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An Evaluation of Forecast Low Pressure Area Development Using George's Technique in the Post C7P Era

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INTRODUCTION

Over the last three winters a study has been made of developing surface low pressure centres over the Eastern Pacific. A comparison has been made between the actual movement and development of the low pressure centres and the movement and development as forecast by the numerical models.

The J.J. George technique as adopted by Snopkowski and Welch (1959) and later by Legal (1981) was applied to each case. The results are very promising.

A comparison has been made of the cases with and without Ocean Weather Station C7P ("PAPA") data. The data set was comprised of 41 cases (Table 1 and 2). Of the 41 cases, 15 were in the 1981-82 winter season when C7P was no longer on station (Table 2).

OBJECTIVES

1) To examine all developing low pressure areas for the three winter seasons, October to March inclusive for 1979-80, 1980-81, and 1981-82 using the following selection criteria:

   a) low centre must have at least 15 knots average speed over 24 hours;
   b) low centre must maintain its identity over the 24 hour period;
   c) the 24 hour period must begin at either 0000Z or 1200Z;
   d) low centre must deepen at least 8 mb over 24 hours;
   e) initial positions must be within the LFM chart boundaries.

2) To determine any bias of the progs for speed, direction, and development. The initial and final positions and depths as determined by the Pacific Weather Centre (PWC) surface analyses were compared with the 24 hour CMC spectral prognosis, the 24 hour LFM prognosis, the 24 hour U.S. Spectral prognosis, and the 18 hour PWC prognosis. The PWC prognoses are manually produced using the numerical prognoses as guidance.

3) To determine any bias in amount of development of the J.J. George technique as adapted by Snopkowski and Welch and later by Legal.

4) To note any significant differences in development of major storms by the numericals as a result of the demise of C7P.

RESULTS

Analysis of Amount of Development:

Of the 41 cases, the average deepening of low pressure centres was 19 mb. In some of these cases the numericals and the PWC progs actually tended to fill the low centre. Of the 41 cases, all forecasting methods tended to underforecast development as follows:

Forecast Type	Amount Underforecast
George's Technique	7 mb
PWC	9 mb
LFM	12 mb
U.S. Spectral	13 mb
CMC	14 mb

15 cases in the winter of 1981-82 (without C7P data).

Forecast Type	Amount Underforecast
George's Technique	7 mb
PWC	9 mb
LFM	15 mb
U.S. Spectral	13 mb
CMC	16 mb

Comments on Development:

1) All methods underforecast development of low pressure areas.

2) The PWC forecast of development definitely shows skill over the numericals.

3) The George's Technique was marginally better than PWC (7 mb instead of 9 mb). The trick of course is to be able to pinpoint the situations where significant development is going to take place. Once this has been decided and confirmed, George's Technique will yield a better result than the numericals. Legal and Younker point out the use of satellite imagery in determining whether development will take place. The reader is referred to these two authors for further consideration of this point.

4) The loss of C7P for the winter 1981-82 did not result in any difference in forecast development figures for George's Technique, PWC, and the U.S. Spectral. The LFM and CMC both increased their error of underforecasting development by 3 mb and 2 mb respectively.

Analysis of Positional Errors:

See Figure 1 which depicts the forecast low position relative to the final actual low centre position.

Figure 2 shows the size of a 3° square relative to the PWC forecast region. The shaded square represents a 3° variation around the final actual low position. Low centre forecasts falling within this square would be a reasonable 24 hour forecast.

The percentage of forecast positions falling within this 3° square are as follows:

	LFM	U.S. Spectral	CMC	PWC
Total Cases	61%	50%	58%	83%
C7P on station (26 cases except for U.S. Spectral)	61%	27%	52%	81%
C7P not on station (15 cases)	60%	67%	67%	87%

Comments on Positional Analysis:

1) It is obvious from the above figures that the PWC prognostician is improving on the numerical guidance by forecasting a more accurate final position for developing low pressure areas.

