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Letters to the Editor

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POSSIBLE INFLUENCE BETWEEN PAIR OF LOW PRESSURE SYSTEMS OVER BAY OF BENGAL AND ARABIAN SEA

1. Two cases, when a pair of low pressure systems simultaneously existed over Arabian Sea and Bay of Bengal during November, have been discussed in this paper. In one case (1986), the low pressure system in Bay of Bengal was found to intensify into a cyclonic storm and in other case (1982), the low pressure system in Arabian Sea intensified into a cyclonic storm. Here, author examines the two cases on the basis of surface and upper air data from coastal stations closer to the systems and attempts to make a comparative study with respect to dynamic and thermodynamic aspects.

2. During the period 1 to 3 November 1982, a pair of low pressure areas, one over south-east Arabian sea off Kerala coast and the other over southwest Bay off south Tamilnadu coast, persisted simultaneously. On 4th morning, the low pressure area off south Tamilnadu coast became less marked, whereas the low pressure area over south-east Arabian sea concentrated into a depression and subsequently intensified into a cyclonic storm on 5th morning with centre around latitude 12.5°N and longitude 63°E. The system recurved on 5th evening and intensified further into a severe cyclonic storm with a core of hurricane winds on the 7th morning. Moving northeasterly, it hit south Gujarat coast on 8th evening and subsequently became less marked, (Fig. 1).

2.1. During 1-7 November 1986 another pair of low pressure areas was present simultaneously, one over south-east and adjoining east-central Arabian sea off south Maharashtra-Karnataka coast and other over west Bay off south Andhra and north Tamilnadu coast. The low pressure area in Arabian sea practically remained stationary till 7th, became well marked on 8th, rapidly concentrated into a deep depression on 9th morning and lay centered around latitude 13°N and longitude 70°E, moving westwards again weakened into depression and became less marked by 11th. The low pressure area over Bay of Bengal moved north initially and thereafter northeast, it concentrated into a depression on 8th morning and intensified into a cyclonic storm over northwest Bay on 9th November morning. It crossed Bangladesh coast in the evening. Subsequently, it became less marked, Fig. 2.

3. Gray (1975) designed a parameter P known as cyclogenesis parameter which can be written as :

$$P = f\,(\zeta_z + 5)\ [1/(S_z + 3)]\ E\ (\partial\theta_e/\partial p + 5)\ (RH—40)/30$$

where, ζ_z — Relative vorticity

f — Coriolis parameter

S_z — Vertical wind shear between 900 and 200 hPa

E — Ocean energy measured in terms of the excess of sea surface temperature over 26°C

θ_e — Equivalent potential temperature

RH — Mean relative humidity between 500 and 700 hPa.

3.1. Generally, the sea surface temperatures in postmonsoon season in most parts of Indian oceanic areas are above 27°C to 29°C. As the systems in pair originated more or less at the same latitude, simultaneously, in Arabian Sea and Bay of Bengal, value of Coriolis parameter is considered to be the same for both the cases. Therefore, computations of ocean energy E and Coriolis parameter f are not included in this study. Computations of vertical wind shear between 850 and 200 hPa, mean relative humidity between 850 and 500 hPa and equivalent potential temperature gradient between 1000 and 700 hPa are done here. Longitudinal variation of horizontal wind shears at 850 hPa of U and V components are computed in Y direction and variation of shear is then expressed in units of knots per 100 km of distance.

3.2. According to Palmer (1956) and Reihl (1956), another pre-requisite condition for formation of tropical cyclone is that lifted air parcel from low level should be considerably warmer than surrounding undisturbed atmosphere upto height of

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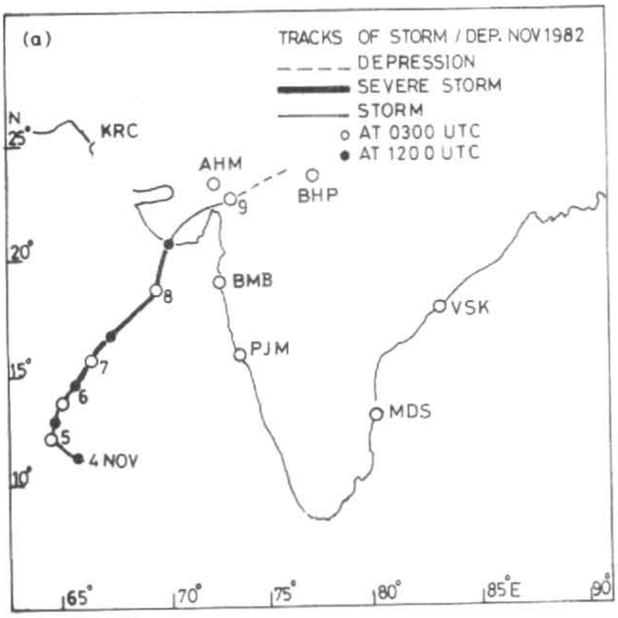

Fig. 1. Tracks of storm/depression in November 1982

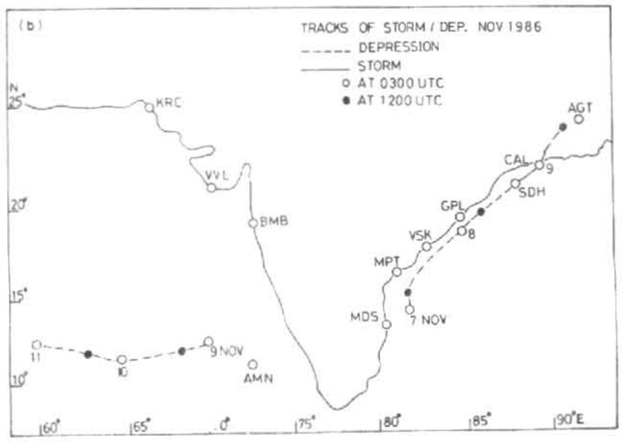

Fig. 2. Tracks of storm/depression in November 1986

12 km. To examine this hypothesis, computation of temperature difference between air lifted from surface to 500 hPa and undisturbed air at 500 hPa is also made.

