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Intensification of a low pressure area over Assam valley and some of its meteorological features

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ABSTRACT. A low pressure area which intensified into a meso-scale depression and crossed Assam valley during 18 and 19 June 1968 has been described. Its surface and upper air structure, movement and associated synoptic situation have been discussed. Probable causes of its intensification, recurvature and weakening afterwards have also been discussed.

1. Introduction

Under favourable synoptic conditions small scale but intense low pressure systems, often form in Indian regions and cause copious rainfall in surrounding areas. But it becomes difficult to assess their intensities and surface structures as very often they do not pass over observatories equipped with autographic and other sophisticated instruments during the course of their movement.

In June 1968, one such system moved across the Assam valley and happened to pass close to Gauhati and Tezpur. From the autographic records and meteorological reports of Gauhati an assessment of intensity, surface structure, rates of movement and other characteristic features of this intense low, bordering to a meso-scale depression have been made and presented in this study.

2. Description

A low pressure area developed over Gangetic West Bengal on the morning of 18 June 1968. The low first moved towards north and then towards northeast. In the morning of 19 June 1968, the low pressure area intensified into a meso-scale depression and at 0830 IST it lay centred close to Gauhati (Fig. 1). It quickly moved away northeastwards and lost its identity.

3. Structure of the system

3.1. *Surface wind pattern* — From the current weather observations of Gauhati and Tezpur for 19 June (Table 1), it may be seen that the surface wind speed at Gauhati increased gradually from 10 kt at 00 IST to 35 kt in gusts at about 0700 IST and became calm by noon. Direction of the surface wind changed from easterly to southeasterly around 0600 IST. On the other hand, the surface wind at Tezpur rose to its maximum of 28 kt in gusts at about 1130 IST and continued so upto 1600 IST before decreasing to calm by the evening. Wind direction changed from easterly to southwesterly around 1300 IST.

From the surface wind pattern of Gauhati and Tezpur it may be concluded that some intense low pressure system has passed across Gauhati and Tezpur that day, *i.e.*, on 19 June 1968.

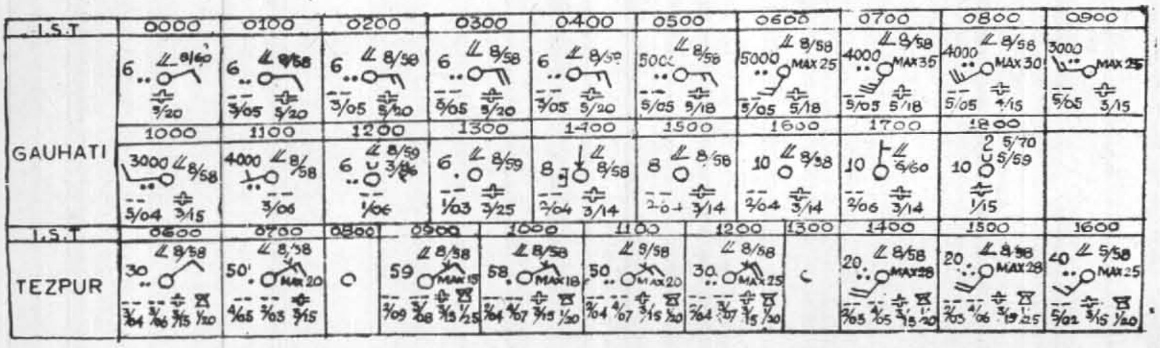
3.2. *Precipitation* — Rainfall was widespread over the sub-Himalayan West Bengal and Assam with scattered heavy to very heavy falls over Assam on 19 June 1968 (Fig. 2). The rainfall over the Gangetic West Bengal on the other hand decreased considerably where, it was widespread with isolated heavy rain on earlier day. On 20 June 1968 the precipitation belt moved further northeast.

3.3. *Speed of the system* — From the surface wind shift shown in Table 1, it appears that the system had crossed Gauhati and Tezpur at about 0530 and 1300 IST respectively on 19 June, covering a distance of 120 km (Gauhati-Tezpur) roughly in $7\frac{1}{2}$ hours. Thus the speed of the system works out approximately as 16 kmph. The speed of the system thus calculated is comparable with the speed of movement of similar deep systems.

