Western Region Technical Attachment
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MARCH 1991 SURFACE CYCLONE PERFORMANCE OF THE AVIATION AND NESTED GRID MODELS

[Editor's Note: This Technical Attachment is a summary of information provided to SSD by Richard Grumm of NMC's Techniques Development Group.]

The Global Spectral Model was operationally upgraded from T80-wave resolution to T126-wave resolution on March 6, 1991. After the implementation of the T126, there was a noticeable change in the character of surface cyclones in the later forecast periods by the Aviation (AVN) run. This Technical Attachment describes this change and compares the performance of the T126 AVN with the Nested Grid Model (NGM) in forecasting surface cyclones during March 1991. Keep in mind that 1) the data set used is very limited (less than one full month), and 2) that a decrease in cyclonic activity in the western Pacific during March may have contributed to increased skill on the part of both models.

Pressure Errors

Trends during previous months showed the AVN to be the model of choice over the NGM in forecasting the position and character of surface cyclones. This trend continued with the T126 version of the AVN in March 1991. Tables 1 and 2 show that the NGM consistently overdeepened (pressure forecast too low) surface cyclones while the AVN tended to underdeepen (pressure forecast too high) them through 24 h. However, by 36 h the AVN began to overdeepen surface cyclones. This tendency by the T126 in March was not seen with the T80 in previous months. Nevertheless, the Root Mean Square (RMS) of the pressure errors were smaller in the AVN than the NGM at all forecast periods (see Tables 1 and 2). The RMS of the AVN pressure errors were also smaller in March than the three previous months.

Position

The AVN has been consistently better at forecasting the position of surface cyclones than the NGM since September 1990. Figure 1 shows the distance errors and corresponding RMS for the 24 and 48 h forecasts for both the AVN and NGM since

September 1990. The March 1991 data show that there may be further improvement in the surface cyclone position forecasting by the T126 version at the 60 and 72 h periods.

Thickness

Both the AVN and NGM have shown a cold bias in forecasting 1000-500 mb thickness at all forecast periods, which continued in March for the T126 AVN. Overall, the RMS of the thickness errors were smaller for the AVN than for the NGM during the month of March (Tables 1 and 2).

Probability of Detection (POD)

Tables 3 and 4 indicate that the AVN showed better skill at detecting a cyclone (POD) than the NGM for the shorter term forecasts, however by 48 h the NGM was better. During the past three months the AVN had shown better POD skill through 48 h and often showed better skill at 72 h than the NGM did at 48 h.

Non-observed and non-forecast cyclones

Figure 2 shows the number of non-observed cyclones that were forecast by the AVN for the 12-48 h forecast periods during the month of March. Only two or more events are displayed for a given location. There were only a few non-observed cyclones forecast by the AVN and these were mainly over the elevated terrain of western North America and the active cyclogenetic regions of the oceans. Figure 3 shows the number of observed cyclones during March that were not forecast by the AVN. (Data plotted are the same as described for Figure 2.) There were significantly more non-forecast cyclones than non-observed cyclones, and again, most occurred over the higher terrain of western North America.

Summary

The AVN continued to out-perform the NGM in terms of forecasting the position and character of surface cyclones during the month of March. However, the NGM demonstrated better POD skill than the AVN by 48 h, which was not the case prior to the implementation of the T126 version. The T126 clearly overdeepened surface cyclones by 36 h and beyond relative to the T80 version of the AVN. However, the AVN still showed better performance in terms of RMS of the pressure errors at all forecast periods than the NGM, and also showed improvement over the previous month. The AVN is clearly superior to the NGM in its ability to forecast the position of surface cyclones. Finally, in March there were more observed surface cyclones that the AVN failed to forecast than the number of incorrectly forecast surface cyclones that were never observed. The AVN had the most difficulty over the higher terrain of western North America and in regions of high cyclone activity.

Month	Fcst	Number	Pressure (mb)		Temp 850 (K)		Thickness (m)		Distance (km)	
			mean	RMS	mean	RMS	mean	RMS	mean	RMS
MAR	12	272	0.07	1.93	−0.10	2.08	−4.21	31.71	121	168
MAR	24	245	0.08	3.00	−0.17	2.44	−7.20	38.49	180	238
MAR	36	242	−0.32	4.26	−0.28	2.77	−9.32	43.33	210	273
MAR	48	226	−0.43	5.19	−0.35	3.31	−12.09	53.52	274	355
MAR	60	198	−0.51	5.44	−0.04	3.85	−8.00	67.29	347	436
MAR	72	178	−0.37	6.12	−0.41	4.22	−14.60	73.78	402	507

Table 1. Mean pressure, 850 mb temperature, 1000 to 500 mb thicknesss, and distance errors in AVN cyclones, March 1991.

