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Report N.:



* T E C - 8 0 0 *

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TORONTO WEATHER OFFICE

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ATMOSPHERIC ENVIRONMENT SERVICE
DEPARTMENT OF THE ENVIRONMENT – CANADA

Technical Memoranda

EXPERIMENTAL AUTOMATED "OUTLOOK"
FORECASTS

JUN 1 1974

by

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ENVIRONMENT CANADA - ATMOSPHERIC ENVIRONMENT SERVICE
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ABSTRACT

Experimental automated outlooks or "day-after-tomorrow" forecasts were prepared based on objective forecasts of probability of cloud and precipitation computed at the Pacific Weather Central, Vancouver, B.C. The simple technique showed an improvement over manually produced forecasts for the fall-winter season 1972-73, but the success was not repeated for the spring 1973 season.

PRÉVISIONS AUTOMATISÉES EXPÉRIMENTALES
DE L'ÉVOLUTION DU TEMPS

par

D.A. Faulkner

RÉSUMÉ

Les prévisions du "surlendemain" ou de l'évolution du temps, à titre expérimental et par voie automatisée, ont reposé sur des prévisions objectives de nuages et de précipitations, elles-mêmes calculées au centre météorologique régional de Vancouver, en Colombie-Britannique. La technique utilisée, relativement simple, représente un progrès par rapport à l'établissement non mécanisé des prévisions concernant l'automne et l'hiver de l'année 1972-1973, mais cette réussite ne s'est pas renouvelée pour le printemps de 1973.

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(Manuscript received January 2, 1974)

1. Introduction

As at other forecast offices across Canada, it is standard practice at the Pacific Weather Central (PWC) to issue outlooks for the "day after tomorrow". These are included in the daily 2:00 PM and 7:00 PM (Pacific) public forecasts. At present, the PWC Public Forecasters base the outlooks on "third-day progs" prepared by CMC and amended by the PWC duty prognostician-analysts. Amendements are made when the experience of the prognostician suggests changes, or when late-received information (such as the U.S. NMC PE Progs) suggests them.

For some time now, objective forecasts of probability of precipitation (POP) and probability of cloud (POC) have been prepared routinely at the PWC for a number of B.C. stations; i. e. Vancouver (YVR), Prince George (YXS), Penticton (YYF), Kamloops (YKA), Revelstoke (YRV), Cranbrook (YXC) and Prince Rupert (YPR). These forecasts, using a multiple discriminant analysis (MDA) technique, have been described by Parent and Rose in three articles listed in the references. The forecasts cover a 48-hour period in 12 hour blocks beginning at 6 hours after initial data time. The morning forecasts thus extend to 1800Z (1000 PST) of the third day. The last 12 hour portion of the forecasts is based solely on CMC surface and 500 mb prognostic data transmitted to the PWC in grid point form.

It was decided to experiment with coding outlook forecasts using a simple algorithm and the POP, POC forecasts and then compare them with the official PWC outlooks. The object, of course, was to seek a better, or equally as good, yet less time-consuming method of preparing the outlooks. This would free the forecasters, to some extent, to concentrate on the shorter range forecasts, which, to this author, are more important, and ones in which the forecasters can have a greater input.

The complete rationale for attempting to automate the outlook forecasts is as follows:

a) Outlooks are worded in simple, broad terms, pointing out the most significant weather feature expected.

b) Third day forecasts for Vancouver and Victoria are now required by 10:30 AM, PST, at a time before the CMC "third-day progs" are available. POC and POP forecasts can easily be available in time to be used as guidance by the forecaster.

c) Most forecasters base their outlook on simple models and attempt to relate the forecast to predicted synoptic patterns: i.e. upper troughs, ridges, etc. This process is similar to that employed in the MDA technique.

d) The factors of simplicity, good memory of the computer, and need for guidance at an earlier time suggest that automated outlooks could readily be incorporated into the routine of an office which has access to a computer.

2. Experiment No. 1.

Automated forecasts for the fall-winter season of 1972-73 were prepared for YVR, YXS, YYF, YKA and YXC. These stations were chosen as there are monthly summaries published for each of them except Cranbrook, and the brief descriptions of the daily weather contained therein were convenient for verification. The Cranbrook forecasts were verified on the weather reported at Castlegar (YCG).

An algorithm was devised to produce forecasts based on the forecast POP and POC. Table 1 shows the probability limits used (cols. 1, 2) and the respective forecasts. For example, if the forecast POP = .32 and the forecast POC = .71 then the computer program would provide a forecast of "cloudy". After a trial period it was found that, for YVR and YXS, the forecasts of "chance pcpn" and "sunny periods" were overforecast. The limits were revised to include more of these in the "pcpn" and "sunny" categories respectively. These revised limits are indicated in cols. 3, 4.

TABLE I

YVR, YXS, YYF, YKA, YXC		YVR, YXS REVISED		FORECAST
POP	POC	POP	POC	
.61 to 1.00		.51 to 1.00		pcpn
.41 to .60		.41 to .50		chnc pcpn
0.0 to .40	0.0 to .20	0.0 to .40	0.0 to .30	sunny
0.0 to .40	.21 to .60	0.0 to .40	.31 to .60	sunny prds
0.0 to .40	.61 to .94	0.0 to .40	.61 to .94	cldy
0.0 to .40	.95 to 1.00	0.0 to .40	.95 to 1.00	ovc

No forecasts of "overcast" resulted from this algorithm and verification indicates that an "overcast" day with no precipitation is rare. The distinction between "cloudy" and "overcast" was therefore ignored.

