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CLIMATE FORECAST VERIFICATIONS, U.S. MAINLAND, 1974-82

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ABSTRACT

An eight-year record (Dec. 1973-Feb. 1982; 33 seasons) of temperature and precipitation forecasts was examined and some conclusions about the predictability of these two fields over the U.S. mainland were drawn. The conclusions are a statistical distillate of the combined forecasts of four types of forecasters working independently, each in his own way. The forecasters are: J. Namias, National Weather Service (via D. Gilman and three colleagues), Analoger (via T. Barnett and R. Preisendorfer), and A. Douglas. Part I defines the forecasters and the method of verification. Summary details are depicted in Part II and extensively tabulated in Part III. Some salient results are summarized as follows:

First of all, winter 1982 (i.e., Dec. 1981; Jan., Feb. 1982) precipitation was the least well predicted of the past five winters (1978-82). Winter 1982 temperature was less well predicted than in winter 1981, but better predicted than in winter 1980. In general, over the given period, temperature was better predicted than precipitation, either as a function of season or region, on the U.S. mainland. Both temperature and precipitation decreased in predictability through the seasonal sequence: best predicted in winter, then spring, then summer, and finally least well predicted in fall. Temperature as a rule was better predicted on the Pacific Coast, Southwestern Desert, Northern Plains; and was less well predicted in the Southern Plains, Gulf Coast, Atlantic Coast. Precipitation as a rule was better predicted in the Southwestern Desert, Great Northern Basin, Great Lakes; and was less well predicted in the Southern Plains, Gulf Coast, Atlantic Coast. It should be noted that these conclusions are based on forecasts and on climate records taken from a recent eight-year stretch, out of eternity, over a single country, and as seen through the imperfect crystal balls of eight mere mortals.

Summary (Data Base: 1974-1982)

- Winter 1982 temperature was less well predicted than in winter 1981, but better predicted than in winter 1980. (Sec. 8.1; Fig. 8.1)

- Winter 1982 precipitation was the least well predicted of the past five winters (1978-1982). (Sec. 8.2; Fig. 8.2)

- Temperature was better predicted than precipitation, as a function of season or region, on the U.S. mainland. (Sec. 8.3; Sec. 9; Sec. 10)

- Both temperature and precipitation decrease in predictability through the seasonal sequence: winter, spring, summer, fall, over the U.S. mainland. (Sec. 8.3; Figs. 8.3, 8.4)

- Temperature was better predicted, as a rule, in (Sec. 10; Fig. 10.4):

  Pacific Coast
  Southwestern Desert
  Northern Plains

  and was less well predicted in:

  Southern Plains
  Gulf Coast
  Atlantic Coast

- Precipitation was better predicted, as a rule, in (Sec. 10; Fig. 10.5):

  Southwestern Desert
  Great Northern Basin
  Great Lakes

  and was less well predicted in:

  Southern Plains
  Gulf Coast
  Atlantic Coast

- The human forecasters are generally better than the Stochaster and the Climater, but they are often no better than the Persister. (Sec. 6; Figs. 6.1-6.18)

- The Most Probable Markover is almost always the best of all operational forecasters (human, benchmark, or empirical). (Tables of Secs. 12, 18)

- The Most Probable Markover, and perhaps even the Best Analoger, despite their relatively high levels of forecasting skill (relative to the Stochaster) must yet be evaluated with regard to their practical guidance in (e.g.) matters of deciding on season-ahead stockpiling of fuel and crop planting.

1. Introduction

For the past eight years (33 seasons from Dec. 1973 to Feb. 1982, '1974-82' for short), four distinct, parallel efforts in seasonal temperature and precipitation forecasts over the U.S. mainland have produced records which we shall compare, in various ways, with their associated observed fields. The remarkable aspect of these parallel efforts rests in the near commonality of several key features of the forecasts: commonality of region (the U.S. mainland), of time period (1974-82), and of format (compatibly-produced, terciled forecast maps).* This aspect permits perhaps for the first time a systematic comparison of a set of predicted and observed temperature and precipitation fields over the U.S. mainland. These verifications have resulted in some new statistical estimates of the relative predictability of temperature and precipitation with respect to season and geographic region over the U.S. mainland. Moreover, the study develops the first indications of the relative rankings of skill of the various forecast methods being used by the Long-Range Forecast Branch of the National Weather Service, and by the researchers affiliated with the first Experimental Climate Forecast Station at the Climate Research Group of the Scripps Institution of Oceanography, La Jolla, California.

The present study is divided into three parts: In Part I we identify the four main human forecasters whose records are subsequently analyzed. In Part I we shall also define some nine non-human forecasters who also attempt in their own ways to predict the same fields as the human forecasters. The outputs of these non-human forecasters serve as objective benchmarks or backgrounds against which to view our efforts at verifying the U.S. mainland seasonal climate forecasts. In Part II we summarize some salient statistics on forecaster skills and climate predictability gleaned from the performances of the human forecasters and a selected few of the non-human forecasters. Part III is the repository of the records from which the diagrams and tables of Part II were made.

The primary records of human forecasts and observed fields, the basis of our compilations in Part III, are the result of the labors of Madge Sullivan at the Scripps Climate Research Group (C.R.G.). She worked by hand directly from the original forecast maps and the observed fields to produce a digitized record of these fields in tercile form on punched cards. We are grateful to Dr. Jerome Namias and Prof. Richard Sommerville of the C.R.G. for making these records available to us. Virginia May of PMEL drafted the figures and Ryan Whitney of PMEL typed the manuscript. We thank Dr. Robert J. Stewart of PMEL for a detailed review of the text. We also acknowledge the support of the U.S. National Climate Program Office (Alan Hecht), through the C.R.G., for making this study possible. A condensed version of this work was presented at the 'Winter 1981-82' Workshop, sponsored by the Climate Dynamics Program Office (K.H. Bergman) of the National Science Foundation, and held at Scripps, on 29-31 March 1982.

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* There are occasional departures from temporal commonality (i.e., simultaneity of predictions) in the records. E.g., the Analoger and Douglas forecasts entered the records later than the forecasts of Namias and the Weather Service. Nevertheless, on the whole, as will be seen in the study below, the periods of commonality are adequately large for our statistical conclusions (see §12.4).

PART I. THE FORECASTERS

2. Human Forecasters

The four human forecasters considered in this study are: Dr. Jerome Namias, of the Scripps Climate Research Group (C.R.G.), Scripps Institution of Oceanography, La Jolla, California; Dr. Donald Gilman (and three colleagues) of the National Weather Service, Washington, D.C.; the Analoger (alias Drs. Tim Barnett of C.R.G., and Rudolph Preisendorfer of PMEL/NOAA, Seattle); and Prof. Art Douglas of the Atmospheric Sciences Department, Creighton University, Omaha, Nebraska. The Analoger's modus operandi has been published* and is under further development. The methods used by the remaining three of these forecasters are largely unpublished, being relatively complex and in a state of experimental development at present.

3. Forecast Verification

The forecasts and their observed fields studied below are expressed in seasonal anomalies--i.e., departures from a thirty year seasonal mean established at each of 99 points on the U.S. mainland. The thirty-year period used is 1941-1970. Moreover, these departures from the mean are classified into three categories called terciles.† Thus, the set of seasonal temperature anomalies (i.e., for winter, spring, summer, or fall) at each point is divided into three equally populous subsets, the upper third, middle third, and lower third. These subsets of the set of anomalies are designated by the letters 'A', 'N', and 'B' (above, normal, below) respectively. Precipitation anomaly subsets are determined similarly and are customarily denoted by 'H', 'M', and 'L' (high, medium, low), respectively.