Month	Fcst	Number	Pressure (mb)		Temp 850 (K)		Thickness (m)		Distance (km)	
			mean	RMS	mean	RMS	mean	RMS	mean	RMS
MAR	12	287	−0.55	2.97	−0.40	2.77	−5.51	38.27	156	195
MAR	24	249	−1.11	4.65	−0.31	3.06	−5.26	45.42	214	272
MAR	36	233	−0.83	6.17	−0.30	3.60	−4.12	59.42	296	372
MAR	48	210	−1.20	6.95	−0.58	3.76	−4.76	60.91	361	451

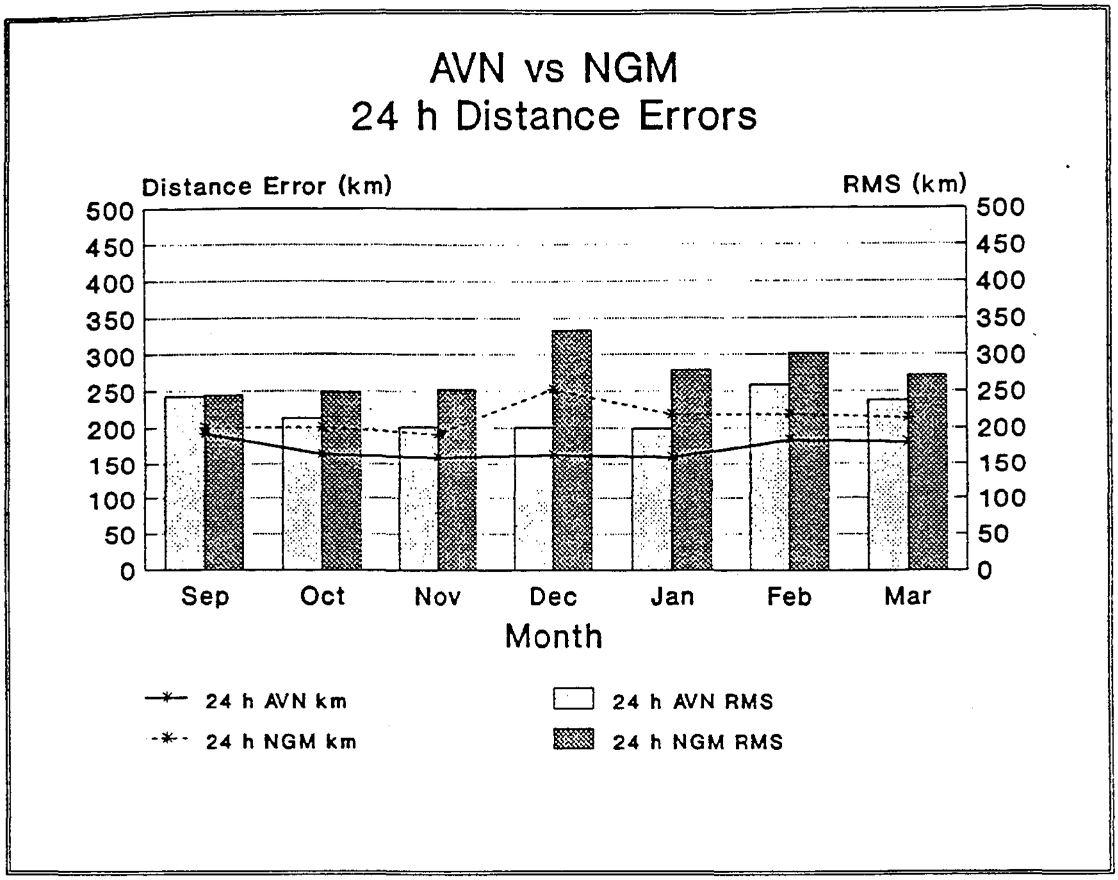
Table 2. As in Table 1 except for the NGM.

