PROBABILITY FORECASTS OF A TEMPERATURE EVENT

George T. Gregg
National Weather Service Forecast Office
Albuquerque, New Mexico 87119

1. INTRODUCTION

A modest, unfunded, fruit-frost program has been operated at WSFO, Albuquerque during the critical spring budding season since about 1968. This evolved in response to requests for forecast assistance from fruit growers in some of the important orchard areas of the state who are equipped with orchard heating devices and other means of coping with late-spring freezes. It has been a cooperative effort with the growers furnishing observational and communications support, the NWS, the meteorological expertise, and press wire and news media facilities materially assisting with distribution of the forecasts.

Most features of the program have been conventional with specific temperature forecasts (low tonight, high tomorrow, low tomorrow night) prepared daily for observation points numbering from four to six in three of the major fruit growing valleys of the state. From these "key point" forecast values, the individual growers extrapolate to their own orchards in the same locality. Average absolute errors for the minimum temperature forecasts usually hover in the three- to six-degree Fahrenheit bracket (both periods) which we consider tolerable and reasonable in consideration of the mountain topography, local effects, and the meteorologically stressful spring season in which the program operates.

Unique, to our knowledge, to the operation has been the addition of probability specification for a defined critical temperature event. The thought was that in this area of endeavor, a forecast user could very practically assess economic values to a forecast which reliably advised him of the relative threat of a, to him, very significant weather event; one which he could, by initiating reactive strategies, mitigate to some extent. If he knows the cost incident to these strategies (fuel, labor, etc.), the probable loss if no protective measures are taken, and has a reliable probability specification, then his decision should be fairly simple.

2. FORECAST PROGRAM

The experiment was begun on an internal basis in the spring season of 1970 and has been continued in subsequent years. The event for which a probability specification was to be made was defined, rather arbitrarily, as the occurrence, overnight, of a temperature of 28°F or colder. Subsequent conversations with fruit growers indicated that the temperature chosen as the event-definer was a fairly good one. Seasonal likelihood (climatological frequency) of the event ranges from more than 50% in early April to less than 10% in the second week of May.

Since a probability forecast has no utility whatsoever unless it possesses reliability, we were vitally interested in determining how well the forecasters could categorize relative threat of the specified temperature event. Therefore, it was considered the better part of valor to conduct the experiment on an internal, unadvertised basis until enough data accumulated to form the basis for a value judgment. By the beginning of the 1975 spring season, we had about one thousand such specifications for each of the two periods "Tonight" and "Tomorrow Night" and plots of relative frequency vs probability specification did, indeed, indicate that reasonable reliability was contained in the forecasts. Therefore, beginning with the 1975 season we included the probability forecast with the conventional forecast after apprising the growers as well as was possible of the intent and of the sug-

gested manner of use of the forecasts.

So through both the 1975 and 1976 seasons the probability forecasts were daily disseminated as well as the conventional "low tonight near __" specification statements. We have not had the opportunity to canvas the forecast users and make a determination of how well understood or widely used the probability forecasts have fared. A few individual growers to whom we have talked have expressed a general appreciation of them and a desire for their continuance. But we cannot, by any means, assert that they are popular nor utilized industry-wide.

