556.131.116 : 551.553.21 (548.1)

MAXIMUM 24-HOUR PERSISTING DEW POINTS DURING THE NORTHEAST MONSOON SEASON OVER TAMIL NADU

1. The basic procedure used in the derivation of probable maximum precipitation (PMP) for a river catchment consists of moisture adjustment of observed areal rainfall values associated with severe rainstorms. For moisture adjustment, the observed areal rainfall values are multiplied by the ratio of the highest amount of moisture recorded in the specific area to that recorded during the rainstorm period. US Weather Bureau (1960) and Reitan (1963) found that the moisture in an air mass from which large precipitation occurs can be estimated from the surface dew point temperatures decreasing with height at the saturated pseudo-adiabatic lapse rate. The present practice is based on the dew point temperature that has persisted for a period of 24 hours. As such the highest value of moisture content ever recorded over an area as well as for the storm is estimated from maximum persisting 24-hour, 1000 hPa dew point temperatures.

1.1. Rakhecha *et al.* (1990) have determined maximum observed persisting dew point temperatures for different stations for the individual months of June to September for the Indian region and incorporated in the monthly maps of maximum persisting dew points.

1.2. In view of the importance of the subject an attempt has been made in this paper to construct such maps of highest persisting dew point temperatures for the individual months of October, November and December for Tamil Nadu as this region receives heavy rainfall in these months associated with northeast monsoon. These maps will provide a ready convenient source for calculating the maximum amount of moisture at any location in the state of Tamil Nadu for PMP studies.

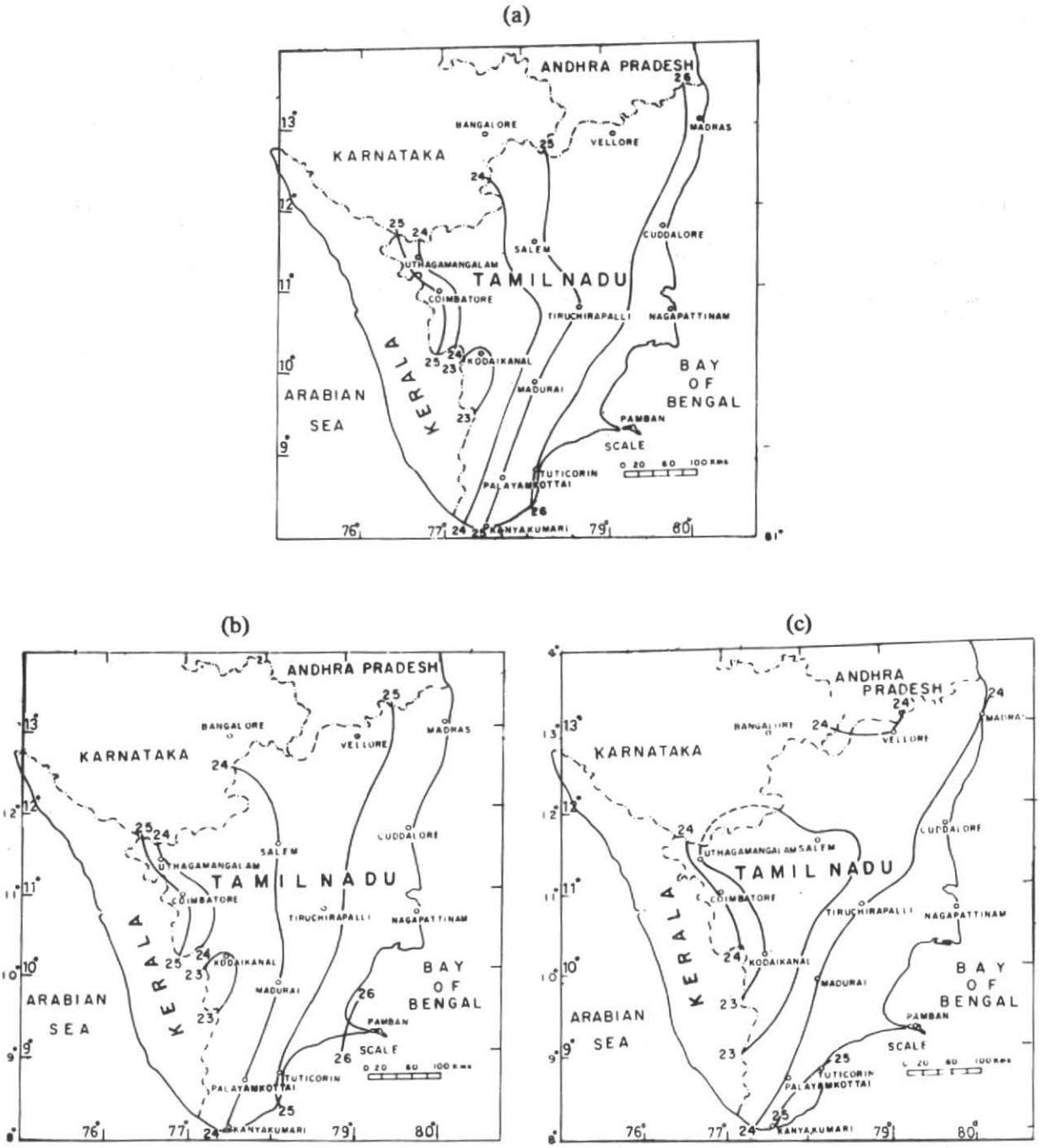
2. The daily dew point temperatures for meteorological stations are published in the Indian Daily Weather Reports (IDWR) brought out by the India Meteorological Department, Pune. The daily dew points recorded at 0830 and 1730 hrs (IST) for 10-year (1980-89) period, during October to December months, were collected from IDWR for 15 stations well distributed throughout Tamil Nadu state. In determining the persisting dew point, values at 0830 and 1730 hrs (IST) during the 24-hr period are examined for reliability and the lowest of these readings was selected as 24-hr persisting dew point. Daily minimum temperatures were also used to check the fall of minimum temperature below the dew point temperature.