When the associated field (temperature or precipitation) is subsequently observed, it is also classified point by point using one of the appropriate letters. Both predicted and observed temperature fields (say) are displayed by means of contoured maps, separating the A, N, or B areas. See, e.g., Fig. 3.1 below. A verification of a forecast using terciles is shown by means of a simple self-explanatory example in Fig. 3.2. In that example the number of points in the map is n = 9. For the actual U.S. mainland maps, we have n = 99 points uniformly distributed along lines of latitude and longitude, as far as the outline of the U.S. mainland will permit. The choice of n = 99 follows from the requirement that n be divisible by 9 and near 100. This divisibility requirement is simply one of convenience as will become clear in the definition of the Stochaster, below.

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* Barnett, T. P., and Preisendorfer, R. W., "Multifield Analog Prediction of Short-Term Climate Fluctuations Using a Climate State Vector," *J. Atm. Sci., 35,* 1771 (1978).

† More precisely, the temperature records were the ones terciled over this period, while the terciled precipitation records were derived from data in the period 1948-1970. We tested the tercile anomaly distributions in the observed data sets 1974-82 for uniformity within the categories, since the latter were formed from the 1941-70 means. The 1974-1982 tercile anomalies were acceptably uniform within the categories.

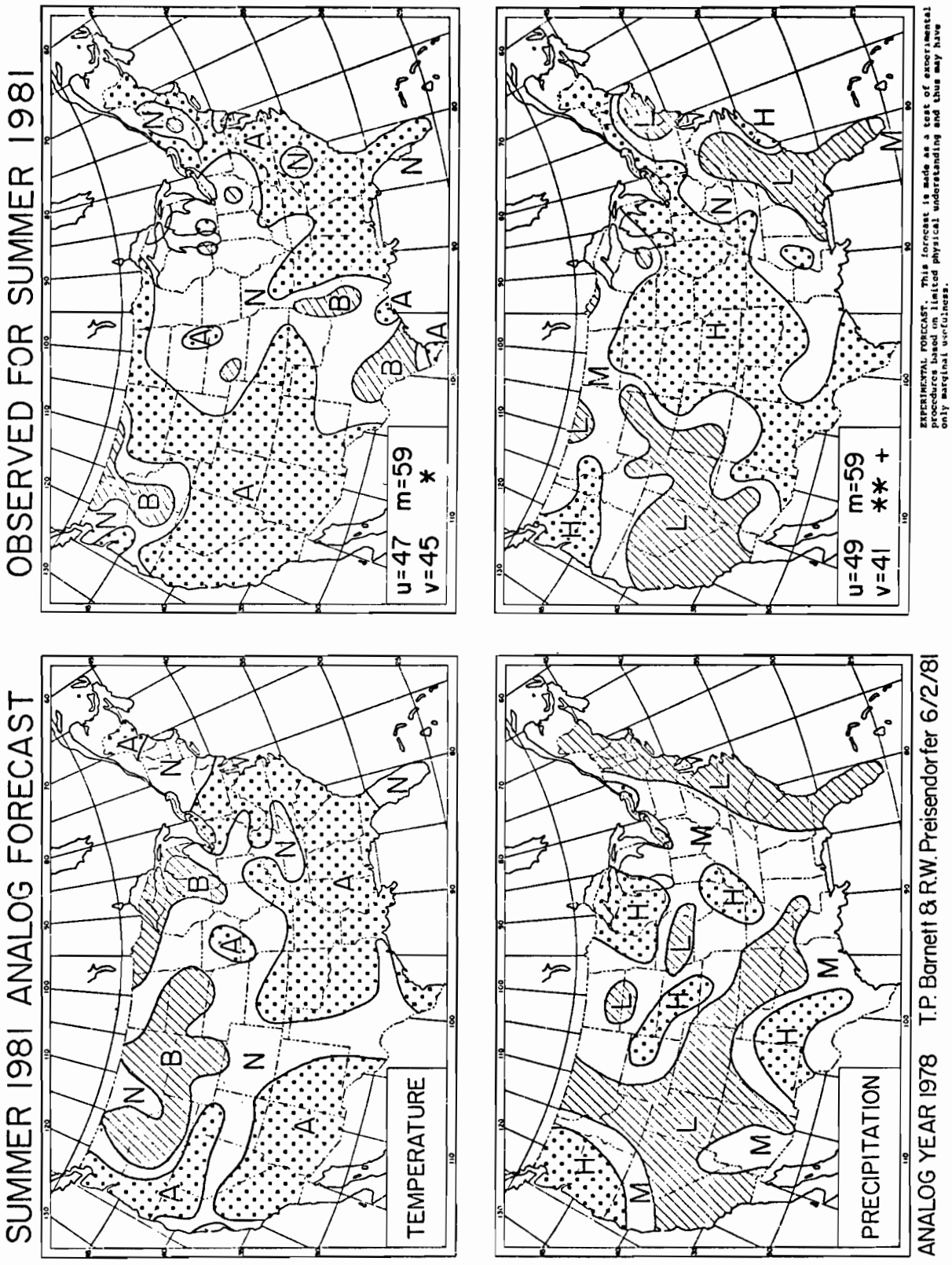
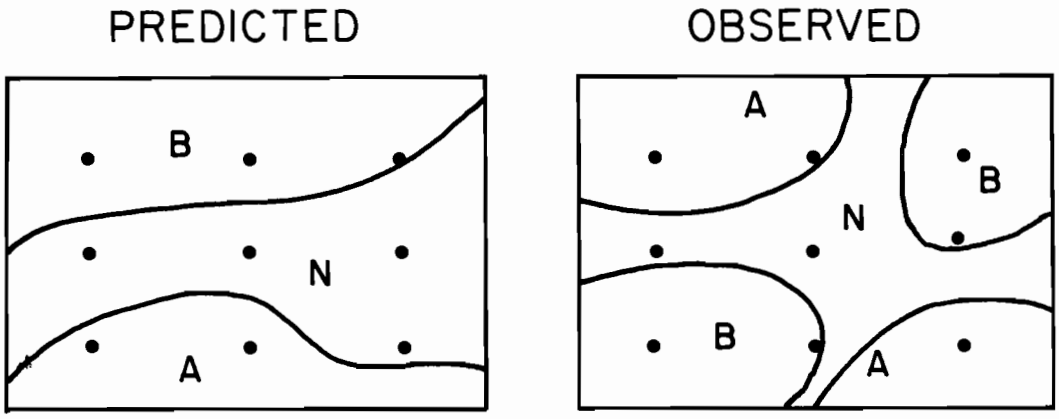

SUMMER 1981 ANALOG FORECAST
OBSERVED FOR SUMMER 1981
TEMPERATURE
u=47 m=59
v=45 *
PRECIPITATION
u=49 m=59
v=41 ** +
EXPERIMENTAL FORECAST. This forecast is made as a test of experimental procedures based on limited physical understanding and thus may have only marginal usefulness.
ANALOG YEAR 1978 T.P. Barnett & R.W. Preisendorfer 6/2/81

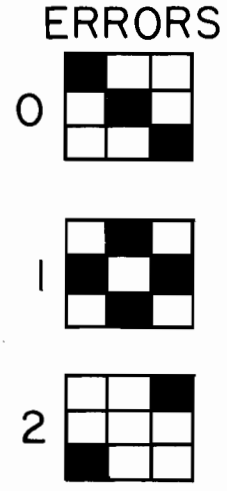
Fig 3.1

COUNTING THE 0,1,2-CLASS ERRORS IN FORECASTS OF ANOMALIES



OBSERVED

PREDICTED	A	N	B
A			//
N	/	//	/
B	//		/



0-CLASS ERRORS (NO. CORRECT) u=3

1-CLASS ERRORS (OFF BY 1) v=2 u+v+w=9

2-CLASS ERRORS (OFF BY 2) w=4

Fig 3.2

4. Benchmark Forecasters

Three non-human forecasters, which we have found useful in setting up benchmarks of performance for the human forecasters, are listed with their definitions below:

4.1.	Climater:	always predicts normal
4.2.	Persister:	always predicts present
4.3.	Stochaster:	always predicts randomly.

Some general comments on these three forecasters will now be made.

