PACIFIC REGION TECHNICAL NOTES

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Pacific Weather Centre Surface Prog Verification Scores

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INTRODUCTION

The Pacific Weather Centre has routinely computed since January 1974, twice a day (00Z and 12Z) verification scores for three operational surface prognoses. These prognoses are the Canadian Meteorological Centre (CMC) numerical 36 hour, the U.S. National Meteorological Centre (NMC) numerical 36 hour, and the Pacific Weather Centre subjective 30 hour. The U.S. NMC model being verified is the Primitive Equations (PE) model and not the Limited Fine Mesh (LFM) model. During the past 5 years many changes have been made to all the numerical models, this note looks at their effect on the Pacific Weather Centre in terms of their relative verification scores.

VERIFICATION METHOD

Gridpoint data are abstracted from the NMC-PE and PWC surface prognoses over a 63 point grid. CMC 1000 mb gridpoint data are received from CMC via teletype into the PWC computer. The 1000 mb CMC data over the 63 gridpoints are converted to surface gridpoint data using a standard 8.5 m/mb conversion.

Two grid areas are considered when providing verification statistics. These are the Pacific Region 63 gridpoint area and the B.C. area which is a 24 gridpoint subset of the Pacific area, see figure 1.

Verification statistics computed are the Root Mean Square Error (RMSE), Root Mean Square Gradient (RMSG), Root Mean Forecast Gradient Error (RMSGE), Average Forecast Error (AE) and a Skill Score defined as $SS = \frac{RMSGE}{RMSG}$. See Appendix A for formulation of these scores.

RESULTS

The primary score of interest is the skill score. Figure 2 shows the twice daily Pacific Region Area scores averaged over a month and plotted since January 1974. Also included on figure 2 are

RESULTS (cont'd)

the recent significant changes to the numerical models. These changes are: Feb. 1976 CMC introduces 20 wave 5 level spectral, Feb. 1977 CMC 29 wave 5 level spectral, Jan. 1978 PE changes from 6 layers to 7 layers and to a 190.5 km resolution from 381 km, Dec. 1978 CMC 29 wave 10 level spectral. It can be seen from figure 2 that some of these changes have made significant impact on the scores. The introduction of the 7 level PE brought scores down from an average of .75 in 1977 to .71 in 1978 (see table 1). The CMC changes to a 10 level 29 wave spectral in December 1978 shows an encouraging trend to lower scores and scores comparable to the PE. There is good reason to believe that CMC scores would be even better if the recent (February 1979) Hone conversion to M.S.L. pressures was being used at the PWC (action is now being taken to incorporate this).

A noteworthy point illustrated in figure 2 is the recent March and April 1979 CMC scores. These scores represent only the second and third time since the scores have been computed that the CMC monthly average verification score has been better than both the PWC subjective and the NMC-PE. The one other month when this happened was April 1976.

Table 1 shows the average yearly scores and their standard monthly deviations. It can be seen that the scores of the progs have been improving however, their consistency as shown by the standard deviations have not shown a similar improving trend.

Since a look at the monthly and yearly average scores by themselves may be misleading in assessing the value of the progs, a study was made of the percentage number of PWC subjective progs per month which were better than the CMC and PE progs. Figure 3 shows, by month, the percentage number of surface progs which are better, in terms of skill score, than the PE and CMC. The converse can also be inferred since the progs that were equal were removed when compiling the statistics for this graph. It can be seen from figure 3 that the PWC surface progs still, in general, improve upon the numerical progs however, the margin of improvement is diminishing.

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FIGURE 1.

