551.501.7 : 551.515.1

SOME AEROLOGICAL OBSERVATIONS DURING THE PASSAGE OF A CYCLONE

It is rare to get detailed upper air observations from the cyclone field as the cyclones may not necessarily cross the coast where an aerological observatory exists. Some field observations for cyclones of the Indian seas are available. But they were mostly surface observations and they were helpful in deriving the surface structure of the cyclone (Mukherjee and Sivaramakrishnan, 1988; Sivaramakrishnan 1987; Biswas *et al.* 1988 and Sivaramakrishnan and Sridharan 1989). The severe cyclone with core of hurricane winds of the Bay of Bengal during December 1993 crossed Tamil Nadu coast over Karaikal where an aerological observatory exists. The temperature and wind observations were taken during the passage of the cyclone at Karaikal and the results of the analysis are interesting.

A depression formed in the southwest Bay of Bengal on 1st December moved west northwards and intensified into a severe cyclone by 0300 UTC of 3rd December lying at about Lat. 9.5° N / Long. 82.5° E. The cyclonic storm with a core of hurricane winds crossed coast around 0400 UTC of 4th December over Karaikal.

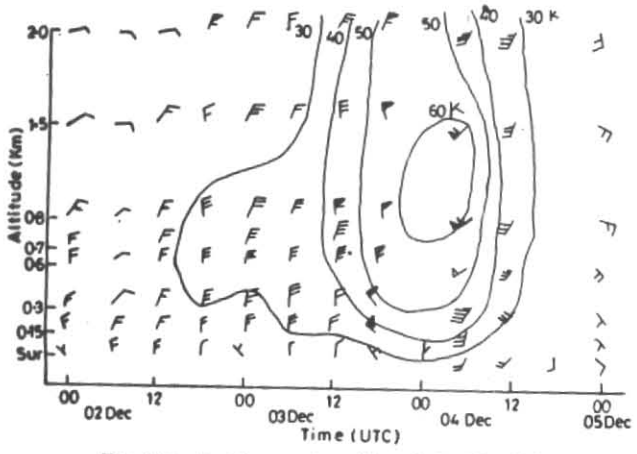

Fig. 1. Vertical time section of the wind at Karaikal

Pilot baloon observations recorded at six hourly intervals from 0000 UTC of 2nd December to 5th December at Karaikal were plotted and Vertical Time section was constructed. The influence of the Cyclone was studied from the analysis. The temperature and humidity observations as well as the level of Tropopause taken at about 0000 and 1200 UTC on 2nd, 3rd, 4th and 5th December were considered and the temperature and humidities at levels upto the altitude of 400 hPa were studied as the data for levels above 400 hPa was missing on some of these days.

Radio Refractive Index is a parameter which brings out the effect of weather on Radio wave propagation in the atmosphere. RRI value depends on the pressure, temperature and humidity. According to CCS IV study group V, unit change in RRI results in a change of 0.2 db field strength. Since a lot of communication and radio equipments operate now a days in UHF and Microwave frequencies, the variations of RRI due to severe weather conditions in association with cyclones affect their operation significantly. Hence, the quantitative information on RRI variation is of vital concern to communication engineers and radio physicists. RRI values for each level were computed using the well known formula (Bean and Dutton, 1968) and RRI changes in association with the severe cyclone have been derived and discussed.

Fig. 1 presents the vertical time section of the winds in the planetary boundary layer (PBL) during the period from

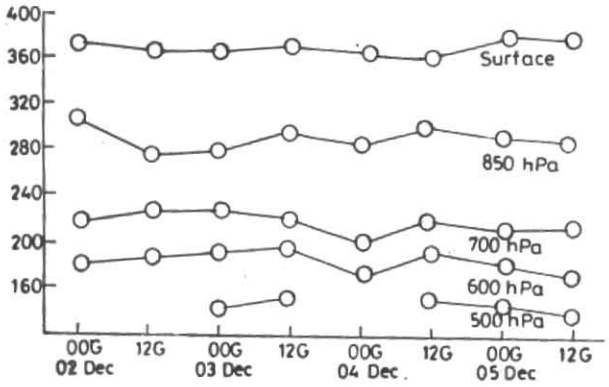

Fig. 2. RRI at various levels (N units)

