Western Region Technical Attachment
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ARE ALL GRIDDED DATA SETS EQUAL?

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This Technical Attachment compares PCGRIDS data with the GRIB data set used by the Forecaster Application and Imagery System (FAIS) software. Data resolution differences are presented, with some important insights for properly utilizing these new data sets. Understanding the details behind gridded data will aid you in applying this "tool" to your forecasts.

Gridded Data Background and Details

Gridded data used in the Western Region all originates from NMC models, but various formats exist for transferring these data outside of NMC. A WMO data format, called GRIB (**GRI**dded **B**inary), was developed in an effort to standardize the dissemination of these data sets. The gridded data used by FAIS originates from GRIB files produced by NMC. In comparison, the PCGRIDS data set has its own unique format. Both data sets contain similar significant digits for each grid point, so the accuracy of the data values is about the same.

However, two major differences exist between PCGRIDS and FAIS data. They are: (1) the grid spacing resolutions, and (2) the geographical area covered by the grid. PCGRIDS data has a grid spacing of about 170 km, and FAIS data about 80 km, but the horizontal spacing of data points is latitude and model dependent. Table 1 shows some of these dependencies for the FAIS and PCGRIDS data.

latitude →	60N	50N	40N	30N
FAIS ETA	91	86	80	73
FAIS NGM	91	86	80	73
FAIS AVN	381	361	335	306
FAIS MRF	381	361	335	306
PCGRIDS ETA	191	180	168	153
PCGRIDS NGM	191	180	168	153

Table 1 - FAIS and PCGRIDS data point distances (in km).

At 60°N the grid spacing is about 91 km. Moving further south causes the grid spacing to approach 80 km. Thus, systems in the southern portion of the region will contain more detail than northern systems. This statement does not imply that weather in the south will appear stronger than in the north, but that the analyses of weather further south will be defined better. The model physics properly maintains the intensity of the system regardless of its location. Figure 1 contains the FAIS grid point locations for the NGM and Eta models on the Western Region background, and illustrates this point. About 55 grid points reside in both Arizona and Montana, although Montana is 32,000 mi^2 bigger than Arizona.