The Climater never makes a calculated try at forecasting, and therefore never tries to predict above or below normal in temperature or precipitation. For him it's "nothing ventured and occasionally something gained." Our verification scoring diagrams for the Climater below show the characteristic tell-tale pattern of his forecasts: all his verification points have w = 0(!). Human forecasters hedging a prognosis leave tell-tale Climater patterns on their uv diagrams if they indulge too heavily in using normal forecasts over the U.S. map.

The Persister is the lazy cousin of the Climater. Whatever pattern now exists over the map, the Persister says that will be the pattern of the next season. As will be seen, he racks up some respectable verification mileage in this simple way.

The Stochaster randomly flips an unbiased cube, with opposite faces marked alike, for each of his forecasts: the cube comes up, with equal probability, an A, N, or B, and the Stochaster assigns the result, in turn, to each point of the map. The joint probability of a Stochaster obtaining a set of u 0-class, v 1-class and w 2-class errors in an experiment consisting of n trials (so that u + v + w = n) is shown in Fig. 4.1. The basis for the uv diagrams used below is displayed in the same figure. Greater detail of the uv plane, where the Stochaster's u's and v's fall, is shown in Fig. 4.2. The stars and pluses used in the forecast records below are also defined in this figure. By means of the stars and pluses of the Stochaster, statistical and physical significance can be assigned any forecast. Further descriptions and properties of the Stochaster may be found in an earlier work*.

The present Stochaster is the first and most lenient in a hierarchy of possible random forecasters for use in gauging statistically significant forecast skill. He is also the simplest possible Stochaster for use in tercile forecasts. For the present there is no reason to replace him by a more

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* Preisendorfer, R. W., "Climate Forecast Verification via Multinomial Stochasters." S.I.O. Ref. 77-33, Scripps Institution of Oceanography, La Jolla, CA 92093, (1977). The moment m used to define the stars and pluses is discussed further in Sec. 7, below. The regions in the uv-plane defining the stars have been determined empirically so that only the best of the human forecasters, so far, occasionally earn three stars. The Stochaster therefore attains ***, by construction, only 4 out of 1000 forecasts, on the average. The plus mark denotes a bonus for a forecaster when he earns a star and the Persister and Climater do not (cf. Sec. 12.2).

stringent taskmaster, as will become clear to readers studying the results, below. The reason for this is that the human forecasters, for all their physical erudition or mathematical prowess, still have considerable ways to go to reach the high-skill region of the uv diagrams defined by the present form of the Stochaster. Furthermore, just how far toward the perfect forecast ($u = 99$, $v = 0$, $w = 0$) one must go for his forecasts to be useful in practice, will not be considered in this study.

THE STOCHASTIC FORECASTER: THE STOCHASTER

		OBSV A	OBSV N	OBSV B
PRED	A	1/9	1/9	1/9
	N	1/9	1/9	1/9
	B	1/9	1/9	1/9

(RELATIVE FREQUENCIES WITH WHICH STOCHASTER PRODUCES j-CLASS ERRORS)

PROB. OF A 0-CLASS ERROR $a_0 = 1/3$ $(= 3/9)$

PROB. OF A 1-CLASS ERROR $a_1 = 4/9$

PROB. OF A 2-CLASS ERROR $a_2 = 2/9$

JOINT PROBABILITY OF OBTAINING u 0-CLASS ERRORS, v 1-CLASS ERRORS, w 2-CLASS ERRORS, OUT OF n TRIALS

$$P(u,v,w) = \frac{n!}{u!\,v!\,w!}\, a_0^u\, a_1^v\, a_2^w$$

$$u+v+w=n,\quad a_0+a_1+a_2=1$$

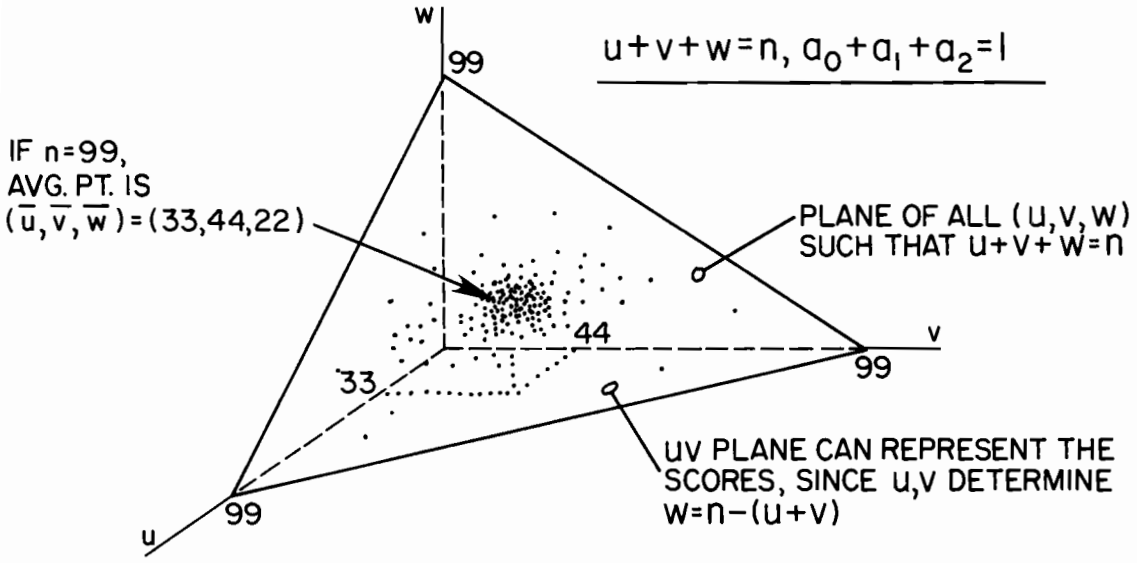
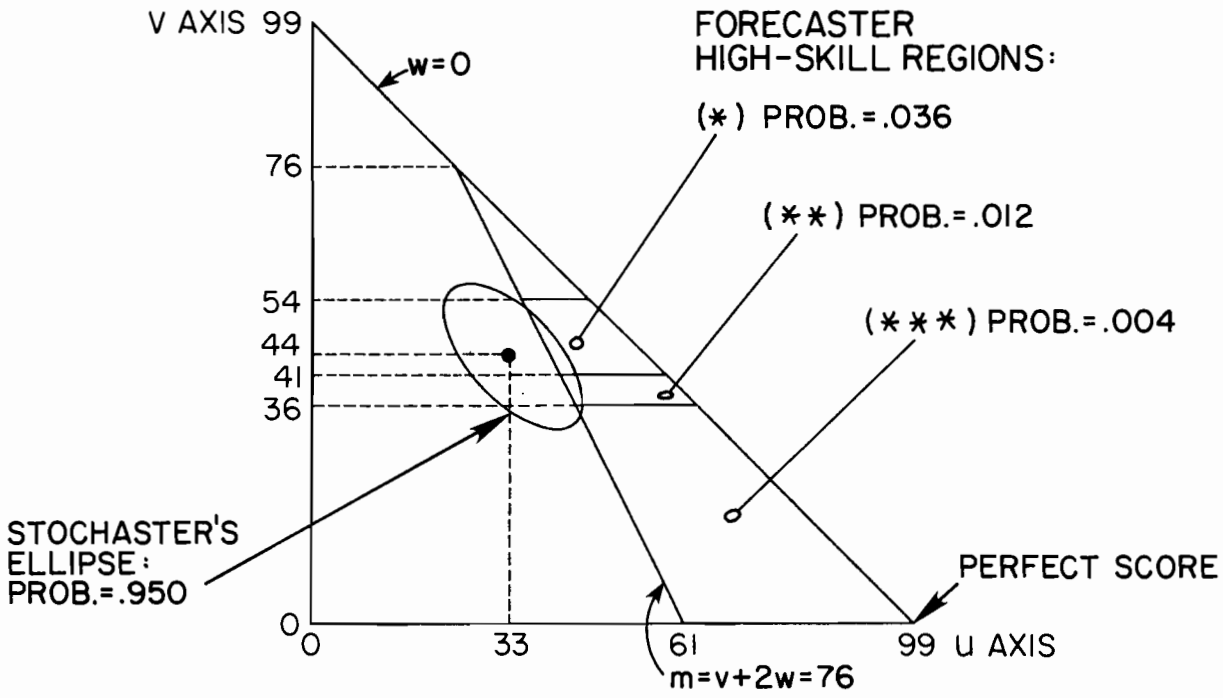