63 GRIDPOINT PACIFIC REGION GRID AREA
AND 24 GRIDPOINT B.C. GRID AREA

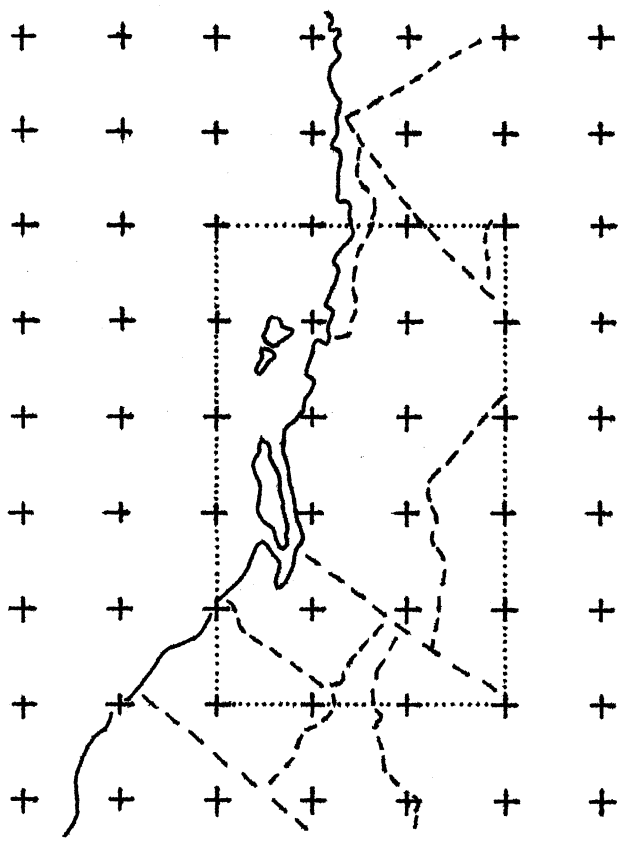

FIGURE 2.
MONTHLY SKILL SCORE VALUES FOR THE 63 GRID POINT PACIFIC REGION AREA