2) There has been a dramatic increase in the accuracy of the U.S. Spectral model (27% vs. 67%). Tuning of the model has undoubtedly played a role.

3) The demise of C7P apparently resulted in no loss of accuracy for forecasting the position of developing low pressure centres. In fact, the positional accuracy for the U.S. Spectral, CMC, and PWC all improved.

SUMMARY

Forecasting major storm development over the Eastern Pacific continues to be one of the primary problems at the Pacific Weather Centre. Major developing low pressure centres over the Eastern Pacific over the last three winter seasons were examined. The man-machine mix appears to be the best formula for evaluating and forecasting low pressure area development. The PWC prognoses showed improvement over all numerical models in forecasting the amount of development and the positional accuracy.

Using George's Technique resulted in a better assessment of development than any other method. The use of George's Technique assumes development which may not always occur. If the prognostician has decided that development will occur, he should seriously consider George's Technique.

The demise of Ocean Weather Station C7P appears not to have affected the accuracy of the numerical models in forecasting low pressure area development. Although two of the numerical models (LFM and CMC) showed slight decreases in the accuracy of low centre forecast depths, the remainder were unchanged. The positional accuracy in the post C7P era was either unchanged (LFM) or significantly improved (all other forecast methods).

REFERENCES

1. George, J.J., 1960, "Weather Forecasting for Aeonautics", Academic Press, London, pp. 133-155.

2. Hammond, Brian, September 1980, "Developing Low Pressure Areas over the Northeastern Pacific - How well are they forecast?", Pacific Region Technical Note 80-029.

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4. Legal, Louis, November 1981, "Satellite Imagery and the Use of the J.J. George Technique for Maritime Cyclones over the Pacific", Pacific Region Technical Notes 81-026.

5. Snopkowski, Edward L. & Welch, Paul R., July 1959, "Evaluation of an Objective Method for the Prediction of Central Pressures of North Pacific Cyclones", Bulletin of the American Meteorological Society, Vol. 40, No. 7, pp. 336-339.

6. Younker, Waldo J., February 1981, "Satellite Intensity Predictions of North Pacific Cyclogenesis", National Weather Digest, Vol. 6, No. 1, pp. 40-47.

TABLE 1.

CASES OF DEVELOPING LOW PRESSURE CENTRES OVER THE EASTERN PACIFIC (BEFORE SHIP PAPA REMOVAL)