Fig 4.1

STOCHASTER'S STARS & PLUSES

UV DIAGRAM



FORECASTER EARNS:

* IF $m \leq 76$ AND $41 < v \leq 54$

** IF $m \leq 76$ AND $36 < v \leq 41$

*** IF $m \leq 76$ AND $v \leq 36$

PLUS EARNED IF, IN ADDITION:

\+ PERSISTER AND CLIMATER EARN NO STARS

(UV DIAGRAM AND PROBABILITIES BASED ON STOCHASTER'S PERFORMANCE)

Fig 4.2

5. Empirical Forecasters

Somewhere between the benchmark forecasters and the human forecasters lie the empirical forecasters. These non-human forecasters have an important property in common: they all are based solely on the observed, terciled, punched-card record over the period 1974-82. These forecasters never have seen the light of day, so to speak; they are oracles in the record: without once looking at other meteorologic or at oceanographic records, and by merely rummaging about in the terciled records on the punched cards, they can make their forecasts. With the exception of the Best Analoger defined below, each forecaster is operable, i.e., capable of making a seasonal U.S. mainland temperature or precipitation forecast, along with the human forecasters. The relatively high performances of some of these operable empirical forecasters are remarkable, and it is on this basis that we include in Parts II and III the records of their forecast skills. Their operational definitions follow. In these definitions, when we speak of 'maps', we mean the maps of anomalies at the 99-points of the U.S. mainland, either for temperature or precipitation. Also, in the definitions below, it will be helpful to think of the maps laid out on a table, in a straight line, from earliest on the left to the latest on the right. In each definition, one of these maps will be singled out as the present or current season map, and the forecast will be for the successor just to its right, i.e., the next season map.

5.1. Pure Analoger: Go through the entire record and find that map of the record which has the smallest verification m-value ($m = v + 2w$) with respect to the current season's map. This is the analog of the current season's map. The forecast for the next season is the seasonal map succeeding the analog's map. (Example in §12.3)

5.2. Persistence Analoger: Proceed, as in the case of the Pure Analoger, of paragraph 5.1, to find the current season's analog. The forecast for the next season is the map of the analog. (Example in §12.3)

5.3. Best Analoger (non operable): Single out an arbitrary map of the record, and designate it as the current season map. Then go to the next season map. (This is where the procedure in practice becomes non-operable.) Find the analog of the next season's map, i.e., that map of the record which is closest to the next season map in the sense of the m-metric (cf. §5.1). The forecast for the next season map is this analog of the next season map. This produces the best possible pure or persistence analog forecast that can be made for the next season map, as contained in the record, and using the m-metric (Example in §12.3).

5.4. Empirical Markover: Fix attention on any one of the 99 points on some arbitrary current map. Go through the record and build the 3 x 3 table, at that point, consisting of relative frequencies of transition from any given one of the 3 states A, N, B, in the current season, to any other given one of these states in the next season. (The rows of the matrices are thus probabilities, adding up to 1.) Repeat this at each of the 99 points, resulting in 99, 3 x 3 transition probability matrices. To forecast the next season's map, use the present season's A, N, or B state and the 3 x 3 matrix at each point. Draw a random number in a suitable manner to determine which final state the initial A, N, or B state will go to, in accordance with the transition probability. Repeat

this at each of the 99 points. The result is a map which is a realization of a random variable.*

5.5. (Most) Probable Markover: Establish the 3 x 3 matrices of paragraph 5.4 above. At a given point, currently in state A, N, or B, find the maximum entry in the associated row of the transition matrix. This maximum entry gives the most probable final state. Use this most probable final state to forecast next season's anomaly state from the present season's observed anomaly state at the given point. Repeat this at each of the 99 points. The result is a deterministic map. (In the event of a tie, i.e., two or more maximal row elements, at a point, make a prediction using the Climater or Persister, as desired. We used the Climater; ties in row elements were relatively rare, 5 or 6 per map.)

5.6. Hybrider: Divide the U.S. mainland into 10 climate regions (cf. §10). Find the climate regions of the U.S. mainland over which each of the preceding operable forecasters has maximal skill. Assemble a new forecast map for the succeeding season by using that part of the forecast of each forecaster over his maximal-skill region. (Ties between two or more of a forecaster's maximal-skill regions are arbitrarily broken by the operator of the method.)

The empirical forecasters defined above were allowed to range over the entire record in order to produce their analogs or their 3 x 3 tables, as the case may be. This tactic was suggested by the relatively small record at hand (33 seasons). The more or less stationary statistics of weather in the present epoch support this tactic and allow us to conclude that, for data sets much longer than the present one, skills of the empirical forecasters generated in this way would be close to their skills generated by using only data in the past of some current season.

The Pure Analoger in paragraph 5.1 above is distinct from the Barnett-Preisendorfer Analoger of §2. The present Pure Analoger is an oracle of the record, in strong contrast to the Analoger of §2, which uses a variety of northern-hemispheric meteorologic and oceanographic fields. The Best Analoger in paragraph 5.3 is included in the roster above to show that the record of merely 33 seasons accumulated for this study already contains analogs that are sufficiently close to any current season to allow a verification score which is as yet, on the average, unattainable in its excellence by any operable

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* A simple extension of this (non-seasonal) Markover can be made to account for the possible seasonal dependence of the 3 x 3 probability table, as follows. Thus, e.g., to make the winter-forecast 3 x 3 table, follow the above recipe, but now limit to the fall seasons the search for transitions from the initial fall A, N or B to the following winter A, N, or B. In the present data set we would have only nine such falls (fall 1973 to fall 1981) from which to build the 3 x 3 table. This is not quite enough to make a useful table. For this reason, we have pooled all the seasons to build the present Markover. As will be seen, this still results in a relatively skillful forecaster.

forecaster, human or otherwise.* By construction, as the record accumulates, season by season, the skill of the Best, the Pure, and the Persistence Analogers, on the average, will monotonically increase. For the human forecasters, this presents a perennial challenge. They are challenged much in the way the hounds in a chase are drawn along by the ever-receding swift hare. As will be seen below, the two Markovers, especially the (Most) Probable one, also provide competitors of naturally increasing skill, drawing along the human forecasters, as time goes on, provided the overall earth climate remains statistically stationary.

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* For 99-point anomaly maps, displayed in terciles of temperature or of precipitation, there is a total of $3^{99} \cong 10^{47}$ distinct maps possible. The probabilities of the Stochaster performing like the Best Analoger are indicated in §24.3.

PART II. SELECTED SUMMARIES OF FORECAST VERIFICATIONS

6. uv Diagrams

One can see at a glance the overall forecast skill of a given forecaster by looking at the sprinkling of numbered points in his uv diagrams. The construction of these diagrams was described in Figs. 4.1 and 4.2. In particular, the u and v counts of 0-class and 1-class errors, that become the coordinates of these points, are tallied for each forecast, in the manner illustrated in Fig. 3.2. If he has not yet done so, the reader may wish to study these three figures before going on to peruse the results summarized in the diagrams below. The reader may also note that the theory of Fig. 4.1 allows us to add a feature to the uv diagrams which is helpful in gauging various forms of significance of the forecasts. These are the four '5% lines' for u, v, w, and m. In particular, the following inequalities define the individual variables' 5% significance regions: $41 \leqq u$, $v \leqq 36$, $w \leqq 15$, $m \leqq 76$. Thus for example a u score of 41 or above is statistically significant, i.e., only in 5% of his attempts on average will the Stochaster achieve a u in the range $41 \leqq u \leqq 99$. We now turn to a brief discussion of the uv diagrams of some of the forecasters.