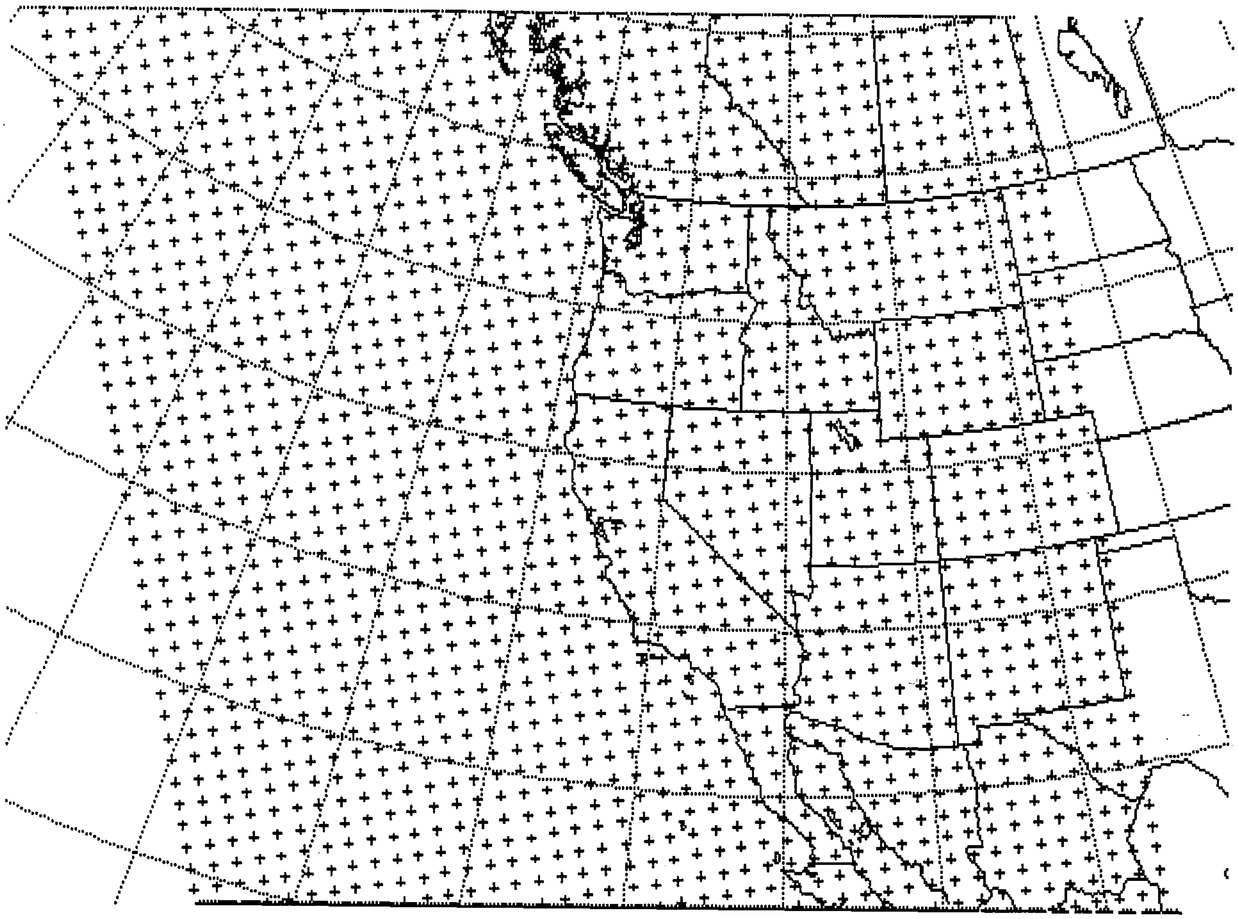

Figure 1 - Eta and NGM grid points on a standard FAIS Western Region background.

The second difference between the two data sets is the geographic coverage. Figure 2 depicts the FAIS and PCGRIDS data domains. The FAIS data extends further west and north than the PCGRIDS data set. However, the FAIS data only contains the western United States to minimize transmission times. Upon close examination of Figs. 1 and 2, you will notice data points exist further north and south of the Western Region background. This background map is the one used in the default FAIS gridded data configuration, so your site is downloading some data which is not displayed. These background boundaries are configured on site, and can be modified if you wish to extend the data domain towards the north or south.

How Resolution Affects Your Products

Figures 3 and 4 depict the height and vorticity fields from the NGM November 10, 1993 12Z run for FAIS and PCGRIDS data. The weather situation for this day has a low dropping down the West Coast with each of the models having a slightly different solution on its forecast track. Nothing special exists in this case, other than it represents a typical forecasting situation. Without much examination, two differences in these charts are evident: (1) the vorticity maximums in Fig. 3 are generally stronger than the PCGRIDS chart, and (2) the FAIS vorticity field is substantially noisier.

Both of these observations are a direct result of the grid spacing differences between the two data sets. The smaller grid spacing in the FAIS data set allows more extreme maximum and minimum values. A similar situation existed between the NGM and LFM vorticity fields. The NGM always had higher vorticity values because of the finer grid. This same condition exists between the FAIS and PCGRIDS data. The FAIS contouring routine also provides the maxima/minima values and locations, which emphasizes this distinction between the packages.

