Western Region Technical Attachment
No. 92-32
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NMC HEAVY SNOW QPFs

[Editor's Note: One of the lab sessions conducted at the recent Winter Weather Workshop discussed heavy snow forecasting. This Technical Attachment (TA) highlights some of the ideas presented in this lab which was led by Bruce Terry of NMC, Meteorological Operations Division (MOD). Furthermore, this TA provides some insights on how NMC produces the AFOS QPF products 94Q, 98Q, and 93S. Text discussions of these graphics can be found in QPFPFD (precipitation forecast discussion), and QPFHSD (heavy snow discussion).]

A heavy snow event is defined by NMC as 4 inches or more of snowfall over an area of 6 square degrees latitude. Forecasting a heavy snow event in the West is more difficult than other areas of the country for two reasons: (1) the influences of the terrain on the event, and (2) the lack of knowledge concerning circulation patterns associated with the development of heavy snows in the West. The majority of synoptic patterns which have been identified can be classified as either "digging" or "coming out" systems. Where "digging" refers to a storm moving south of east, and "coming out" refers to a storm moving north of east.

Even though these difficulties exist, NMC has developed several subjective rules to aid in producing wintertime QPFs for the West. These rules are as follows:

1. The greatest predominance of heavy snow usually occurs under an area bounded by the -20°C and -30°C isotherms at 500 mb.

2. For "digging" events, the greatest probability of heavy snow is 4° to 5° latitude downstream and 3° left of the 500 mb vorticity maximum track. See Figure 1 for a composite 500 mb pattern of this type.

3. For "coming out" events, the greatest probability of heavy snow is 3° to 5° latitude downstream and 3° left of the 500 mb vorticity maximum track. A secondary area of maximum snows exists about 7° latitude downstream and 1° to 2° left of this track. See Figure 2 for a composite 500 mb pattern of this type.

4. Heavy snows usually occur between 5340 m to 5460 m thickness values.

Aside from the "digging" and "coming out" system types, another type called the "Pacific Northwest" situation has been documented. The "Pacific Northwest" type predominately generates heavy snowfall amounts in Washington State. The rules for this type differ from the other western types by: (1) a strong correlation with the vorticity center maximum and the heavy snow area does not exist (unlike the "digging" and "coming out" types), (2) the 500 mb low center is about 10° latitude distance from the heavy snow area, (3) the snowfall area occurs between 5280 m and 5400 m thickness values, and (4) the snow is usually associated with a warm advection pattern. See Figure 3 for a composite 500 mb pattern.

For a heavy snow event, NMC expects a well-defined mid-level circulation and an accompanying well-defined surface low to exist for a large area of heavy snow to occur in the West. These conditions are much like what is required elsewhere in the United States. Locally heavy snow is usually the result of a weaker, upper-level progressive trough.

