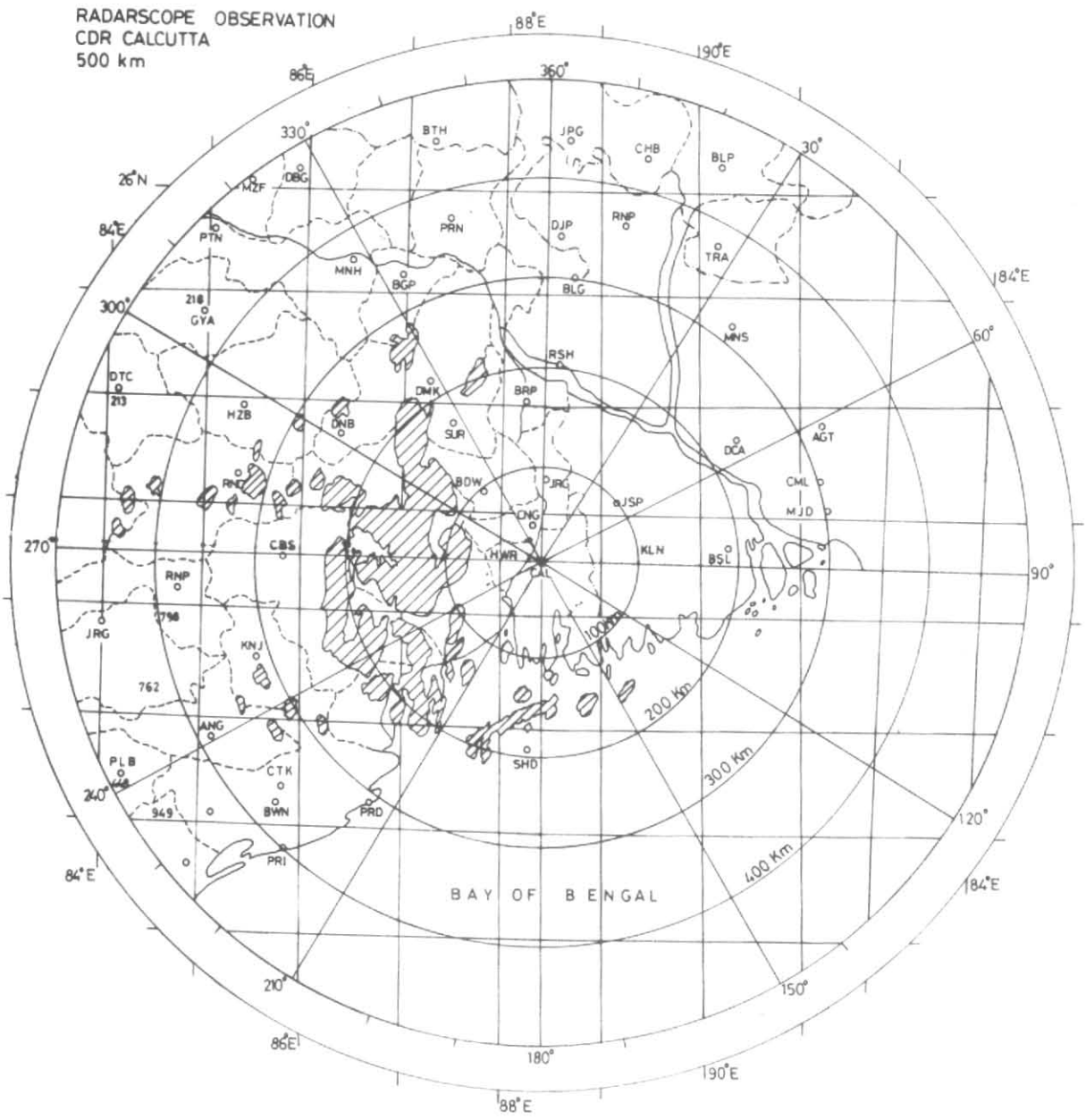

Fig. 3. Radarscope observation of CDR, Calcutta at 1100 UTC on 8 April, 1993

cell at 1130 IST, but at about 1600 IST a few isolated cells could be seen at a distance of 160 to 250 km towards north of Calcutta (radar site). Other sectors were free from convective activity. One cell, which was located at 355 degree azimuth and at a distance 180 km, had an arc-type shape (just short of a hook) having altitude of 10 km (Fig. 4). This particular cell was located near and towards southwest of Berhampur of Murshidabad districts where devastation due to tornado was reported. Perhaps this may be the later stage of the tornado at the place.

