

## Letters to the Editor

### 551·577·37(541·4) 1967.09 EXCEPTIONALLY HEAVY RAINS IN AND AROUND PATNA CITY IN SEPTEMBER 1967 : A CASE STUDY OF MID-TROPOSPHERIC INTERACTION BETWEEN AN EASTERLY WAVE AND A WESTERLY WAVE

1. Exceptionally heavy rain in a very small area of about 150 km radius around Patna (Bihar) occurred during 19-20 September 1967. Patna City recorded a rainfall of 36 cm on the morning of 20th and Patna Airport recorded 27 cm. Press reports indicated similar heavy falls in the neighbouring suburbs and Tehsils, and a break in the embankment of the river *Punpun*, about 25 km east of Patna, bringing in devastating floods in Patna City and neighbourhood and paralysing life and activity in this part of the State.

2. The observation on the actual rainfall over Bihar State and neighbouring areas for the period 16 to 21 indicated a small core of heavy rainfall in the extreme SW sector of West Bengal on 16th morning, which shifted slowly north-northeastwards to eastern Bihar Plateau by 18th morning and weakened. By 19th morning this core suddenly shifted northwest close to Patna, intensified and remained stationary for next 24 hours. On 21st morning it weakened appreciably and moved north.

Fig. 1 shows rainfall at representative stations of Bihar for the 5-day period 17 to 21 September 1967. The sudden appearance of a very heavy rainfall core of meso-extent over Patna on the 19th and its enormous increase on the 20th decreasing rapidly by 21st can be seen. The past weather charts for the period 17th to 21st, when examined show, that there had been hardly any thunderstorm activity in and around the meso-area of Bihar under consideration, during the period 18th to 20th but for the continuous heavy rains insuing from a thick altostratus cum Nimbus deck.

3. In the surface charts from 14th onwards, the significant feature had been the orientation of the monsoon trough, northwest-southeast, from NW India to the Bay of Bengal, where on the 15th a low from the northwest angle of the Bay

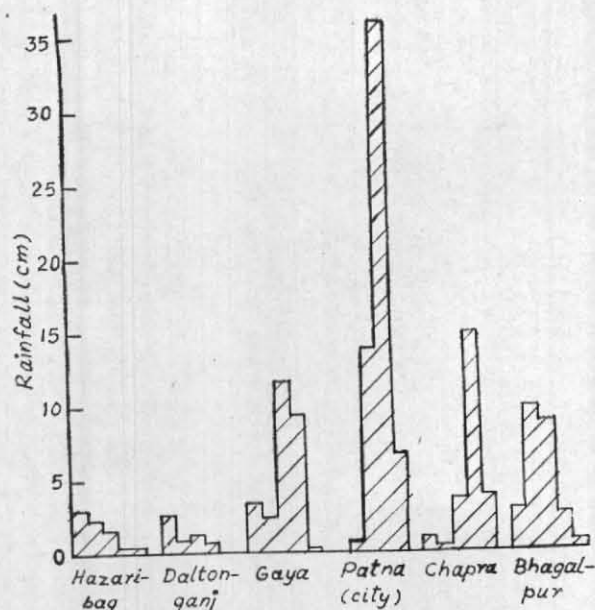


Fig. 1. Histograms of representative stations in Bihar Plains and Bihar Plateau for the 5-day period 17 to 21 Sep 1967

entered inland, moved northwest as a surface low with lower tropospheric cyclonic circulation forming over central Bihar by the 18th. On 19th, this low got suddenly accentuated and a depression of small extent formed around Patna City (Fig. 2). On 20th this meso-depression moved slightly northwest and weakened abruptly to a low pressure area. The associated heavy rainfall in the small area corresponded to the life span of the said meso-depression only. It, therefore, occurred how a surface low could be activated to such an extent, so suddenly and rapidly towards a meso-depression causing exceptionally heavy rainfall in the small area in a very short time. The cause of activation could well be seen in the upper air features.