3. RESULTS

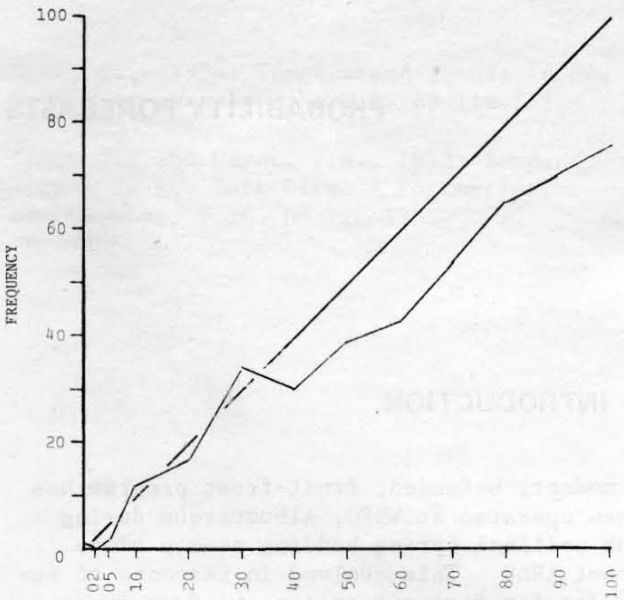
The degree of reliability so far demonstrated has not been as high as we had hoped for. The results of seven years of efforts are presented in Table 1 and in the conventional graphic reliability diagram (Fig. 1). The straight line at a 45-degree angle represents "perfect reliability" while the broken line displays the actual performance of the group of forecasters. It will be noted that throughout the categories from 40% on up there is a consistent bias toward overforecasting, the bias generally increasing in the higher categories.

But even with this fault, which we hope to correct, we believe the reliability is adequate to be of material use to the grower in his need to make a decision as to whether to spend a modest amount of money to protect on a given night in comparison to the potential loss of a substantial sum in the event of a damaging freeze. The program will be continued in 1977.

EVENT: OVERNIGHT OCCURRENCE OF 28° OR COLDER
1970 THROUGH 1976

CATEGORY	NO. OF FORECASTS	NO. OF EVENTS	FREQUENCY
0	524	7	.01
.02	14	0	0
.05	45	1	.02
.10	161	19	.12
.20	115	20	.17
.30	76	26	.34
.40	57	17	.30
.50	56	22	.39
.60	84	36	.43
.70	79	43	.54
.80	81	53	.65
.90	79	55	.70
1.00	72	55	.76

Reliability of "TONIGHT" Forecasts
1970 Through 1976 Seasons - 1443 Forecasts



THE COOPERATIVE WEATHER OBSERVER IN YOUR COMMUNITY – ANONYMOUS

The phenomenon known as the Cooperative Observer Program of the NOAA-National Weather Service never ceases to amaze meteorologists, hydrologists and climatologists. The program and its success has, on occasion, aroused the envy of other countries. All too often, those of us working with the program routinely are lulled into complacency as year after year, valuable data from 12,000 to 13,000 observers flows into the National Records Center. Every once in a while, though, the full significance of the contribution of cooperative observers to NOAA and, in turn, the national economy penetrates the veil of daily routine and one ponders "why" the program works. The following is one such reflection from a National Weather Service State Climatologist in Idaho.

Why:
1. Why do we have a program of climatological observation?
2. Why do thousands of people in the United States serve as cooperative observers?
3. Why is it important that the observations be accurate and that they be recorded accurately?

