

NEW ZEALAND METEOROLOGICAL SERVICE

TECHNICAL NOTE 221

THE SUCCESS OF THREE TO FOUR DAY
FORECASTS OF FINE WEATHER FOR PARTS
OF THE NORTH ISLAND

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THE SUCCESS OF THREE TO FOUR DAY FORECASTS OF FINE WEATHER FOR PARTS OF THE NORTH ISLAND

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Abstract

Over the last nine summers the National Weather Forecasting Centre in Wellington has issued routine daily forecasts of the prospects of the next 3 or 4 days being fine over parts of the North Island. In this note the accuracy of those forecasts, issued for the Taranaki, Wanganui, Manawatu Region, is assessed for the 1964-65 summer and for the 1971-72 and 1972-73 summers. It is found that about two-thirds of the forecasts are correct and that the percentage of dry spells forecast correctly increases as the number of dry spells increases. A climatology of dry spells in the Taranaki, Wanganui, Manawatu Region is included.

Introduction

During the summer months of December to March the National Weather Forecasting Centre at Wellington has been issuing daily forecasts for the prospects of the next 3 or 4 days being fine in the Taranaki, Wanganui, Manawatu area. Similar forecasts are issued for Waikato, Bay of Plenty, Gisborne, Canterbury, North Otago and Buller. In addition a number of non-routine forecasts are issued on request to private individuals. The routine forecasts are all sent to the local meteorological offices.

The forecasts concentrate on the probability of rain and give only scant attention to temperature, wind, cloudiness and other features of the weather. They also aim very strongly at getting the sequence of wet and dry periods correct, so that even if the timing of the beginning or ending of wet periods is in error, the user is probably still able to rely on the sequence of events.

The main users of the forecasts are farmers and the forecasts are often referred to as 'haymaking forecasts' though their use is not limited to what that title implies.

The Checking System

In trying to assess the accuracy of forecasts of the type considered here there are two main problems. Firstly trying to decide exactly what the forecast means and secondly trying to decide exactly what the weather was. These problems are equally difficult since the forecaster is often going to the limit of what he thinks he can predict

when he makes a 3 to 4 day forecast and therefore often has to use hedging statements, and the weather for its part can and frequently does vary a lot over short distances.

In the summertime heavy showers and thunderstorms are a particular problem for checking rainfall forecasts. Within thunderstorms the rainfall varies considerably over distances of the order of a few hundred metres and hence the records from the raingauges in the area would very probably give an incomplete picture of the rainfall over the area. The system of grading forecasts given below attempts to take account of this problem.

The forecasts which were checked were all for the Taranaki, Wanganui, Manawatu area and were issued daily at 1830 hours NZST. The check period taken was for 72 hours from 0900 hours on the morning following the issue of the forecasts. This period was convenient since daily rainfalls are recorded at 0900 hours each day. The rainfalls during this 72 hour period at six stations (New Plymouth, Stratford, Waverley, Wanganui, Ohakea and Foxton, see Fig. 1) were used as the grading criteria in the following way.

| Grade | Interpretation |
|-----------------------------|--|
| A ₁ | Forecast given for 3-4 days of fine weather and no more than 0.1 mm was recorded at any station during the 72 hour period. |
| A ₂ | Forecast given for 3-4 days of fine weather and no more than 1.0 mm was recorded at any station during the 72 hour period. |
| A ₃ | Forecast given for 3-4 days of fine weather and no more than 5.0 mm was recorded at any station during the 72 hour period and no more than a total of 15.0 mm at the six stations during the 72 hour period. |
| A ₃ ¹ | As for A ₃ but a note of caution was given in the forecast. |
| a | Forecast given for 3-4 days of fine weather and rainfall too great to qualify for A ₃ |
| a' | Forecast given, with a note of caution, for 3-4 days of fine weather and rainfall too great to qualify for A ₃ . |
| B | Definite advice against 3-4 days fine weather and the rainfall was too great to qualify for A ₃ . |
| b ₁ | Definite advice against 3-4 days of fine weather and rainfall would have qualified for A ₃ but not A ₂ . |

| <u>Grade</u> | <u>Interpretation</u> |
|----------------|--|
| b ₂ | Definite advice against 3-4 days of fine weather and the rainfall would have qualified for A ₂ but not A ₁ . |
| b ₃ | Definite advice against 3-4 days of fine weather and the rainfall would have qualified for A ₁ . |

With these gradings it should be noted, firstly, that the capitals represent successes and the lower case symbols represent failures; secondly, that A and a are advice in favour of 3-4 days fine weather and B and b are advice against it; thirdly that as the suffix increases the success decreases (A₁ - A₂ - A₃) and the failure becomes greater (b₁ - b₂ - b₃). The dashes indicated caution in the forecasts. The inclusion of A₃ is an attempt to deal with heavy showers and thunderstorm weather in a realistic way.

