Mausam, (1984), **35**, 2, 181-182

551.552 : 551.515.1

Surface winds in the cyclone field

T. R. SIVARAMAKRISHNAN*
NOAA, Silverspring, Maryland, USA
and
A. K. MUKHERJEE
Meteorological Office, Pune

(*Received 17 January 1983*)

सार — सन् 1976 में अरब सागर में भीषण चक्रवात आने की अवधि में तेल एवं प्राकृतिक गैस आयोग के मस्तूलों की सहायता से अंकित सतही पवनों का विश्लेषण किया गया और उसे संयुक्त किया गया । स्पर्शरेखीय और अरीय (रेडियल) दोनों प्रकार की पवनें चक्रवात के केन्द्र के संदर्भ में असममिति दर्शाते हैं । दाबमानों से अधिकतम पवन की गति के आकलन के लिए उपलब्ध विभिन्न सूत्रों की जांच करने के बाद पता चला है कि फ्लेचर के सूत्र से आकलित मान, वास्तविक अधिकतम पवन गति से काफी मेल खाता है ।

ABSTRACT. The surface winds recorded by the ONGC rigs in Arabian Sea during the passage of a severe cyclonic storm in 1976 have been analysed and composite is prepared. The distribution of both the tangential and radial winds exhibits asymmetry with respect to the centre of the cyclone. Of the different formulae tried for the estimation of maximum wind speed from pressure values, Fletcher's formula is found to give a value close to the recorded maximum wind speed.

1. Introduction

One of the dangers associated with a tropical cyclone is the wind of very high velocity. Estimation of the surface wind in a cyclone is an important task of a forecaster. It is very rare to get detailed observations of surface wind and weather from a severe cyclone field. The only documented set of data in this regard is the one due to Arakawa and Suda (1953) describing the experience of main squadron of the Imperial Japanese Fleet as it inadvertently passed through the typhoon of September 1935. Gopanath cyclone of May/June 1976 passed over Bombay High area in Arabian Sea off Bombay harbour. Three rigs belonging to Oil and Natural Gas Commission stationed for off shore oil explorations at this site took hourly wind and weather observations during the passage of the cyclone. The data were analysed and the results are presented here.

2. Method

The track of the cyclone with the positions of the rigs is shown in Fig. 1. The centres of the cyclone are as given by the Area Cyclone Warning Centre, Bombay. The data considered for analysis were those recorded when the cyclone maintained the hurricane strength. Knowing the centre of the storm and the orientation of the observation points (rigs), composite of wind velocity was prepared. The lowest pressure recorded during the passage of the cyclone was 980 millibars. Using this value the maximum speed of the wind was estimated as per known formulae and their suitability seen.

3. Discussion

3.1. *Wind speed composite*

Fig. 2 gives the wind speed composite. In fact a preliminary analysis of surface winds and waves has been reported by Mukherjee and Sivaramakrishnan (1977). The core of maximum wind speed going to the right rear sector is a point to be seen.

Fig. 3 gives the composite of radial component winds. Though the core of maximum winds goes to the right, it extends to the right front sector also. The gradient of the radial winds is more to the front than to the back. Fig. 4 presents the composite of tangential winds. The core goes to the rear of the cyclone field. Thus both the radial and tangential wind composites are not symmetrical with respect to the centre of the cyclone.

3.2. *Estimation of maximum wind*

From the pressure at the centre and the periphery of the cyclone, it is possible to estimate the maximum speed of the wind for a cyclone. The pressure at the periphery is usually taken as the value of the outermost closed isobar from weather charts. But sometimes even deciding the value for the outermost closed isobar poses a problem as ships' observations will be lacking. Since the normal atmospheric pressure is 1013 mb, that is taken as the value for the peripheral pressure.

*On deputation from India Meteorological Department

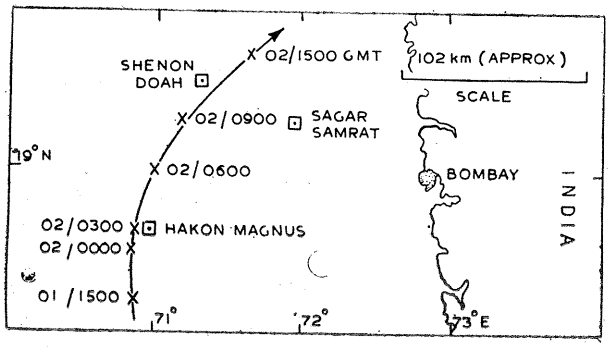

Fig. 1. Cyclone tracking by radar fixes of Arabian Sea storm, May/June 1976, with position of drilling rigs

