Evaluation of a 5-Year Forecast

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Abstract

A forecast 5 years in advance for each of 6 successive days is verified. Although the forecast has some interesting features, forecasters did not rate it highly. The forecast correlates lower with verifying observations than a monthly normal forecast does.

1. Introduction

Accurate weather forecasts for seasons, years, and decades in advance have been a dream of mankind for many thousands of years.

The present status of long-range forecasts has been summarized by the American Meteorological Society (1976, p. 1460, p. 1461):

For periods of more than 1 month: skill in day-to-day forecasts is nonexistent and skill in seasonal outlooks and climate forecasts is minimal at the present time. . . .

Recent theoretical work on atmospheric predictability indicates . . . an upper limit for the prediction of day-to-day weather changes. This limit is believed to be about 1–2 weeks. . . .

At present the National Weather Service issues experimental long-range forecasts for up to one season in advance. They are couched in probabilistic terms and are very general.

2. Data and forecasts

Some meteorologists have made specific forecasts for years in advance. In a paper delivered in 1972 at the Annual Meeting of the American Geophysical Union, Krick (1972) stated that

the computer output permits the preparation of daily prognostic charts for years into the future of sufficient quality to be used effectively in the evaluation of the weather factor in relation to any human activity [and that] no deterioration in the quality of the forecasts occurs during the prediction interval, whether it be a few days or several years.

To illustrate the procedure and the accuracy of the forecasting system, a 6-day series of daily prognostic sea-level pressure charts was given. They covered the period 17–22 January 1977 and are shown in Fig. 1. Note that these 5-year prognostics contain considerable detail: exact locations of highs, lows, fronts, troughs, and ridges.

The statement of the AMS (1976) used the term “weather” to mean such elements as rain, wind, and

temperature rather than pressure fields and fronts. It is, however, common practice for meteorologists to use prognostic charts to help predict weather, and the above excerpt from Krick (1972) ties prognostic pressure charts to weather forecasts.

The actual weather charts for the verifying period 17–22 January 1977 are shown in Fig. 2. The problem is to determine how good the 5-year prognostics are—how much skill is demonstrated. It was decided to use both subjective and objective methods to make this determination.

3. Verification

In the subjective test a group of four experienced Los Angeles forecasters was asked to compare the 5-year prognostic charts with the verifying charts and to rate them as excellent, good, fair, poor, or very poor. In making the comparisons, the forecasters were asked to evaluate the 5-year prognostic charts as they would evaluate the routine 30 h prognostic charts issued by the National Meteorological Center. They were not told either the origin of the charts or how far in advance they had been prepared. Specifically, they were asked to compare locations of highs, lows, fronts, and pressure gradients. It was assumed that the isobaric interval on the 5-year charts was 5 mb and that the verifying time was 1200 GMT. The results of the subjective evaluation are shown in the first column of Table 1.

On the basis of the prognostic chart for 20 January, the forecast was made (Krick, 1972) 5 years in advance that “The Presidential Inaugural of January 20, 1977,

TABLE 1. Subjective evaluation of the 5-year prognostics by a group of forecasters (first column) and correlations between verifying sea-level pressures and: 5-year prognostics (second column), January sea-level normal pressures (third column), 5-day prognostics (fourth column), and 30 h prognostics (fifth column).

Jan. 1977	Sub- jective	5 Years	Normal	5 Days	30 Hours
17	Poor	0.07	0.55	0.46	0.95
18	Fair	0.59	0.33	0.16	0.90
19	Poor	0.23	0.38	0.42	0.93
20	Poor	0.68	0.49	0.12	0.85
21	Poor	0.29	0.47	−0.39	0.82
22	Poor	−0.04	0.20	0.37	0.88
Average		0.30	0.40	0.19	0.89

SYNTHESIZED SYNOPTIC CHARTS BASED ON PROJECTED
WAVE AXES FOR JANUARY 17-22, 1977 TYPE: B_n

FIG. 1. Five-year prognostic charts for 17-22 January 1977.

MONDAY, JANUARY 17, 1977

TUESDAY, JANUARY 18, 1977

WEDNESDAY, JANUARY 19, 1977

THURSDAY, JANUARY 20, 1977

FRIDAY, JANUARY 21, 1977

SATURDAY, JANUARY 22, 1977

FIG. 2. Weather maps 1200 GMT 17-22 January 1977.

should occur on a cool, fair day in Washington, D.C. . . ." Those who were in Washington on that day or watched the President, on television, walk up Pennsylvania Avenue will surely agree that the forecast was brilliantly verified. One should keep in mind, however, that the January climatological record shows that a clear or partly

cloudy day occurs 48% of the time in Washington, D.C., and the normal midday temperatures are in the 40s (°F).

The objective evaluation consisted of computing four correlation coefficients for each day. These were the correlation coefficients between sea-level pressures observed and 1) the 5-year prognostic, 2) the January nor-

mal, 3) the 5-day prognostic, and 4) the 30 h prognostic.

Pressures were read at a grid of 54 points covering the contiguous United States and adjacent areas. The points were at 5° latitude/longitude intersections extending from 50°N to 30°N and from 130°W to 70°W.

Figure 3 shows the 5-day prognostic charts, and Fig. 4 shows the 30 h prognostic charts verifying at 1200 GMT for the period 17–22 January 1977.

The second column of Table 1 shows the correlation between the verifying observations and the 5-year prog-

nostic chart. Interestingly enough the best correlation is on Inaugural Day. Further, the 5-year coefficients for 18 and 20 January are higher than any of the coefficients computed by using the normal for the forecasts (third column of the table). The normal, however, had a better average score for 6 days.

When the 5-day prognostic charts were compared with the verifying charts, the prognostics yielded the coefficients shown in fourth column of the table. The range of coefficients was greater for the 5-day prognostics than

FIG. 3. Five-day prognostic charts for 1200 GMT 17–22 January 1977.

FIG. 4. Thirty-hour prognostic charts for 1200 GMT 17–22 January 1977.

it was for the 5-year prognostics. The 5-year average score was the better.

The last column clearly shows that the 5-year prognostics are completely outclassed by the 30 h prognostics. But one could reasonably argue that it is hardly fair to compare a 5-year forecast with a 30 h forecast for an exact time. Perhaps a lag of a day or so should be considered. However, an examination of the data did not suggest that a lag of plus or minus a day or two would improve the scores much.

4. Conclusion

The data at hand are, of course, insufficient to draw solid conclusions about the quality of forecasts made years in

advance. However, if one uses the test recommended by the AMS (1976, p. 1460)—“Unless forecast accuracy exceeds levels achieved by basic methods such as these [climatology], skill cannot be said to exist”—then the 5-year forecasts for 17–22 January 1977 demonstrated no skill and neither did the 5-day forecasts.

References

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- Krick, I. P., 1972: A viable method of ultra long range weather prediction. Paper presented at the 53rd Annual meeting of the American Geophysical Union, Washington, D.C.