5. Discussion

From the available information on the tornado, and the touring officer's report, a track of the Kandi tornado has been made (Fig. 2). It appears that the tornado started from the "Patan Bil", amarshy area and then moved in a northeasterly direction and ultimately dissipated in Motra, about 18 km southwest of Berhampur. The length of the tornado track was about 14 km and its width about 300 m on an average. From the nature of destruction and damages observed, the wind speed

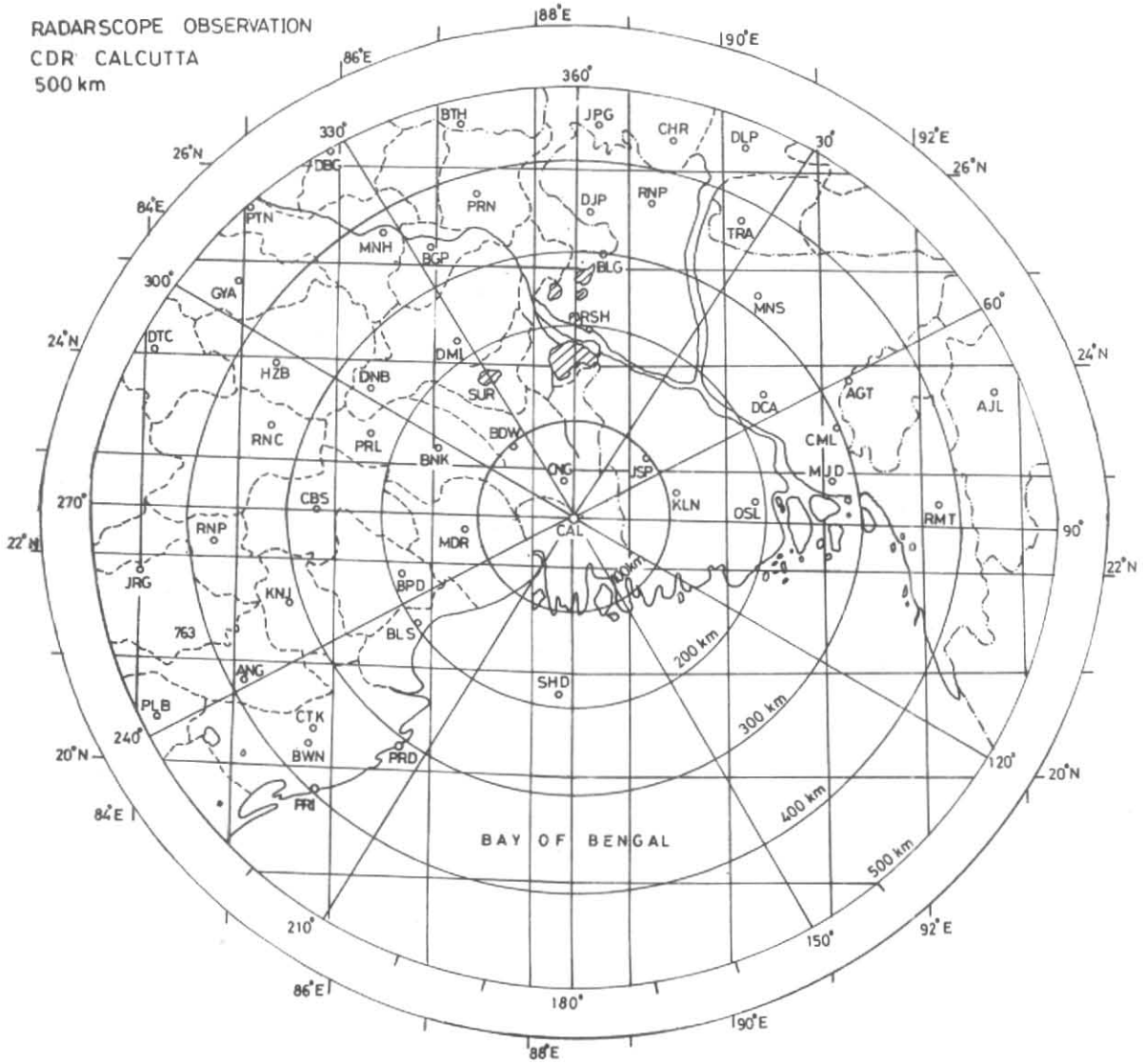

Fig. 4. Radarscope observation of CDR, Calcutta at 1030 UTC on 9 April, 1993

in the core of tornado could be estimated to about 250 kmph as per Table VIII of Saffier-Simpson Scale applicable to Indian condition.

The synoptic situations of 7 and 8 April, 1993 were conducive to widespread thunderstorm activities over northeast India and squalls were reported at the departmental observatories. The situation, however, was different on 9 April morning. The atmosphere was stable over Bihar and West Bengal. The north-south trough, at the surface across Bihar and Orissa, became less marked. Moisture increased over Bihar Plateau and adjacent Gangetic West Bengal but decreased over coastal West Bengal and Bihar. Over Calcutta, moisture decreased at all levels but lower level became warmer and upper levels became colder, thereby increasing the potential instability due to moisture advection. This is what happened in the evening of 9 April, 1993 over West Bengal. But as other conditions were not favourable, convective activity was subdued as a whole. Scattered convectivity were observed over Bihar Plateau and adjacent Gangetic West Bengal in the afternoon and one of them gave rise to the tornado near Berhampur.

It is worthwhile to compare tornado studies made by some of the earlier authors who had reported occurrence of tornado over northeast India, *viz.*, Nandy and Mukherjee (1966), Mukherjee and Bhattacharya (1972) and Bhattacharya and Banerjee (1980). Like Kandi tornado, they had also reported rumbling sound in association with tornado which

had been attributed by Brooks (1951) to the vibration created by frictional effect in the strong wind shear of the whirl.

Anti-cyclonic gyration of tornado was also observed by Bhattacharya and Banerjee (1980) for Contai tornado in 1977 like the one which occurred on 9 April, 1993 at Kandi.