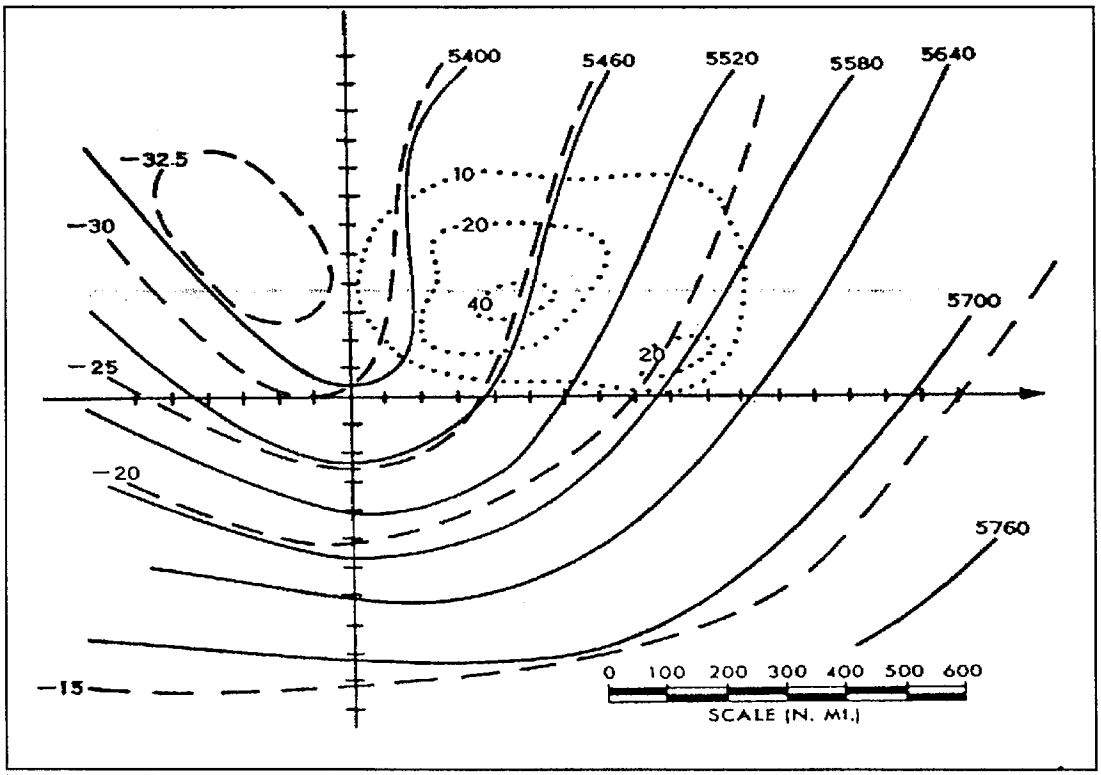

Figure 1 - Composite 500 mb height (solid lines) and temperature (dashed lines) for the "digging" type. Dotted lines represent the percentage of occurance of heavy snow. Tick marks represent degrees of latitude (Russell, 1968).