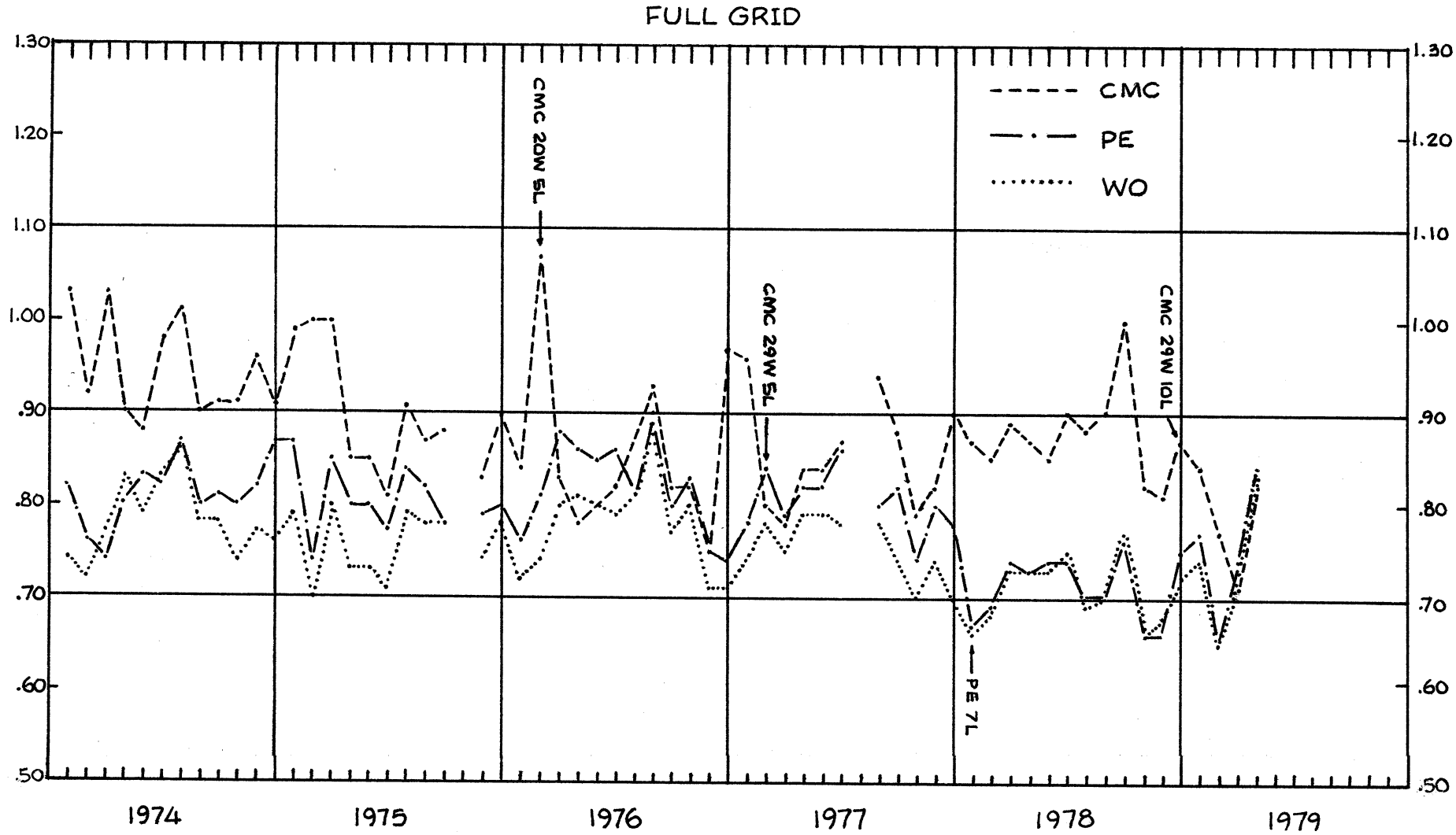

FIGURE 3.

PERCENTAGE OF NUMBER OF MAPS PER MONTH (INCLUDES 00Z AND 12Z PER DAY) THAT PWC 30HR SUBJECTIVE SURFACE PROG IS BETTER THAN 36HR CMC AND 36HR NMC PE