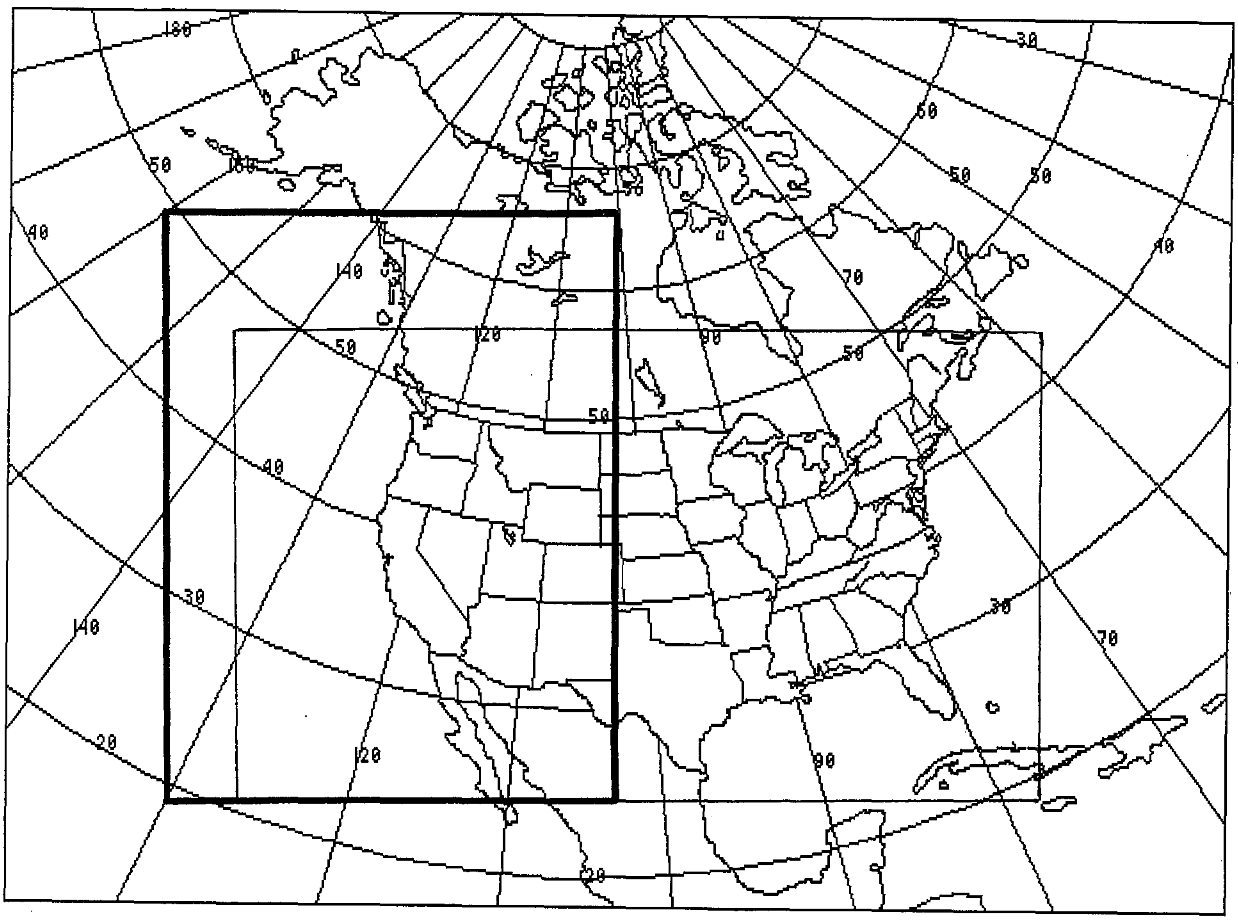

Figure 2 - Domains for FAIS (bold) and PCGRIDS (narrow) data sets.

