

## Letters to the Editor

551.542 : 551.515.82 (547) "1964"

### EXAMINATION OF STATEMENT OF DIXIT AND JONES ABOUT THE GUJARAT LOW CHANGING FROM A COLD-CORE TO A WARM-CORE TROPICAL CYCLONE DURING 2-8 AUGUST 1964

Dixit and Jones (1965) have stated that the Gujarat low can change from a cold-core cell to a warm-core tropical depression similar to the Kona storm in the eastern Pacific. "A striking example of such occurrence was the apparent transformation of the cold-core mid-tropospheric Gujarat low of 2-8 August 1964 into a warm core tropical cyclone in the vicinity of Bombay. Initially appearing at the 500 mb and 700 mb levels early in the time period (located just off the west coast between 15°-20° N), and overlying strong lower tropospheric southwesterlies, this cyclonic cell was likely the principal cause of heavy rainfall along the central west coast. As the cell extended downward to the 850-mb level on 4 August and to the surface on 6 August, rainfall maxima and squalliness became concentrated nearer the surface low pressure centre as it passed close aboard the city of Bombay. Here, at this time, surface easterly winds gusted to 70 km per hour early on the 7th, slackened to 10 km per hour from the south and for the following period of six hours averaged 60 km per hour from the southwest with gusts to 100 km per hour. The slope of this system in contrast to the usual equatorward one of the mid-tropospheric Gujarat low, was nearly vertical, and the surface pressure fall was rapid and much below normal. The areal extent of the Gujarat surface low, scarcely larger than a meso-scale phenomenon, in contrast to macro-scale dimensions at the 500 mb level (with the resultant geometrical configuration of an inverted cone), is antonymous to the tropical cyclones of the western Pacific and Atlantic Oceans, where storm dimensions are much larger in the lower than in the upper troposphere".

It is proposed to discuss the above statements with reference to the synoptic charts for the days which the author has examined. Rao, Srinivasan, Ramakrishnan and Raman (1970) have given upper winds for 00 GMT for 2 August 1964 and 03 GMT

surface and 00 GMT upper winds charts for 3 to 8 August in Figs. 3.1 to 3.13 of their paper. Although their upper air charts do not contain data west of Bombay-Ahmedabad line and the surface charts do not contain data for northeast Arabian Sea they are useful and the discussion below is based on those charts as well as 12 GMT charts for the period 1 to 8 August 1964 examined by the author.

(1) From an examination of the charts it is seen that a trough moved from off Konkan northwards upto the 3rd (Figs. 3.2 and 3.3 of Rao *et al.*). At 03 GMT of the 4th the trough persisted across Saurashtra, Kutch and lower Sind at the surface as on the 3rd and it extended upto 850 mb; the trough at 700 and 500 mb was further south and weak, as judged from Ahmedabad and Bombay upper winds (Figs. 3.4 and 3.5 of Rao *et al.*). The rainfall during the period was controlled by the movement of the trough off Konkan and the weather situation developing in the northwest Bay of Bengal. There was no cold-cored Gujarat low. Thus the statement of Dixit and Jones that the cold-cored mid-tropospheric Gujarat low initially appeared at 500 mb and 700-mb levels located just off the west coast between Lat. 15° and 20°N early in the period 2-8 August, is *not* correct.

(2) On the 5th at 03 GMT the trough at the surface across Saurashtra had extended southeastwards to off north Konkan; there was also a trough off Konkan at 500 mb (Figs. 3.6 and 3.7 of Rao, *et al.*). At 12 GMT of the day there was also a trough off north Konkan at 850, 700, 600 and 500 mb. This trough showed signs of concentrating into a depression at the surface off north-Konkan-south Saurashtra at 03 GMT of the 6th and the circulation extended even to 850 and 700 mb although at 500 mb there would not appear any circulation (Figs. 3.8 and 3.9 of Rao *et al.*); at 12 GMT the cyclonic circulation off Konkan was better defined upto 700 mb, but at 600 mb there was no trough off the coast and at 500 mb there was a trough over the north Peninsula with east-west axis between Lats. 18° and 17°N. The easterly air flow in association with the depressions in northwest Bay had moved considerably westwards and had reached Gujarat at 850 mb and above on the 6th (Figs. 3.8 and 3.9 of Rao, *et al.*)

and had reached that area below 850 mb by the 7th morning (Figs. 3·10 and 3·11 of Rao, *et al.*).

Under the combined influence of developments off Konkan and depression in the northwest Bay centred near Lat. 19°N, Long. 86·5° E, widespread rain fell between the 5th and 6th mornings on the west coast and over the area extending from Balasore and Musulipatam on the east coast to a line from Chanda to Jubbulpore (Fig. 3·8 of Rao, *et al.*). In view of what has been stated above it is clear that the statement of Dixit and Jones that the Gujarat cell extended downwards to 850-mb level on the 4th and to the surface on the 6th is *not* correct; the trough was there even earlier at the surface farther northwestwards and had extended southwards to off north Konkan by the 5th morning (Figs. 3·4, 3·5 and 3·6 of Rao, *et al.*) where it showed signs of concentrating into a depression on the 6th (Fig. 3·8).