3.4. *Surface structure* — From the records of microbarograph, thermograph, hygrograph and hyetograph of Gauhati from 0200 to 0800 IST on 19 June 1968 (Fig. 3), it can be seen that in association with the passage of the intense low

TABLE 1

Current weather observation of Gauhati and Tezpur on 19 June 1968



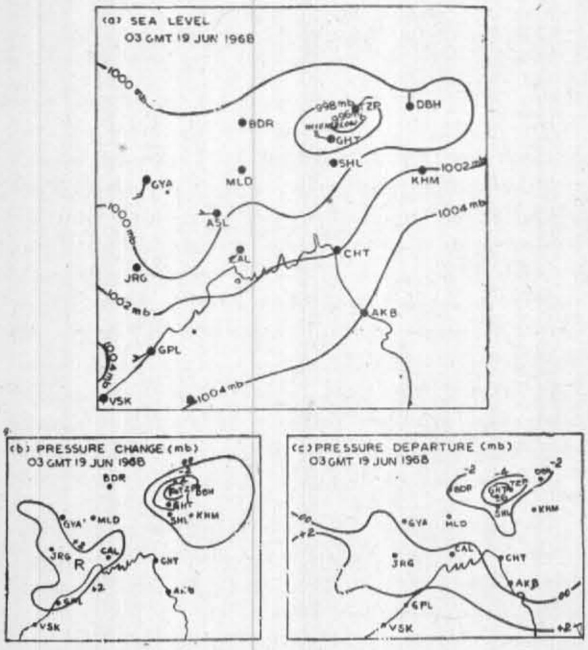


Fig. 1. Charts depicting (a) Sea level pressure distribution, (b) Pressure change (mb) and (c) Pressure departure at 0300 GMT on 19 June 1968

