Indian J. Met. Geophys. (1971), 22, 193-196.

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A note on the movement of storms and depressions in the Bay of Bengal during October and November

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(*Received 17 December 1969*)

ABSTRACT. The October-November storms and depressions of the period 1950-1968 in the Bay of Bengal have been classified into three distinct classes based on their tracks. Certain distinct synoptic features associated with each of these classes as observed at the time of formation of the depression or storm in the Bay, in extended charts covering the Indian region and West Pacific Ocean west of 150°E have been listed and their validity in individual cases examined.

1. Introduction

In a study of the October and November storms of the period 1950-1968, the author found that the storm tracks in the Bay of Bengal could be classified into three distinct classes and each class could be associated with certain recognisable synoptic features (as seen in extended charts covering the Indian region and West Pacific Ocean west of 150°E) at the time of formation of depression or storm in the Bay of Bengal. It appears from the study that these synoptic features give certain possible clues, in the climatological sense, to the future movement of the depression or storm. In view of their possible utility to the forecaster, the results are reported here briefly. The synoptic associations presented below have been chosen after examining a large number of depression and storm charts for the existence of possible common features. In this sense the association with remote regions of the Pacific may be considered as justified.

2. Method of analysis

The tracks of the storms and depressions of October and November during the 19-year period mentioned above were grouped under the following three different classes.

Class A — Storms or depressions which have their origin in the southeast Bay and adjoining Andaman Sea and which move more or less WNW and strike the Tamil Nadu coast south of Lat. 15°N.

Class B — Those that initially move NW or WNW, recurve in the vicinity of latitude 15°N and strike the East Pakistan or Burma coast.

Class C — Those that move sometimes irregularly but have an effective northwest motion and strike the north Andhra or Orissa coast.

The synoptic situations associated with each of the three above classes *at the time of formation of the storm or depression in the Bay* (The charts of the Japan Meteorological Agency, Thailand Met. Service and Vietnam Met. Service were examined in this connection, in addition to the charts of Indian Ocean and Southern Hemisphere Analysis Centre and Weather Central, Poona) are found to be as follows —

Class A

(1) There is storm activity in the Pacific. A typhoon or a storm or depression is moving WNW and is crossing or has crossed Philippines round about 15°N and is moving into the China Sea; or a depression is moving westwards in the China Sea.

Note—Sometimes a typhoon or storm in the Pacific is seen moving WNW near 10° N in the longitude belt 130°-145°E. These cases occurred during the period 1930-1950.

(2) Easterlies (zonal component) of 10-20 kt appear over extreme south peninsula (Madras and south) at 500 mb (5·4 km a.s.l.) and there is practically no change in the direction of these winds between 3·6 and 5·4 km a.s.l.

Class B

(1) There is no activity in the Pacific nor is there a depression in the China Sea; or a typhoon or storm is recurving northeastwards east of Philippines.