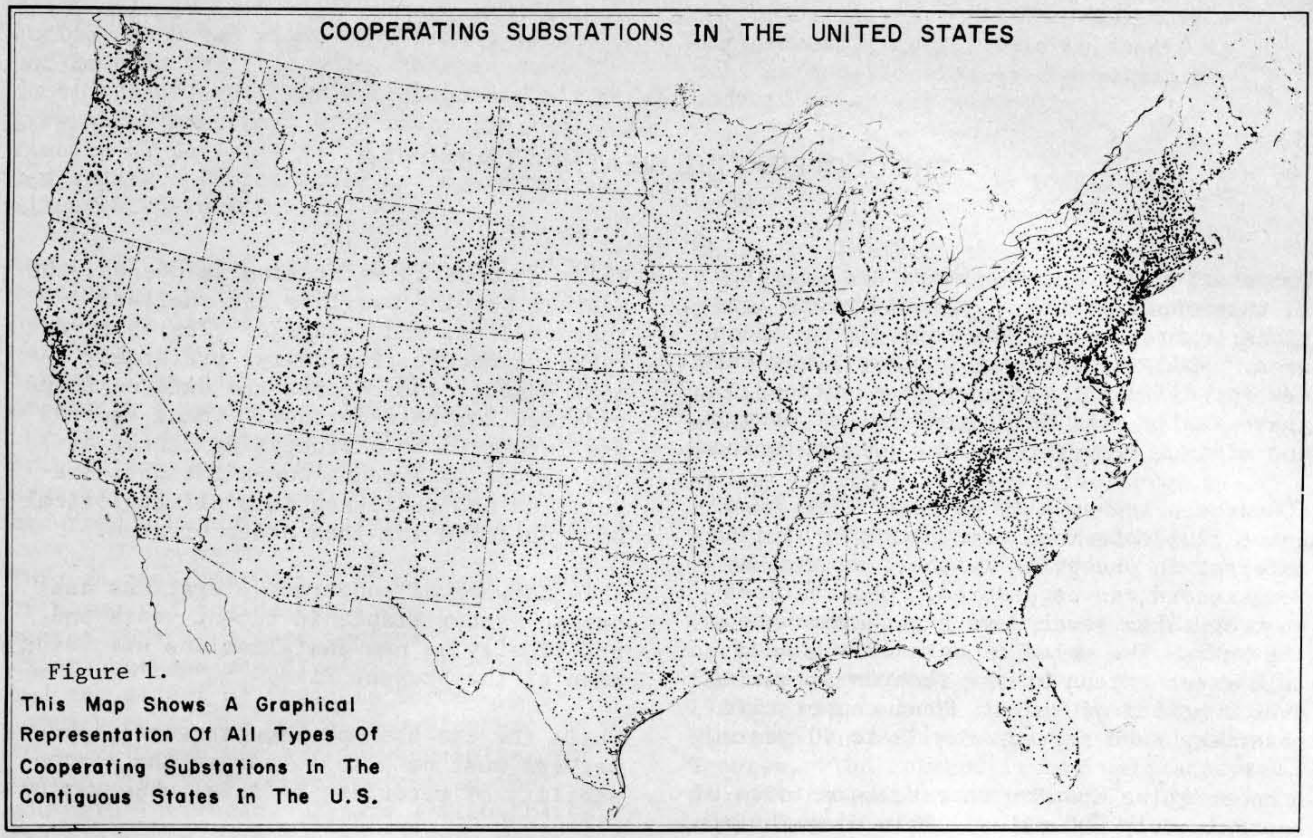


Figure 1.
This Map Shows A Graphical Representation Of All Types Of Cooperating Substations In The Contiguous States In The U.S.

HERE'S WHY:

1. Without such observations at thousands of places we would not begin to know the details of the climate of the United States. Buildings would be designed by guesswork and might fall far short of the needed protection against the elements. Highways might be built on too shallow a base to withstand extreme temperatures, alternate periods of freezing and thawing, and the ravages of heavy runoff. Crops might be planted in areas of unsuitable climate -- too short a growing season, too much or too little rain, etc. Dams might be built that would not be large enough to hold back an extreme flood or they might be too big and the cost would be excessive. Years of records from cooperative observers provide information on which to plan.

2. A group of observers would undoubtedly respond with many answers. For some, the motive is simply a real interest in weather and its vagaries. Others accept the responsibility as a civic duty. A few, at points where observations are entrusted to an institution or an organization, would probably say, "I do it because the boss says so." The best observers are those who realize the importance of the program and conscientiously and carefully observe, read, measure, and record the data whether the boss says so or not. (Incidentally, if the boss says so, you can bet he is convinced of the importance of the records.) As in all human endeavors, self-discipline is the key to good performance.

3. Accuracy is of prime importance because nearly all of our knowledge of climate is based on the records of cooperative climatological observers. If we are ever to learn anything about climatic changes through long periods of time, we must have consistently good records, not just for a month, not just for a year, but for decades, or maybe centuries.

So, take a new look at the weather observer for your community. Your weather records are important; they are not just a set of figures mailed to a National Weather Service Office to satisfy the whims or the curiosity of people employed by that agency. Your records are public property, used currently, used time and time again through the next few months or years, and reused countless times many years after the observations are made and recorded. Your records are a permanent part of the archives of the nation.