Western Region Technical Attachment
No. 90-08
February 27, 1990

WHY IS IT NOT SNOWING?

As noted in Western Region Technical Attachment (WRTA) 90-07, the quasi-geostrophic (QG) diagnostics program can be a good tool for better understanding initial synoptic situations. This increased understanding can lead to improved short-term forecasts. Another reason for looking at QG diagnostic fields is to prepare for the future when forecast QG fields will be possible from model gridded data.

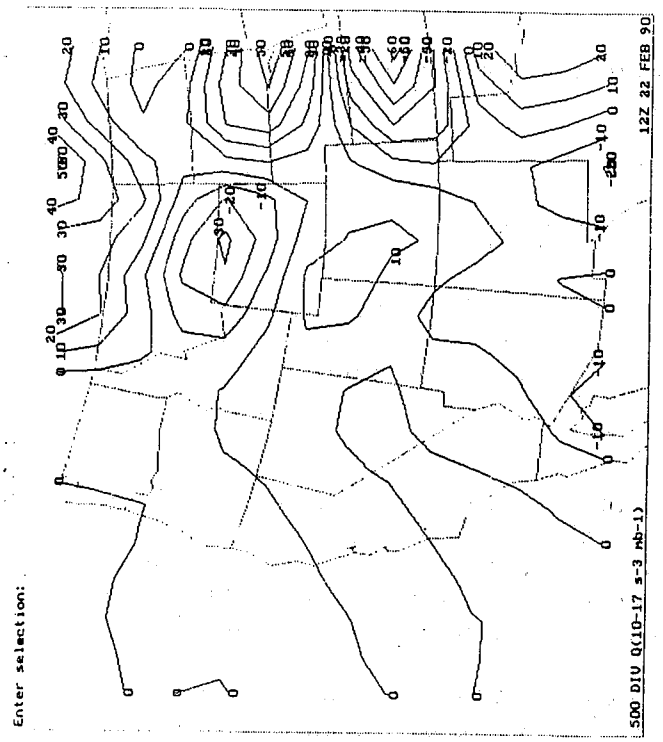
In using the UA program, one technique would be to correlate observed weather with the strength of the DIV Q fields. This is analogous to 1960s "rules of thumb", e.g., using the 12 or greater vorticity or the 500 mb 564 or lower height line to forecast precipitation. However, the UA program conducts a Barnes analysis on a relatively small bounded domain. Thus, forecasters must be very careful in attempting such a direct numerical approach.

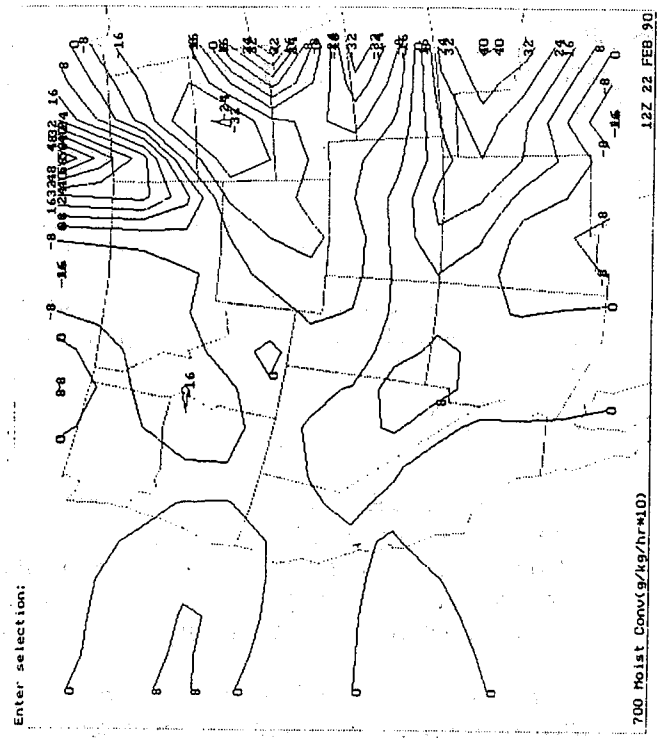
On February 22, 1990, a strong ridge of high pressure aloft was centered along about 120W with moderate northerly flow over the eastern half of the western U.S. In Fig. 1, the 700 mb and 500 mb DIV Q analyses indicated upward vertical motion through a deep layer of the troposphere over Wyoming. The central values at both levels were only about one-half the values analyzed for the significant snow event in WRTA 90-07. Even so, the values of DIV Q were of sufficient magnitude to suggest moderate vertical motion. This was further supported by the analysis of the 300 mb jet axis directly over Lander, with strong wind speed shear over eastern Wyoming under the left exit region of a jet maximum. However, the only weather occurring in Wyoming was patchy low clouds and a few snow flurries.