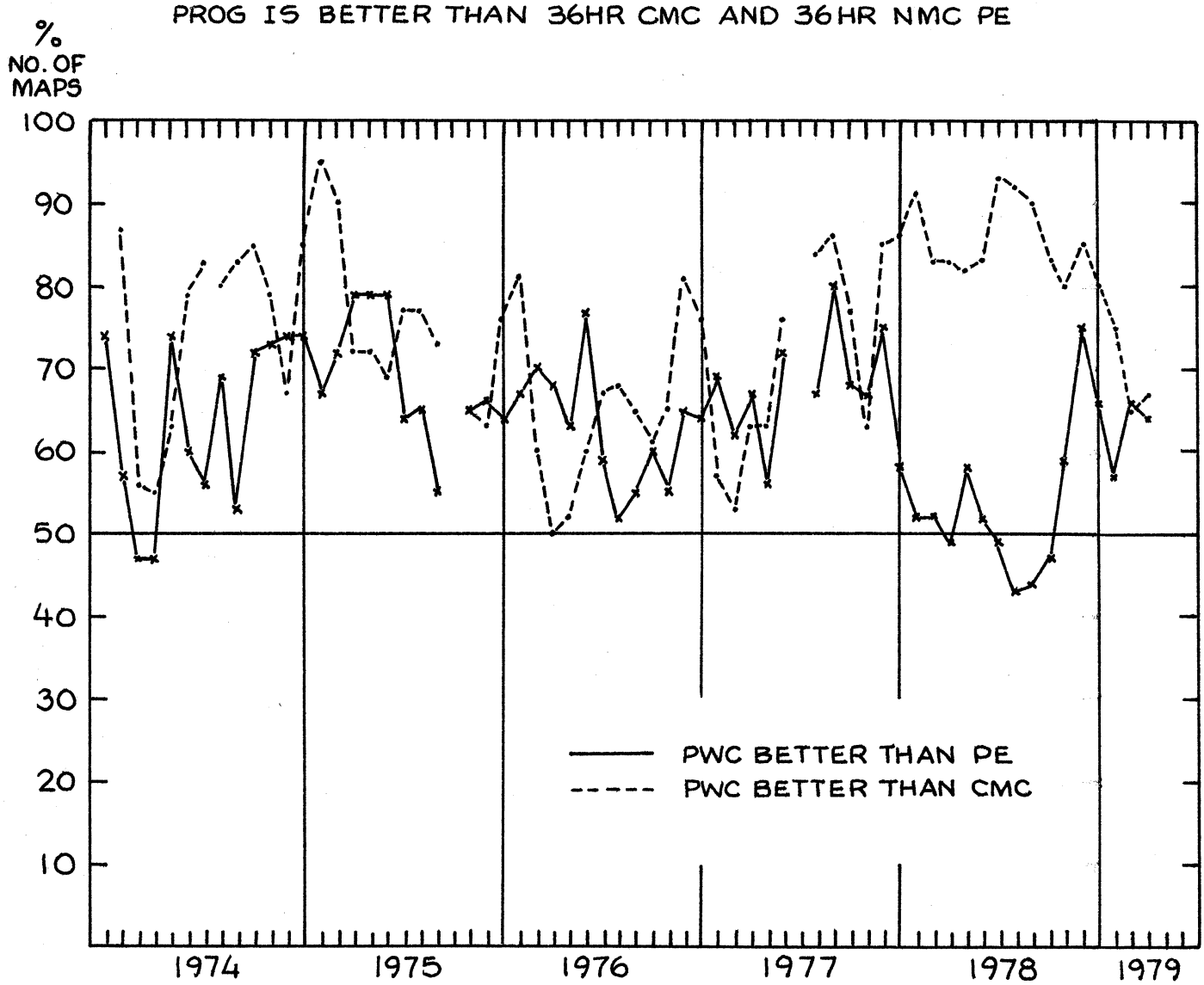

TABLE 1.

AVERAGE YEARLY VERIFICATION SCORES AND THE STANDARD MONTHLY DEVIATIONS

		1974	1975	1976	1977	1978	1979*
PWC	SCORE	.78	.76	.78	.75	.71	.74
	STANDARD DEVIATION	.04	.04	.05	.03	.04	.08
CMC	SCORE	.95	.90	.86	.86	.88	.79
	STANDARD DEVIATION	.05	.07	.09	.06	.05	.06
PE	SCORE	.81	.81	.82	.80	.71	.75
	STANDARD DEVIATION	.04	.04	.05	.03	.04	.08

*COMPUTED ON 4 MONTHS DATA (JANUARY - APRIL)

APPENDIX A

PWC SURFACE PROGNOSES VERIFICATION STATISTICS

$$RMSE = \left(\sum_{i=1}^{63} \frac{(f_i - P_i)^2}{63} \right)^{\frac{1}{2}}$$

$$RMSG = \frac{1}{d} \left(\sum_{i=1}^{48} \frac{(G_{xi}^2 + G_{yi}^2)}{48} \right)^{\frac{1}{2}}$$

$$RMSGE = \frac{1}{d} \left[\sum_{i=1}^{48} \left(\frac{(F_{xi} - G_{xi})^2 + (F_{yi} - G_{yi})^2}{48} \right) \right]^{\frac{1}{2}}$$

$$AE = \sum_{i=1}^{63} \frac{|fi - pi|}{63}$$

$$SS = \frac{RMSGE}{RMSG}$$

WHERE: P_i = actual pressure
f_i = forecast pressure
$G_{xi} = (P_i - P_{i+1})_x$ in x-direction
$G_{yi} = (P_i - P_{i+1})_y$ in y-direction
$F_{xi} = (f_1 - f_{i+1})_x$ in x-direction
$F_{yi} = (f_i - f_{i+1})_y$ in y-direction

RMSE: Root mean forecast pressure error over the grid.

RMSG: Root mean gradient over the grid.

RMSGE: Root mean forecast gradient error over the grid.

AE: Average forecast error in pressure per grid point over the entire map.

SS: A measure of that fraction of the total root mean gradient which has been correctly forecast.