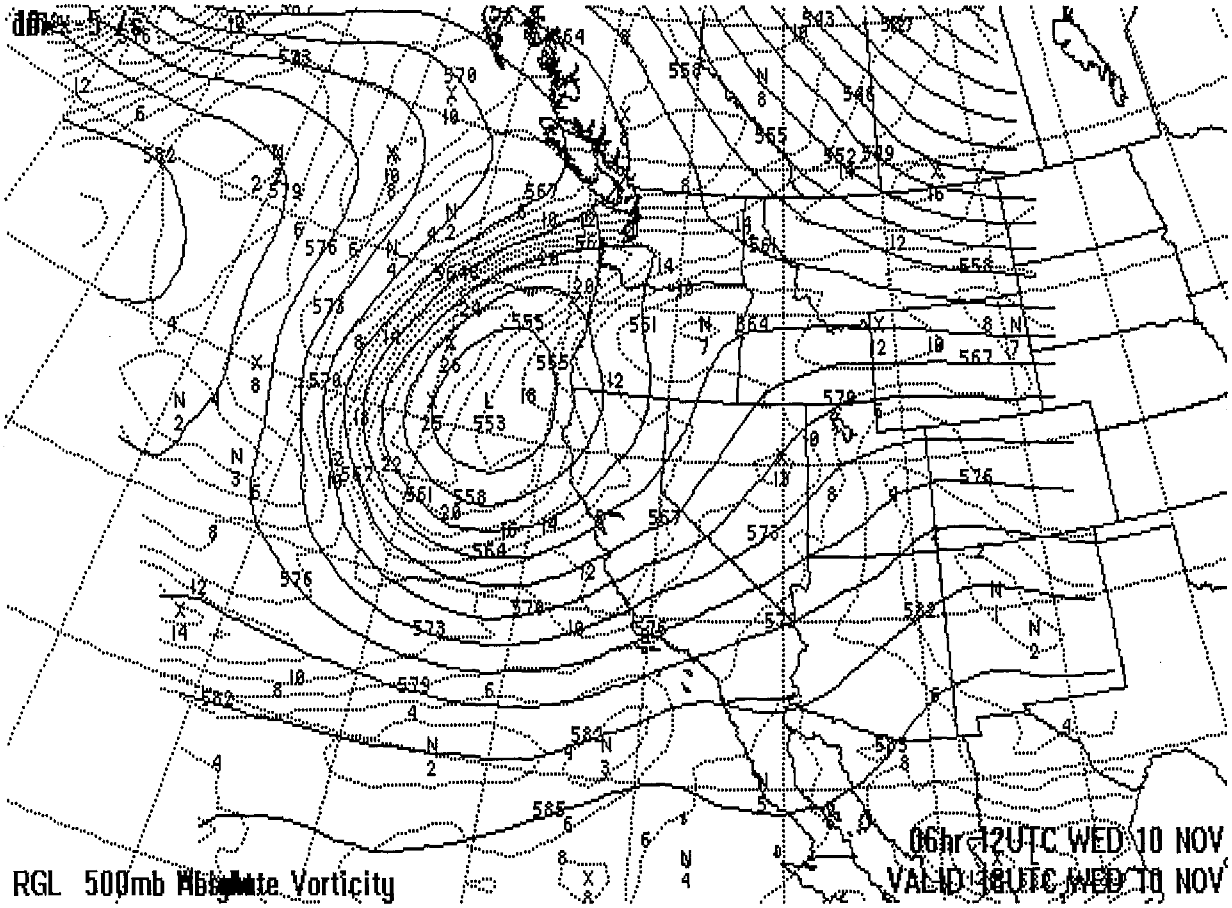

Figure 3 - FAIS generated heights and vorticity 6 hour forecast valid 18Z November 10, 1993.

The height fields on the two charts are almost identical, but the details of the vorticity fields are significantly different. The "kinky" vorticity field in the FAIS chart is a real part of the analysis and not fictitious data. These added details can make a quick glance at the chart harder to understand, but provide excellent resolution of smaller scale features. An example of this fact can be seen by examining the short wave off the California coast near Vandenberg. Both charts show this feature, but the FAIS depiction is much more detailed in describing the characteristics, orientation, and intensity.

When examining any Eta or NGM vorticity loop through 48 hours on FAIS, you will see the "kinks" smooth out towards the end of the loop. The smoother fields at longer time steps are a side effect of the model dispersion used to dampen smaller scale features. Thus, the higher resolution data provides insights into model characteristics never before available.