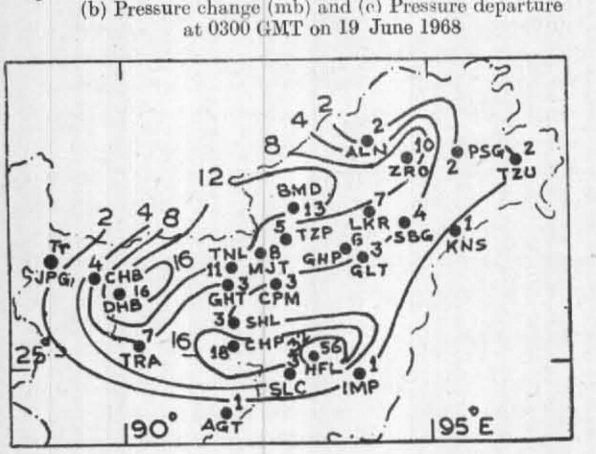


Fig. 2. Rainfall distribution at 03 GMT on 19 June 1968

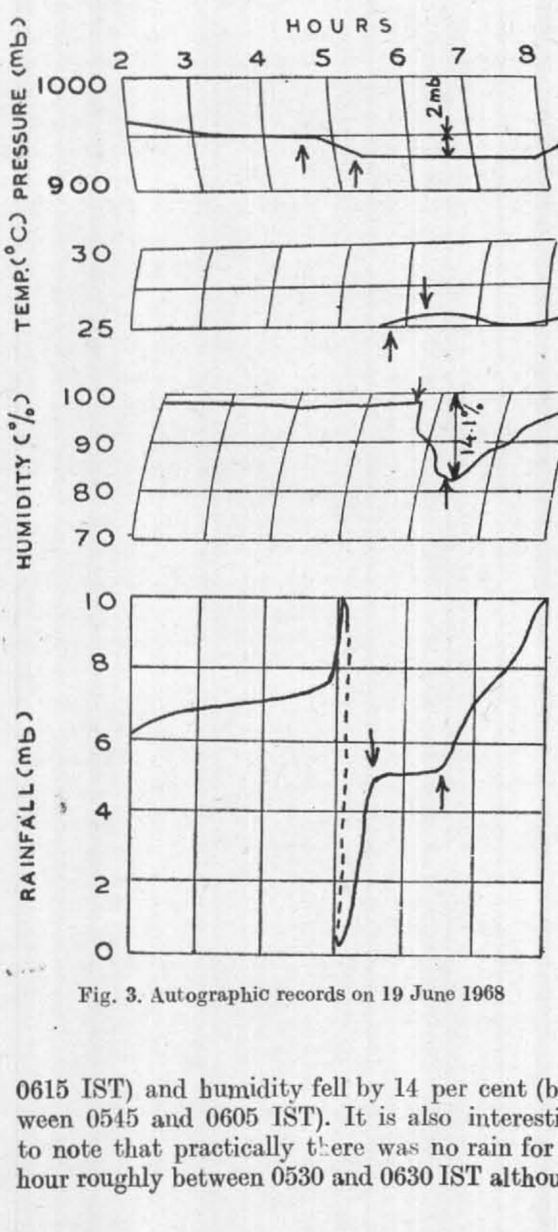


Fig. 3. Autographic records on 19 June 1968

pressure system (bordering a meso-scale depression) in close vicinity of Gauhati, the pressure fell by about 2 mb (between 0430 and 0515 IST), the temperature rose by 1°C (between 0545 and 0615 IST) and humidity fell by 14 per cent (between 0545 and 0605 IST). It is also interesting to note that practically there was no rain for an hour roughly between 0530 and 0630 IST although

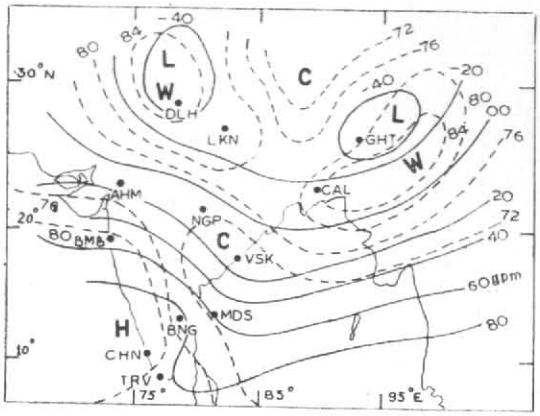


Fig. 4. 1000 mb contours and 1000-500 mb thickness pattern at 00 GMT on 19 June 1968. Thickness value plotted below contour value. Solid lines contours (in gpm), Dashed line of thickness values in gpm, thousands figures omitted

there was quite intense rain just before and after the above period. The above characteristic features of the system apparently show close resemblance to those associated with inner core of the tropical disturbances. Since an 'eye' is practically an un-expected proposition for the system described here, the rise in temperature and fall in relative humidity might be due to down-draft from mountain ranges (Riehl 1954). The case study thus reveals probably a rarely documented surface structure of a meso-scale depression close to a mountain range.

3.5. *Upper air thermal structure* — Monsoon depression are known to be cold cored. Koteswaram and George (1958) studied the thermal structure of a typical monsoon depression and found warm advection ahead and cold advection in the rear. Keshavamurty (1972) observed that monsoon depressions are neither cold nor warm cored but have considerable thermal advection associated with them. The present case study shows interesting similarity with the above findings. There was considerable warm advection ahead and cold advection on the rear of the system (judged from the thickness pattern —Fig. 4) on 19 June 1968 when the system was quite intense and close to Gauhati. Temperature patterns of standard pressure surfaces at Gauhati for 00 GMT of 18, 19 and 20 June 1968 (Fig. 4) also suggest considerable warming in all the levels on the morning of 19 June when the system was very close to Gauhati. Rai Sircar (1956) has documented similar temperature structure for some of the depressions and cyclonic storms of Bay of Bengal with the help of a single station Calcutta data.

4. Intensification

Upper air divergence is a common occurrence in advance of the trough in middle and upper troposphere (Petterssen 1956). On 18 and 19 June 1968 there was an upper air trough in westerlies west of Gauhati and to the west of the surface low (Fig. 6, position A). There was almost in-phase superposition of upper air divergence ahead of the trough in westerlies with the surface low close to Gauhati on the morning of 19 June. Probably this is one of the reasons for its intensification over this area. The heights of standard pressure surface at Gauhati for 00 GMT of 18, 19 and 20 June 1968 (Fig. 7) also support this view. Rai Sircar (1956) had observed similar height patterns of standard pressure surfaces at Calcutta in association with the depressions and cyclonic storms in Bay of Bengal.

