

## Response of the sub-tropical ridge of Asia towards an unstable wave of the mid-latitude

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सार — जुलाई 1977 में मध्य अक्षांशों में एक अस्थिर तरंग विकसित हुई। परिणामस्वरूप एशिया के उपउष्णकटिबंधीय कटक (उच्चदाब) में प्रतिचक्रवाती कोशिकाएं बनीं। मध्य क्षोभमण्डलीय कोशिकाएं पश्चिम की ओर गईं जबकि उच्च स्तर वाली पूर्व की ओर गईं। इन कोशिकाओं के गमनपथ में पड़ने के कारण बर्मा, वर्षा प्रतिमान के परिवर्तन का अनुभव कर सका है।

**ABSTRACT.** In July 1977, an unstable wave has developed in the mid-latitude. As a consequence, anticyclonic cells formed in the subtropical ridge of Asia. The cells in the mid-troposphere moved west while those in the upper levels moved east. Burma happened to be in the passage of the cells and have experienced change of rainfall pattern.

### 1. Introduction

Many authors have presented different approaches to show the effects of the waves in the upper troposphere of the mid-latitude upon the vagaries of the southwest monsoon. The intrusion of upper level westerlies into the low latitude and the weakening of the circulation index in the middle troposphere are known to be responsible for the weak monsoon situations (Hla 1984). The free and unimpeded passage of upper level trough at 200 mb level over Asia is essential for the good monsoon and the passage of the ridge may even lead to drought in India (Raman *et al.* 1980).

The present study deals with the response of the monsoon towards the passage of the upper waves in the westerlies of the mid-latitude that did not penetrate into low latitudes.

### 2. Development of the wave

On the 10 July 1977, a deep unstable wave began to develop near 90°E in the mid-latitude over the Tibetan Plateau. It was most defined in the 300 mb level. The wave propagated eastward at the rate of about 4° latitudes per day. The maximum intensification took place on 16th near the 115°E over the eastern parts of China and USSR. There was no further propagation of the wave probably due to the strengthening of the anticyclone which formed initially near 35°N, 89°E on the 11th. Sequential progress of the wave during 10 to 20 July 1977 appeared on northern hemispheric charts published by USSR is shown in Fig. 1.

### 3. Anticyclonic cells

During the initial development of the wave, three anticyclonic cells may be observed in the subtropical ridge between the Arabian Sea and the northwest Pacific. On the 10th, one was observed over northwest India, another over Bangladesh and the remaining one over Yunnan (China).

During the life span of the wave, the anticyclonic cell over the Bangladesh moved southeast slowly across southeast Asia, while the subtropical ridge over Asia became weak. As the cell moved into the equatorial region over Borneo, the subtropical ridge prevail over Asia as usual. The passage of the anticyclonic cell at 300 mb is shown in Fig. 2 (a).

The development of the wave was also defined at 200 mb and 500 mb levels. The anticyclonic cells that had formed in 200 mb moved eastward and became stationary near 30°N and 95°E over northern part of Burma (see Fig. 2 b). However, the anticyclones that had formed in the subtropical ridge in 500 mb moved westward from Indochina to north India. There is a possibility of the steering effect of the mid-latitude westerlies at 200 mb and the westward movement of the cells at 500 mb due to strengthening of the anticyclone in the northwest Pacific as shown in Fig. 3. But explanation for the southeastward movement of the cells at 300 mb remains complicated.

### 4. Surface pressure pattern

The movement of the anticyclonic cell at 300 mb level has been delayed over central part of Burma for about