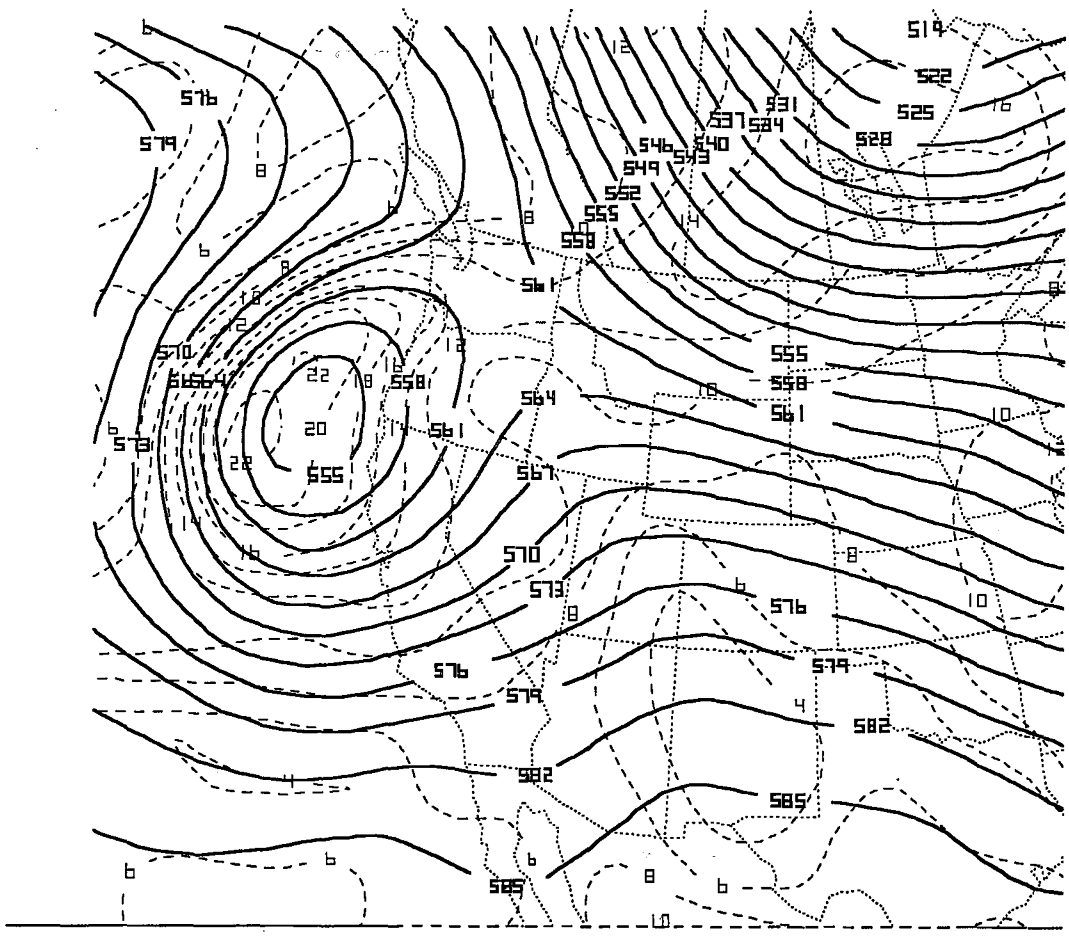

Figure 4 - PCGRIDS generated height and vorticity 6 hour forecast valid 18Z November 10, 1993.

Switch now to the divergence of Q fields found in Figs. 5 and 6. Both of these charts use a 300-700 mb layer calculation to get Q-vectors. The divergence of these vectors is calculated normally. Figure 6 is in units of 10^{-17} m /(s kg), so the labeling between the two charts is slightly different, although the contour intervals and values are the same.

As in the previous set of charts, the FAIS field has significantly better resolution. Notice that Q-vector convergence areas associated with the vorticity field ripples are carried through to Fig. 5. On the other hand, the PCGRIDS chart captures the essence of the Q-vector convergence associated with the low, but lacks detail elsewhere.

Whereas the FAIS vorticity field is realistic and a valuable asset to operations, the FAIS divergence of Q chart can be misleading. Q-vectors are derived under quasi-geostrophic theory; thus, quasi-geostrophic assumptions must be satisfied. One of these assumptions is synoptic scale (about 1000 km) motion (Holton, 1992). The ripples in the vorticity field and the associated Q-vector convergence areas do not satisfy this assumption. Therefore, the PCGRIDS chart is a more realistic depiction of synoptic scale, quasi-geostrophic fields, because the lower data resolution helps filter-out these mesoscale and smaller features. Cases could also exist where PCGRIDS exhibits the same phenomena as FAIS does in this case.