6.1. Stochaster

The Stochaster's uv diagram for temperature is shown in Fig. 6.1. There are 33 points in the diagram, one for each season, starting at point number 1 associated with the winter of 1974, and ending with point number 33 for the winter of 1982. (Here the year of a winter is associated with the Jan. and Feb. of the year.) The remaining points and their associated seasons are listed in Fig. 6.0. The (u,v) coordinates of the points of the Stochaster's diagram were obtained by a Monte Carlo procedure, as described in §4, suitably programmed on a computer. It is easy to see that the theory of the Stochaster's performance (in Figs. 4.1, 4.2) is essentially realized in Fig. 6.1. His precipitation forecast performance is shown in Fig. 6.10 which begins the sequence of precipitation uv diagrams.

6.2 Climater

The characteristic disposition of the Climater's points in the uv diagram is seen in Figs. 6.2, 6.11. By his nature (§4) the Climater predicts only normal temperature or normal precipitation anomalies. Therefore his 2-class errors are always zero. Hence his points must fall on the line $w = 0$. The heavy segment on this line is where on average 90% of the forecasts of a Stochaster, playing the role of a Climater, will fall.* It can be seen that the Climater's range of temperature verification points is very wide. His

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* More precisely, in P(u, v, w) of Fig. 4.1, set $w = 0$. The associated conditional probability function defines the Climater Stochaster. His average u and v values are 33 and 66, respectively. One can visualize the conditional probability function erected on the line $w = 0$, with average point at $u = 33$, $v = 66$. The heavy line contains 90% of the probability mass.

worst score in the temperature diagram occurs at number 21 (which by Fig. 6.0 is associated with the winter of 1979; and winter, as shown also on that figure, is associated in turn with January and February of a year). The Climater's best temperature score is at number 8 (fall 1975). The perfect forecast score would be the one with u = 99, v = 0, w = 0. The closer a verification point in the diagram is to this perfect score, the better the forecast. We shall make this idea of better and worse scores precise in §7. For the moment, our intuitive visual use of the diagram will suffice. Note how relatively compact the Climater's precipitation point set is in and around the heavy segment, indicating a strong resemblance to the Stochaster's performance as a Climater. This means, of course, that precipitation patterns are relatively random, compared to temperature patterns on the 99-point grid, as seen through the skill scores of the Climater.

6.3. Persister

The performance of the Persister, in forecasting temperature, is shown in Fig. 6.3. His temperature point set differs radically from that of the other two benchmark forecasters, in that his scattering of points is neither Stochaster-like nor Climater-like, but rather exhibits an impressive amount of relatively high forecast skill: see the number of points in the *, **, and *** regions (recall Fig. 4.2). The precipitation forecast performance of the Persister is shown in Figure 6.12. Note how Stochaster-like that performance is. Recall that the Climater's precipitation forecasts were also Stochaster-like. Once again, this means that precipitation patterns are relatively random compared to temperature patterns on the 99-point grid, now as seen through the scores of the Persister.

6.4. Probable Markover and Best Analoger

The uv diagrams for temperature and precipitation for the Probable Markover are shown in Figs. 6.4, 6.13, respectively. The superior forecasting skill of this empirical forecaster (§5) is readily evident on examination of his diagrams and on comparing them with the Stochaster's diagrams. The Best Analoger's diagrams are shown in Figs. 6.5, 6.14. In view of his impressive skill, it is frustrating that this forecaster is not operable. (Being able to operate him, however, would be tantamount to having a clear crystal ball, i.e., to being able to foresee next season's observed pattern on the 99-point grid. Study Sec. 5.3.) He is shown here for the reasons mentioned in the closing remarks of §5. It is quite possible that some day a human forecaster, perhaps combining powerful statistical and dynamical techniques, will for several years on average have done better than the Best Analoger. That day will be a milestone in the history of long range (say seasonal) climate forecasting.

6.5. Human Forecasters

The four temperature uv diagrams for the human forecasters are shown in Figs. 6.6-6.9. The Namias and NWS diagrams have, respectively 31 and 33 points. (Missing points indicate no recorded forecast for that season.) The Analoger and Douglas diagrams have, respectively, 22 and 19 points. It is

instructive to contrast each forecaster's temperature point set with that of each of the benchmark and empirical forecasters. None of the human forecast patterns has the compact, purely random pattern of the Stochaster. Rather, the scatter is relatively high in the human forecasters' temperature diagrams. This is characteristic of the capture-trajectory of a fast, slippery-footed hound (the forecaster) after a nimble zig-zagging hare (the observed weather pattern). Thus there are spectacular catches and misses represented in each of the four diagrams. For example, in the Namias pattern, point number 6 (spring 1975) is the best temperature forecast of the lot, while number 17 (winter 1978) is among the worse. The spring 1975 temperature forecast map is recorded in §24. In the case of the NWS point set, this situation is reversed: point 6 is among the worse while point 17 is among the better forecasts. By looking for point 17 in the Analoger's and Douglas' temperature diagrams, we see that this season (winter 1978) was independently agreed to be one of the more predictable of the set of seasons. As the seasons accumulate, the individual characteristic pattern of each forecaster will emerge. We have already seen in paragraphs 6.1, 6.2, 6.3, the marked individuality of the benchmark forecasters.

When we go on to the precipitation uv-diagrams in Figs. 6.15-6.18, we find a systematic decrease in overall skill in every human forecaster's diagram relative to its temperature correspondent. There is also an unmistakable shrinkage in the scatter of the diagrams. Recall the similar shrinkage effect in the Climater's and Persister's precipitation patterns relative to their temperature correspondents. This is indicative of the relative randomization occurring in the trajectory of the hare. Thus precipitation appears to be a relatively random process and the forecasters are finding it somewhat less predictable than temperature. We will see this fact from another view in Figs. 10.2, 10.3.

It is still too early to make definite statements about ultimate forms of the four human forecasters' uv-patterns. Some statistics which summarize these patterns to date (averages, standard deviations, etc.) are compiled in the tables of Part III. The points in the uv diagrams were plotted, e.g., from the Tables in §§12, 18.

SEASON INDEX FOR UV DIAGRAMS

INDEX	SEASON	INDEX	SEASON
1	1/74	17	1/78
2	2/74	18	2/78
3	3/74	19	3/78
4	4/74	20	4/78
5	1/75	21	1/79
6	2/75	22	2/79
7	3/75	23	3/79
8	4/75	24	4/79
9	1/76	25	1/80
10	2/76	26	2/80
11	3/76	27	3/80
12	4/76	28	4/80
13	1/77	29	1/81
14	2/77	30	2/81
15	3/77	31	3/81
16	4/77	32	4/81
		33	1/82

1 = WINTER	WINTER = DEC + JAN + FEB
2 = SPRING	SPRING = MAR + APR + MAY
3 = SUMMER	SUMMER = JUN + JUL + AUG
4 = FALL	FALL = SEP + OCT + NOV