TABLE 1

Dates of storm/ depression	Synoptic situation in the Pacific on the day of formation of storm/ depression in the Bay	Synoptic situation in the extreme south Peninsula (Madras and south) in relevant cases on the day of formation of depression/storm	Class to which storm/depression belongs		Evaluation of the criteria	Remarks
			Predicted	Actual		
16-29 Nov 1950	No storm	—	B	B	Fully satisfied	A trough in the westerlies at 500 mb affecting West Pakistan and neighbourhood
26-30 Nov 1952	A typhoon moving NW across Luzon	Easterlies (zonal component) more than 10 kt at 500 mb. No appreciable shear in wind direction between 3·6 and 5·4 km a.s.l.	Probably A	A	Partly satisfied	For complete fulfilment of the criteria movement of the typhoon has to be WNW
8-12 Nov 1952	No storm	—	B	B	Fully satisfied	
4-8 Nov 1953	Do.	—	B	C	Not satisfied	The system weakened in the sea itself
21-22 Oct 1953	Do.	—	B	C	Partly satisfied	The system was a shallow depression about 300 km from the coast on 21st and weakened as soon as it crossed coast
23-26 Nov 1953	No storm in the Pacific. Probably a depression is present in the China Sea	Easterlies of more than 10 kt at 500 mb. No appreciable shear in wind directions between 3·6 and 5·4 km a.s.l.	A	A	Fully satisfied	
20-22 Oct 1954	A depression crossed Philippines and weakened into a low	Do.	A	A	Do.	
29 Nov -1 Dec 1955	A storm moving WNW is crossing Philippines	Do.	A	A	Do.	
4-7 Nov 1955	No storm	—	B	B	Do.	
6-13 Oct 1955	A number of depressions present. One of them later became a recurving typhoon.	—	C	C	Do.	
19-20 Nov 1956	A typhoon crossed Philippines and is moving W	Winds not available.	A	A	Partly satisfied	Winds were not available. System weak
26-30 Oct 1956	A typhoon is moving west towards North Vietnam coast	Easterlies of more than 10 kt at 500 mb. No appreciable shear in wind direction between 3·6 and 5·4 km a.s.l.	A	C	Not satisfied	
6-16 Oct 1958	Depression moving west in the China Sea	Do.	A	A	Fully satisfied	
18-29 Nov 1958	A depression in the China Sea moving W on the 19th	Easterlies of more than 10 kt present on the 19 November. No appreciable shear in wind direction between 3·6 and 5·4 km a.s.l.	A on 19th	A	Partly satisfied	The criteria were satisfied on the 19th
27-30 Oct 1959	No storm	—	B	B	Fully satisfied	
28-31 Oct 1960	Do.	—	B	B	Do.	

TABLE 1 (*contd*)

Dates of storm/ depression	Synoptic situation in the Pacific on the day of formation of storm/depression in the Bay	Synoptic situation in the extreme south Peninsula (Madras and south) in relevant cases on the day of formation of depression/storm	Class to which storm/depression belongs		Evaluation of the criteria	Remarks
			Predicted	Actual		
19-20 Nov 1960	No storm	Easterlies of more than 10 kt not present	B	A	Not satisfied	Depression was too near the coast. It crossed coast and weakened
26-31 Oct 1962	A typhoon recurved east of Philippines and was moving NE	—	B	B	Fully satisfied	
26-29 Nov 1962	Typhoon moving W crossing Philippines	Easterlies of more than 10 kt present. No appreciable shear in wind direction between 3·6 and 5·4 km a.s.l.	A	A	Do.	
19-28 Oct 1963	A typhoon had recurved east of Philippines	Easterlies averaged over 3·6-5·4 kms were 10 kt on 19th and 20 kt on 20th over east coast at the same latitude as that of storm	B	B	Partly satisfied	The storm struck coast and recurved. The wind criterion was satisfied only on the 20th
3-8 Nov 1964	Storm moving W towards South Vietnam coast	Easterlies of more than 10 kt at 500 mb. No appreciable shear in wind direction between 3·6-5·4 km a.s.l.	A	A	Fully satisfied	
17-21 Oct 1964	No storm	Easterlies of 15 kt present over the coast at the same latitude as the storm averaged over the levels 3·6 to 5·4 km a.s.l.	B	B	Do.	The depression formed north of 15° N, crossed coast and recurved
21-25 Oct 1965	Do.	—	B	B	Do.	
11-13 Nov 1966	A typhoon moving W across Philippines	Easterlies of more than 10 kt at 500 mb. No appreciable shear in wind direction between 3·6 and 5·4 km a.s.l.	A	A	Do.	
8-13 Nov 1966	Depression moving W in China Sea	Do.	A	A	Do.	The storm recurved in the Arabian Sea
18-22 Nov 1966	A typhoon moving WNW across Philippines	Easterlies not present	C	C	Do.	Second criterion of A class storms not satisfied. There fore belongs to C
25-30 Nov 1966	Storm moving in China Sea	A circulation present over south Peninsula in lower tropospheric levels. Shear present in wind direction between 3·6 & 5·4 km a.s.l. However, criterion satisfied at 12 GMT of same day	A	A	Do.	
20-23 Oct 1967	Typhoon moving NW recurved on the 21st	—	B on 21st	B	Partly satisfied	The criterion was satisfied only on 21st
21-27 Oct 1968	Two typhoons present in the Pacific	—	C	C	Fully satisfied	
9-15 Nov 1968	No storm	—	B	B	Do.	
2-5 Nov 1968	Two storms present in the Pacific	Easterlies not present	C	A	Not satisfied	This would have normally belonged to class C. It is probable that the appearance of a well marked low extending up to 500 mb over south Peninsula was responsible for its departure from class C