(3) By 03 GMT of the 7th there was a depression, probably a cyclonic storm of small extent, off Konkan with centre about 125 km westsouthwest of Bombay and the circulation extended to about 600 mb (Figs. 3·10 and 3·11 of Rao *et al.*), while at 500 mb there was probably only a trough off the south Konkan coast, the circulation being displaced southwards with height. The Bay depression had become an elongated trough after entering inland. In association with the two low systems widespread and locally heavy rain fell on the west coast of the Peninsula and in the interior as far north as about Lat. 23°N (Fig. 3·10 of Rao, *et al.*).

From the description of winds at Bombay given by Dixit and Jones it would appear that there was a cyclone of very small extent off Bombay between the morning and evening with central area of light winds surrounded by a core of strong winds. The vortex moved northwards in the course of the day and at 12 GMT, it was centred about 80 km westnorthwest of Bombay. In the absence of observations in the upper air over sea it is not possible to say if the vortex extended above 700 mb, its extension being only upto about 600 mb even in the morning.

The cyclone off Bombay weakened rapidly while moving northnorthwestwards and lay as a low pressure area over Saurashtra at 03 GMT of the 8th (Fig. 3·12 of Rao, *et al.*); there was a trough in the upper air with axis between Ahmedabad and Bombay at 850 and 700 mb but at 500 mb the trough was off Konkan (Fig. 3·13 of Rao, *et al.*). It will appear from rainfall charts between 6th and 7th and 7th and 8th given in Figs. 3·10 and 3·12 respectively of Rao, *et al.*, that rainfall on the west coast had decreased considerably during the

latter 24 hours, particularly between Lats. 15° and 18°N; but at Alibag, Colaba, Santacruz and Dahanu 2, 2, light and 2 cm rain was recorded on the 7th morning and light, 4, 6 and 6 cm respectively on the 8th morning, the increase in rainfall on the 8th being due to increase in the westerly component of winds over the area with the cyclone moving northnorthwestwards (compare Figs. 3·11 and 3·13 of Rao, *et al.*).

By 12 GMT of the 8th the low pressure area over Saurashtra had moved northwestwards and was located at the surface off west Saurashtra and Kutch. There was a trough circulation over Saurashtra and adjoining northeast Arabian Sea at 850 mb, while there was a trough axis across the country along about Lat. 21°N at 700 mb; there was cyclonic circulation over northwest of the Peninsula at 500 mb.

From an examination of the day-to-day charts it is seen that by the 7th morning the easterly air from the Bay side had spread to Saurashtra side right from the surface to 500 mb and there might not be any continental air in the disturbance field on the 7th. Thus on the 7th there were the westerly and easterly moist air masses in the disturbance field off north Konkan as is usually the case in the depressions at the head of the Bay during the monsoon months. This has led Dixit and Jones to state that the disturbance off Bombay on the 7th was a warm-cored tropical cyclone like warm-cored depressions over the north Bay moving west or northwestwards. In contrast the cyclonic vortex off Bombay from the 2 to 4 July, 1963 had no easterly air from Bay side at any level upto 500 mb (Desai, 1970 a), the easterly winds being the westerly winds which had backed under the pressure pattern and also the influence of the Western Ghats; in that disturbance there were also two air masses, but the second air mass was continental instead of the easterly moist one from the Bay. As stated by Desai (1970 a) the temperature and wind distribution can be understood if one takes into account the nature of air masses involved and the lapse rates in them. When the second air mass is the continental one, its temperature is higher than that of the westerly moist air mass at the surface but the latter becomes warmer than the former above a certain level—the reversal level; when the second air mass is the easterly moist air its temperature is higher than that of the westerly moist current at all levels upto 500 mb.

In view of what has been stated above the statement of Dixit and Jones about transformation of the cold-cored Gujarat low of 2-8 August, 1964 into a warm-cored tropical cyclone on the 7th in the vicinity of Bombay, is *not* correct. If they had considered the nature of air masses in the

system from the surface upto 500 mb on different days as in this note, it is felt that they would have come to a different conclusion. It has also been shown by Desai (1970 b), that the streamlines analyses and conclusions of Dixit and Jones (1965) about active and weak monsoon conditions are *not* tenable.

The nature of the air masses involved in the monsoon depressions and cyclones in the northeast

Arabian Sea is usually such that it is not correct to compare them with the tropical cyclones in the Pacific and Atlantic Oceans as in the latter case there is no presence of continental air which is hottest at the surface but which becomes colder than the moist air above a certain level—reversal level as a result of a difference in the lapse rates in the two air masses. Such conditions have also been observed by Desai (1967) in the Arabian Sea cyclone of 20-29 May 1963.

173, Swami Vivekananda Road,  
Vile Parle (West), Bombay-56.  
August 5, 1970

B. N. DESAI

## REFERENCES

- |   |        |   |
|---|--------|---|
| Desai, B. N.  | 1967   | <i>Indian J. Met. Geophys.</i> , <b>18</b> , pp. 61-68.   |
|   | 1970 a | <i>Ibid.</i> , <b>21</b> , pp. 71-78.   |
|   | 1970 b | <i>Ibid.</i> , <b>21</b> , pp. 421-432.   |
| Dixit, C. M. and Jones, D. R.                                 | 1965   | Kinematic and dynamical study of active and weak monsoon conditions during June-July 1964; Report from I. M. C. Bombay. |
| Rao, Y. P., Srinivasan, V., Ramakrishnan, A. R. and Raman, S. | 1970   | FMU. Rep. No. III-3·2, India met. Dep.  |