Fig 6.0

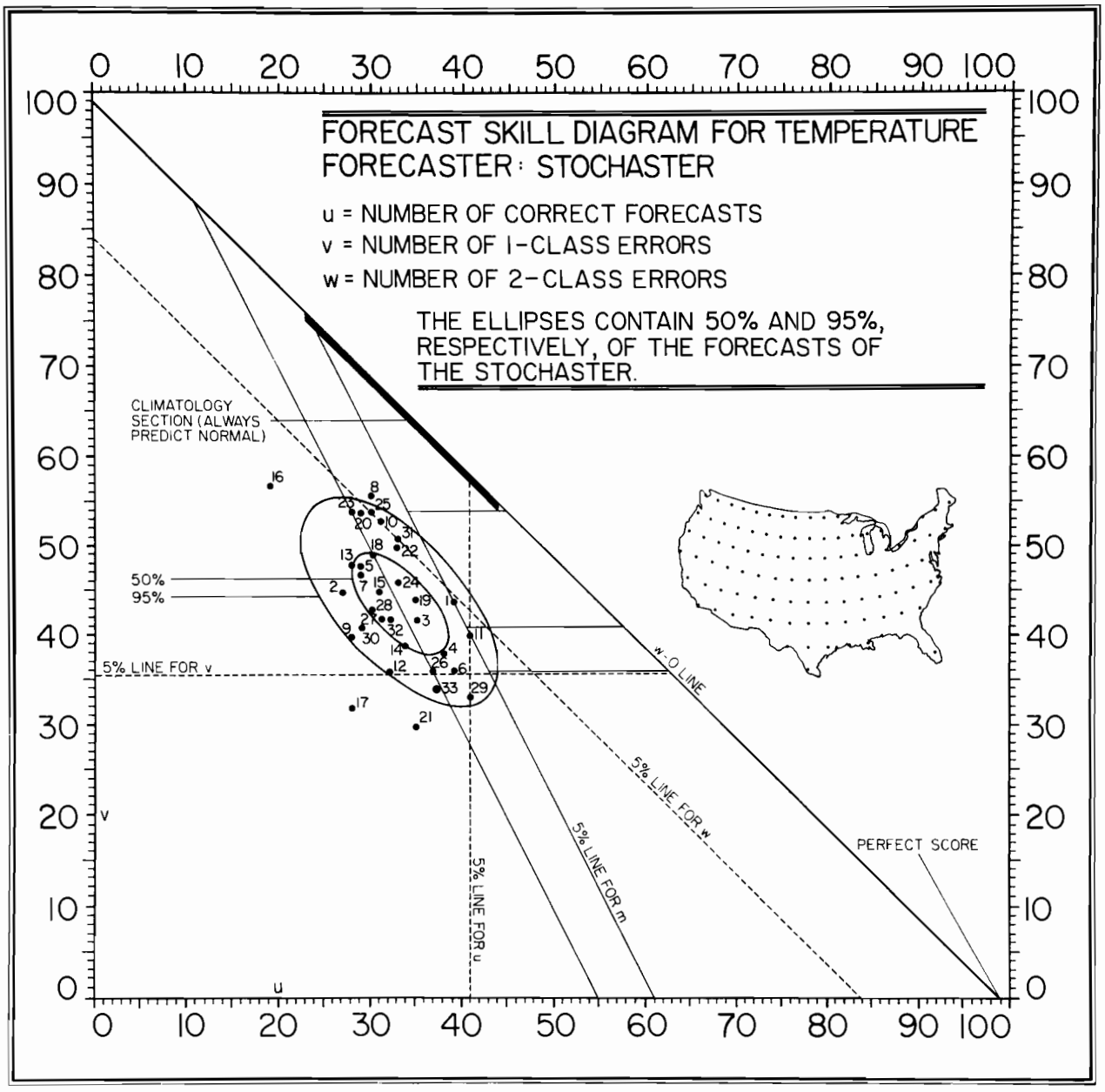
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: STOCHASTER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w=0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.1

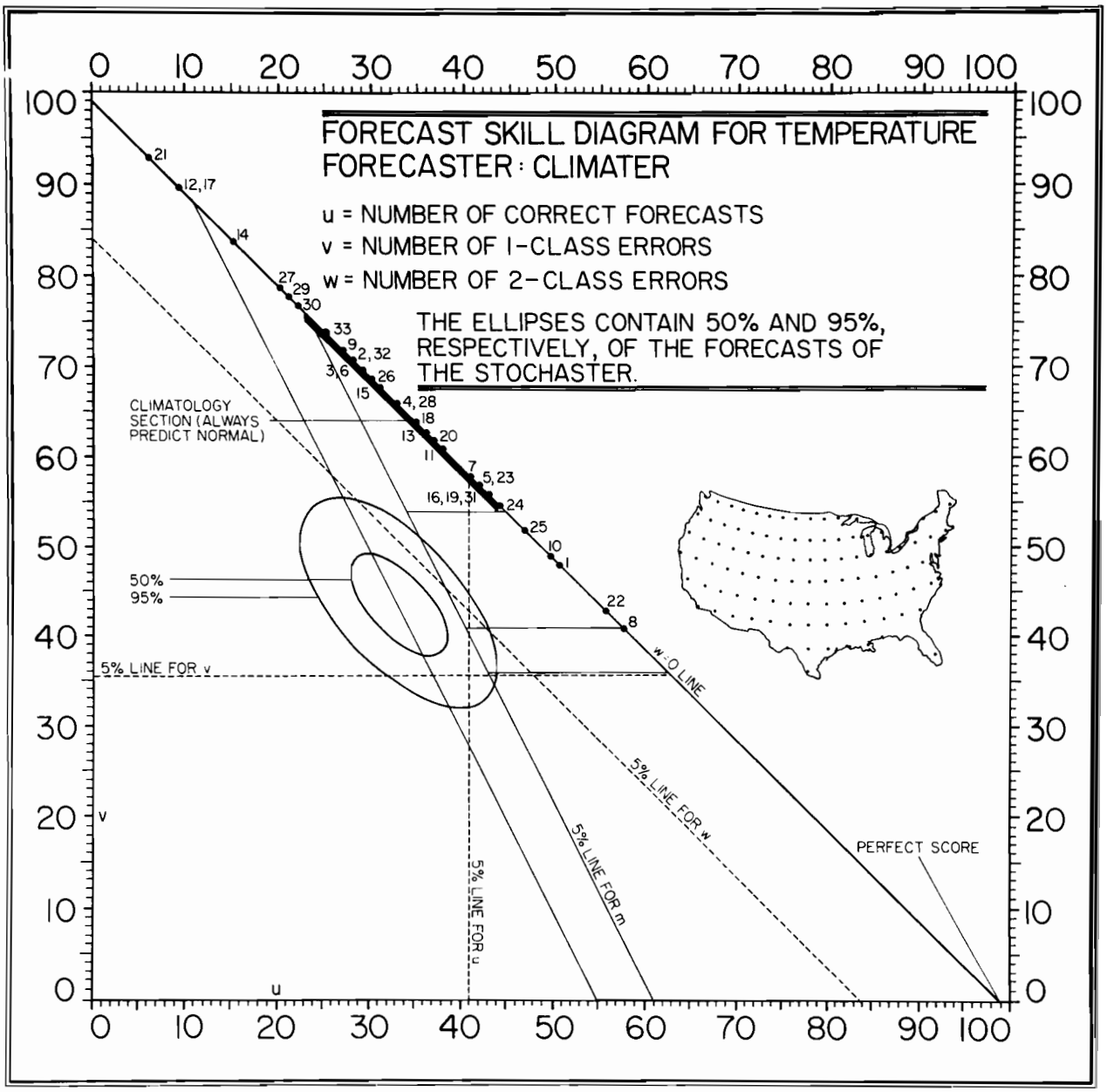
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: CLIMATER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100
21
12,17
14
27
29
30
33
9
2,32
3,6
26
15
4,28
18
13
20
11
7
5,23
16,19,31
24
25
10
1
22
8

