

Cyclone tracks and positions in ECMWF forecasts and analysis for September and October 1980

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1. INTRODUCTION

In ECMWF Monthly Forecast Reports from edition number 3 March 1980, the positions of cyclones and anticyclones in the ECMWF analyses and forecasts in the Europe-Atlantic area are discussed. For the present study, using the ECMWF VERIFY Program (E. Oriol, 1979) positions of cyclones (see definition of a cyclone below) in the forecasts to 10 days and in the verifying analyses were plotted on hemispheric charts (Northern Hemisphere only) for every 12 hour time step. The ten day forecast period was divided into two periods, one from $D+\frac{1}{2}$ to $D+5\frac{1}{2}$, the other from $D+5\frac{1}{2}$ to $D+10$ (the $D+5\frac{1}{2}$ step is overlapping). For each period a separate map was produced (See Figure 1a, b, c and d), Figures 1a and 1c show forecasts, 1b and 1d show verifying analyses corresponding to 1a and 1c respectively. A letter with a subscript number shows the location of the cyclone in the forecast or in the analyses, and the time step is indicated by the subscript number.

A cyclone is defined as a grid point minimum value in geopotential height which is 20 m. deeper than the grid points in the surrounding area within a distance of seven grid intervals. Twenty meters is an arbitrary number for the definition of a cyclone and can be changed. The distance between grid points is 2.5 degrees in latitude and 5 degrees in longitude (See Figure 2).

The method followed to find a cyclone track consists of calculating the possible situation of a low in the next half day from the winds at 500mb, and the last track if known. If a set of lows are identified as belonging to the same track, they are plotted with the same letter and listed together. However, sometimes, although the cyclones at consecutive time steps belong to the same track, the same letter is not used, i.e. the program cannot always judge whether it is following the same track or not. For example,

figure 1a indicates two cyclone tracks near the Aegean Sea and the Black Sea (Near 40N, 30E), indicated by the letters P and G. An examination of the corresponding 1000 mb forecasts charts shows only one cyclone track.

For September 1980, the cyclone positions in the forecasts and in the verifying analyses were computed using this technique. The positions of the cyclones in succeeding time steps were joined, and cyclone tracks have thus been constructed for the forecasts and for the verifying analyses (Figures 3 to 6). Also in the D+4, D+7 and D+10 forecasts which were made in September and October 1980, and in the corresponding verifying analyses, the positions of the cyclones were plotted (Figures 7 to 12).

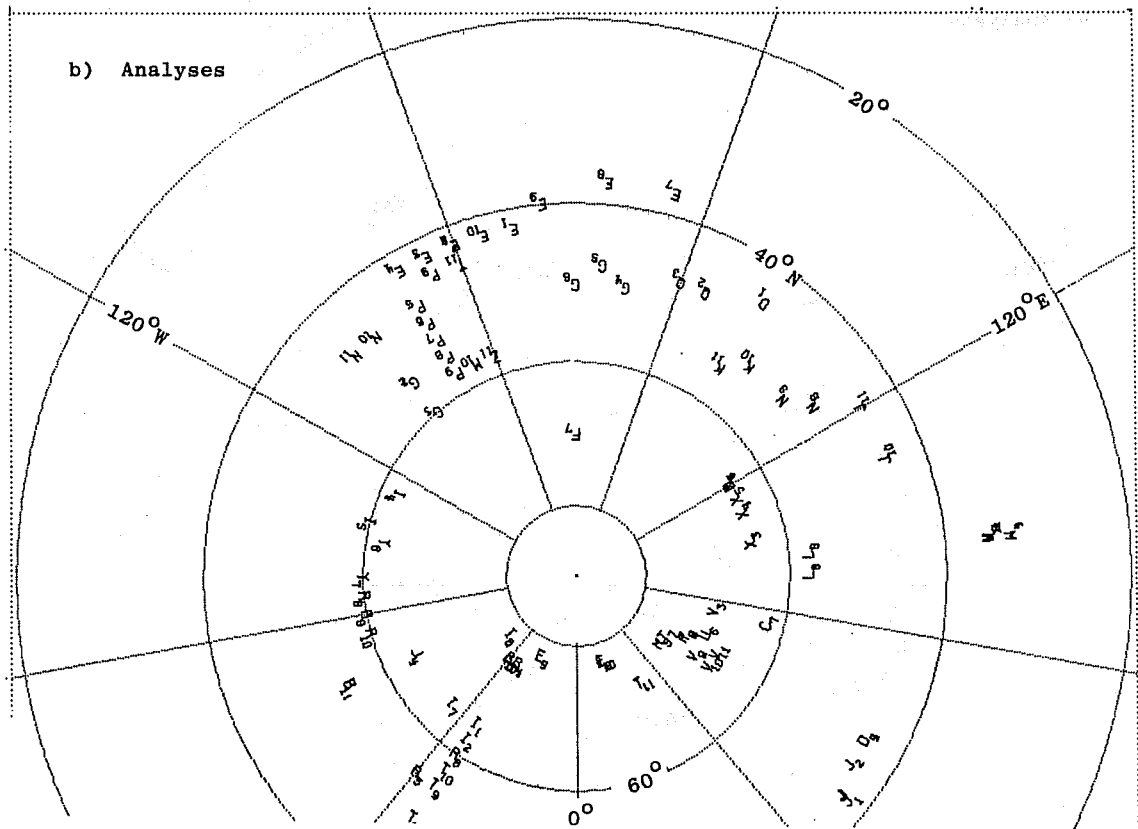
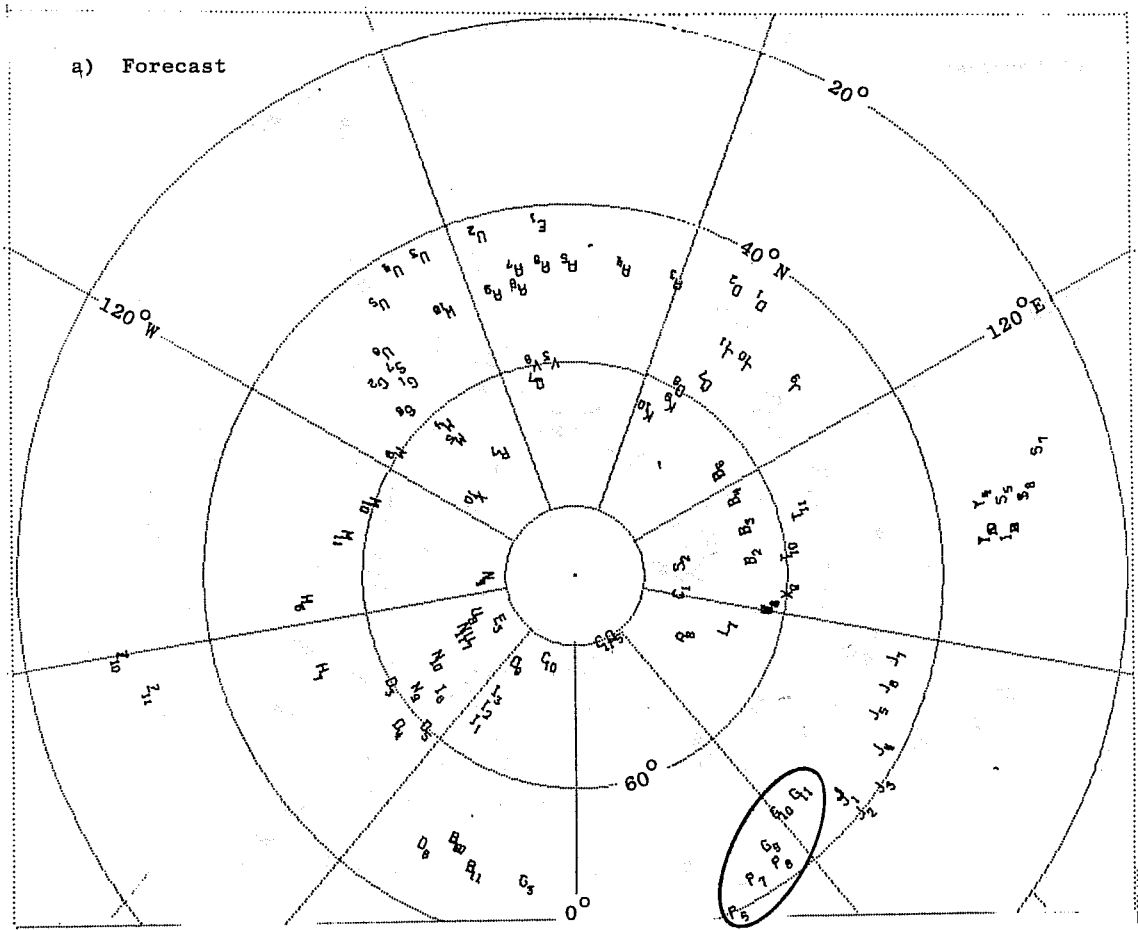