In the month of June and July this part of the country gets rain almost everyday. On these days, rivers and rivulets flowing across the valley generally get overflooded. Due to the typical shape and very little slope of the valley, during the spells of heavy rain, water gets accumulated and stretched into the valley virtually turning it into a topographically bound sea in miniature. Thus the moisture and sensible heat which are basically required for the growth and maintenance of the life of a depression were also available in plenty in the valley on that day. Added low level friction, because of the hilly terrain all around the valley, with strong surface winds also favoured intensification by generating vertical velocity.

5. Recurvature

Generally during June, storms, depressions or lows move along the seasonal trough line towards northwest. Sometimes in this month they recurve towards northeast after crossing West Bengal-Bangladesh coast, and strike the Shillong-Burma hills. Monsoon depressions or lows entering the valley is however rarely seen. In fact no similar case is available on record. In that respect the track of the system considered here was abnormal.

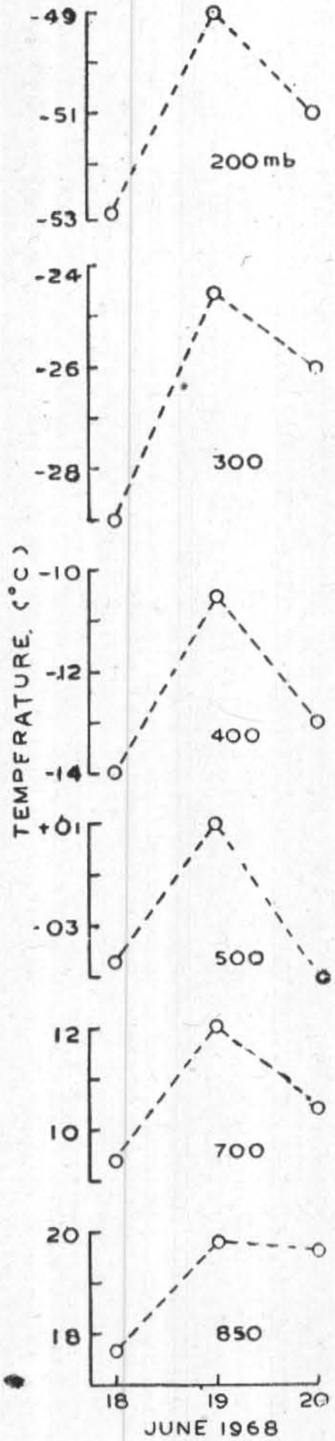


Fig. 5. Upper air temperature patterns at Gauhati for the period 18-20 June 1968

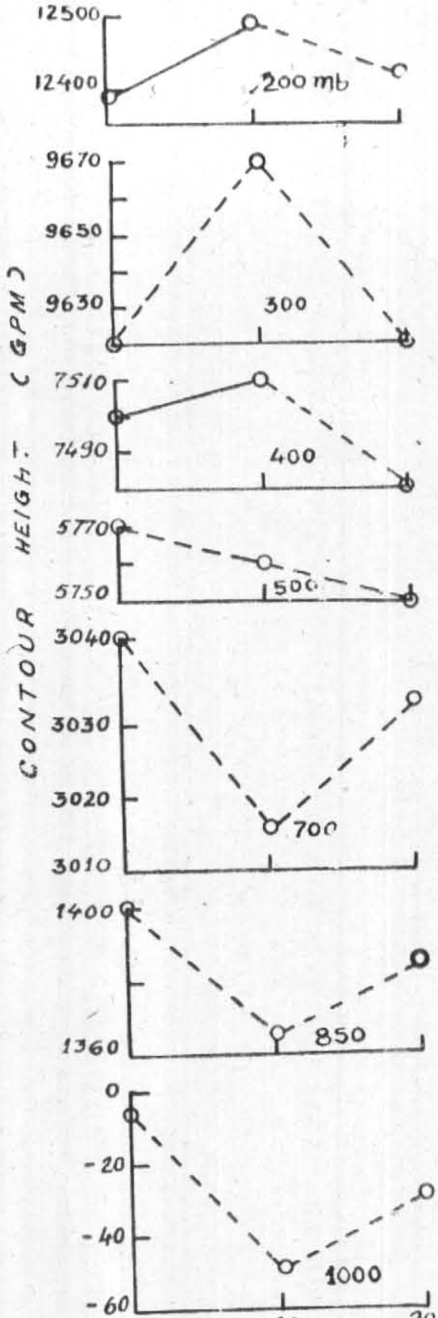


Fig. 6. Heights of standard pressure surfaces for the period 18-20 June 1968