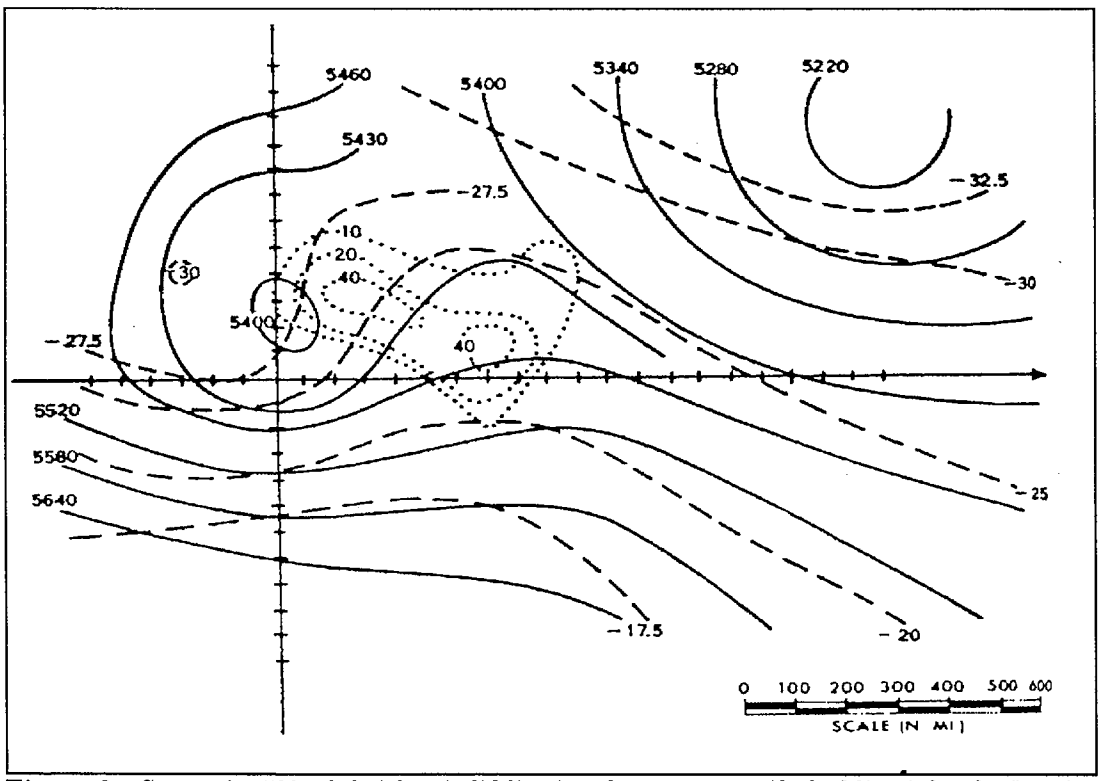

Figure 2 - Composite 500 mb heights (solid lines) and temperature (dashed lines) for the "coming out" type. Dotted lines represent the percentage of occurance of heavy snow. Tick marks represent degrees of latitude (Russell, 1968).

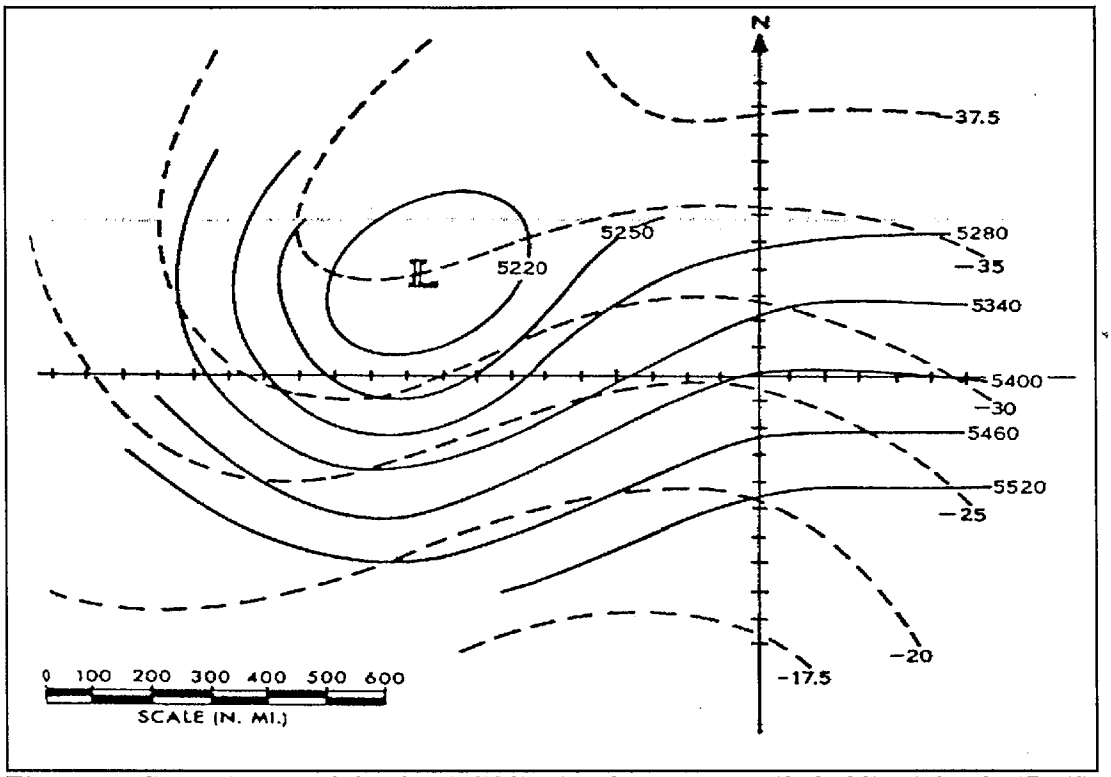

Figure 3 - Composite 500 mb heights (solid lines) and temperature (dashed lines) for the "Pacific Northwest" type. The center of the heavy snow area is the origin. Tick marks represent degrees of latitude (Russell, 1968).

Reference:

Younkin, R.J., 1968: Circulation Patterns Associated with Heavy Snowfall Over the Western United States. Mon. Wea. Rev., Vol. 96, No.12, pp 851-853.