Fig. 1 Cyclone tracks from 80103112 A31 0.5 to 5.5 days 12H step

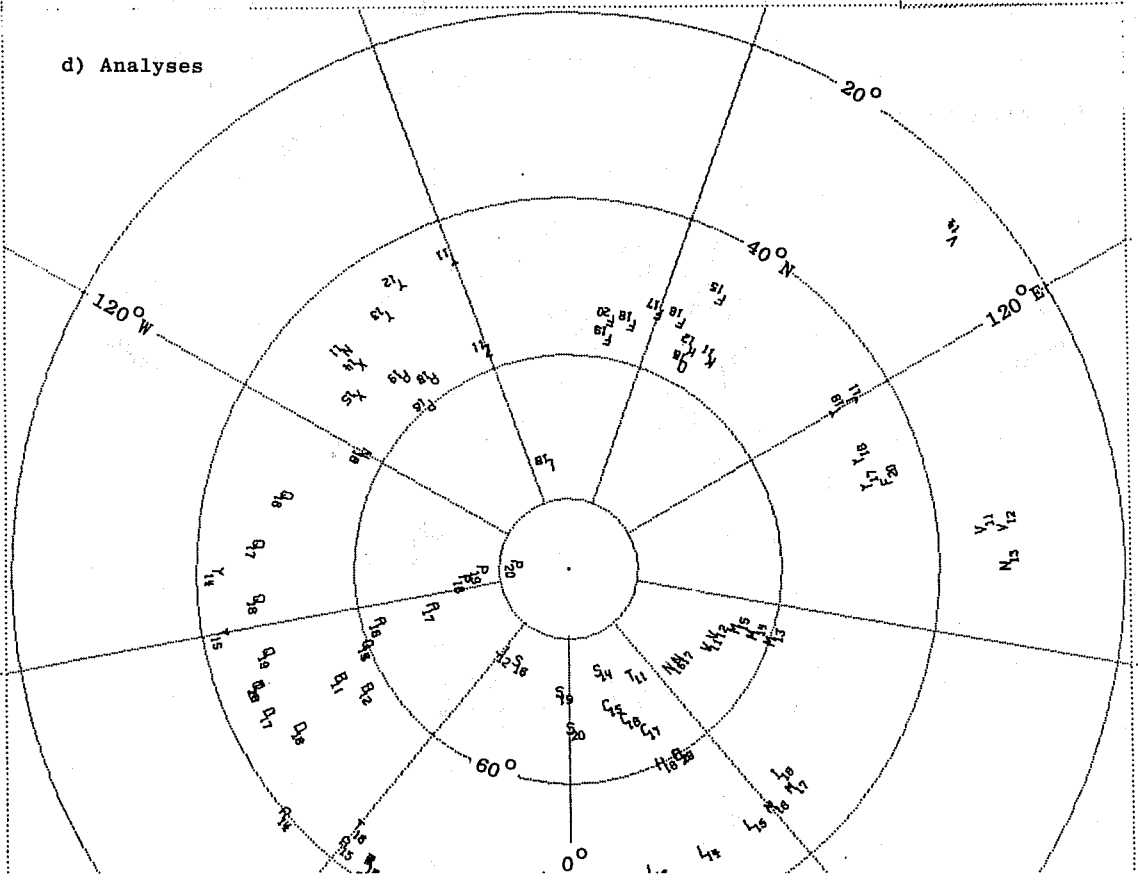
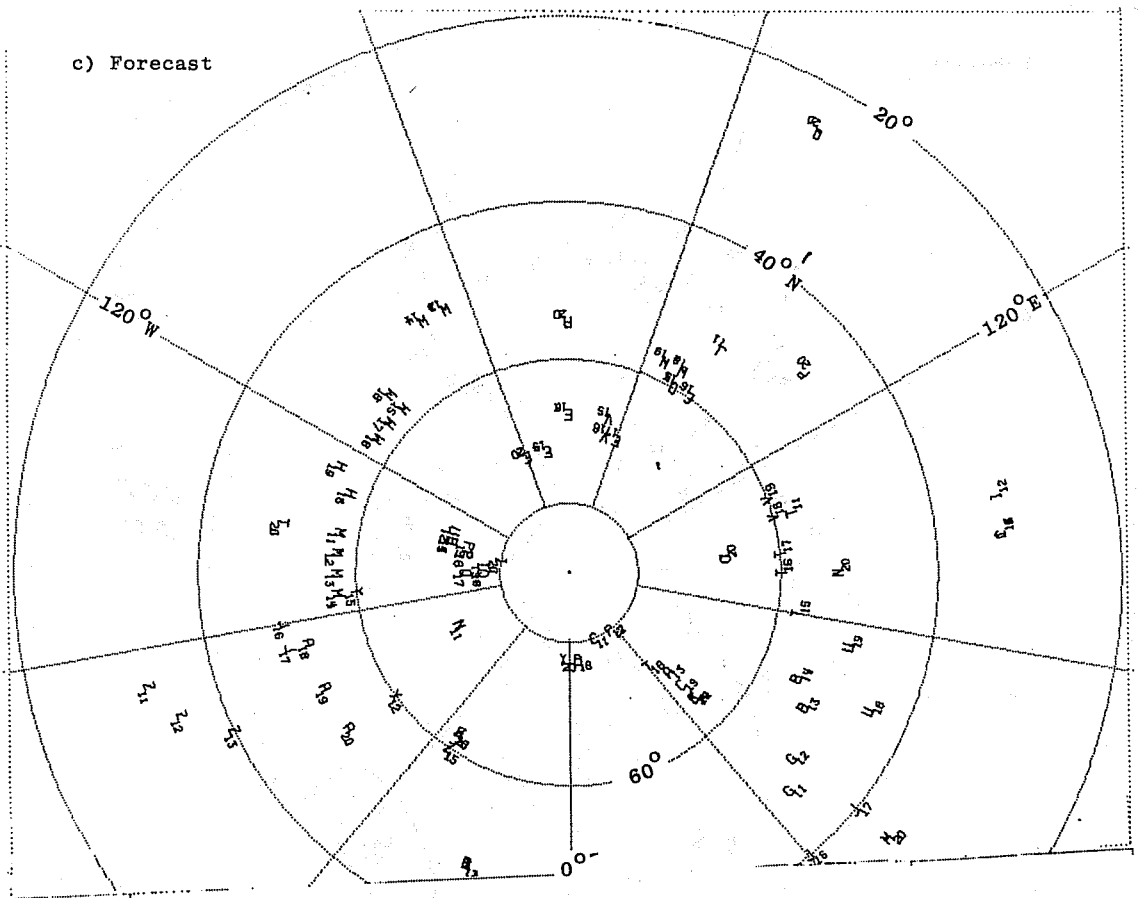