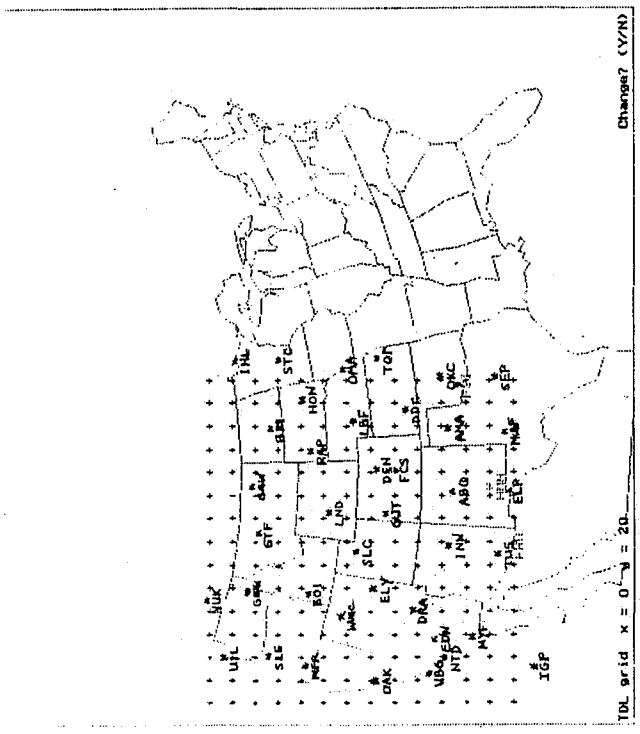
One explanation for the lack of clouds and precipitation is that the wind field and the distribution of moisture were working in conjunction to produce horizontal divergence of moisture and hence counteract the effects of vertical motion. Fig. 1 shows that divergence of moisture was in fact occurring at 700 mb. While not shown, analyses at other levels indicated similar patterns.

Fig. 2 depicts the effects on the analyses when the UA program grid is moved northward. This results in the Barnes analysis using several additional Canadian observations upstream from Wyoming. The overall patterns of DIV Q at 700 and 500 mb in Fig. 2 are similar to those in Fig. 1, but the amplitudes have changed significantly and the sign of the field has reversed over southern Montana, as the area of Q vector convergence in Wyoming shrank. Also note the anomalous field in Canada due to boundary problems. As shown in Fig. 2, the strength of the convergence of the Q vectors appears to be only about 20 percent of the strength analyzed for the major snow event discussed in WRTA 90-07. Thus, Fig. 2 graphically illustrates the sensitivity to available observations of the UA analysis routine.

The best method for minimizing adverse effects is to position the UA grid so that the geographic area of interest makes optimum use of available observations, and at the same time the area is as far removed from the boundaries as possible. Unfortunately, this technique will not work very well along the coast, but as illustrated in Fig. 1 and 2, this extra step will be well-worth the time of inland forecasters who are trying to correlate observed weather with the strength of DIV Q fields.