The Accuracy of Forecasts

Using the ten gradings given above the forecasts for the period December 1 to March 31 were marked for the three seasons 1964-65, 1971-72 and 1972-73. The results are given in percentage form in the next table. Percentage form is appropriate since one or two forecasts could not be located and so the number checked varied a little from season to season.

| <u>Grade</u> | <u>1964-65</u> | <u>1971-72</u> | <u>1972-73</u> |
|------------------|----------------|----------------|----------------|
| A ₁ | 2.1 | 15.6 | 25.9 |
| A ₂ | 3.1 | 0.8 | 3.6 |
| A ₃ | 2.1 | 3.9 | 9.8 |
| A ₃ ' | 15.6 | 11.7 | 18.8 |
| a | 4.2 | 10.2 | 10.7 |
| a' | 6.3 | 10.9 | 4.5 |
| B | 45.8 | 28.9 | 13.4 |
| b ₁ | 14.6 | 5.5 | 6.2 |
| b ₂ | 1.0 | 5.5 | 6.2 |
| b ₃ | 5.2 | 7.0 | 0.9 |
| Total | 100.0 | 100.0 | 100.0 |

If it is assumed that grade A₃ is a success then the two by two contingency table below allows the forecasts to be more clearly appraised.

| Forecast | | | |
|----------|---------|--------------------------|-------------------|
| | | Dry | Not Dry |
| Actual | Dry | $A_1 + A_2 + A_3 + A'_3$ | $b_1 + b_2 + b_3$ |
| | Not Dry | $a + a'$ | B |

For the three seasons the corresponding tables are:

| | 1964-65 | | 1971-72 | | 1972-73 | |
|---------|---------|---------|---------|---------|---------|---------|
| | Dry | Not Dry | Dry | Not Dry | Dry | Not Dry |
| Dry | 22.9 | 20.8 | 32.0 | 18.0 | 58.1 | 13.3 |
| Not Dry | 10.5 | 45.8 | 21.1 | 28.9 | 15.2 | 13.4 |

These seasonal data can be alternatively summarised to show how the results relate to the amount of settled weather in a season.

| | 1964-65 | 1971-72 | 1972-73 | All Seasons |
|---------------------------|---------|---------|---------|-------------|
| Percent of all Spells | 43.7 | 50.0 | 71.4 | 55.0 |
| Dry Spells | | | | |
| Percent Correctly Fcst | 52.4 | 64.0 | 81.4 | 65.9 |
| Percent of all Spells | 56.3 | 50.0 | 28.6 | 45.0 |
| Wet Spells | | | | |
| Percent Correctly Fcst | 81.4 | 57.8 | 46.8 | 62.0 |
| Percent Correct Forecasts | 68.7 | 60.9 | 71.5 | 67.0 |

From this table it is clear that as the percentage of 3-day dry spells in a season increases so does the success at forecasting them and conversely (and to some degree independently) as the percentage of 3-day wet spells in a season increases so does the success at forecasting them.

For the seasons combined, about two-thirds of the daily

forecasts were correct and about two-thirds of all the 3-day fine spells which occurred were forecast to occur.

The Climatology of Fine Spells

Daily rainfalls (9 a.m. to 9 a.m.) have been analysed at New Plymouth and Palmerston North to show the probabilities of spells of fine weather in past data. The results of a small part of this analysis are given below where the seasons are consecutive 3 month periods beginning with December, January and February for Summer.

Probabilities (percent) of Dry Spells of Durations of 1 to 7 days (total rainfall not exceeding 1 mm)

1. Palmerston North (1928-70 inclusive)

| | <u>Summer</u> | <u>Autumn</u> | <u>Winter</u> | <u>Spring</u> | <u>Year</u> |
|---------------|---------------|---------------|---------------|---------------|-------------|
| 1 day periods | 71.1 | 70.1 | 62.8 | 64.8 | 67.2 |
| 2 day periods | 55.0 | 53.6 | 45.4 | 46.2 | 50.1 |
| 3 day periods | 43.0 | 41.8 | 33.2 | 33.5 | 37.9 |
| 4 day periods | 33.6 | 32.8 | 24.2 | 24.3 | 28.7 |
| 7 day periods | 16.7 | 14.9 | 8.7 | 9.1 | 12.4 |

2. New Plymouth (1967-70 inclusive)

| | <u>Summer</u> | <u>Autumn</u> | <u>Winter</u> | <u>Spring</u> | <u>Year</u> |
|---------------|---------------|---------------|---------------|---------------|-------------|
| 1 day periods | 69.8 | 62.8 | 53.0 | 58.2 | 61.9 |
| 2 day periods | 53.9 | 45.9 | 37.8 | 37.9 | 43.8 |
| 3 day periods | 40.7 | 33.2 | 26.9 | 26.6 | 31.8 |
| 4 day periods | 30.1 | 25.2 | 18.5 | 18.8 | 22.9 |
| 7 day periods | 13.8 | 8.4 | 5.9 | 9.9 | 9.5 |

The similarity of these figures, particularly in the summer season, and the geographical location of the places almost at either ends of the Taranaki, Wanganui, Manawatu Region, suggests that the figures would reasonably represent conditions in all areas below 500 metres (1600 feet) in the region.