Fig. 1 cont. Cyclone tracks from 80103112 A31 5.5 to 10 days 12H step

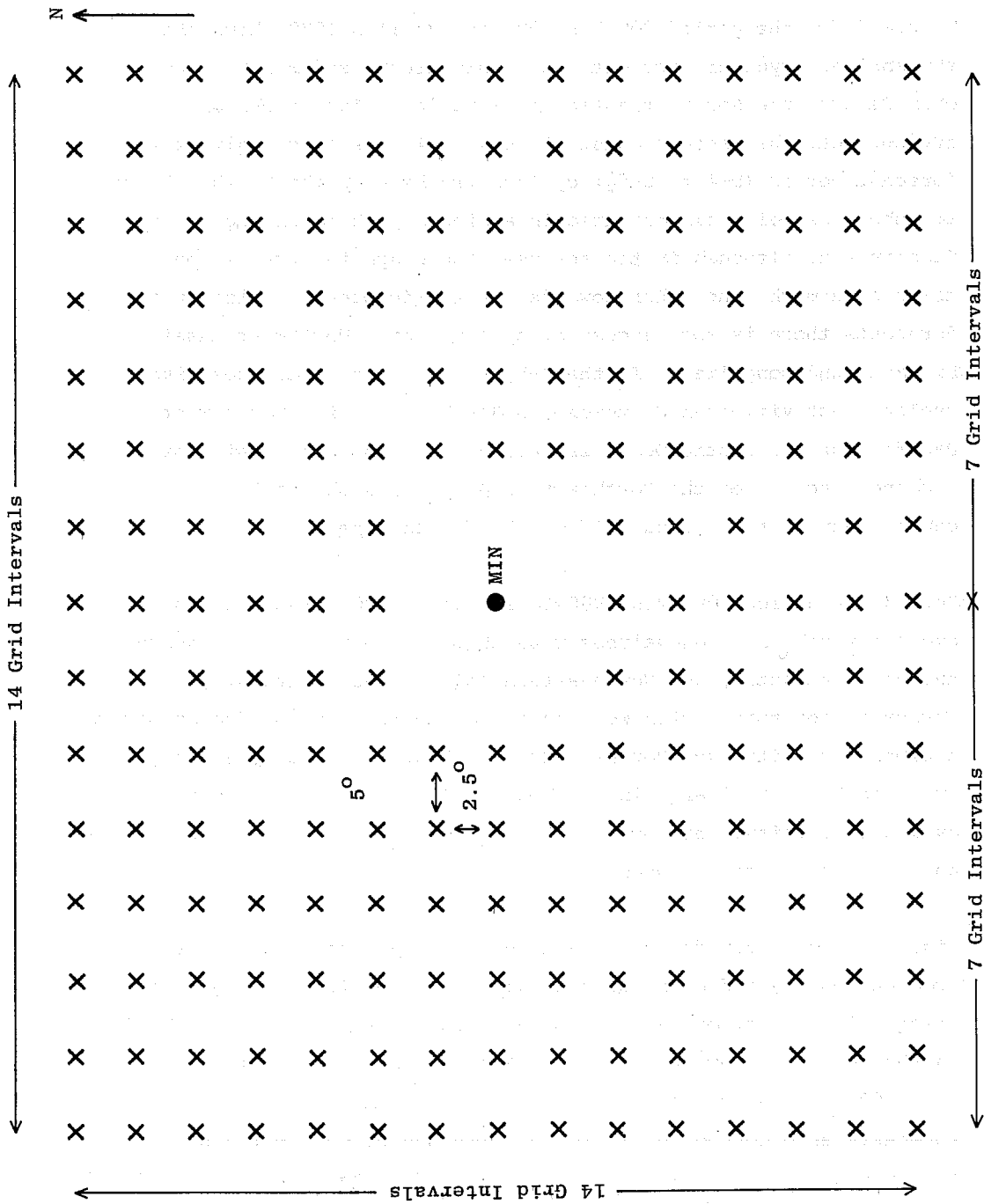


Fig. 2 Searching area

2. CYCLONE TRACKS AND POSITIONS IN THE FORECASTS AND
IN THE VERIFYING ANALYSES FOR SEPTEMBER, 1980

Figure 3 for the period 00Z 2.9.1980 to 12Z 11.9.1980 shows that in the analyses cyclonic activity is mainly around and North of 60N over Canada, the North Atlantic and Siberia. Two tracks are also evident near the Eastern Coast of Asia. In the first half of the forecast period (D+ $\frac{1}{2}$ to D+5 $\frac{1}{2}$) cyclone tracks over the North Atlantic are shown as being concentrated in a single path extending towards Scandinavia, although in the analyses there are two tracks, one towards Denmark, the other towards the Arctic Ocean. Also in the forecasts there is some excess of cyclones over Northwest Russia, Finland, and Mongolia. In the D+5 $\frac{1}{2}$ to D+10 forecasts excessive cyclonic activity over Northwestern Russia, Siberia, North Western Pacific and the Arctic Ocean is evident. A southward shift of cyclone tracks over the Northeastern U.S.A. and the North Atlantic can be seen in the second half of the forecast period.

During the period 00Z 12.9.1980 to 12Z 21.9.1980 (Figure 4) the cyclone tracks in the analyses were mostly positioned over Canada, the North Atlantic, and Northeastern Asia. The D+ $\frac{1}{2}$ to D+5 $\frac{1}{2}$ forecasts for this period were quite successful, except for excessive cyclonic activity over Northern Europe, East of the Caspian Sea, and over Alaska. Similarly in the D+5 $\frac{1}{2}$ to D+10 forecasts an excess of cyclonic activity over Northern Europe, Near 60W, 90E over Russia, and over Alaska can be seen.

Figure 5 shows very few major analyses cyclone tracks, (one starts from Hudson Bay and goes towards East, South of Iceland, here it changes its direction towards the North East, and ends near 80N, 60E; another extends over the Northwest Pacific), for the period 00Z 22.9.1980 to 12Z 30.9.1980. In this figure in the D+ $\frac{1}{2}$ to D+5 $\frac{1}{2}$ forecasts an excess of cyclonic activity can be seen North of Afghanistan, East of Japan, over Alaska and to the Northwest of Canada. Almost no cyclones were predicted over the Eastern Atlantic and Europe, in agreement with the analyses in this period. The D+5 $\frac{1}{2}$ to D+10 forecasts for this period predicted excessive cyclonic activity in

many areas; such as, Northwestern Europe, Northwest Russia, Siberia, the North China Sea, the Bay of Alaska, Northwestern and Northern parts of Canada, with a notable Southward shift of cyclone positions over Northeastern U.S.A., Northern Atlantic and Northern Pacific.

Figure 6 shows the cyclone tracks in the analyses for the period 00Z 2.9.1980 to 12Z 30.9.80 in the Northern Hemisphere. According to this figure, cyclonic activity during September 1980 was evident in three main areas in the Northern Hemisphere, firstly, the Northern Part of North America and Northern Atlantic (North of 50N), secondly, Northern Russia (North of 60N), and thirdly, China and Northwestern Pacific.

Figures 7, 8, and 9 show cyclone positions in the forecasts (D+4, D+7, D+10) made in September 1980, and in the verifying analyses. The positions of cyclones in the analyses verifying the D+4 forecasts were captured in a correct way by the D+4 forecasts (see Figure 7). In the forecasts no cyclones are evident over the continent of Europe and the Mediterranean.

Figure 8 shows that the cyclones in the analyses south of 50N over the North Atlantic were not captured by D+7 forecasts. There is a Northward shift of cyclone positions over Northern Pacific, and an excess of cyclones over Alaska are evident in these forecasts. Similarly, Figure 9 shows that the D+10 forecasts did not predict the cyclones south of 50N over the North Atlantic, Western Russia, Northern U.S.A., and Southern Canada, also in these forecasts an excess of cyclones can be seen over Northern Europe and Alaska. Over the Northern Pacific more numerous cyclones were positioned in the analyses than the D+10 forecasts.

3. CYCLONE POSITIONS IN THE FORECASTS (D+4, D+7, D+10)
AND IN THE VERIFYING ANALYSES IN OCTOBER 1980

Figures 10, 11, and 12 depict the positions of lows in the D+4, D+7 and D+10 forecasts made in October 1980, and in the verifying analyses respectively. According to figure 10, in the D+4 forecasts an excess of cyclones over Turkey, China, and Alaska with a Northward shift of cyclone positions over the North Pacific can be seen. Further, the D+4 forecasts did not predict the lows southwest of the Iberian Peninsula, the Continent of Europe, and over Mongolia. Figure 11 shows an Eastward shift of cyclone positions in the D+7 forecasts over the Northern Atlantic, and a northward shift over the Northern Pacific. Also Figure 11 shows that the D+7 forecasts did not capture the cyclones over Europe and the Northern Mediterranean satisfactorily. In Figure 12, in the analyses verifying the D+10 forecasts there are more numerous cyclones over Europe, Mongolia, and near 30W over the Atlantic, although in the forecasts excesses of cyclones over Newfoundland, China, Siberia and Alaska are evident. Also in this figure a notable northward shift of cyclone positions in the forecasts (D+10) over the North Pacific can be seen.