Month	Fcst	CSI	BIAS	POD	FAR
MAR	12	0.70	0.90	0.78	0.13
MAR	24	0.59	0.83	0.68	0.18
MAR	36	0.57	0.88	0.68	0.23
MAR	48	0.53	0.85	0.64	0.24
MAR	60	0.46	0.86	0.59	0.31
MAR	72	0.42	0.94	0.58	0.39

Table 3. AVN cyclone skill scores, March 1991.

Month	Fcst	CSI	BIAS	POD	FAR
MAR	12	0.63	0.87	0.72	0.17
MAR	24	0.52	0.81	0.62	0.23
MAR	36	0.55	1.02	0.71	0.30
MAR	48	0.56	1.01	0.72	0.29

Table 4. As in Table 3 except for the NGM.


AVN vs NGM
24 h Distance Errors
Distance Error (km)
RMS (km)
500
450
400
350
300
250
200
150
100
50
0
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Month
24 h AVN km
24 h NGM km
24 h AVN RMS
24 h NGM RMS

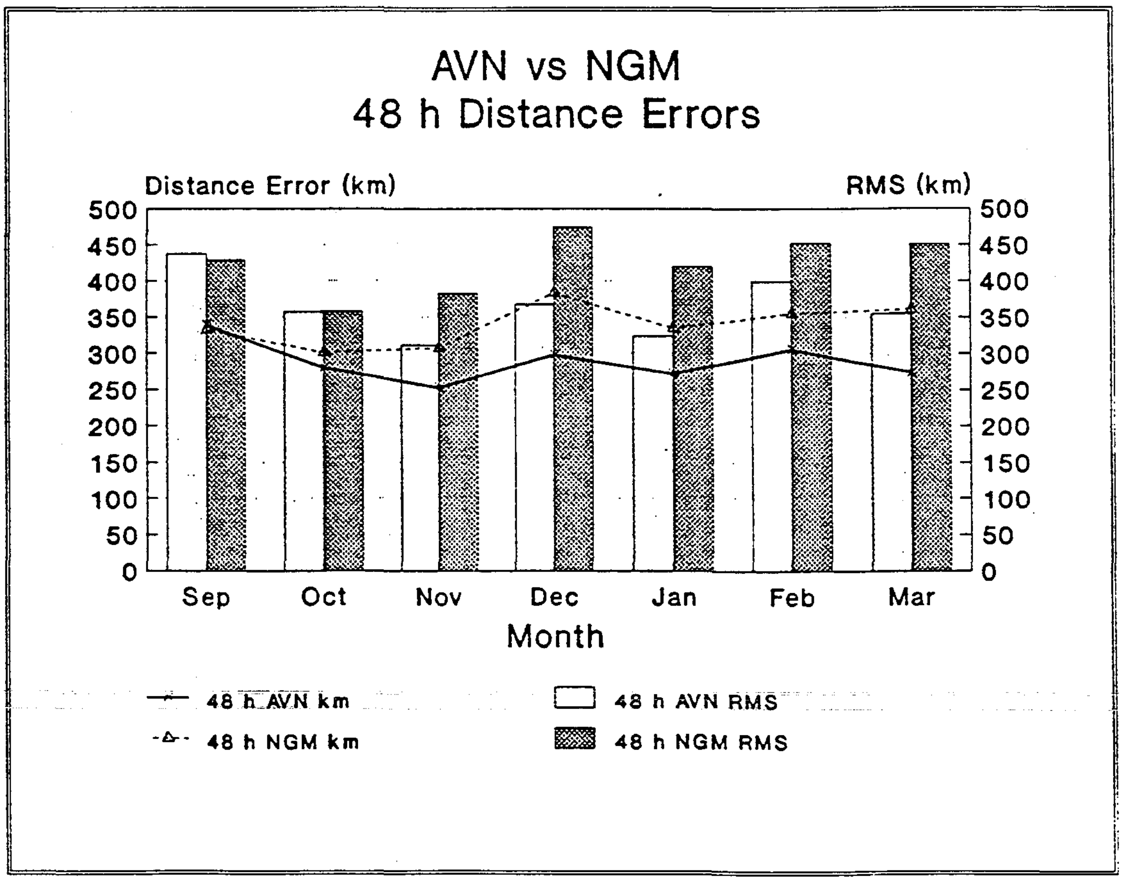

AVN vs NGM
48 h Distance Errors
Distance Error (km)
RMS (km)
500
450
400
350
300
250
200
150
100
50
0
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Month
48 h AVN km
48 h NGM km
48 h AVN RMS
48 h NGM RMS

