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Influence of extratropical flow patterns on the onset of monsoon over India during 1979

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सार -- 1979 में भारत पर मानसून के शुभारंभ में 10 दिन की देरी ने मानेक्स 1979 में लगे वैज्ञानिकों को रहस्य में डाल दिया। इस शोधपत्र में हमने बहिउष्णकटिबंधीय अवरोधी उच्चों के प्रभाव के आधार पर देरी के संभावित कारण को प्रस्तुत किया है जो कि 5 दिन के माध्य कन्टूर चार्टों से स्पष्ट हुआ है। मई 1979 में ये अवरोधी उच्च (दाब) कैस्पियनसागर-अरालसागर क्षेत्र पर दो बार छाए रहे। पहला अप्रैल के अंतिम सप्ताह तथा दूसरा मई के तीसरे सप्ताह से शुरु होकर जून 1979 के प्रथम सप्ताह तक फैला रहा। प्रबल देशान्तरीय (ध्रुवों से भूमध्य रेखा की ओर) प्रवाह कैस्पियन सागर से अफगानिस्तान, पाकिस्तान और भारत के उत्तर-पश्चिम भागों तक देखा गया।

ABSTRACT. During 1979, the onset of monsoon over India was delayed by about 10 days baffling all scientists engaged in Monex-1979. In this paper, we present the possible causes of this delay based on the influence of the extra-tropical blocking highs, as revealed by the 5-day mean contour charts. The blocking highs prevailed over the Caspian Sea-Aral Sea area during May 1979 in two spells, one starting from last week of April and the other from third week of May extending upto first week of June 1979. Strong meridional flow was observed from east of the Caspian Sea to Afghanistan, Pakistan and the northwestern parts of India.

1. Introduction

Monsoon is a seasonal reversal of wind patterns due to differential heating of land and sea. Arabs termed this wind reversal as *Mausim* from which the word monsoon has been derived. This is a unique meteorological phenomenon which has no parallel elsewhere in the world. The causes determining the monsoon currents are many and complex which have been baffling meteorologists all over the world and especially in India. Indian economy still continues to be a gamble in the monsoon. To probe into the mysteries of monsoon, India in collaboration with scientists from other countries has conducted various observational experiments like International Indian Ocean Expedition (IIOE 1960-65), Indo-Soviet Monsoon Experiments (ISMEX 1973 and 1977) and International Monsoon Experiment (MONEX 1979) in addition to the regular studies carried out every year. Amongst these, MONEX-79 has been the most comprehensive in which a large number of countries participated.

Monsoon is characterised by three main aspects, *viz.*, its onset, activity durng the season including breaks and its withdrawal. In this study we have concentrated mainly on the causes of the delay in onset of monsoon over India during 1979.

The southwest monsoon advances into India with a fair degree of regularity, however, there are year to year variations about the actual dates of its onset. There is also variation in the process of onset of monsoon. Vigorous attempts have been made by meteorologists in India as well as elsewhere, to understand the mechanism of the onset of monsoon on a large scale and also about the possibilities of predicting the same. Ramaswamy (1971) studied 500 mb contour patterns over Asia, averaged over second half of June 1965, a year in which monsoon had not advanced into northern India to the west of 78 deg. E even by the end of June. He observed that westerly circulation was dominating the subcontinent at 500 mb with a well marked mean trough extending from the middle latitudes into northern India. In our study, we have examined 5-day and

monthly mean charts for 700, 500, 300 and 200 mb levels for the months of May and June 1979 to explore the possible causes for the delayed onset of monsoon in 1979.

2. Mean charts

In Northern Hemisphere Analysis Centre, New Delhi, we prepare daily objective analysis of 850, 700, 500, 300 and 200 mb level charts using the technique proposed by Cressman (1959). The details of the scheme adopted have been described by Datta *et al.* (1970) and Singh and Datta (1973). These objectively analysed grid point values of contour heights are stored in magnetic tapes to produce 5-day and monthly mean contour charts. For the present study which pertains to MONEX-1979 period, utmost care was taken to include all available observations.

3. Discussion of results

In Figs. 1(a) and 1(b), we have reproduced normal contour patterns of 700 and 500 mb respectively for the month of May (Crutcher *et al.* 1970). It will be seen that at 700 mb, except for a small trough over Black Sea area, the flow over Russia, China and northern parts of India is more or less zonal. Almost similar flow patterns prevail also at 500 mb and above upto 200 mb.