4. CONCLUDING REMARKS

A study has been made using the ECMWF VERIFY program (E.Oriol 1979) to assess the accuracy of the prediction of cyclone tracks in the ECMWF forecasts of September and October 1980. Cyclone tracks in the forecasts for September 1980, and in the verifying analyses, were constructed, and cyclone positions in the D+4, D+7 and D+10 forecasts made in September and October 1980, and in the verifying analyses were plotted on Hemispheric Charts (Northern Hemisphere only), and comparison has been made between the forecasts and the verifying analyses. According to this comparison the following conclusions can be derived:

1. Over Eastern Canada, the North Atlantic and Northern Europe, there is some southward shift of the cyclone tracks.
2. Over the North Western Pacific cyclone tracks are positioned to the North in the forecasts.
3. There is excessive cyclonic activity in many areas including:
 - Japan - China
 - Central Asia and Siberia
 - Southern Russia
 - Northwest Canada and Alaska
 - North of Japan
4. (September only) Cyclones South of 50N in the Atlantic were not captured in the forecasts.

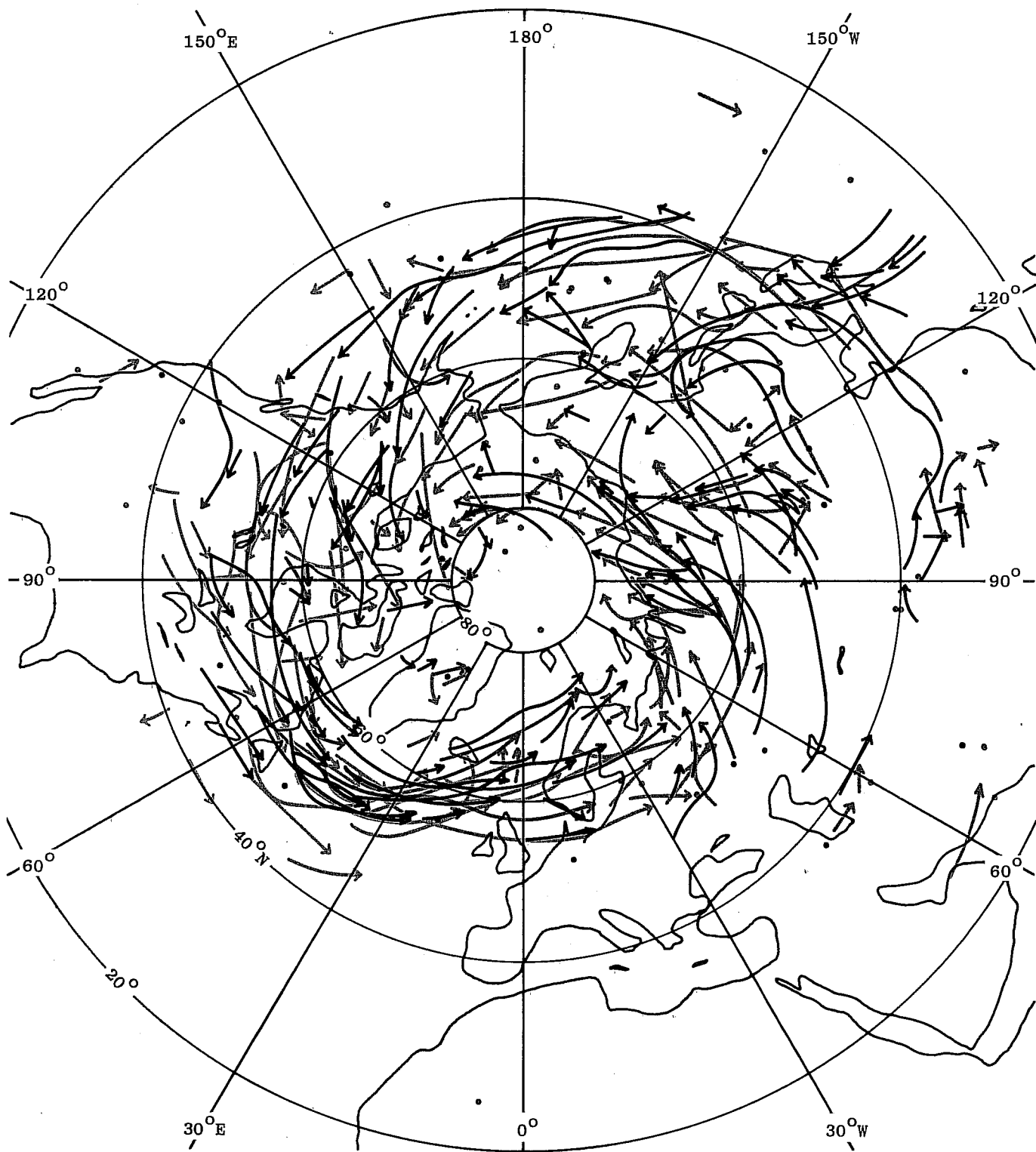
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References

- Akyildiz, V. 1980. Positions of cyclones and anticyclones in 1000 mb analyses and forecasts verifying in March 1980. ECMWF Forecast Reports, Number 3, March 1980, pp.10-11.
- Oriol, E. "Modification of KA program to identify highs and lows, in analyses". ECMWF Internal Memo 10.1.1979.

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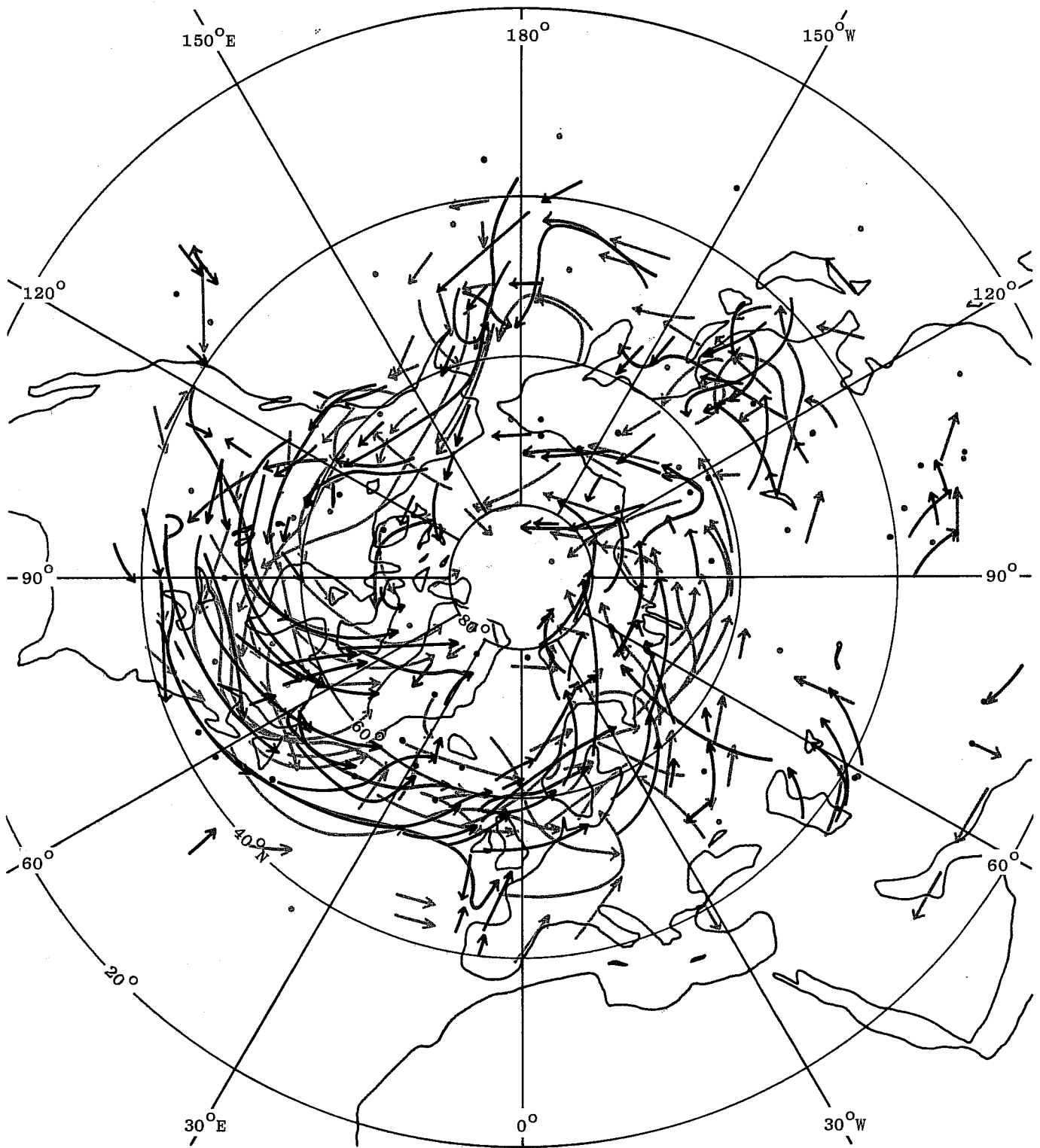