2.1. In this way, a series of 24-hr persisting dew points for the individual months of October, November and December, for each year, were constructed for each station. The maximum value of the individual months was, then, taken as the maximum persisting dew point for that month. Like this, the maximum persisting dew points for each month of October, November and December, for all years, were determined and the highest, out of these, was taken as the highest persisting 24-hr dew point for that month. The monthly highest persisting dew point values for each station were, then, reduced pseudo-adiabatically to 1000 hPa level so that highest dew points observed for stations at different elevations are comparable.

3. The highest persisting dew point values are plotted on a base map of Tamil Nadu and isotherms of 24-hr persisting dew points have been drawn. The isotherms of 24-hr maximum persisting dew point temperatures over the Tamil Nadu region, for each month of October, November and December are shown in Figs. 1(a-c). The spatial pattern of maximum persisting dew points, which is a measure of maximum moisture over an area, depends upon the direction of moisture flow, topographic barrier and other geographical factors. It is seen that the maximum persisting dew points range from 23° to 26°C. The persisting dew point values decrease from east to west. The lowest values are observed over Kodaikanal region of the State. The low values in the interior are due to the decreasing effect of the inflowing moist currents from the Bay of Bengal. These maps are useful for estimating maximum persisting dew point for any area for moisture maximization studies.

4. The method of storm transposition and moisture maximization is described in WMO No. 332 (1973) and in the Indian context by Dhar (1972). The moisture maximization of an observed storm is made to determine the rainfall which would result if the moisture charge available to this storm was the maximum that would be available to the storm in its transposed position over the project basin. The Moisture Maximization Factor (MMF) which would be applied to the observed rainfall from a particular storm is defined as

$$\text{MMF} = \frac{\text{Depth of maximum precipitable water over the area}}{\text{Depth of storm precipitable water}}$$



Figs. 1 (a-c). Maximum persisting 24-hr, 1000 hPa dew point temperature (°C) over Tamil Nadu during (a) October, (b) November and (c) December

4.1. The maximum persisting dew points for the project basin, where the rainstorm is transposed, is obtained from the Figs. 1 (a-c). For example, a rainstorm has occurred in the month of November and the maximum persisting 24-hr dew point for the project basin, where the storm is transposed, is 26°C. The representative persisting 24-hr, 1000 hPa dew point for the storm is 23°C. The moisture maximization factor (MMF) is computed from precipitable water tables. For example,

Precipitable water corresponding to a 1000 hPa dew point of 26°C = 80.8 mm

Precipitable water corresponding to a 1000 hPa dew point of 23°C = 67.9 mm

$$\text{MMF} = \frac{80.8}{67.9} = 1.19$$

4.2. The MMF is then multiplied by the transposed raindepths so as to obtain

probable maximum precipitation over the project basin.

References

Dhar, O. N., 1972, Manual of Hydrometeorology, Part I, India Met. Dep.

Rakhecha, P. R., Deshpande, N. R. and Nandargi, S. S., 1990, "Maximum persisting dew points during the southwest monsoon season over India," *Mausam*, **41**, 1, pp. 140-142.

Reitan, C. H., 1963, "Surface dew point and water vapour aloft," *J. of Applied Meteorology*, **2**.

U. S. Weather Bureau, 1960, Tech. Paper No. 38.

World Meteorological Organization (WMO), 1973, Manual for estimation of probable maximum precipitation, Operational Hydrology No. 1, WMO No. 332.

B. D. KULKARNI
P. R. RAKHECHA

Indian Institute of Tropical Meteorology, Pune

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