Fig 6.2

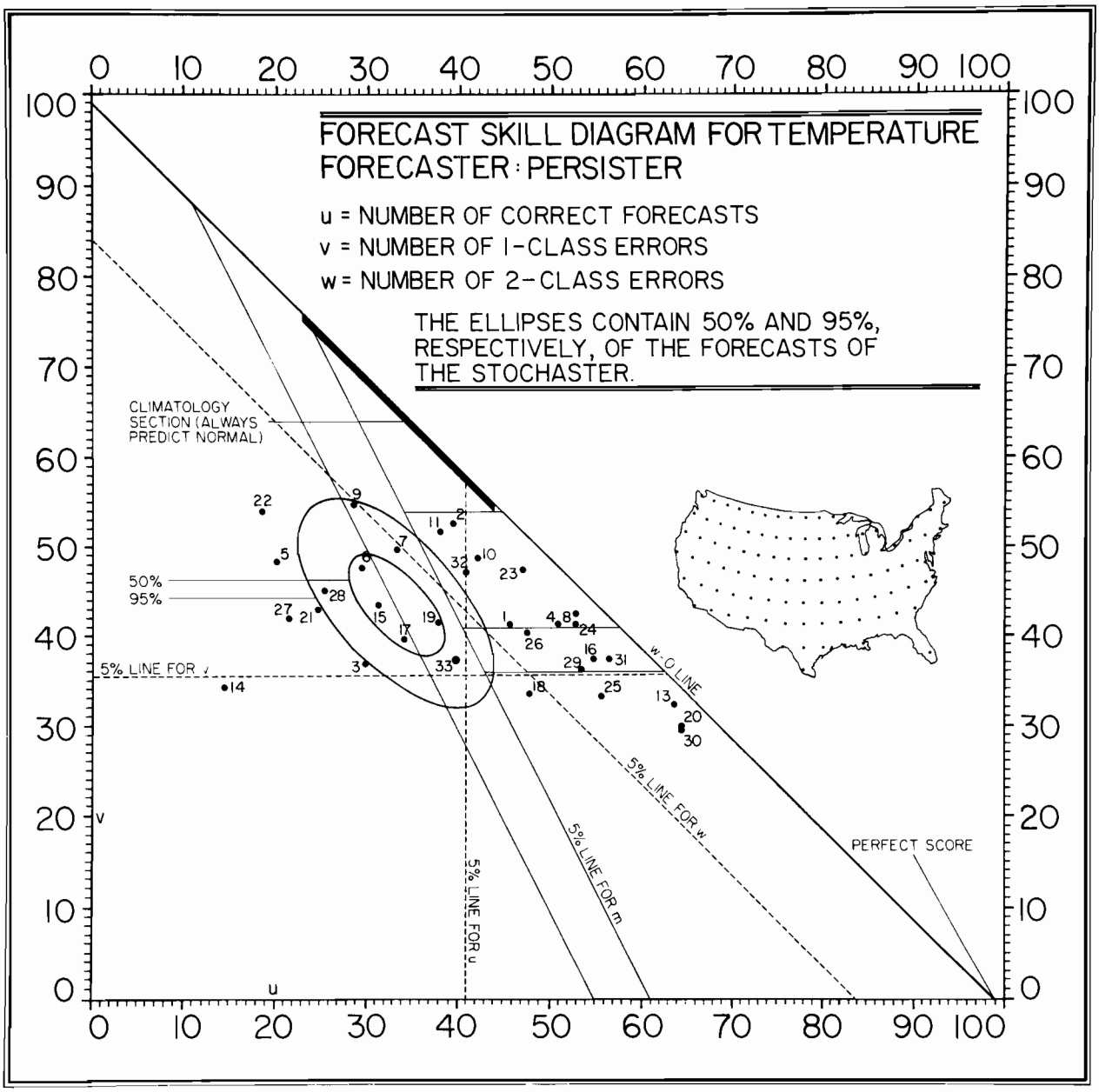
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: PERSISTER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.3

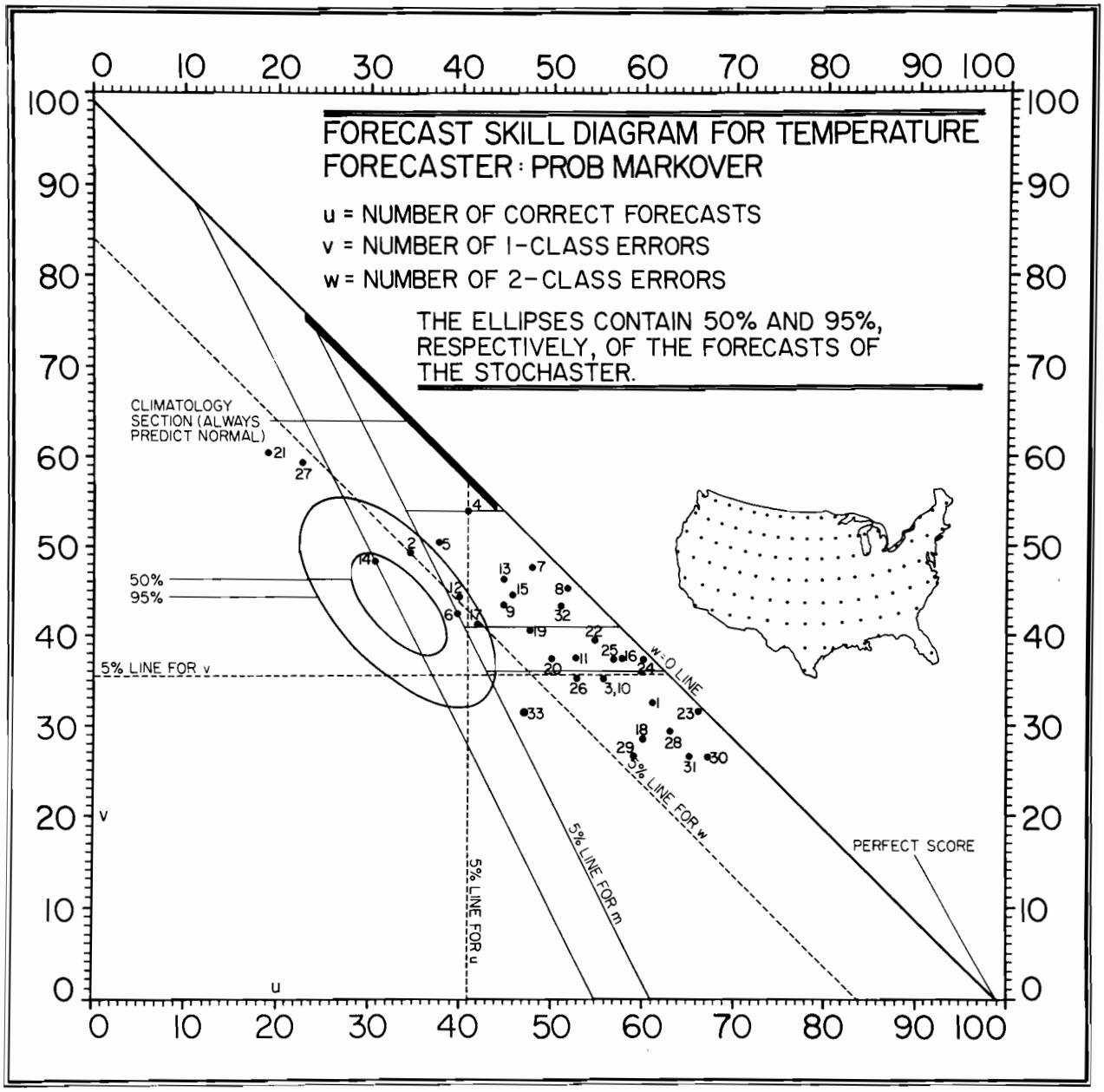
FORECAST SKILL DIAGRAM FOR TEMPERATURE FORECASTER: PROB MARKOVER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.4