Mukherjee and Bhattacharya (1972), Bhattacharya and Banerjee (1980) had observed tornado location at the bent portion of the wedge-shaped echo on radar. But Kandi tornado, which occurred on 9 April, 1993 in Murshidabad, had an arc-type isolated echo only on radarscope and location of tornado perhaps was on the rear side of the arc which may be in the region of Bounded Weak Echo Region (BWER). It is interesting to note that though widespread thunderstorm and squalls at several places occurred over northeast India on 8 April, 1993 however, there was no report of occurrence of any tornado on that day. But on 9 April, 1993, the day the tornado struck at Kandi, convective activity was very less. These can be seen from radar observation of 8 and 9 April, 1993 as recorded on polar diagram. Surface observations also corroborate the fact.

One important observation about the Kandi tornado was that, all the people living near the track of the tornado had felt a strange heating and burning sensation from the approaching tornado. The dark towering cloud was associated with red glow within the cloud.

As per postulation made by Davis Jones (1982) on tornado-genesis, a forced descent of air along the axis of the tornado from tropopause to the near ground levels may cause temperature rise of about 60°C on the ground and can cause high wind speed as high as 115 m/s. Moist adiabatic ascent in the tornado core can also account for wind speeds as high as 65 m/s.

As is generally the case with most tornadoes, actual meteorological observations from the Kandi tornado field were not available. Nearest Meteorological Observatory at Berhampur, located about 18 km from tornado site did not record any appreciable change at 1200 or 0600 UTC observations of any meteorological parameter like wind, temperature, pressure or rainfall.

6. Conclusion

(*i*) Mehta *et al.* (1975) have observed that only the most severe tornadoes inflict serious structural damage on reinforced concrete or steel frame building/structure. From the severe structural damages inflicted by the tornado in Kandi subdivision of Murshidabad district of West Bengal, it can be said that Kandi tornado belonged to the most severe type of tornadoes.

(*ii*) It was one of the cases of isolated cell causing severe tornado.

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