In Figs. 2(a) and 2(b), we present mean contour patterns of 700 and 500 mb respectively for the month of May 1979. We observe an Omega type of flow pattern with a blocking anticyclone over north of Caspian Sea covering western portion of Kazakh and its neighbourhood with a strong meridional flow to the east of it extending southwards upto Afghanistan and adjoining Pakistan. The same flow pattern is also seen at 500 mb and aloft upto 200 mb.

We have examined 5-day mean contour charts for the pentads starting from 1, 9, 27 May and 7 June 1979 for all the four levels. We are, however, reproducing the charts for 700 mb level only for want of space. The strong Omega type flow patterns observed in the mean charts of May 1979 was mainly due to two prolonged spells of blocking highs over the Caspian Sea and its neighbourhood. The first spell started from the last week of April to mid of May 1979 (Figs. 3 and 4) followed by another spell of strong Omega type flow pattern from 3rd week of May to first week of June (Fig. 5). A strong meridional flow extending upto northwestern parts of India is clearly depicted in these diagrams. The turning point was seen during the pentad 7-11 June 1979 (Fig. 6), when the anticyclone shifted to China and more or less zonal flow prevailed over the Caspian and Aral Seas, which more or less resemble the normal flow pattern for May. The northwest-southeast trough established over this region at 700 mb. Monsoon also advanced into southwest coast of India during this period. We have also observed the existence of strong meridional flow extending upto Pakistan and northwestern parts of India in almost all the five-day mean charts for the pentads starting from 1 May to 2 June 1979.

The role played by the north-south trough in the westerlies on the eastern side of the blocking anticyclone in delaying the onset of the southwest monsoon was also noticed by Ramaswamy (1971). The present work also corroborates his findings. The appearance of a blocking anticyclone at 700 and 500 mb levels in 5-day mean charts during the month of May, especially during the second half, over the Caspian Sea-Aral Sea area, may give a good indication for predicting delay in the onset of monsoon a week or two in advance.

4. Conclusion

During the month of May, strong mean meridional flow from east of Caspian Sea and Aral Sea area with a blocking high to the west of it, is likely to delay the onset of monsoon over the country.

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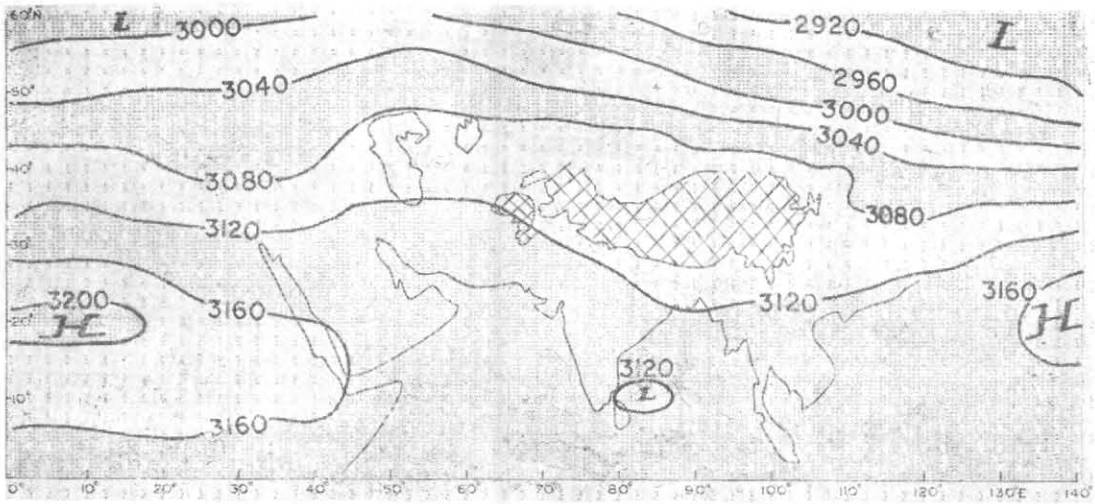

