551.577 : 556.124

WILL IT BE RAIN OR SNOW AT SHIMLA?

1. The mid altitude and high altitude of Himachal Pradesh experience both rainfall and snowfall during winter months in association with the eastward moving cyclonic circulation or low pressure areas commonly known as "Western Disturbances (WDs)". An intense WD is capable of producing wide spread heavy snowfall over the western Himalayas region and rain over northern plains for a day or two (Hatwar, *et al*., 2005). Some other studies are also available on WDs affecting northwest India (Chand and Gupta, 1991; Sharma and Subramanian, 1980; Veeraraghavan and Nath, 1989). The mid altitude of Himalayas, however, receives both rainfall and snowfall in association with the WDs. On some occasions, it becomes difficult to predict whether a station will receive rainfall or snowfall or both. Shimla is an important hill station in the north of the country and various users like the municipal authorities, tourism department, media and general public are interested to know whether the precipitation at the station will be in the form of rain or snow. Keeping this in view, it has been attempted to identify the local weather parameters which can be used as guiding tool for indicating the occurrence of rain or snow in Shimla.

2. Snowfall in Shimla is generally experienced from second fortnight of December to first fortnight of March. Occasionally, snowfall is experienced in the month of November also, particularly in association with intense WDs. Daily rainfall/snowfall data of Shimla observatory for the past 16 years (1990 – 2005) have been used in the study.

3. The average precipitation and percentage of days with precipitation in the form of rain or snow for the period under study are given in Fig. 1. The Fig. 1 shows that the average precipitation increases from November to February as the winter season progresses and then decreases slightly in March. The percentage of days with snow also increases from 5% in November to 53% in January. It decreases to 43% in February and then there is a sharp fall in March with only 8% of the precipitation days recording precipitations in the form of snow.

Whether a station will receive precipitation in the form of rain or snow has been related to the surface air temperature, freezing level altitude and the 1000-500 hPa thickness. However, the surface air temperature seems to be a more reliable indicator (Upadhyay, 1995). An analysis was carried out for Shimla to find out a cut off limit of minimum surface temperature which could be used as an indicator of rain or snow over the station. As most of the cases of snow are confined to the months of December, January and February, the analysis was carried out for these months only. Fig. 2 gives the percentage of precipitation days with rain or snow during the day with different minimum temperatures. It is found out that when the minimum temperature of the station is < 0° C, 91% of the precipitation days (63 out of 69) have reported precipitation in the form of snow in the subsequent 24 hours. When the minimum temperature is between 0 and 1° C, about 69% of the precipitation cases are in the form of snow. As minimum temperature increases, the percentage of cases with snow decreases with only 13% such cases when the minimum temperature is between 3 and 4° C; and no case when the temperature is >4° C.

Above analysis gives an idea to the local weather forecasters that if any precipitation is expected over the station during next 24 hrs, there are about 70% or more chances of its being in the form of snow, if the minimum temperature of the day had been 1° C or less. It is most likely to be in the form of liquid precipitation if the minimum temperature of the day had been 3° C or more.

Temperatures at each synoptic hour during the day [0830, 1130, 1430 and 1730 hrs (IST)] were then analyzed (Fig. 3) to find their relationship with the type of precipitation in very short range (subsequent 3 hours). It has been found that when dry bulb temperature is <2° C almost all precipitation, if it occurs during the next 3 hours is in the form of snow. There are almost equal chances of liquid or solid precipitation when the temperature is between 2 and 3° C. The chances of precipitation in the form of snow decrease to less than 10% at temperatures > 5° C.

Cloud amount and relative humidity were also studied at the synoptic hours, before the occurrence of precipitation to find out whether they could give any indication about the type of precipitation that is likely to follow. No significant difference was noticed in the cloud amount and humidity between both types of precipitation. However average humidity was found to be slightly on the higher side in cases of snowfall (88%) than in case of rainfall (81%).

4. It can be inferred from the study that

(*i*) In case of presence of a WD and cloudiness, if the minimum temperature of the day is 1° Celsius or less, any precipitation during the subsequent 24 hours is most likely to be in the form of snow.

(*ii*) There is hardly any chance of occurrence of snowfall at the station during the day if the minimum temperature during the morning had been 4° Celsius or more.

