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ON THE INTERDIURNAL VARIATIONS OF UPPER AIR TEMPERATURES

With the introduction of civil jet air liners flying at high altitude, the question of forecasting of upper air temperatures at heights between 30,000 to 40,000 ft with a reasonable degree of accuracy has assumed greater importance. The normal practice followed at our forecasting offices is to look up the temperatures available from the tephigrams of the latest hour of observation and give them in the forecast issued. As the latest available tephigram on which these forecasts are based may sometimes be 12-24 hrs old it would be of interest to know the order of day to day variation of upper air temperatures at high levels with a view to see whether any correction can be applied to the last observations based on different kinds of synoptic situations.

A study was made of the interdiurnal changes of temperatures at 800 mb, 500 mb and then at intervals of 50 mb up to the highest level available, from the tephigrams of Poona, Madras, Calcutta and New Delhi for various representative months of each meteorological season during the years 1950 and 1951.

The months chosen were—

January for winter, August for monsoon, May for premonsoon and October for postmonsoon period.

The purpose was to first study in a qualitative way what order of changes takes place at various levels from 800 mb upwards and to see how the changes at levels >20,000 feet compare with changes at lower levels and where there are significant changes throughout, say $>\pm5°$ F, whether the changes can be explained by the changes of synoptic situation since the last radiosonde ascent.

The temperature values (in °F) were tabulated and interdiurnal changes worked out and then represented graphically against the dates to get a ready picture of the level to level change, suitably marking + or — ve changes, as the case may be. A graphical picture of the changes in January 1950 for Delhi is reproduced in Fig. 1 as an illustration. The change from one day to the other has been plotted as change for the next day, *i.e.*, change from 2nd to 3rd has been plotted against 3rd.

Where the changes were significant, it was studied with respect to the synoptic situation as given in the Indian Daily Weather Report from day to day in the period under consideration.

It was noticed that the changes above 20,000 ft level are as well marked as at lower levels; in some cases, they are even more marked. Under certain situations, as for example, when an active western disturbance has moved away across the Punjab hills on a particular day, falls of temperature of the order of 20° to 30°F occurred over Delhi on the next day, during the winter period. In Fig. 1 marked falls can be seen on 3rd, 13th, 20th, 26th and 30th. In all these cases, an active western disturbance was moving away across the Punjab-Kumaon hills on the previous day.

Seasonwise study was also made of the changes with respect to typical changes of synoptic situations in the season under consideration. It was seen that in most cases, significant changes could be explained by the changes in synoptic situation. A brief synopsis of this is given below.

Monsoon season—When a depression is forming in the head Bay and westerlies prevail over the Gangetic plain, it is seen

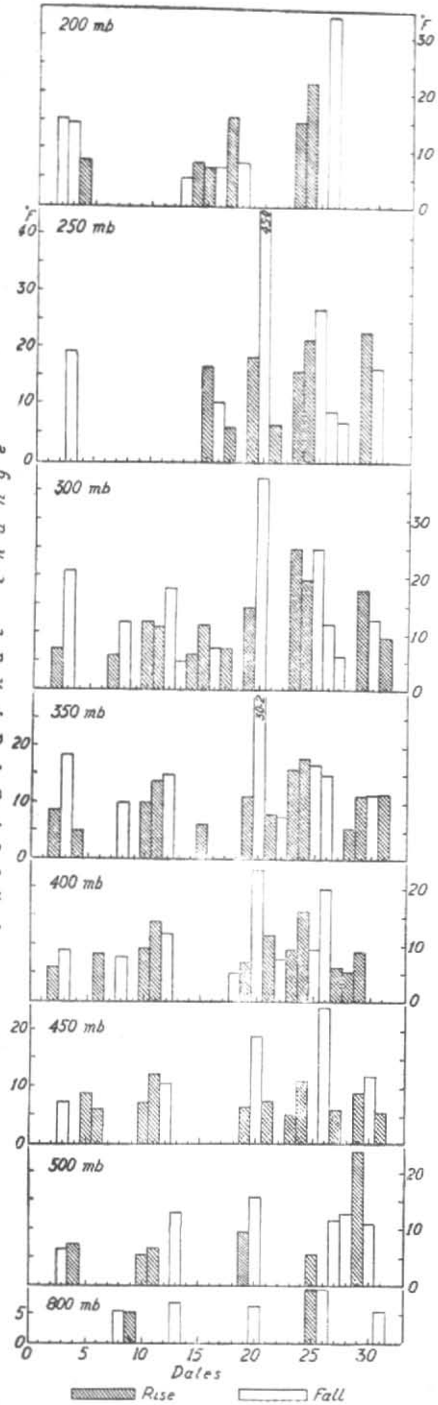

Fig. 1. Delhi (January 1950)

that Calcutta temperatures show a rise of the order of 5 to 10°F and when these depressions (during SW monsoon season) enter inland and take a westerly or northwesterly course causing an activation of the monsoon over the Gangetic plain, Delhi temperatures fall by an amount which varies from 5 to 15°F.

When the monsoon strengthens along the west coast, Poona temperatures fall by 5 to 10°F and another interesting effect seen is that with the strengthening of the monsoon, the effect on the upper air temperatures takes place gradually, *i.e.*, if on a particular day the temperatures have shown a fall upto 500-mb level, the fall at the higher levels occurs the next day.

Premonsoon and winter seasons— The study was confined to the study of variations of Delhi and Calcutta temperatures. Most pronounced effects are seen in Delhi temperatures in association with the passage of western disturbances across northwest India in winter. When a western disturbance is approaching northwest India from Baluchistan causing extensive cloudiness over northwest India, Delhi temperatures rise by 5 to 15°F and after the passage of an active western disturbance which has given good rainfall over the plains and snowfall over the hills, the temperatures fall by 20 to 30°F.

Similar effects were seen over Calcutta temperatures a day or two later after the passage of a western disturbance across the Punjab-Kumaon hills, though to lesser degrees; the fall rarely exceeding 10°F. In cases where an active secondary is induced over Madhya Bharat and neighbourhood, which takes an easterly or northeasterly course, affecting East Uttar Pradesh, Bihar and Chota Nagpur area, Calcutta temperatures show the same characteristics as in the case of Delhi when a western disturbance is approaching from Baluchistan.

In Fig. 1, the rises in temperatures can be seen varying from 1 to 3 days before the days of fall in temperatures. In the hot season moist easterlies and southeaster lies brought over Delhi by western dis turbances produce a fall in temperatures o the order of 15 to 25°F. Occurrence o widespread dust or thunderstorms produce falls from 10 to 20°F.

Postmonsoon season—The effect on Madra temperatures was studied when the NE monsoon strengthens. Tangible effects were seen, though not so marked as in the case of formation of SW monsoon depression and active western disturbances. Activa tion of the northeast monsoon producec a fall of the order of 5°F. Not very con clusive effect was seen in the case of a depression forming in South Bay on Madras temperatures. This aspect requires more study.

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