It is a well known fact that middle latitude influences determine recurvature of tropical disturbances (Riehl 1954, Sen 1959). This is particularly true, when the low level system and the upper level trough are sufficiently near (Desai and Rao 1954). The system might have recurved from north to east due to the upper tropospheric westerly trough (Fig. 6) to the west but close to the system. Moreover thickness patterns (Fig. 4) also justify its movement from north to east from the region of cold advection to the region of warm advection.

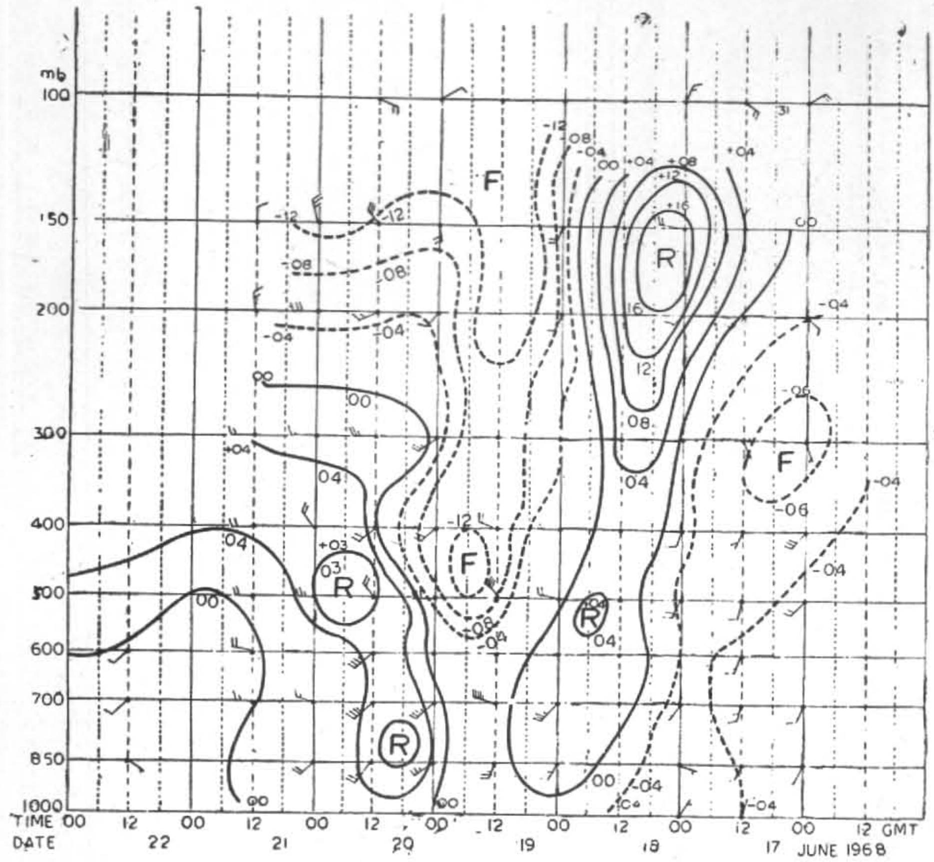


Fig. 7. Vertical time-section of winds and changes of heights over Gauhati for the period 17 to 23 June 1968
Solid lines : Rises (R); Dashed lines : Falls (F)

6. Weakening

Towards the evening of the same day (19 June 1968) upper tropospheric conditions changed considerably and were no longer favourable for the intensification. Moreover its exit from the topographically bound limited area of moisture source might have also contributed for the rapid weakning of the system.

7. Conclusions

(*a*) The meso-scale depression which happened to pass close to Gauhati equipped with radiosonde and autographic instruments has revealed porbably a rarely documented surface structure of a meso-scale depression close to a mountain range.

(*b*) The system had considerable warm advection associated with it.

(*c*) Upper air divergence played a definite role in its intensification.

(*d*) The topographically bound surface water had also contributed to its intensification.

Acknowledgement

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