4. In the upper air, around 400-mb level, an easterly wave was seen propagating westward through the Andamans from 15th onwards, slowly gaining in amplitude. Meanwhile a westerly wave was also moving eastwards through Afghanistan, steadily extending its trough down south. On the 18th these two troughs were in juxta position, where

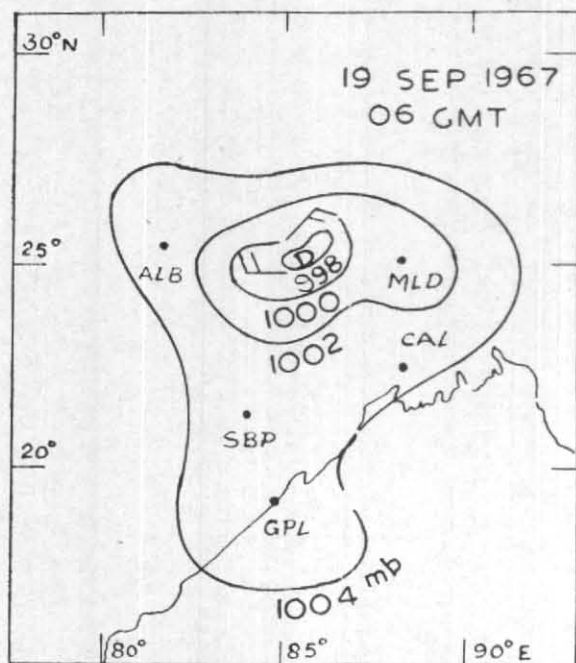


Fig. 2. Surface chart showing a meso-depression around Patna

a surface low of small dimension in the vicinity of Patna was already present. On 19th the two wave troughs moved apart, fracturing the common axis at around  $25^{\circ}\text{N}$ , leaving an intense anticyclonic shear zone, oriented almost west-east situated aloft the surface of Bihar, a situation favourable for the intensification of existing low pressure area. A fraction of the superimposed surface low immediately assumed meso-depression with centre near Patna. In association with this intense system there was continuous heavy rain from a thick altostratus cum nimbus deck of clouds. On 20th the wave troughs moved further apart and the mid-tropospheric divergent zone positioned slightly south of the previous day, marked with less shear. The meso-depression with its heavy rainfall activity weakened abruptly since then. Day to day movements of the upper air trough at 400-mb level are indicated in Fig. 3.

5. Pisharoty and Desai (1956) have dealt with the interaction of wave troughs but have not made

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18 February 1969

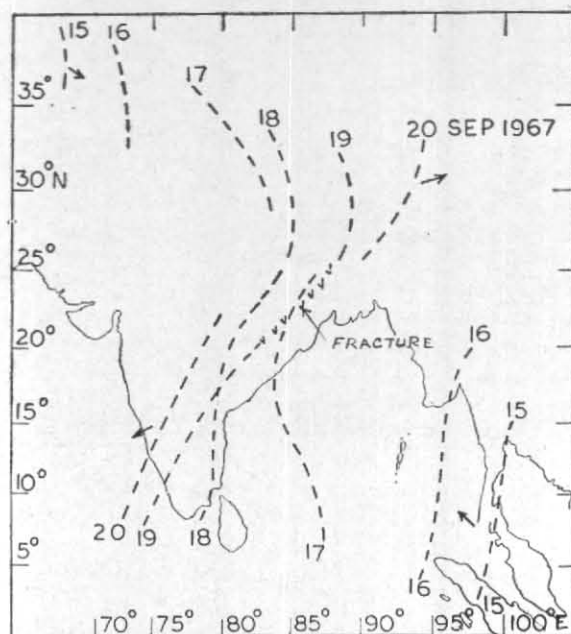


Fig. 3. Day-to-day movement of easterly and westerly waves at 00 GMT at 400m level  
The optimum interaction on 18th and the fracture of the common axis on 19th can be seen

much reference to the meso-developments in the surface features. Ranganathan and Soundararajan (1965) have in a case-study discussed the interaction mainly in the lower levels, again without reflecting on the meso-formations out of the upper divergence aloft a pre-existing surface low. In this note, however, an attempt has been made to deal a development in the mid-troposphere mainly owing to interaction and subsequent fracture of two opposite moving wave troughs at that level. The intense anticyclonic divergent zone thus developed aloft a pre-existing surface low caused the rapid accentuation and sudden development, leading to the formation of a meso-depression.

6. The author expresses his heart-felt thanks to the appreciations and encouragements extended by Shri M. S. V. Rao, Meteorologist-in-charge, Main Meteorological Office, Nagpur, in connection with this work. The author also thanks the Director, Regional Meteorological Centre, Calcutta for supplying some rainfall data of Bihar in connection with this work.

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| Ranganathan, C. and Soundararajan, K. | 1965 | <i>Ibid.</i> , <b>16</b> , p. 607.                  |