Forecasts for ($D+\frac{1}{2}$ to $D+5\frac{1}{2}$) verifying 00GMT 2.9.1980 to 12GMT 11.9.1980

Forecasts for ($D+5\frac{1}{2}$ to $D+10$) verifying 00GMT 2.9.1980 to 12GMT 11.9.1980

Analyses for 00GMT 2.9.1980 to 12GMT 11.9.1980

Fig. 3 Cyclone tracks

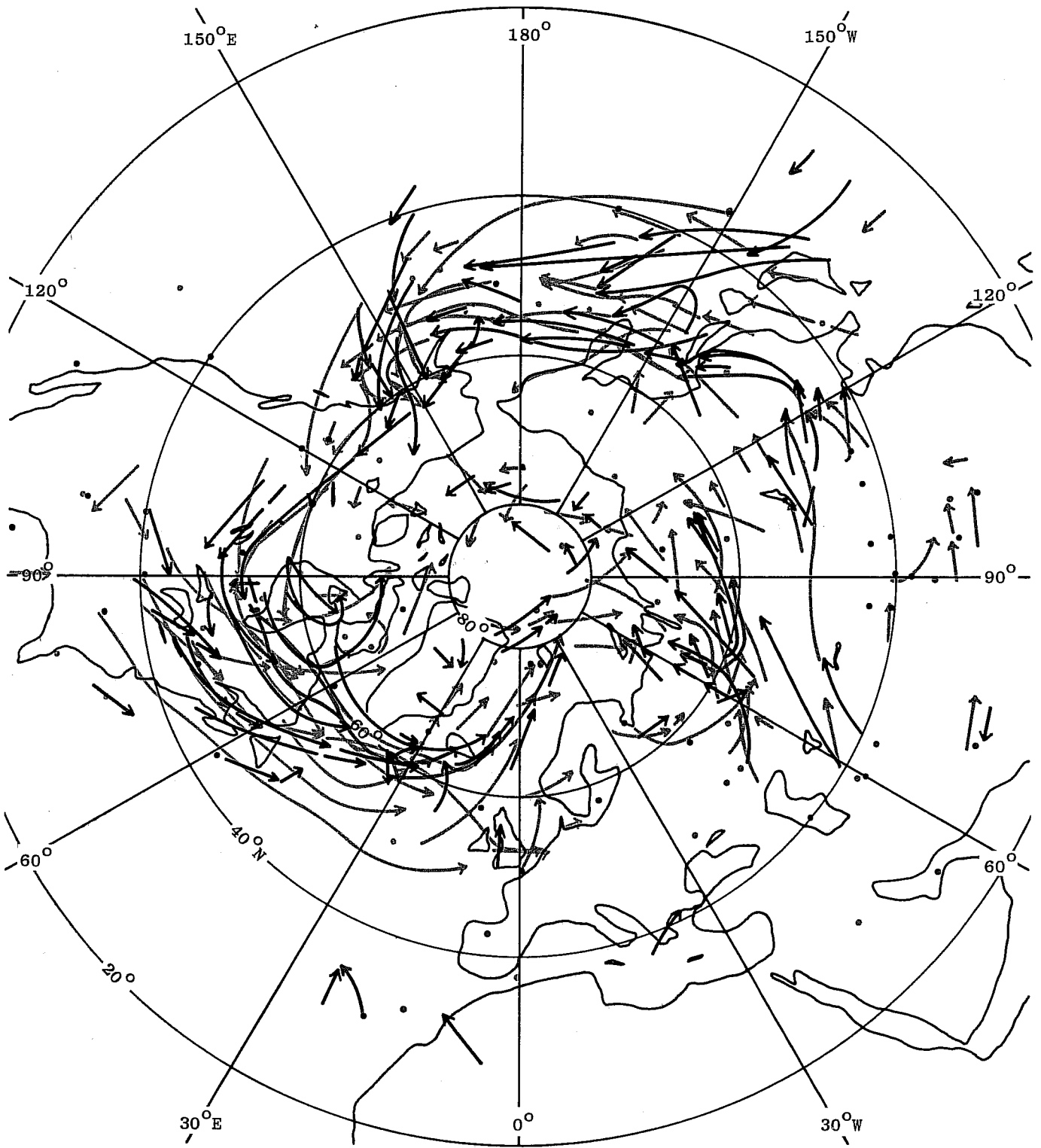


Forecasts ($D+\frac{1}{2}$ to $D+5\frac{1}{2}$) verifying 00GMT 12.9.1980 to 12GMT 21.9.1980

Forecasts ($D+5\frac{1}{2}$ to $D+10$) verifying 00GMT 12.9.1980 to 12GMT 21.9.1980

Analyses for 00GMT 12.9.1980 to 12GMT 21.9.1980

Fig. 4 Cyclone tracks

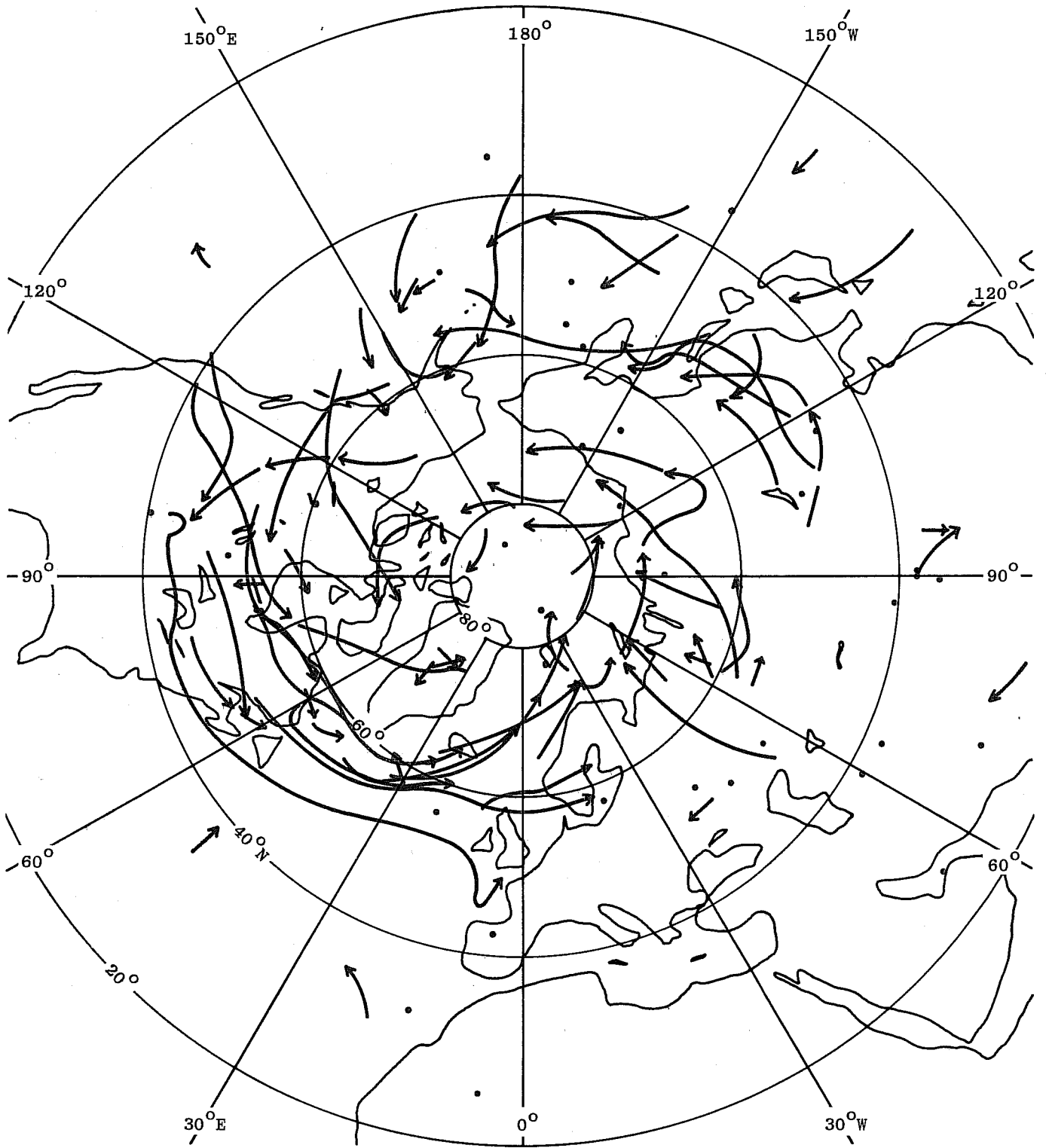


Forecasts ($D+\frac{1}{2}$ to $D+5\frac{1}{2}$) verifying 00GMT 22.9.80 to 12GMT 30.9.1980