TABLE 1
Upper air temperature (°C) at Karaikal

Level (hPa)	2 December		3 December		4 December		5 December	
	0000 (UTC)	1200 (UTC)	0000 (UTC)	1200 (UTC)	0000 (UTC)	1200 (UTC)	0000 (UTC)	1200 (UTC)
Surface	23	26	23	22	–	24	26	28
925	19	20	21	19	20	22	23	24
850	15	16	18	16	18	17	19	19
700	06	09	09	07	09	12	11	12
600	04	01	03	01	04	06	05	05
500	-01	-06	-04	-06	–	-02	-03	-02
400	-10	-17	-14	-15	–	-11	-13	-14
Tropopause height (km)	15.8	15.6	–	15.7	–	16.7	16.5	16.3

TABLE 2
RRI Gradient

Range (hPa)	3 December 1200 (UTC)	4 December 1200 (UTC)	4 December 1200 (UTC)	Undisturbed value
Surface to 925	71	70	55	85
Surface to 850	58	65	51	69
Surface to 700	46	44	43	51
Surface to 600	41	44	38	44
Surface to 500	37	–	35	39

2 to 5 December over Karaikal. Because of the severe gusty winds of the cyclone of hurricane strength the pilot balloon tracking at 0000 UTC of 4th December was very difficult and observations could not be made. The approach of the Cyclone could be seen from 1800 UTC of 2nd itself when the Cyclone was 500 kms away as the winds started strengthening between 0.3 and 0.9 kms agℓ. The strong wind regime in association with this cyclone could extend upto about 1.5 kms agℓ as the core of 60 kts wind indicates. The passage of the cyclone over Karaikal was confirmed by the radar and surface observations of Karaikal. The northerlies observed at 1800 UTC of 3rd giving way to the southerly component by 0600 UTC of 4th December between 0.3 & 2.1 km brings out spectacularly the passage of the tropical cyclone in the PBL wind field over this place.

Table 1 presents the temperatures at standard levels during 2 to 5 December for the station Karaikal. The warming of the mid troposphere with the arrival of the cyclone is seen from 700 hPa onwards by 4th December. This may be due to the warm core nature of the tropical cyclones. The tropopause level which was about 15.6 km agℓ on 2nd and 3rd rose upto 16.7 kms agℓ by 1200 UT of 4th as a result of the passage of the cyclone.

RRI at surface level can change by more than 20 N units in association with the cyclone gradually as per an earlier study (1990). The RRI at each standard levels during each observation time for this cyclone are shown in Fig. 2. There is a significant fall observed around 0000 UTC of 4th when the centre of the cyclone was very close by. This is clearly seen at 700 and 600 hPa levels. The effect of the cyclone was not discernible in RRI values above 500 hPa. The RRI gradient between surface to different levels were computed for the 0000 & 1200 UT of 2nd and 5th December separately. On 2nd December the depression had formed and was 600 kms away from Karaikal. On 5th December the cyclone had already weakened after crossing coast and moved away. Hence observations of these days were taken tacitly to represent the undisturbed condition over Karaikal close to the occurrence of the event of cyclone. The surface and upper air charts of ACWC Madras were consulted before making this consideration. The mean of the values for the gradients computed for the 0000 and 1200 UT observations of 2nd and 5th December was computed and this was taken to reasonably represent the undisturbed value of the RRI gradient for the station. The RRI gradients computed for 1200 UTC/03 December and 0000 & 1200 UTC of 4th December when the station was under the influence of the cyclone were compared with the undisturbed values in Table 2. It can be seen that RRI gradient reduces with the passage of the cyclone in the lower troposphere. It is hoped that these informations will be of practical importance to radio and communication engineers.

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