Enter selection:
500 DIV Q(10-17 s-3 mb-1)
12Z 22 FEB 90


Enter selection:
700 Moist Conv(g/kg/hr*10)
12Z 22 FEB 90


Change? (Y/N)
TDL grid x = 0 y = 20

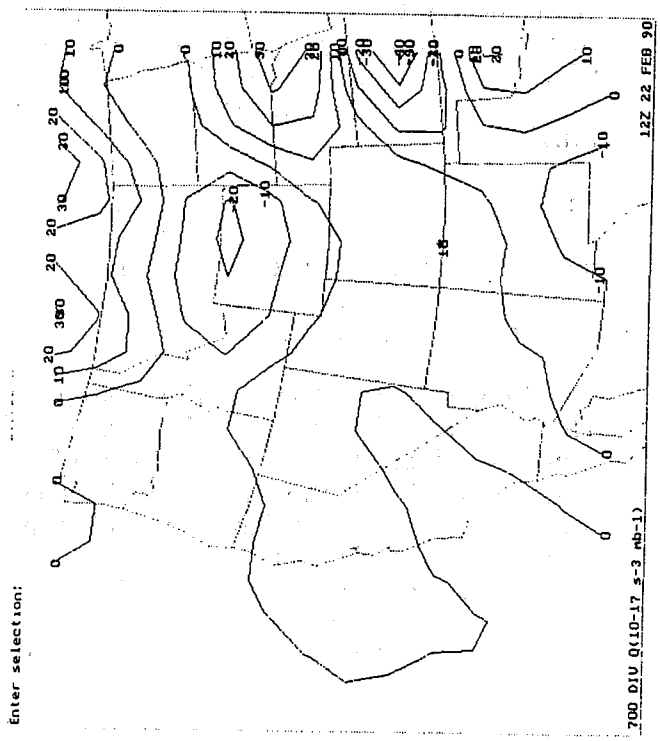
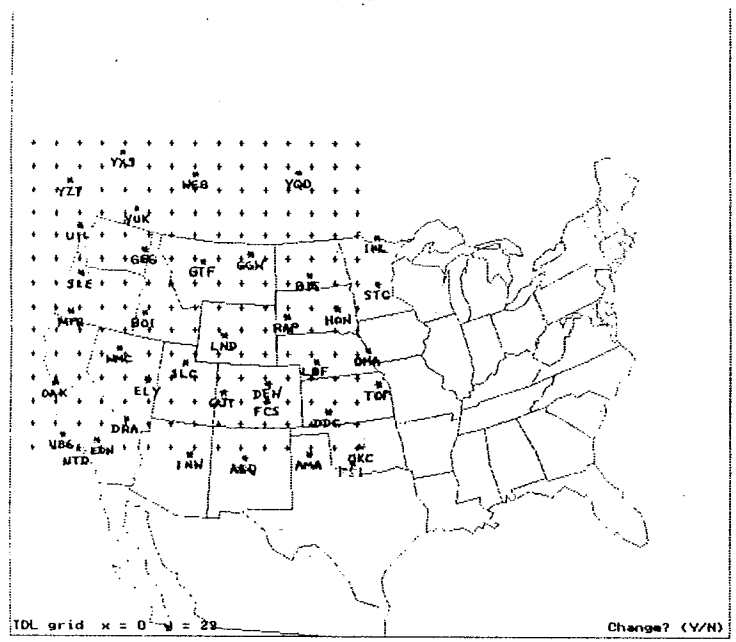
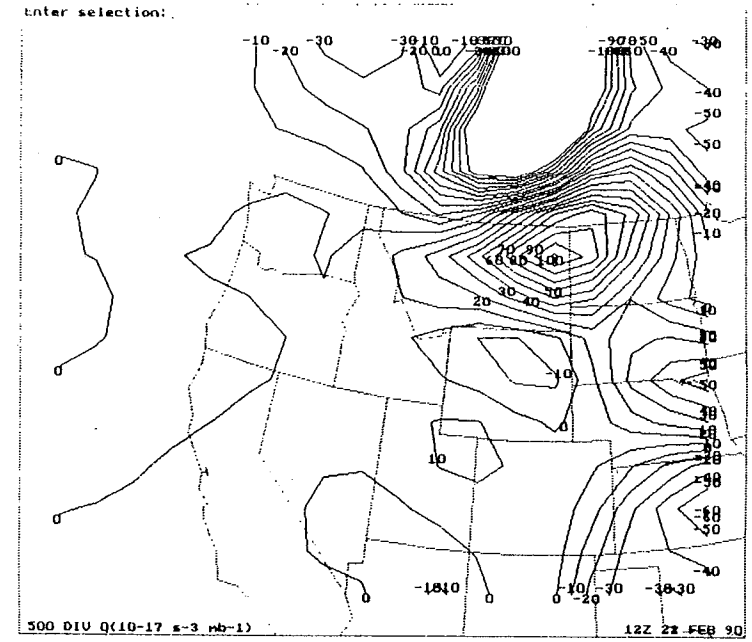
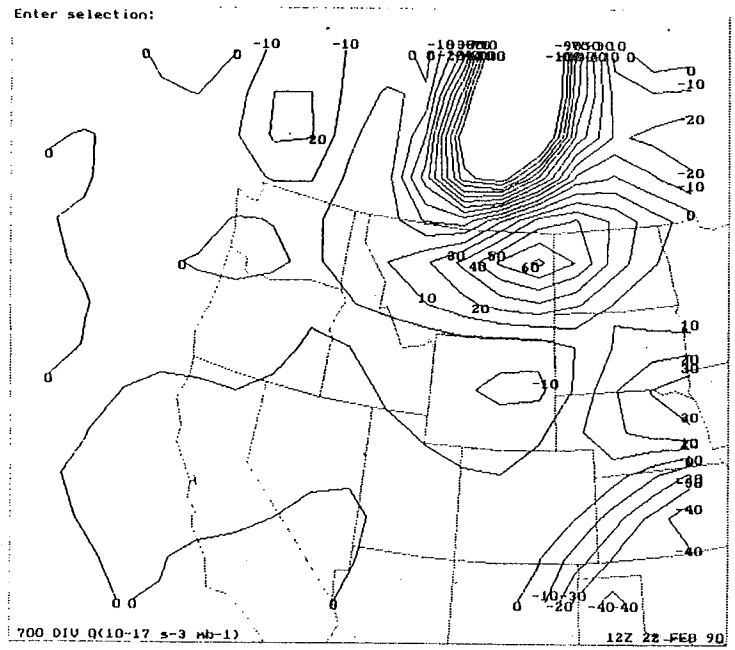