Fig. 1(a). 700 mb normal geopotential height, May

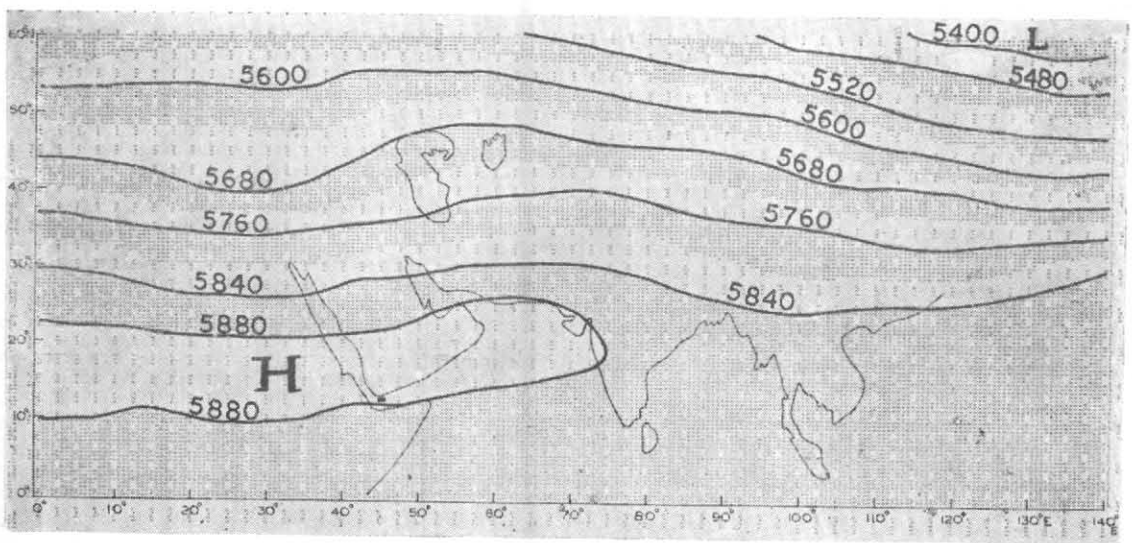

Fig. 1(b). 500 mb normal geopotential height, May

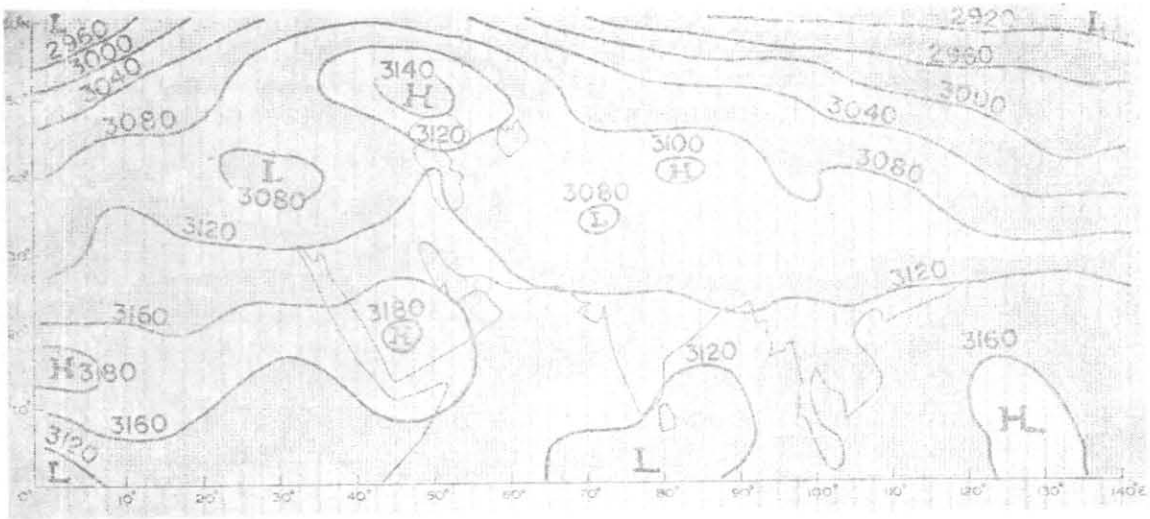

Fig. 2(a). 700 mb mean geopotential height, May 1979