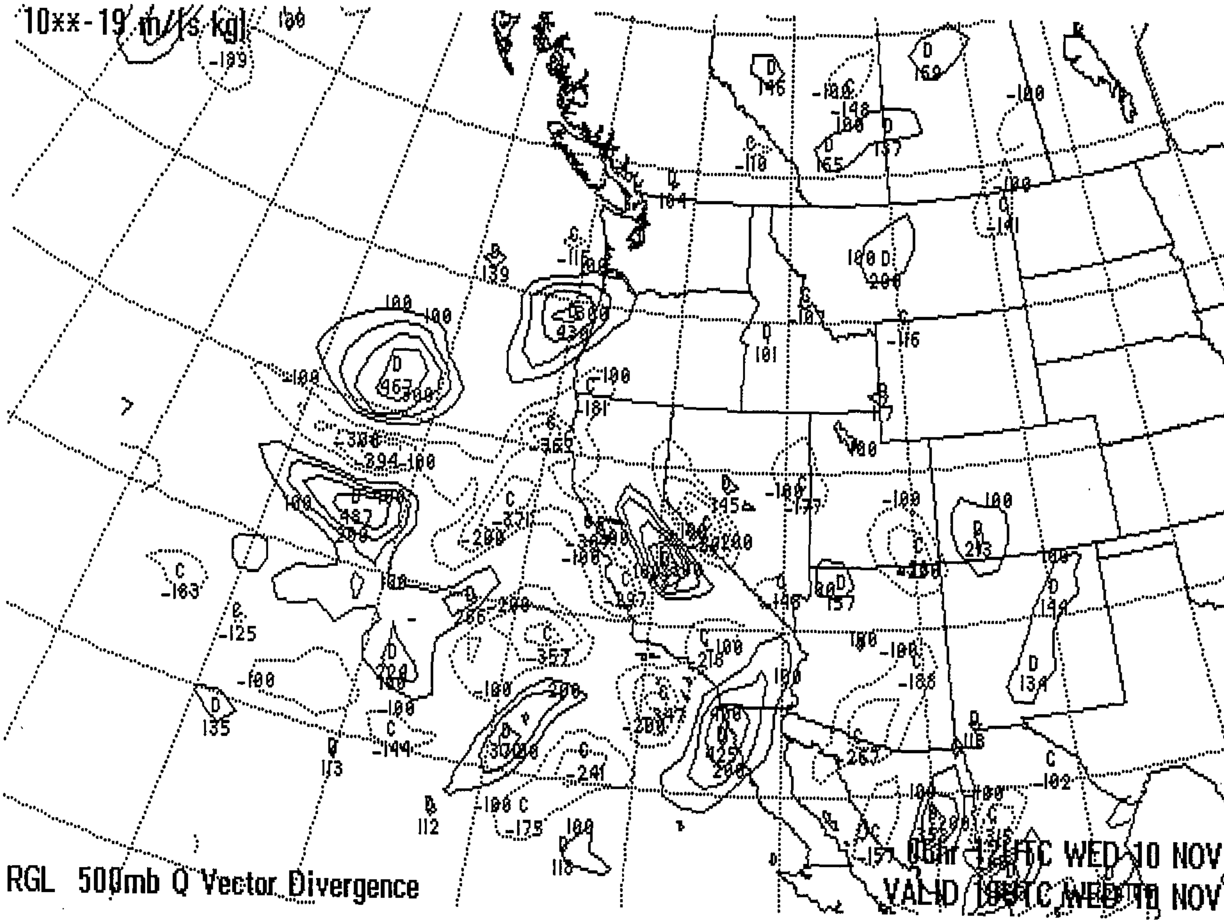

Figure 5 - FAIS generated 500 mb Q-vector divergence for the 700-300 mb layer valid 18Z November 10, 1993.