FIGURE 1

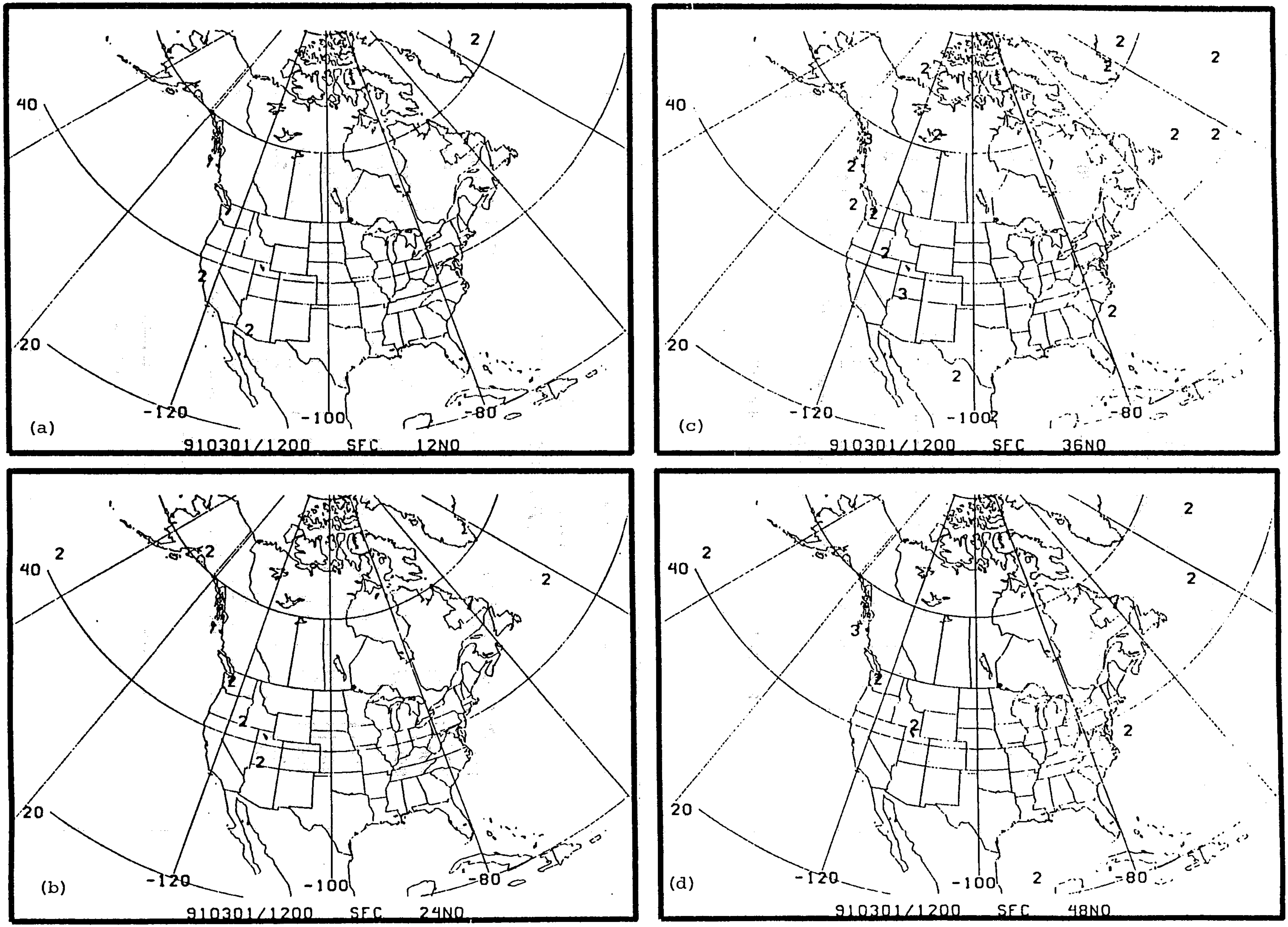


FIGURE 2

The number of non-observed cyclone events in any given grid for the month of March 1991. Numbers less than 2 are not displayed. a) 12 h forecast cyclones not observed, b) 24 h forecast, c) 36 h forecast, d) 48 h forecast.