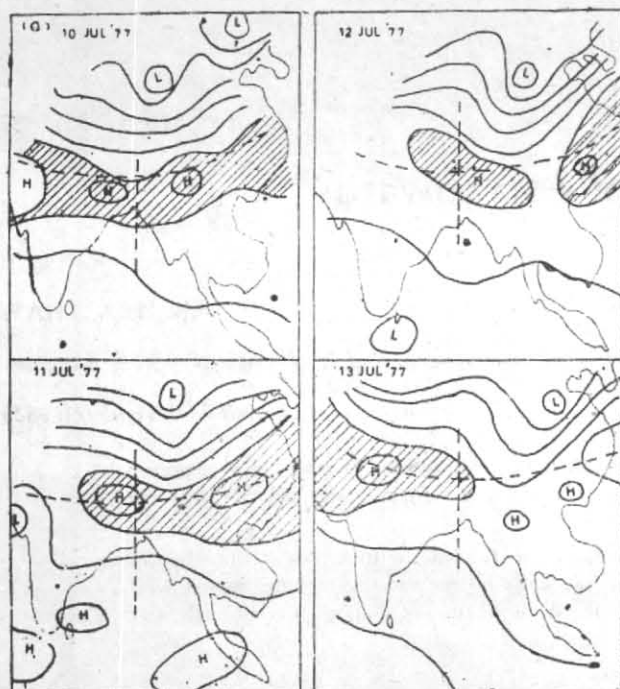


Fig. 1 (a). Progress of the mid-latitude wave

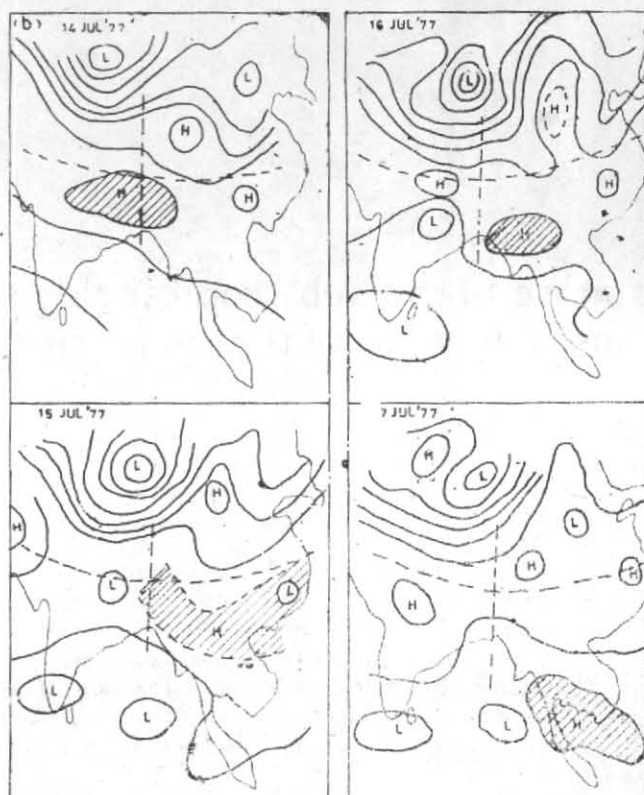


Fig. 1(b). Formation of blocking high during the progress of the wave

5 days during 12th to 16th. The anticyclonic cell at 200 mb level has been stationary for about 5 days during 15th to 19th over the northern Burma area and its proximity. Pressure pattern change from day to day during the period 10 to 18 July 1977 is shown in Fig. 4.

There is a marked decrease of pressure gradient and the monsoon trough running parallel near  $23^{\circ}\text{N}$  during 12 to 14 July. The anticyclonic cells at 300 mb level were right over Burma and the cells at 200 mb level near  $32^{\circ}\text{N}$ ,  $82^{\circ}\text{E}$  were over southern part of the Tibetan Plateau.

From 16th to 18th, the Martaban ridge became dominant over the country while the anticyclonic cells at 300 mb level rested over the middle part of Burma and the cells at 200 mb level on northern part of Burma. The Martaban ridge receded on the following days, when the cell at 300 mb level has moved away from the middle part of Burma towards Borneo.

#### 5. Rainfall pattern

Daily rainfall distribution in Burma from 12th to 18th is shown in Fig. 5. On the 12th and 13th, the rainfall were very scanty over most part of the country. Areas of more than 20 mm of rainfall were very limited over Kachin State, Upper Sagaing Division, Mon State and Tenasserim Division.

On the 14th and 15th, rainfall had increased to 100 mm in Mandalay and Sagaing divisions probably due to the low level westward moving low from the eastern part of the country showing the precipitation enhancement by coupling effect of the low level convergence with the divergence aloft.

On the 16th, when the low had moved away from Burma, there was less rainfall in the country.

#### 6. Topic for discussion

The development of the waves in the upper troposphere of the mid-latitudes over Asia have been found to initiate the anticyclonic cells in the subtropical ridge. The cells in the upper troposphere have the tendency to move eastwards. The anticyclonic cells inhibit the rainfall underneath, a condition which is similar to that of the anticyclonic cut-offs in the mid-troposphere (San Hla Thaw 1985).

When the upper level anticyclonic cell is coupled with low level convergence the rainfall is enhanced.

Among other reasons, the intensification of Martaban ridge is also due to the dominating anticyclonic cell in the upper troposphere at 300 mb level.