CASE NUMBER	YEAR	INITIAL		FINAL		INITIAL			FINAL			AMOUNT OF DEEPENING	INITIAL CMC			24HR PROG CMC			INITIAL LFM			24HR PROG LFM			18 HR PROG PWC			FINAL US SPECTRAL		
		DATE	TIME	DATE	TIME	LAT	LONG	PRESS	LAT	LONG	PRESS		LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS
1	1979	OCT 01	12Z	OCT 02	12Z	45	165	992	55	157	978	14	LOW CENTRE OFF CHART			50	155	992	47	166	990	58	156	970	54	156	976			
2		OCT 17	12Z	OCT 18	12Z	48	146	1000	53	137	975	25	47	148	1000	55	145	994	M	M	M	56	145	989	55	142	988			
3		OCT 20	12Z	OCT 21	12Z	44	159	1008	45	141	980	28	LOW CENTRE OFF CHART			43	144	997	44	159	1012	46	142	985	48	143	994			
4		OCT 21	12Z	OCT 22	12Z	45	141	980	51	138	950	30	45	141	987	52	128	973	47	142	970	50	137	968	53	135	966			
5		OCT 24	12Z	OCT 25	12Z	43	133	984	49	134	974	10	44	135	990	NO LOW SHOWN			43	133	989	NO LOW CENTRE SHOWN			52	128	978			
6		NOV 20	12Z	NOV 21	12Z	47	157	966	50	144	950	16	57	160	975	M	M	M	45	159	969	52	144	953	51	141	956			
7		NOV 27	00Z	NOV 28	00Z	36	147	982	51	151	949	33	38	145	985	47	145	970	40	135	992	50	147	975	50	149	968			
8		DEC 07	00Z	DEC 08	00Z	52	152	1007	57	138	992	15	50	153	1009	55	140	1002	52	152	1006	52	140	996	57	137	996			
9		DEC 22	12Z	DEC 23	12Z	47	149	992	49	138	966	26	47	151	999	48	138	986	47	150	999	49	136	989	51	138	976			
10	1980	JAN 01	12Z	JAN 02	12Z	50	147	1002	52	135	990	12	M	M	M	57	140	1003	50	148	1000	57	141	1007	55	140	1004			
11		JAN 07	00Z	JAN 08	00Z	58	141	1024	50	128	1006	18	62	140	1027	50	127	1010	57	142	1025	51	129	1007	52	129	1006			
12		FEB 02	00Z	FEB 03	00Z	42	143	984	57	143	962	22	NO LOW CENTRE SHOWN			55	147	970	42	143	978	54	140	964	53	138	972			
13		MAR 12	00Z	MAR 13	00Z	46	151	1008	48	131	978	30	NO LOW CENTRE SHOWN			55	138	1002	NO LOW CENTRE SHOWN			50	130	1001	51	130	992			
14		MAR 26	12Z	MAR 27	12Z	46	161	996	54	145	982	14	43	166	1000	54	150	1000	LOW CENTRE OFF CHART			49	146	1010	52	142	998			
15		OCT 02	12Z	OCT 03	12Z	47	147	1000	58	142	988	12	47	145	1002	54	145	998	45	150	1003	56	144	995	57	142	994	60	137	1001
16		OCT 10	00Z	OCT 11	00Z	45	141	1008	54	137	988	20	42	138	1015	54	137	1007	NO LOW CENTRE SHOWN			54	133	1005	55	136	992	55	136	1000
17		OCT 23	00Z	OCT 24	00Z	48	145	988	54	143	978	10	49	145	988	56	146	992	49	145	991	56	149	989	55	144	988	55	149	989
18		OCT 31	12Z	NOV 01	12Z	40	138	990	54	133	977	13	41	139	988	58	145	979	41	139	990	55	138	983	52	133	976	52	127	985
19		NOV 15	00Z	NOV 16	00Z	52	156	996	58	146	966	30	52	155	1000	53	147	1001	52	156	1000	CHART MISSING			59	149	998	57	140	988
20		NOV 18	12Z	NOV 19	12Z	48	166	992	55	157	974	18	48	166	988	56	160	990	47	166	987	56	163	989	54	152	980	56	163	989
21		NOV 26	00Z	NOV 27	00Z	46	153	972	57	147	948	24	48	153	976	55	146	978	46	155	978	56	145	967	55	145	966	57	146	963
22		DEC 12	00Z	DEC 13	00Z	43	157	986	50	152	976	10	43	159	988	47	152	988	42	157	988	CHART MISSING			51	152	984	50	153	984
23	1981	JAN 12	00Z	JAN 13	00Z	41	150	980	49	144	972	8	40	142	994	51	140	987	41	147	986	48	149	990	51	146	986	49	149	989
24		JAN 31	12Z	FEB 01	12Z	48	143	992	57	152	980	12	46	148	994	55	153	988	46	146	988	56	154	985	54	151	987	NO LOW CENTRE SHOWN		
25		FEB 12	12Z	FEB 13	12Z	38	145	976	49	140	968	8	37	147	988	47	140	980	39	149	989	47	140	987	47	138	980	44	137	991
26		MAR 6	00Z	MAR 07	00Z	44	145	996	49	138	980	16	45	146	1004	48	136	1003	NO LOW CENTRE SHOWN			49	139	999	50	140	988	45	147	998

TABLE 2.