Forecasts ($D+5\frac{1}{2}$ to $D+10$) verifying 00GMT 22.9.1980 to 12GMT 30.9.1980

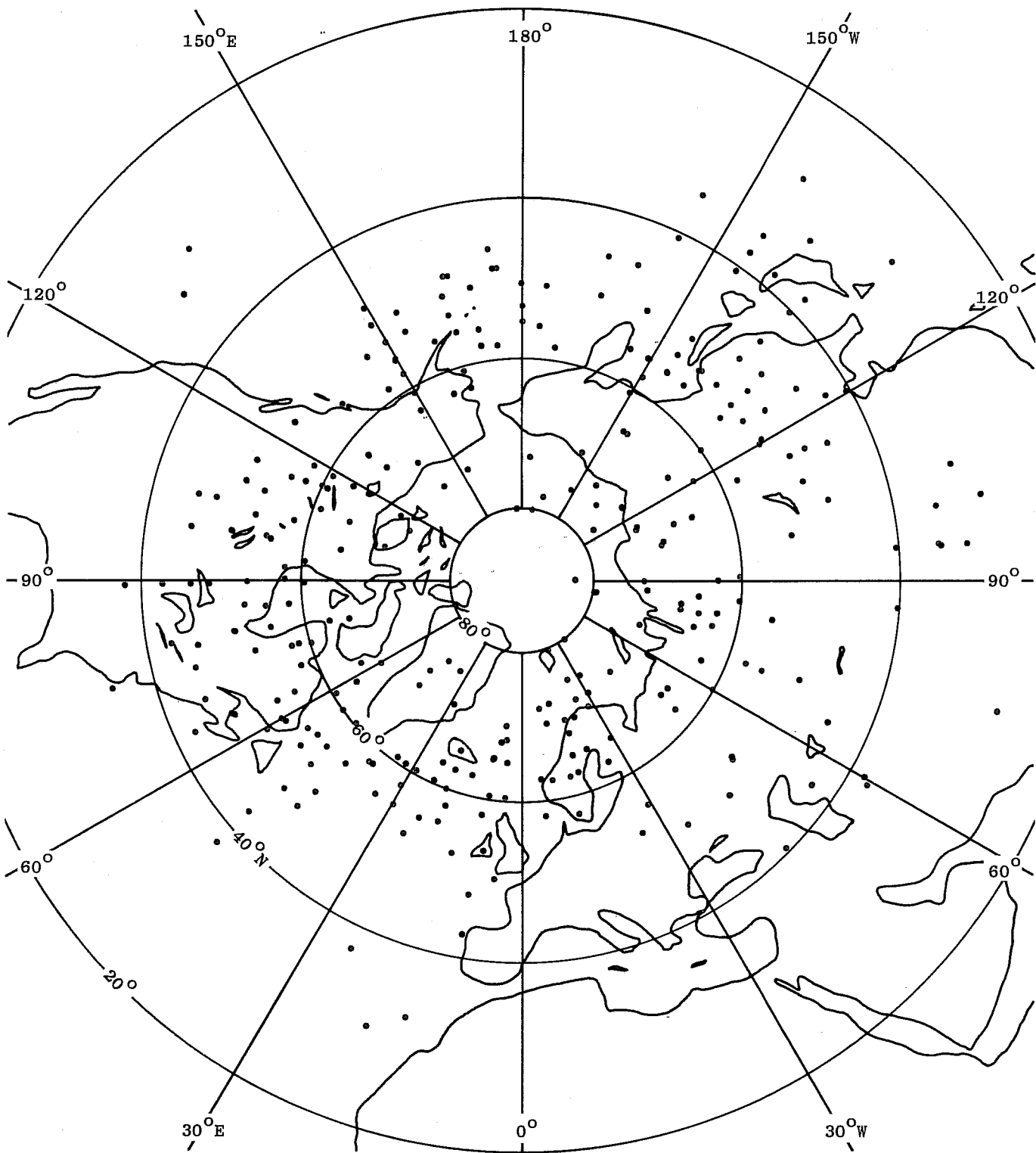
Analyses for 00GMT 22.9.1980 to 12GMT 30.9.1980