Enter selection:
700 DIV Q(10-17 s-3 mb-1)
12Z 22 FEB 90

Figure 1


YXJ
YZT
WEB
YQD
YUK
GEG
GTF
GGW
INL
SLE
BIL
STC
MSO
BOI
RAP
HON
LND
SLC
LBF
OMA
ELY
OAK
GJT
DEN
FCS
TOP
DRA
ABQ
INW
AMA
OKC
TDL grid x = 0 y = 29
Change? (Y/N)


Enter selection:
500 DIV Q(10-17 s-3 mb-1)
12Z 22 FEB 90


Enter selection:
700 DIV Q(10-17 s-3 mb-1)
12Z 22 FEB 90

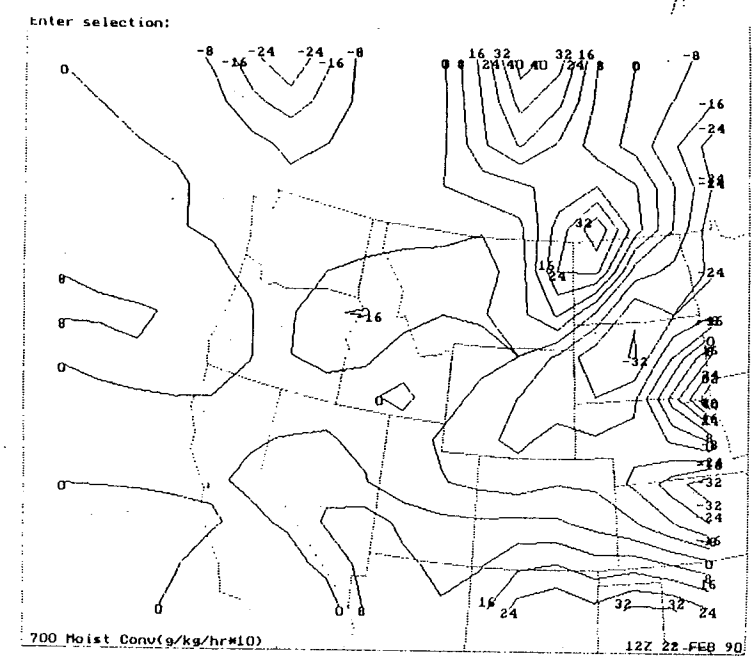

Enter selection:
700 Moist Conv(g/kg/hr*10)
12Z 22 FEB 90

Figure 2