CASES OF DEVELOPING LOW PRESSURE CENTRES OVER THE EASTERN PACIFIC (AFTER SHIP PAPA REMOVAL)

CASE NUMBER	YEAR	INITIAL		FINAL		INITIAL			FINAL			AMOUNT OF DEEPENING	INITIAL CMC			24 HR PROG CMC			INITIAL LFM			24 HR PROG LFM			18 HR PROG PWC			FINAL US SPECTRAL		
		DATE	TIME	DATE	TIME	LAT	LONG	PRESS	LAT	LONG	PRESS		LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS	LAT	LONG	PRESS
27	1981	OCT 04	12Z	OCT 05	12Z	49	151	1005	48	134	976	29	49	152	1000	54	140	990	49	152	1006	57	142	988	48	143	992	48	143	990
28		OCT 05	00Z	OCT 06	00Z	49	143	990	52	135	965	25	47	142	992	53	137	982	50	143	997	54	138	980	51	136	972	53	138	980
29		OCT 17	00Z	OCT 18	00Z	43	149	1004	60	144	988	16	41	149	1008	61	143	1002	43	150	1009	60	144	1008	61	144	1005	59	144	1010
30		OCT 29	12Z	OCT 30	12Z	46	160	997	51	138	980	17	46	159	988	48	147	990	46	149	1000	48	148	994	49	144	974	48	145	984
31		OCT 30	00Z	OCT 31	00Z	49	144	993	56	134	972	21	TROF			53	140	988	46	153	995	55	137	992	54	137	985	53	136	982
32		NOV 03	00Z	NOV 04	00Z	50	161	988	56	146	974	24	50	161	996	54	147	993	50	164	995	56	145	996	55	143	992	55	146	992
33		NOV 09	12Z	NOV 10	12Z	47	147	960	56	152	948	12	48	148	960	57	154	953	47	147	964	57	151	962	58	153	961	56	153	964
34		NOV 10	00Z	NOV 11	00Z	45	159	972	53	142	952	20	CHART MISSING			53	144	964	45	160	977	50	144	967	CHART MISSING			50	144	964
35		NOV 13	12Z	NOV 14	12Z	38	137	990	46	137	964	26	38	133	996	49	124	992	TROF			50	123	989	48	123	989	45	136	968
36	1982	JAN 25	00Z	JAN 26	00Z	42	138	1000	49	132	968	32	41	139	1002	49	130	1000	41	138	1005	51	126	984	49	130	989	49	129	974
37		FEB 09	12Z	FEB 10	12Z	59	141	1004	54	135	992	12	60	140	1008	CHART MISSING			59	140	1011	55	135	992	54	134	987	55	135	986
38		FEB 27	12Z	FEB 28	12Z	39	149	996	43	139	980	16	40	148	1000	43	136	996	40	148	1000	48	137	996	42	137	992	44	136	988
39		FEB 28	00Z	MAR 01	00Z	41	143	998	47	137	960	28	43	141	990	45	135	985	40	142	993	47	138	979	47	137	978	45	135	978
40		MAR 23	00Z	MAR 24	00Z	45	163	1020	54	149	1000	20	45	164	1023	54	148	1014	CHART MISSING			NO LOW CENTRE SHOWN			54	145	1020	56	146	1009
41		MAR 23	12Z	MAR 24	12Z	51	156	1009	55	144	990	19	51	156	1009	57	145	1004	52	156	1010	57	145	999	57	145	1004	56	145	998