TABLE 1
Estimation of maximum wind speed

Investigator	Formula	Calculated wind speed (kt)
Myers, V.	$V=11(1010-P_0)^{\frac{1}{2}}$	61
Takahashi	$V=13.4(1010-P_0)^{\frac{1}{2}}$	74
Natarajan & Ramamurthy	$V=13.6\ (P_n-P_0)^{\frac{1}{2}}$	78
Kraft, R.	$V=14\ (1013-P_0)^{\frac{1}{2}}$	80
Mishra, D.K. & Gupta, G.R.	$V=14.2(P_n-P_0)^{\frac{1}{2}}$	82
Fletcher, R.D.	$V=16\ (P_n-P_0)^{\frac{1}{2}}$	92
Schwerdt *et al.*	$V=\frac{0.9}{(de)^{\frac{1}{2}}}(P_n-P_0)^{\frac{1}{2}}-rf/2$	118

P_0=Pressure at the centre (=980 mb here), P=Peripheral pressure (taken as 1013 mb), e=2.71828,
f=Coriolis parameter,
d=Density of the air computed from sea surface temp.,
r=Radius of maximum wind.

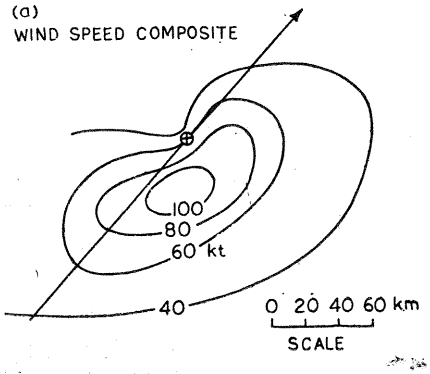

Fig. 2. Wind speed composite (kt)

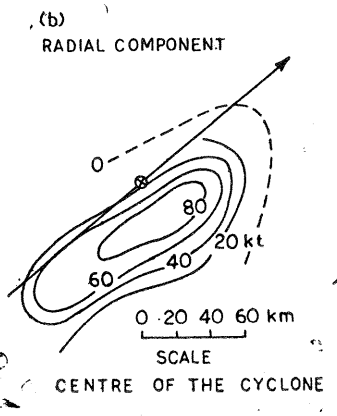

Fig. 3. Radial component (kt)

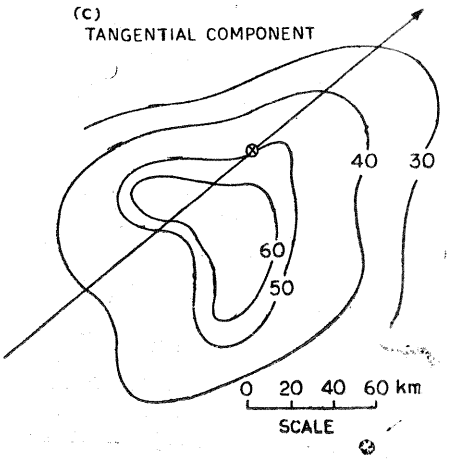

Fig. 4. Tangential component (kt)

Recently Schwert *et al.* (1979) have given a modified formula for the probable maximum hurricane winds. The different formulae and the estimate of maximum wind for the storm are given in Table 1. The maximum wind speed recorded in this cyclone was 100 knots. It is seen that among the different formulae, Fletcher's formula gives a value close to the recorded speed.

4. Conclusion

The unsymmetric nature of the wind field in the severe cyclone field of hurricane strength in Arabian Sea is established by the observational analysis. The core of maximum winds is to the right sector of the storm field. Among the different formulae tried for the estimation of maximum wind speed, Fletcher's formula is found to give an estimate close to the observed maximum wind.

Acknowledgement

The authors are thankful to Oil and Natural Gas Commission for supplying the data.

References

Arakawa, H. and Suda, K., 1953, *Mon. Weath. Rev.*, **81**, p. 31.

Fletcher, R.D., 1955, *Bull. Am. met. Soc.*, **36**, 6, p. 247.

Kraft, R., 1961, *Mar. Weath. Log.*, **5**, 5, p.2157.

Mishra, D.K. and Gupta, G.R., 1976, *Indian J. Met. Hydrol. Geophys.*, **27**, p. 285.

Mukherjee, A.K. and Sivaramakrishnan, T.R., 1977, *Nature*, 19 May, p. 236.

Myers, V , 1957, *Bull. Am. met. Soc.*, **38**, 4, p. 227.

Natarajan, R. and Ramamurthy, K.M., 1975, *Indian J. Met. Hydrol. Geophys.*, **26**, p. 165.

Schwerdt, R.W., Ho, F.P. and Watkins, R.R., 1979, NOAA Tech. Rep. NWS 23, Washington.