Lastly, the automated forecasts were compared with the official forecasts issues by the WO and the number of "better", "equal" (good or bad), and "poorer" forecasts were counted. A "better" ("poorer") forecast was defined as one which was closer to (further from) the actual weather for the day using the following categories:

1. Precipitation
2. Cloudy
3. Sunny Periods
4. Sunny

Thus, for example, an automated forecast of "sunny periods" was considered better than a WO forecast of "sunny" if precipitation was reported.

Since the occurrence or non-occurrence of precipitation is probably the most important element to be forecast, decisions

were weighted strongly in favour of correct precipitation/no precipitation forecasts. An automated forecast of "chance of precipitation" was thus considered better if precipitation occurred and was not forecast by the WO, but was considered poorer if precipitation was forecast by the WO and it occurred.

Admittedly the verification was slightly subjective inasmuch as some days could not be characterized simply by one of the 4 terms above. For example, a day which was cloudy until noon clear thereafter could really fit into either of the two categories "sunny" or "sunny periods". In such cases, the forecast which best covered the afternoon period was considered the better one.

The results obtained are listed in Table II below:

TABLE II

PERIOD	SEPT. 19/72 FEB. 28/73		SEPT. 19/72 JAN. 31/73		SEPT. 19/72 FEB. 28/73	SEPT. 19/72 FEB. 28/73	NOV.1/72 FEB.28/73
STATION	YVR	YVR revised	YXS	YXS revised	YYF	YKA	YXC/YCG
WO FCSTS BETTER	43	32	51	38	35	41	30
WO/ NMCL FCSTS EQUAL	70	84	37	56	60	61	50
NMCL FCSTS BETTER	48	45	46	40	68	61	38
NMCL FCSTS EQUAL OR BETTER	118	129	83	96	128	122	88
TOTAL	161	161	134	134	163	163	118

3. Experiment No. 2.

A second, almost identical experiment was carried out for the period March 5, 1973 to May 28, 1973. The algorithm described in paragraph 3 above, but using the revised limits (Cols. 3 and 4, Table I) for POP, POC, was employed. Also, instead of using the descriptions of daily weather from the monthly weather summaries, verification was based on average reported cloud amounts and daily precipitation totals which were available as a result of other ongoing research at the PWC. This enabled the experiment to be expanded to include those stations listed in Table I, plus Prince Rupert (YPR) and Revelstoke (YRV).

The results are given in Table III below.

TABLE III

PERIOD	MARCH 5, 1973 - MAY 28, 1973						
	YVR	YXS	YYF	YKA	YXC	YRV	YPR
WO FCSTS BETTER	34	27	27	35	28	29	29
WO/NMCL FCSTS EQUAL	31	28	37	29	30	29	31
NMCL FCSTS BETTER	20	30	21	21	27	27	25
NMCL FCSTS BETTER OR EQUAL	51	58	58	50	57	56	56
TOTAL	85	85	85	85	85	85	85

4. Discussion and Conclusions

The results of these experiments were encouraging for the fall-winter case, but less so for the spring case. The reasons for this are not clear but may very well have to do with the choice of POC, POP limits. These were set rather arbitrarily and better limits might be obtained by relating them to the climatological probabilities of cloud and precipitation. The improved results obtained by varying the limits in the fall-winter case hint, but do not confirm that this would be so. In all, however, the method appears to offer hope of obtaining as good, or better outlook forecasts with less expenditure of forecaster time.

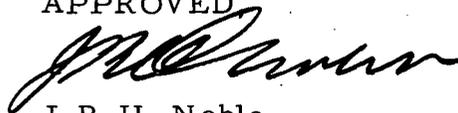
With the introduction of improved models at CMC (such as the PE model that is expected to be introduced shortly), it can be expected that the method would improve. The method might also be improved by using 60 rather than 48-hour prognostics, or both. At the outset, it was felt that using 48-hour prognostics might be a drawback. However, it was expected this would not be serious since there is a correlation between "morning" and "afternoon" weather.

Forecasts prepared using this simple technique would not be complete and would need revision by the forecaster. For example, a forecast of "precipitation" could be changed to "rain" or "snow" depending on temperature forecasts (the CMC objective to temperature forecasts could be used). The forecaster might also wish to change the forecast to "showers", or "morning rain", etc. depending on his assessment of the situation. Significant temperature trends could be added. Also, it might be necessary to alter the forecast under certain circumstances. An example of this would be a period of clear weather in fall in the Lower Mainland of B. C., a situation where fog is prevalent. In this case, a forecast of "sunny" could be amended to "morning fog", or, perhaps, "foggy". In short, it is conceived that the basic forecast would be prepared automatically from the POC, POP forecasts, but the forecaster would have an over-riding control on wording of the forecast.

5. Acknowledgement

The assistance of Mr. M. Rose in carrying out the experiments is acknowledged. Thanks also go to Mr. L. Parent and Mr. Rose for helpful comments.

APPROVED



J. R. H. Noble,
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TEC 800
11 February, 1974

UDC:551.509.21

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