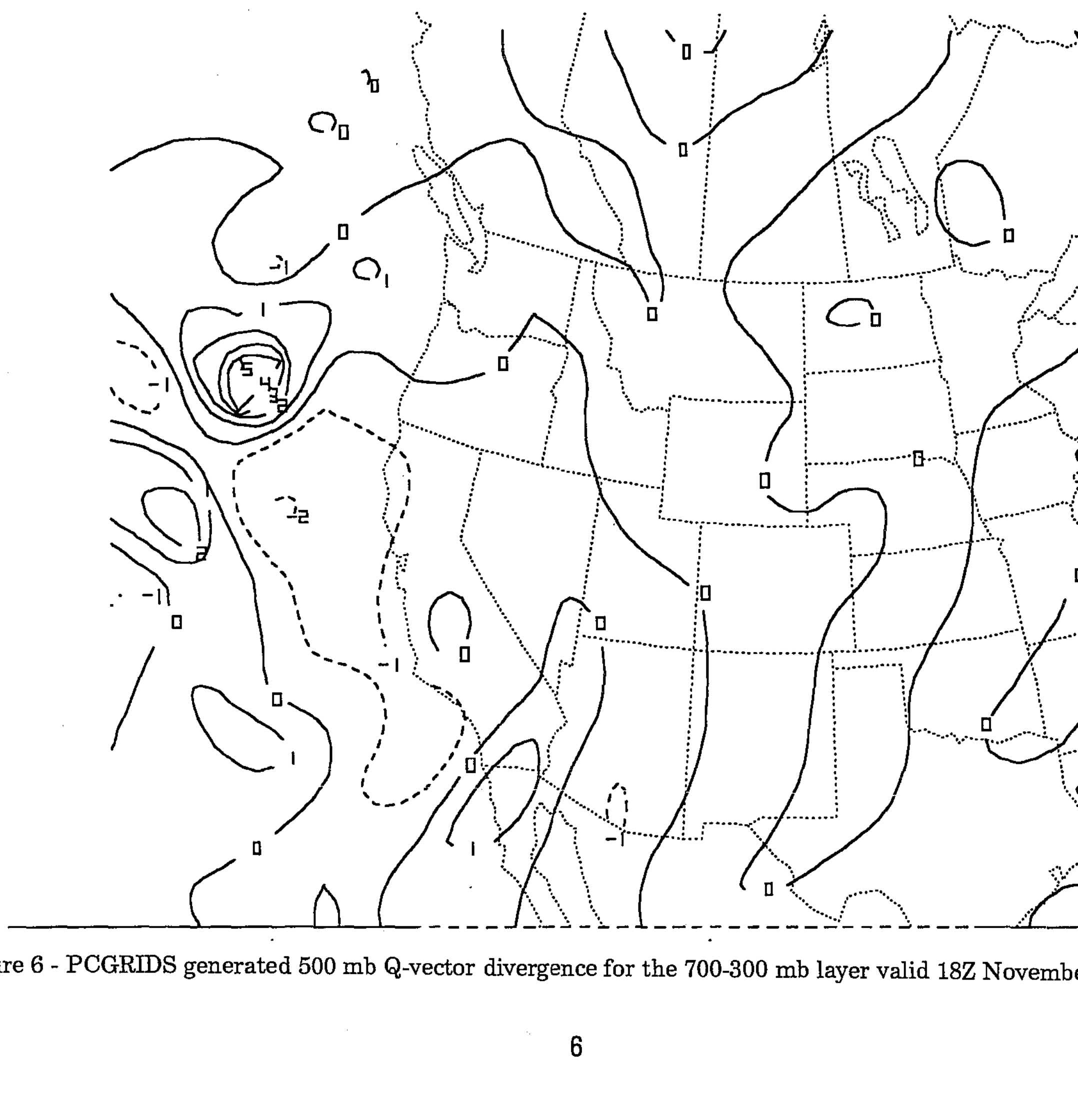
Figure 6 - PCGRIDS generated 500 mb Q-vector divergence for the 700-300 mb layer valid 18Z November 10, 1993.

On the other hand, isentropic analyses are valid for all scales of motion making them better suited for higher resolution data sets. Many gridded data charts require quasi-geostrophic theory assumptions, so care must be taken when higher resolution data are available. A higher resolution data set can be both a blessing and a curse when you don't consider the physical principles and assumptions behind the fields.

In Conclusion...

Are all gridded sets equal? The answer is a definite no. Higher resolution gridded data can provide detailed information for generating timely forecasts, but it can also be misleading. Likewise, lower resolution data do not provide the detail, but some fields may be represented more realistically. Both the FAIS and PCGRIDS data sets are useful, so one is not distinctly better than the other. Proper utilization of each depends on the weather situation and your understanding of the meteorology behind the charts.

References

Holton, J. R., 1992: An Introduction to Dynamic Meteorology. Academic Press, 511 pp.

Western Region SSD, 1993: Processing NMC Gridded Data. Western Region FAIS Technical Note #8, August.