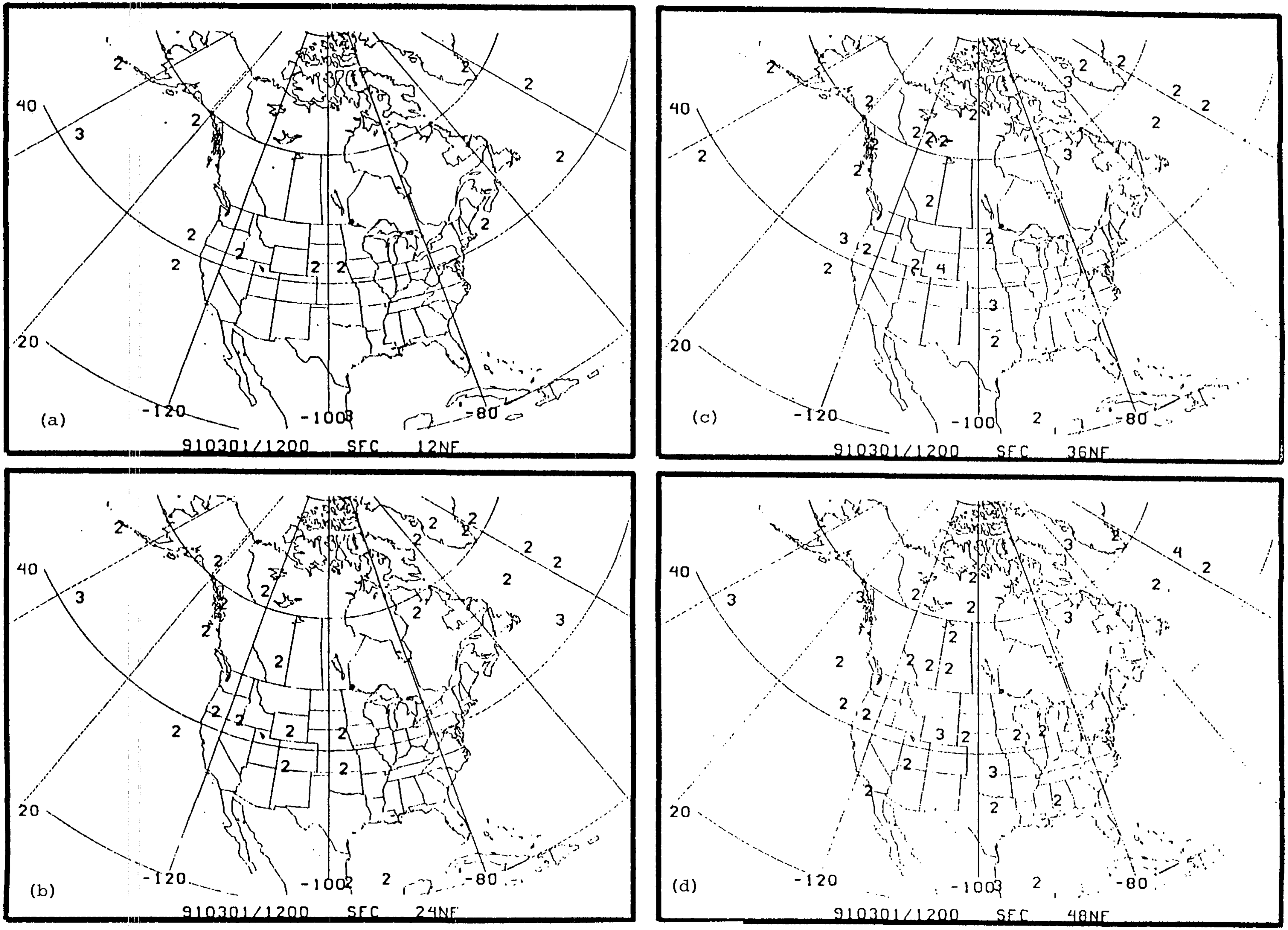


FIGURE 3

Similar to Figure 2 except observed cyclone events not forecast in March 1991 are plotted. a) not forecast by 12 h, b) not forecast by 24 h, c) 36 h, d) 48 h.