The probability of any 3-day spell being fine during the summer is about 41% to 43% so that the 1964-65 season represented conditions considerably nearer to the average in this respect than the 1971-72 and 1972-73 seasons.

Conclusions

The checking system used is objective but has the serious limitation of relying on six spot reports of rainfall.

It must be noted that reliance on only six reporting stations gives the benefit of doubtful forecasts for 3 to 4 days of dry weather to the forecaster and not the user. This is because the probability of any of the six stations recording any isolated heavy rain is less than the probability that they will not record it.

Approximately two-thirds of all forecasts issued were correct and about two-thirds of all the dry spells which occurred were correctly forecast.

The probability of correctly forecasting dry spells increases as the number of dry spells increases.

In the Taranaki, Wanganui, Manawatu area in the summer season the probability of any day being 'dry' is about 70% and similar figures for any period of 2, 3, 4 or 7 consecutive days are about 55%, 42%, 32% and 15 % respectively.

Acknowledgement

I wish to express my thanks to the members of the 1972-73 'Meteorology Advanced' Course for the routine forecast checking which they carried out.

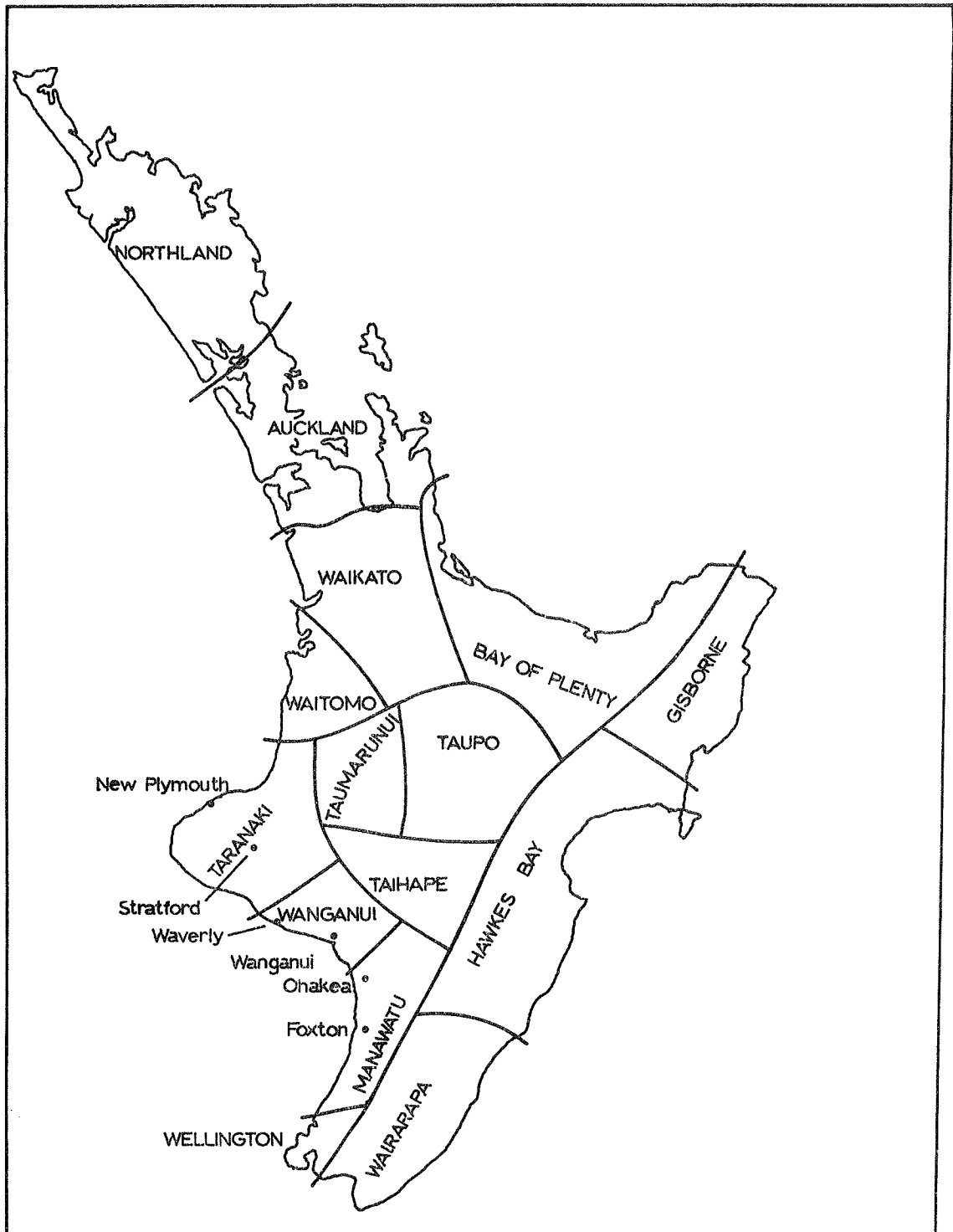


Figure 1
WEATHER FORECAST DISTRICTS
IN THE
NORTH ISLAND OF N.Z.