TABLE 2

Table showing the performance of the technique

No. of cases studied	No. belonging t class			No. of success in class		
	A	B	C	A	B	C
31	14	11	6	12(3)*	11(2)*	3

* The number in brackets indicates cases of partial success

(2) A trough in the westerlies, moving eastwards is affecting the northern latitudes (north of 30°N) of India. [Condition (2) is not always satisfied and should, therefore, be considered only as an additional feature, not an essential one].

Note—If the zonal component of the easterlies over the east coast of the Peninsula averaged over the levels 3·6-5·4 km a. s. l. are 15 kt or above at the latitude of the storm or if the depression /storm forms within about 300 km of the coast the storm is likely to hit the coast and then recurve.

Class C

(1) A typhoon or storm is moving NW and is heading towards east China coast (round 25° Lat.) or (2) more than one storm or depression is present in the Pacific, one tending to recurve and the other tending to move in some westward direction, or (3) A storm in the Bay satisfies the first criterion of Class A but not the second criterion.

3. Results and discussion

Applying the above criteria to the individual depressions/storms of the period under study (1950-1968), it was possible to predict at the time of formation in the Bay, the Class (A, B or C) to which it would belong and, therefore, guess the track which it is likely to follow on the subsequent days. By comparing the guessed track with the actual one, we can examine the validity of the criteria evolved in the previous paragraphs. Table 1 gives the details of the depressions/storms of the period under study, the synoptic features associated with them and the predicted and the actual track. An evaluation of the criteria is also given. From the table it is seen that in 21 out of 31 cases our criteria were fully satisfied, in 6 they were partly satisfied and in 4 only, they were not satisfied. The cases in which the criteria were partly satisfied include those where the prediction of the track was possible only on the second day. A closer examination of the entries in the table for cases where the ceriteria were either partly satisfied or not satisfied seems to show that a radical revision of the criteria enunciated by us may not be called for to account for these cases. We are, therefore, of the opinion that our results are climatologically significant.

We have summarised in Table 2 the performance of the technique evolved, separately for each class. From this table it would appear that the percentage of successes in class C is not high.

4. Conclusions

The implication of what is discussed in the previous paragraph is that if the suggested technique covered the majority of cases, it should become possible on the very first day a depression forms in the Bay of Bengal, to lay down the entire life history of its track which may last 2 to 3 days or even longer. This of course would be an oversimplification of an admittedly difficult problem, and no claim is made here that such a marked degree of success would be within the reach of the technique. The suggested method needs repeated testing and minor modifications may have to be made in the light of future experience. All that we may say at the present stage is that the classification of the depressions and storms as discussed above may help in the foreshadowing of the probable latitude at which the system will strike the east coast.

A few words about the possible reasons for the observed association between Pacific systems and the Bay systems may not be out of place here. It is well known that the flow patterns in the upper levels in middle and sub-tropical latitudes do influence the movement of cyclonic storms. It is likely that the trough ridge pattern in middle and sub-tropical latitudes in our longitudes is influenced by what is happening in the same latitudes in the West Pacific longitudes and, therefore, there is an association between the movements of co-existing storms in the Bay and in the West Pacific. This is only a possibility and may be that there are other dynamic factors which are responsible for the observed association.

Acknowledgements

The author conveys his sincere thanks to Shri S. Majumdar, Director, Indian Ocean and Southern Hemisphere Analysis Centre, Poona who went through the manuscript and offered valuable suggestions.

REFERENCE

India met. Dep. 1964 *Tracks of storms and Depressions in the Bay of Bengal and Arabian Sea*, 1877-1960.