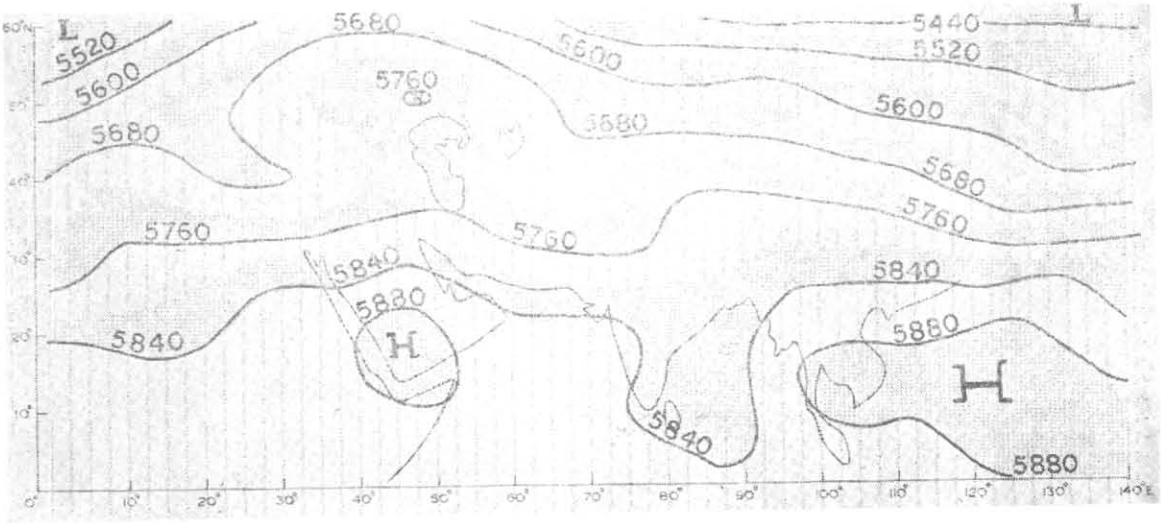

Fig. 2(b). 500 mb mean geopotential height, May 1979

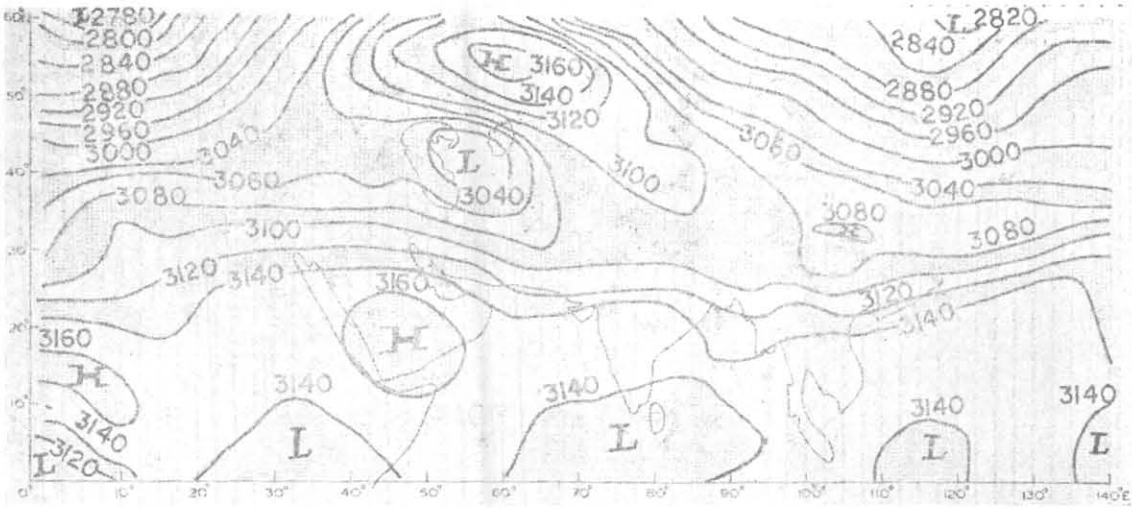

Fig. 3. 700 mb 5-day mean geopotential height, 1-5 May 1979

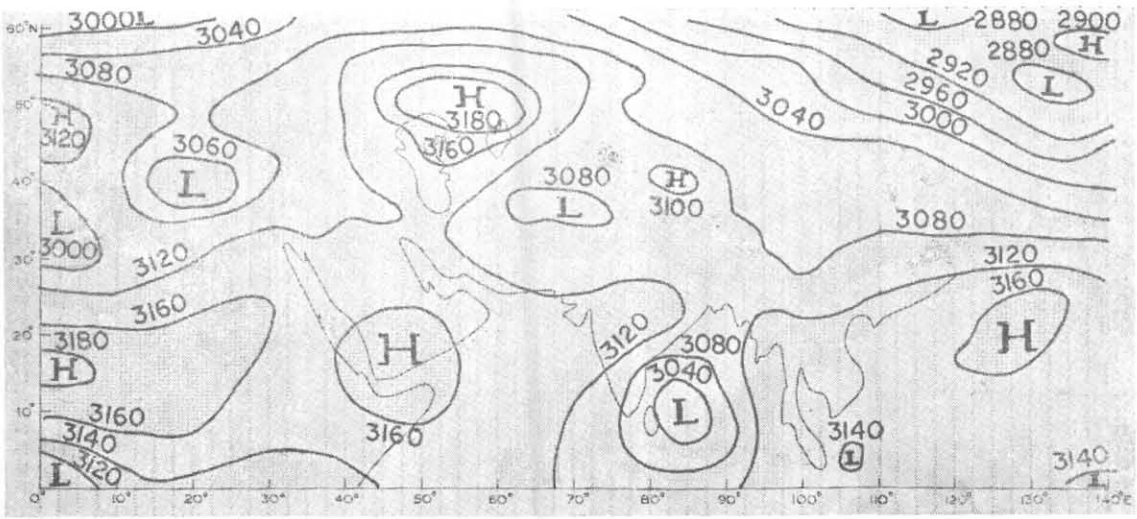