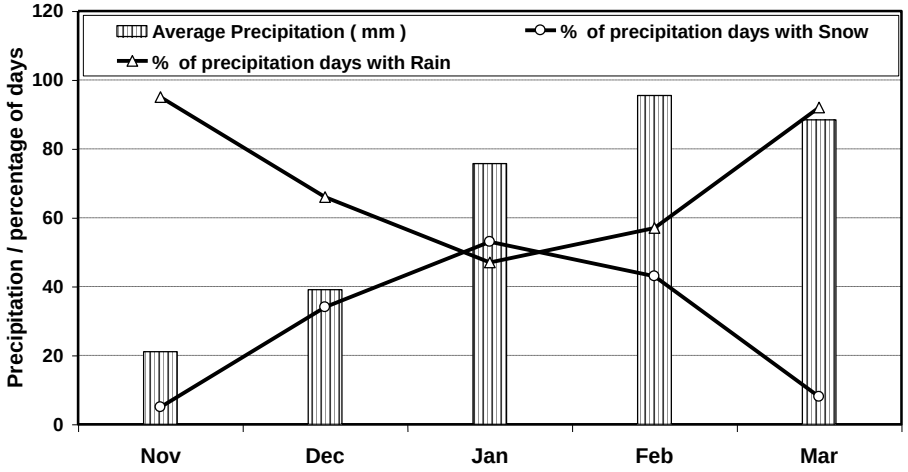

Fig. 1. Average precipitation and the percentage of precipitation days with rain/snow

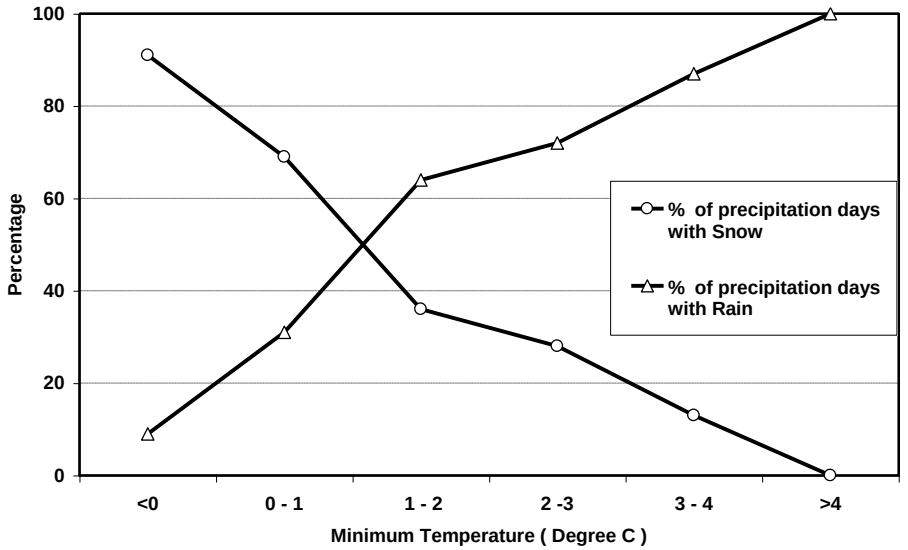

Fig. 2. Percentage of precipitation days in the form of rain or snow as related to minimum temperature of the day

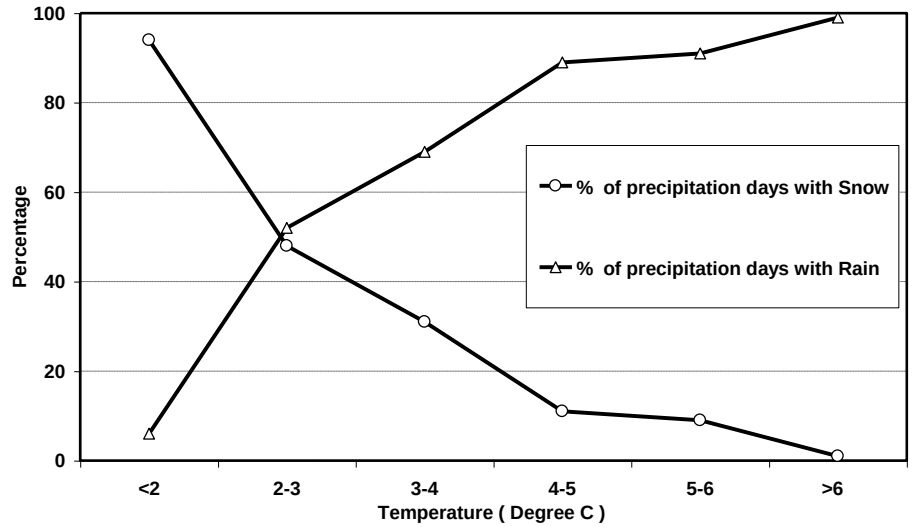

Fig. 3. Percentage occurrence of rain or snow as related to the dry bulb temperature at the synoptic hours preceding the precipitation

(*iii*) Similarly the dry bulb temperature at a synoptic hour can also be taken as a reliable indicator of whether the precipitation till the next synoptic hour will be in the form of rain or snow.

(*iv*) The analysis can help the local forecaster to indicate the concerned state/municipal authorities, public and media whether the precipitation over Shimla during the day will be in the form of rain or snow.

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MANMOHAN SINGH
S. C. BHAN*

Meteorological Centre, Shimla, India
**Regional Meteorological Centre, New Delhi, India*
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