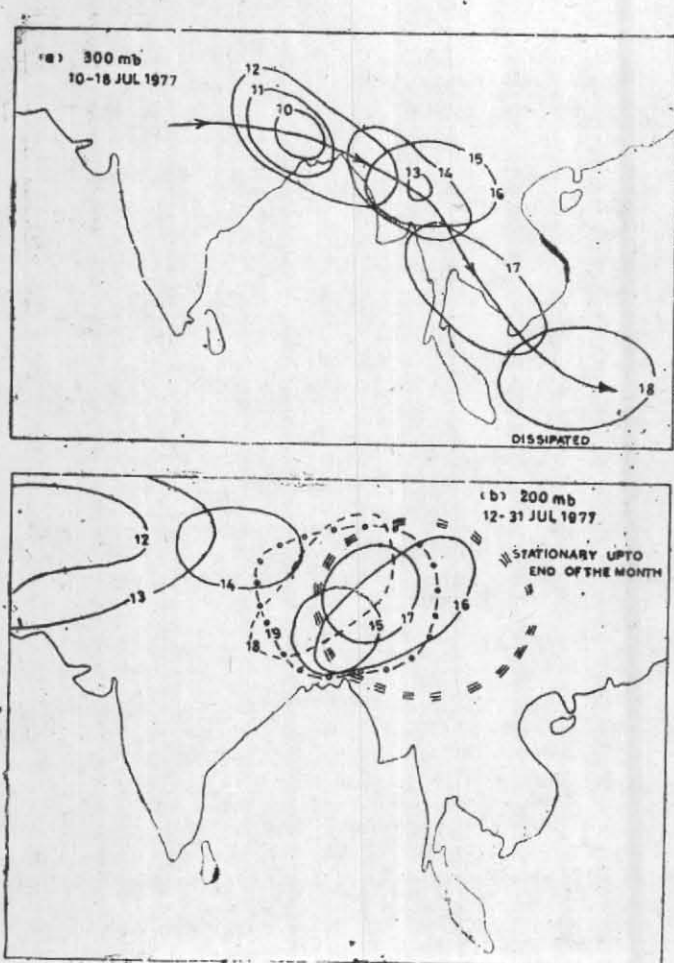


Fig. 2. Passage of the anticyclonic cell at (a) 300 mb during 10 to 18 July 1977 and (b) during 12-31 July 1977 at 200 mb

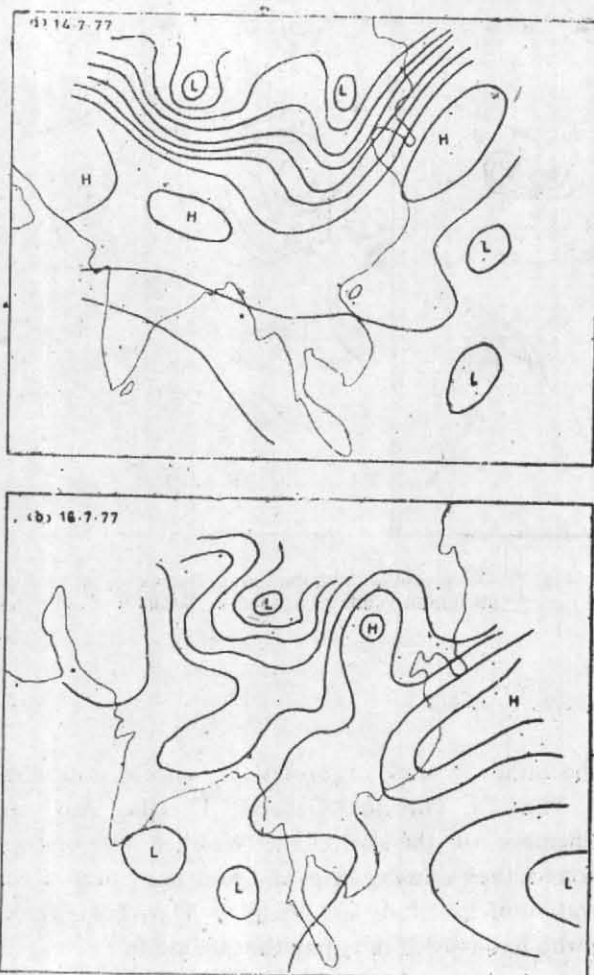


Fig. 3. Intensification of 500 mb subtropical ridge from the northwest Pacific as the mid-latitude wave blocked over northeast Asia : (a) on 14 July & (b) 16 July 1977