Fig. 4. 700 mb 5-day mean geopotential height, 9-13 May 1979

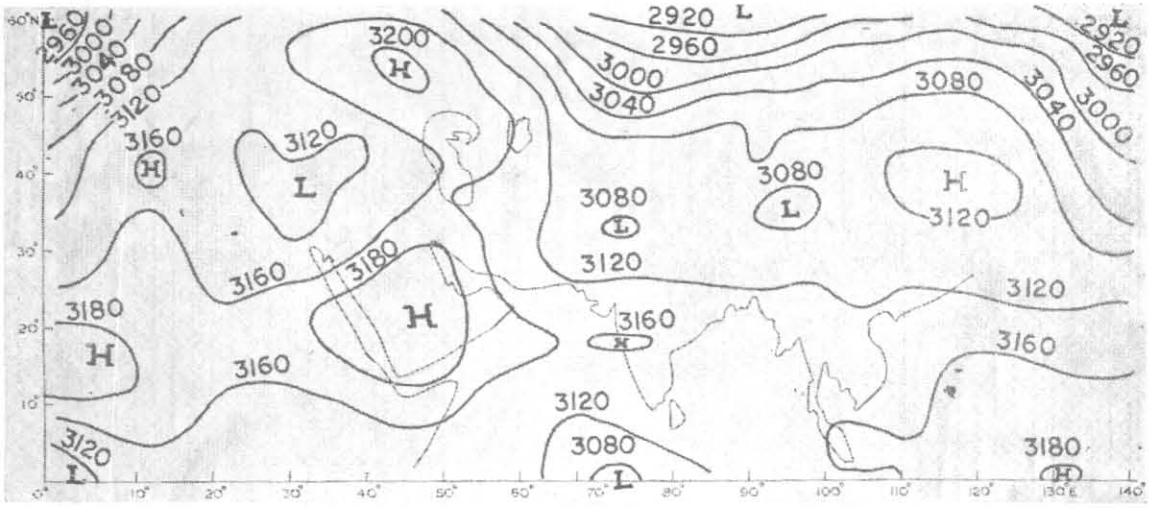

Fig. 5. 700 mb 5-day mean geopotential height, 27-31 May 1979

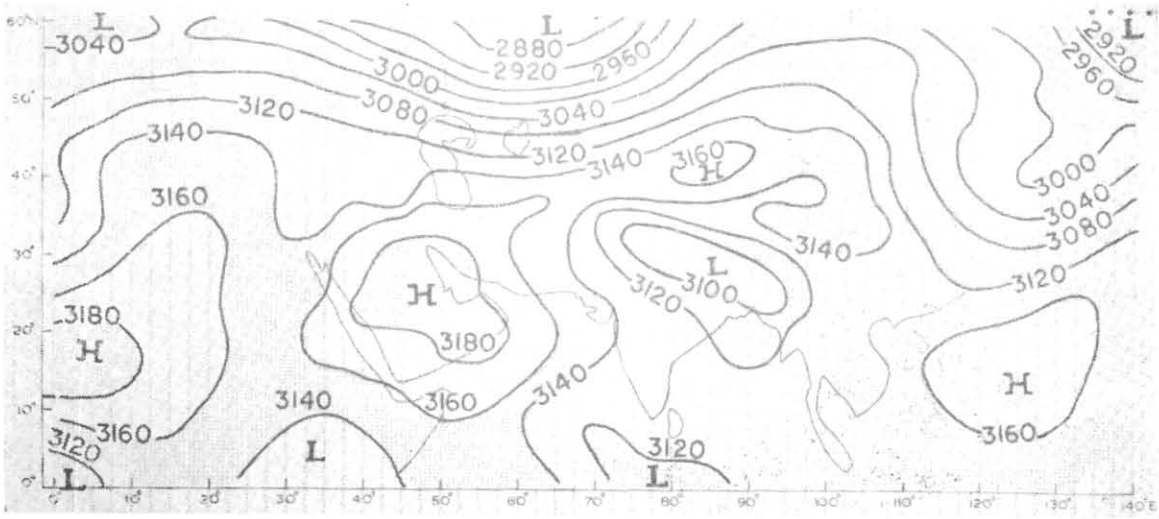

Fig. 6. 700 mb 5-day mean geopotential height, 7-11 June 1979