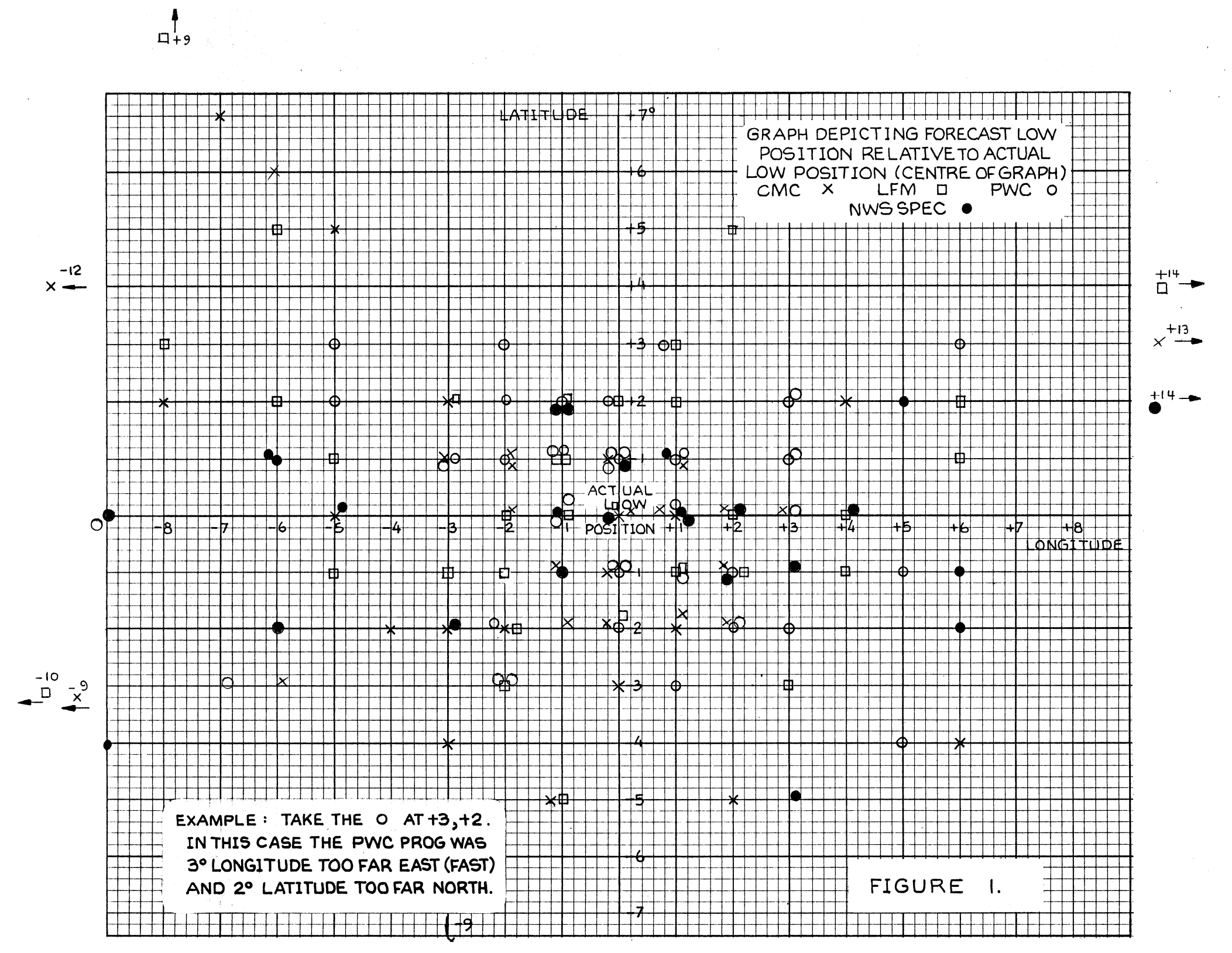
GRAPH DEPICTING FORECAST LOW POSITION RELATIVE TO ACTUAL LOW POSITION (CENTRE OF GRAPH)
CMC X LFM □ PWC o
NWS SPEC ●
LATITUDE
LONGITUDE
ACTUAL LOW POSITION
+9
-12
+14
+13
+14
-10
-9
EXAMPLE : TAKE THE o AT +3, +2. IN THIS CASE THE PWC PROG WAS 3° LONGITUDE TOO FAR EAST (FAST) AND 2° LATITUDE TOO FAR NORTH.

FIGURE 1.

FIGURE 2.

Example of a 3 degree longitude/latitude area relative to the PWC forecast region. Low centre forecasts falling within this size square would be judged as an acceptable 24 hour forecast.