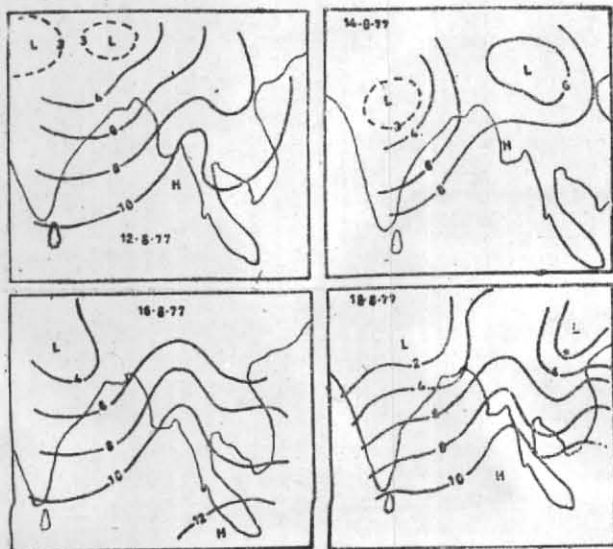


Fig. 4. Sea level pressure pattern during the development of the unstable wave in mid-latitude over Asia

The rainfall condition in twenty sub-divisions and sub-states during the period dominated by the upper level anticyclones, *i.e.*, during 11 to 20 July 1977 showed that there is above normal rainfall in five sub-states and sub-divisions, about normal in three and below normal in twelve. Thus the inhibiting nature of the upper level anticyclonic cells is quite evident.

7. Conclusion

In the study it is found out that the upper level wave developed in the mid-latitude westerlies has initiated the anticyclonic cells in the subtropical ridge area. These cells have the tendency to move generally eastward along with the mid-latitude westerlies. The cells inhibit the rainfall situation and also strengthen the Martaban ridge when they dominate middle part of Burma.

However, the enhancement of precipitation takes place if the upper level anticyclonic cells is coupled with the low level convergence underneath.

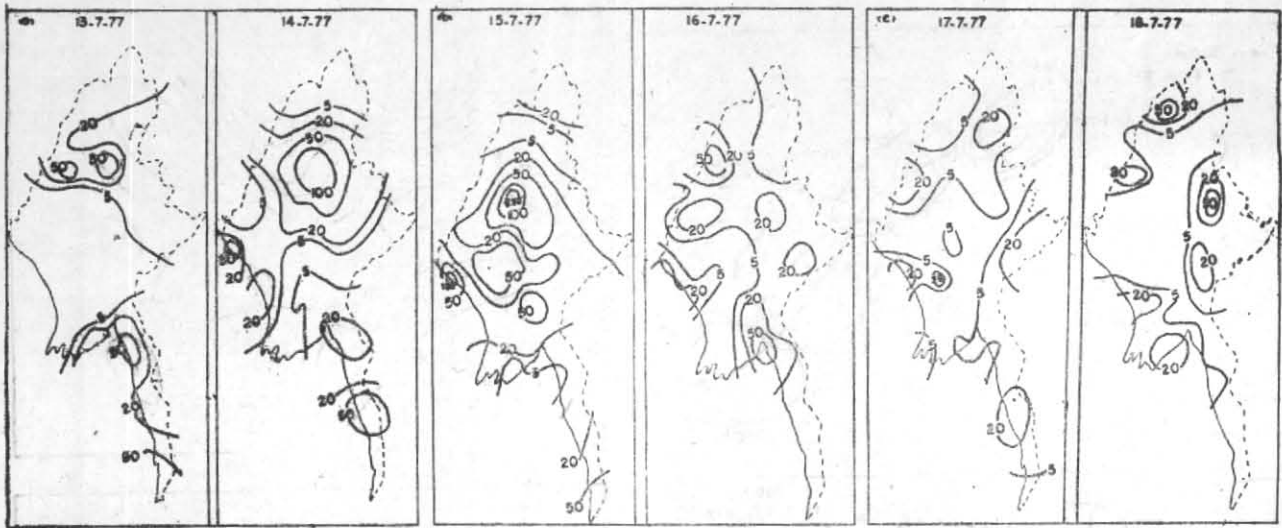


Fig. 5. Daily rainfall distribution in Burma on (a) 13 & 14 July 1977, (b) 15 & 16 July 1977 and (c) 17 & 18 July 1977. The maximum rainfall recorded at Katha was 123 mm on 14 July 1977 and 174 mm on 15 July 1977

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