Fig. 5 Cyclone tracks



Analyses for 00GMT 2.9.1980 to 12GMT 30.9.1980

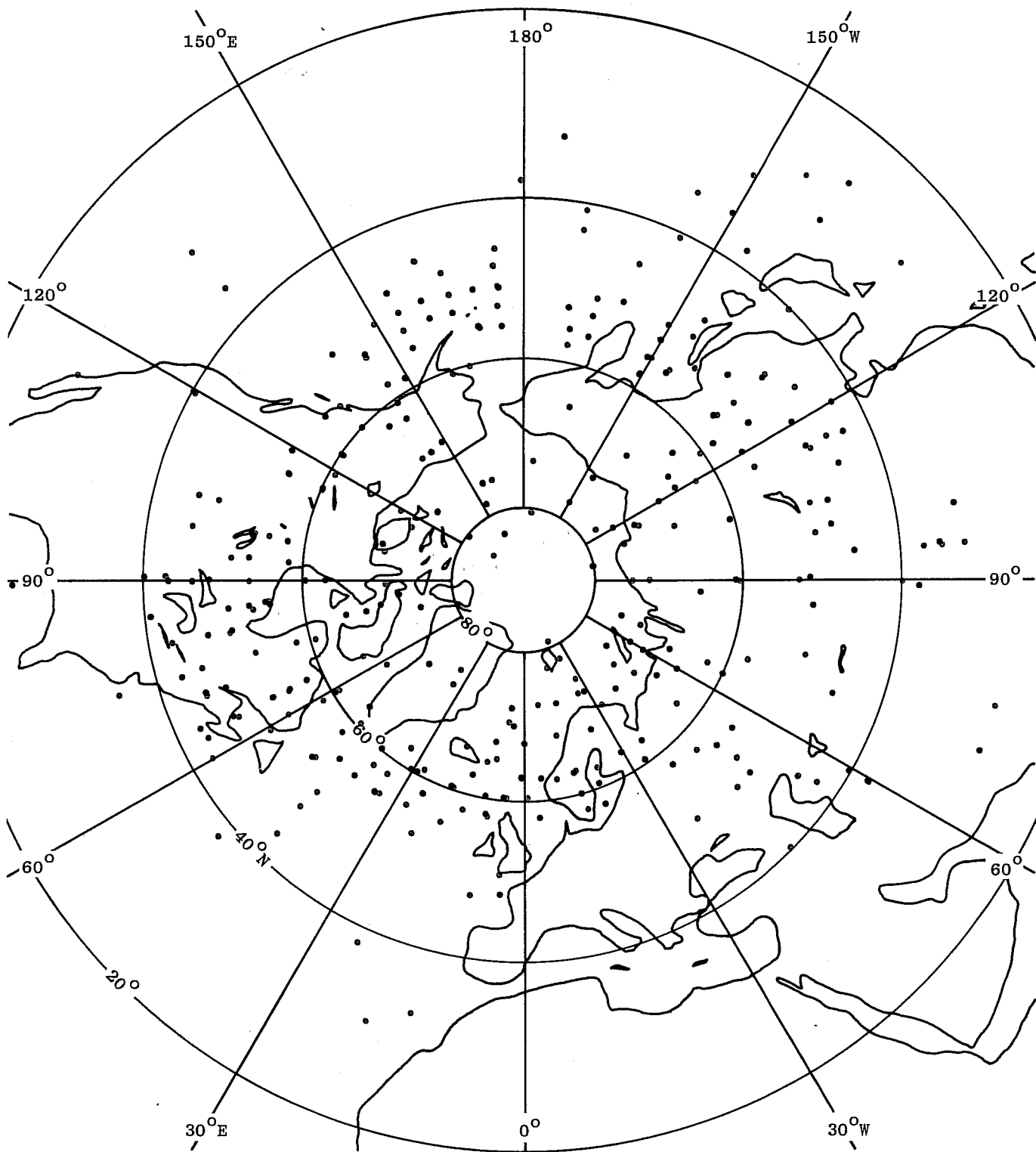
Fig. 6 Cyclone tracks



Four-day forecasts (D+4) made in September 1980

Analyses verifying the D+4 forecasts made in September 1980

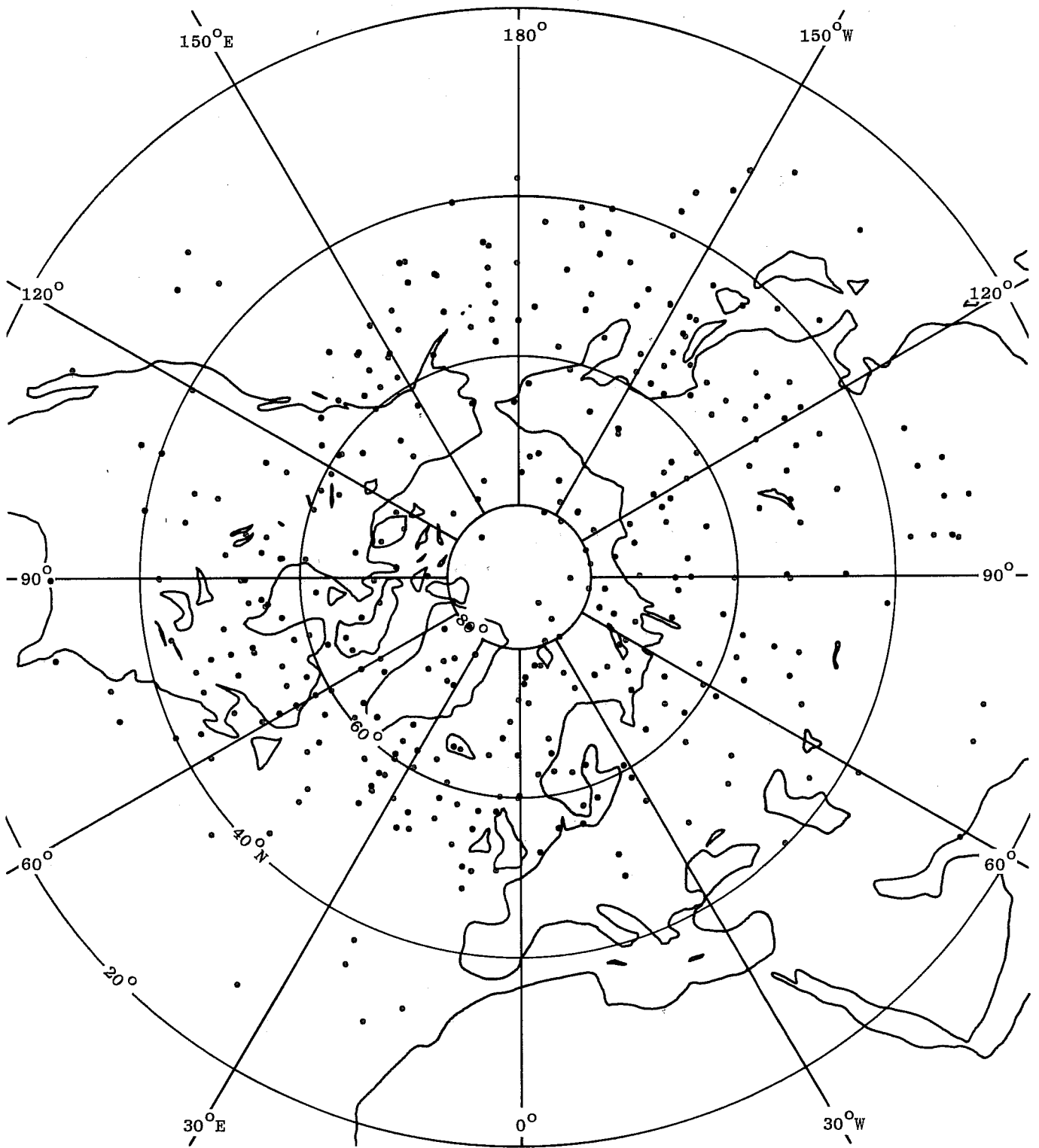
Fig. 7 Cyclone positions



Seven-day forecasts (D+7) made in September 1980

Analyses verifying the D+7 forecasts made in September 1980

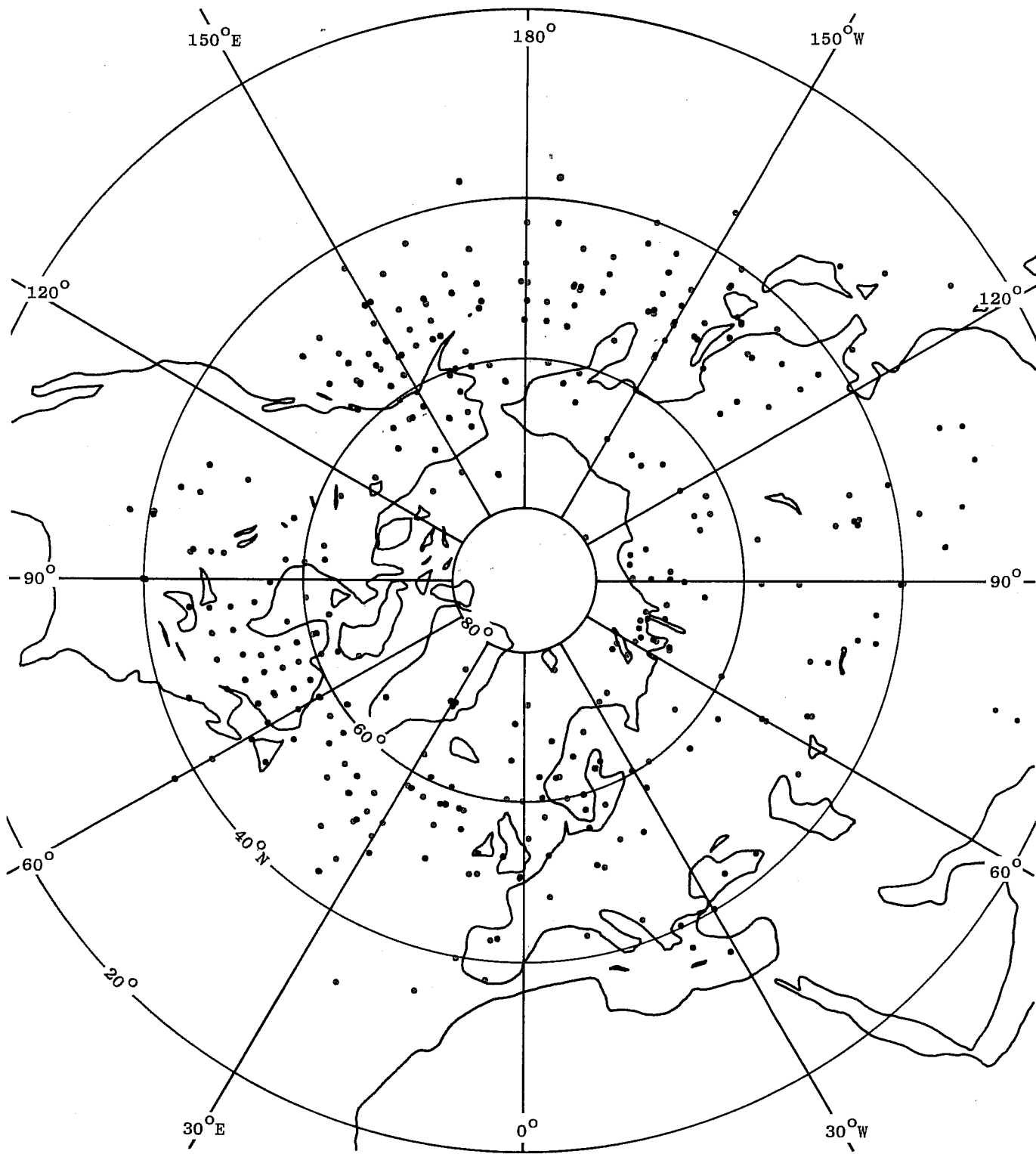
Fig. 8 Cyclone positions



Ten-day forecasts (D+10) made in September 1980