3.3. The most reliable sign of an approaching cyclonic storm is the fall of barometer pressure, initially slowly and then more rapidly as centre comes closer to the station. Investigation of change in surface pressure field is also included here. In addition to these, investigation of mean mixing ratio between 1000 and 700 hPa is also made.

3.4. Vertical wind shear of zonal wind between 850 and 200 hPa less than or equal to 15 knots, mean mixing ratio (1000-700 hPa) more than 8 gm/kg and surface pressure fall by 5 hPa/day are generally considered favourable conditions according to check list for intensification of cyclonic storm from the stage of depression as illustrated by Sensharma and Chakraborty (1984).

4. The elements discussed above are computed for coastal stations closer to the systems for the period 1 to 5 November 1982 and 5 to 9 November 1986. Contribution of each of these parameters associated with two low pressure systems are compared and summarised with respect to some significant values as shown in Table 1. Stations nearest to the system is taken as representative station and in case of missing observation next closer station's observation is considered. In 1982 case, Arabian Sea system was having vertical wind shear of the order of 10 to 15 knots, longitudinal shear of horizontal wind (*U*-component/100 km) −15 to −20 knots, longitudinal shear of *V*-component around −3 knots/100 km, relative humidity 75 to 85%, mixing ratio about 9 gm/kg, temperature difference 2 to 3°C, θ_e gradient 17 to 30°C and the system intensified into a cyclonic storm. This trend was noticed to continue for about 48 hours in advance of intensification into cyclonic storm. Whereas, for the Bay system the relative humidity, mixing ratio and longitudinal wind shear of *V*-components were of the same order but vertical wind shear was more than 30 knots, longitudinal variation of *U*-component 3 to 7 knots per 100 km, temperature difference 1 to −10°C, θ_e gradient 7 to 17°C. These four parameters were less favourable and system did not intensify.

4.1. In 1986 case, Bay system was having vertical wind shear of 10 to 15 knots, longitudinal variation of horizontal wind, *U*-component around −15 knots per 100 km and *V*-component around −10 knots per 100 km, humidity 75 to 85%, mixing ratio around 9 gm/kg, temperature difference 1 to 4°C and system intensified. For Arabian Sea system relative humidity, mixing ratio, longitudinal variation of *U*-component and θ_e gradient were of the same order but vertical wind shear were 25 to 30 knots, horizontal wind shear (*V*-component) around −3 knots per 100 km, temperature difference −2 to 2°C. These three parameters were less favourable and system did not intensify. This trend was observed about 48 hours before the stage of depression.

TABLE 1

Elements	Significant value	1982		1986	
		Arabian Sea	Bay of Bengal	Arabian Sea	Bay of Bengal
Vertical wind shear (850-200 hPa)	Below 15 kt	10 to 15 kt	>30 kt	>25 kt	10 to 15 kt
Longitudinal variation of *U*-comp/100 km at 850 hPa	Higher negative value	−15 to −20 kt	3 to 7 kt	For both around −15 kt however initially Bay was having higher cyclonic shear	
Longitudinal variation of *V*-comp/100 km at 850 hPa	Higher negative value	For both the systems about −3 kt		Around −3 kt	around −10 kt
Relative humidity (850-500 hPa)	More than 75%	For both 75 to 80%		For both 75 to 80%	
Mixing ratio (1000-700 hPa)	More than 8 gm/kg	For both around 9 gm/kg		Around 9 gm/kg for both	
Temperature difference at 500 hPa	Higher positive value	2 to 3°C	1 to −10°C	−2 to 2°C	1 to 4°C
θ_e gradient (1000-700 hPa)	Higher positive value	17 to 30°C	7 to 17°C	for both 15 to 25°C	
$P_{24} P_{24}$	−5 hPa/day	could not trace		−2 to −4 hPa/day	−3 to −7 hPa/day

4.2. Study of surface pressure field also showed that there has been a significant change in pressure field along east coast from 7 November 1986 morning when Bay system was intensifying into depression and both the system were locating roughly at a same distance from coast. From 7 November onwards 24 hours pressure changes (pressure departure) (hPa) along east coast were −4.5(−6), −7.3(−7), −3(−8), 0(−7), and these figures for west coast were −2(−5), −4(−5), −3(−6), −0(−5). In case of 1982, this feature could not be traced. It is, because, Bay system itself was weak and subsequently dissipated. Arabian Sea system though it was intensifying, at the same time it was moving away from coast.

5. This study tends to indicate that when a pair of low pressure system is close to the coasts, dynamic and thermodynamic parameters computed from the observations of coastal stations may provide clue to assess which of the two systems is likely to intensify into a cyclonic storm with a lead time of about 48 hours in advance. Among these parameters (*i*) vertical wind shear and (*ii*) temperature difference at 500 hPa are more reliable as in both the cases, these two were observed to be more favourable for the system that intensified into cyclonic storm.

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