Analyses verifying the D+10 forecasts made in September 1980

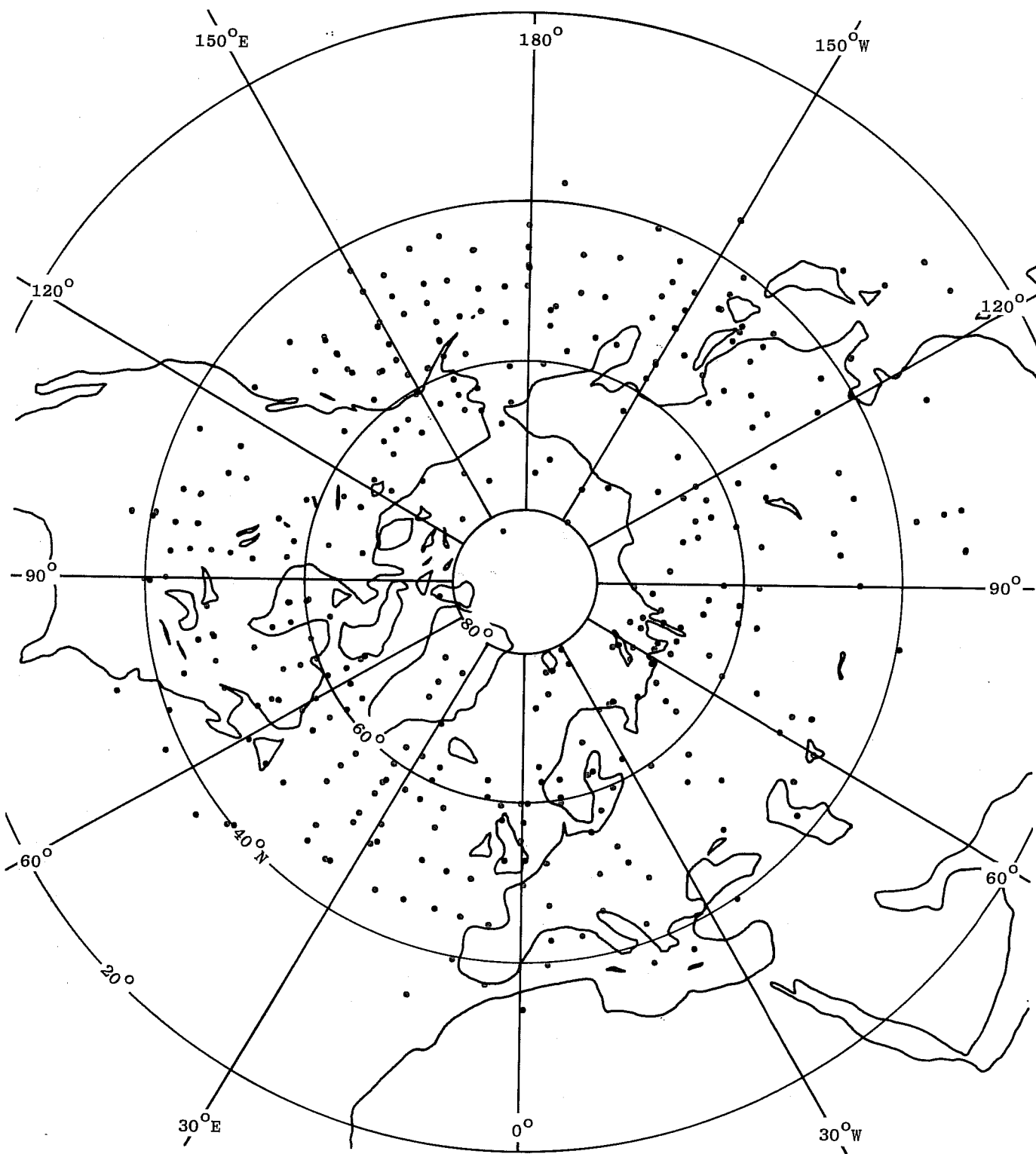
Fig. 9 Cyclone positions



Four-day forecasts (D+4) made in October 1980

Analyses verifying the D+4 forecasts made in October 1980

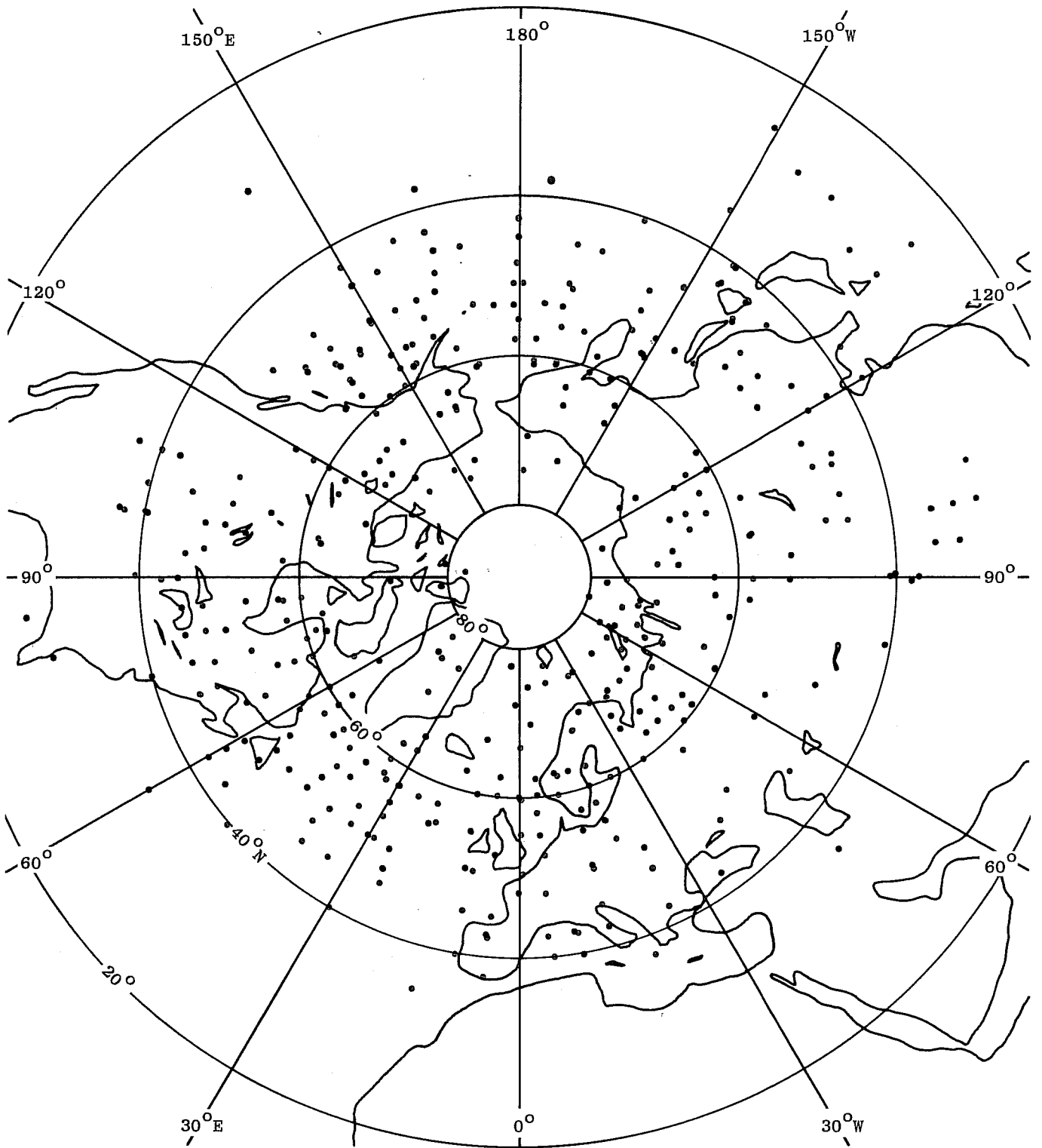
Fig. 10 Cyclone positions



Seven-day forecasts (D+7) made in October 1980

Analyses verifying the D+7 forecasts made in October 1980

Fig. 11 Cyclone positions



Ten-day forecasts (D+10) made in October 1980

Analyses verifying the D+10 forecasts made in October 1980

Fig. 12 Cyclone positions