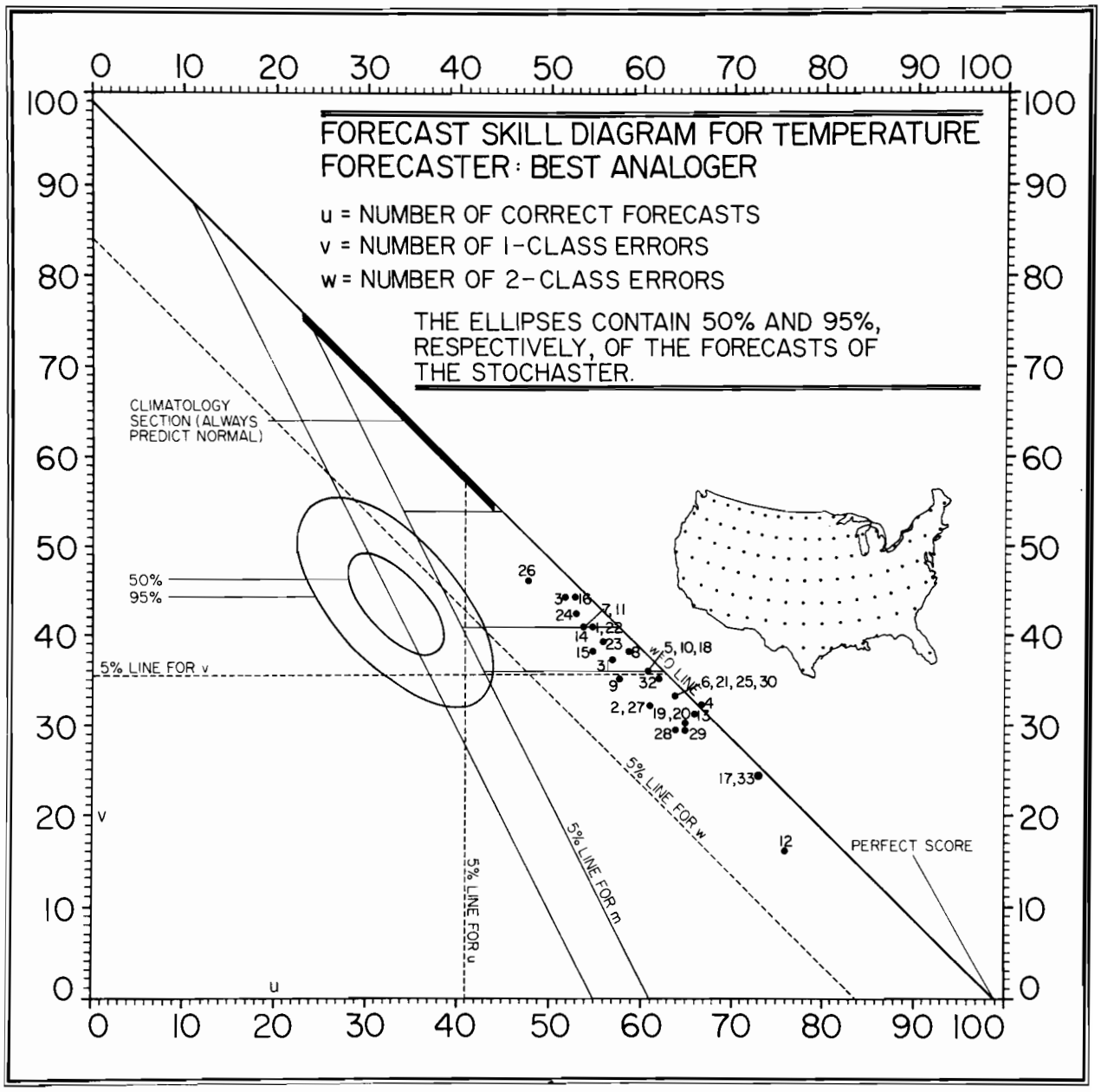
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: BEST ANALOGER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
u
v
0 10 20 30 40 50 60 70 80 90 100
26
3,16
24
7,11
14
1,22
15
23
8
5,10,18
31
9
32
6,21,25,30
4
2,27
19,20
13
28
29
17,33
12

Fig 6.5

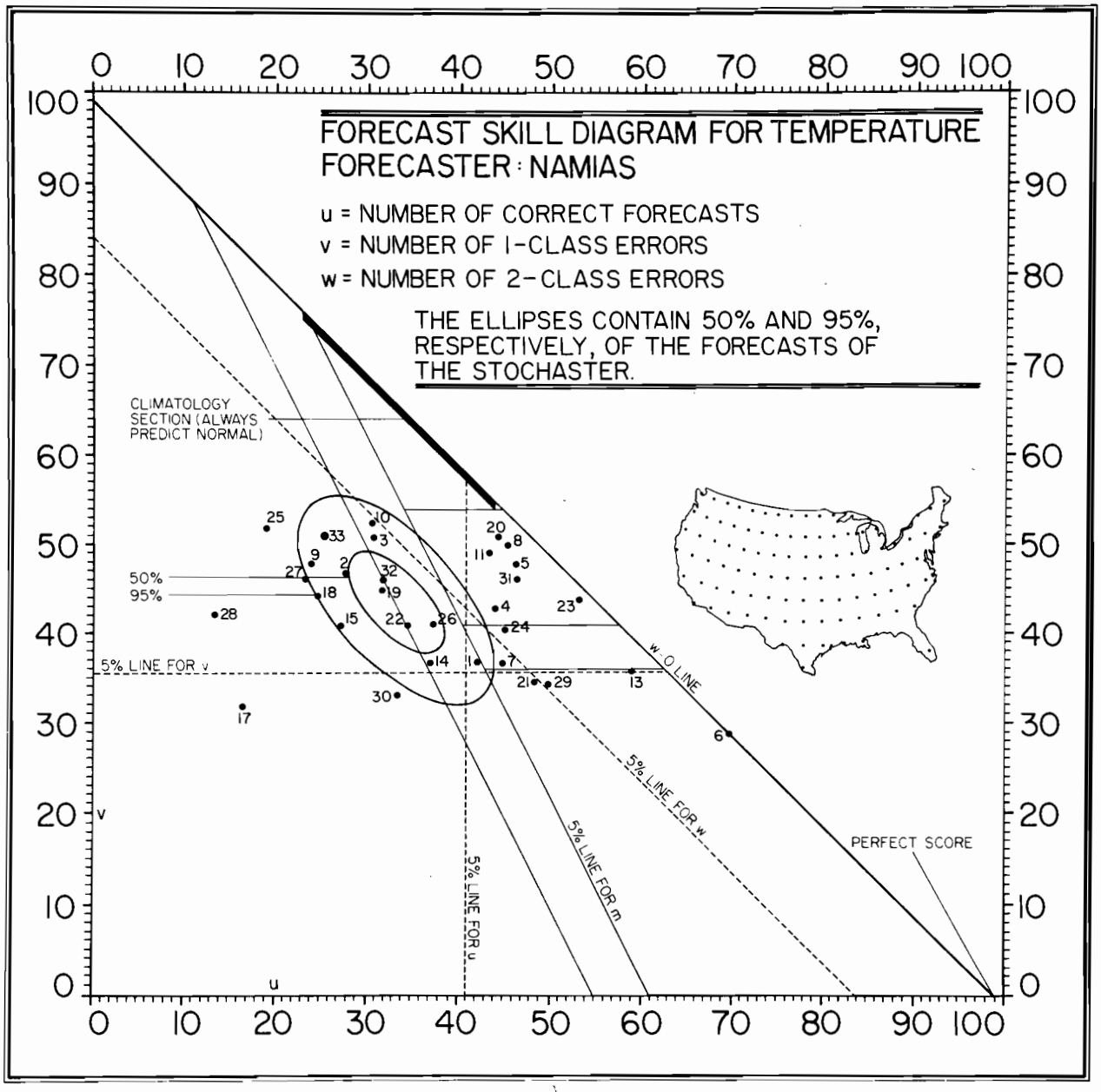
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: NAMIAS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w = 0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.6

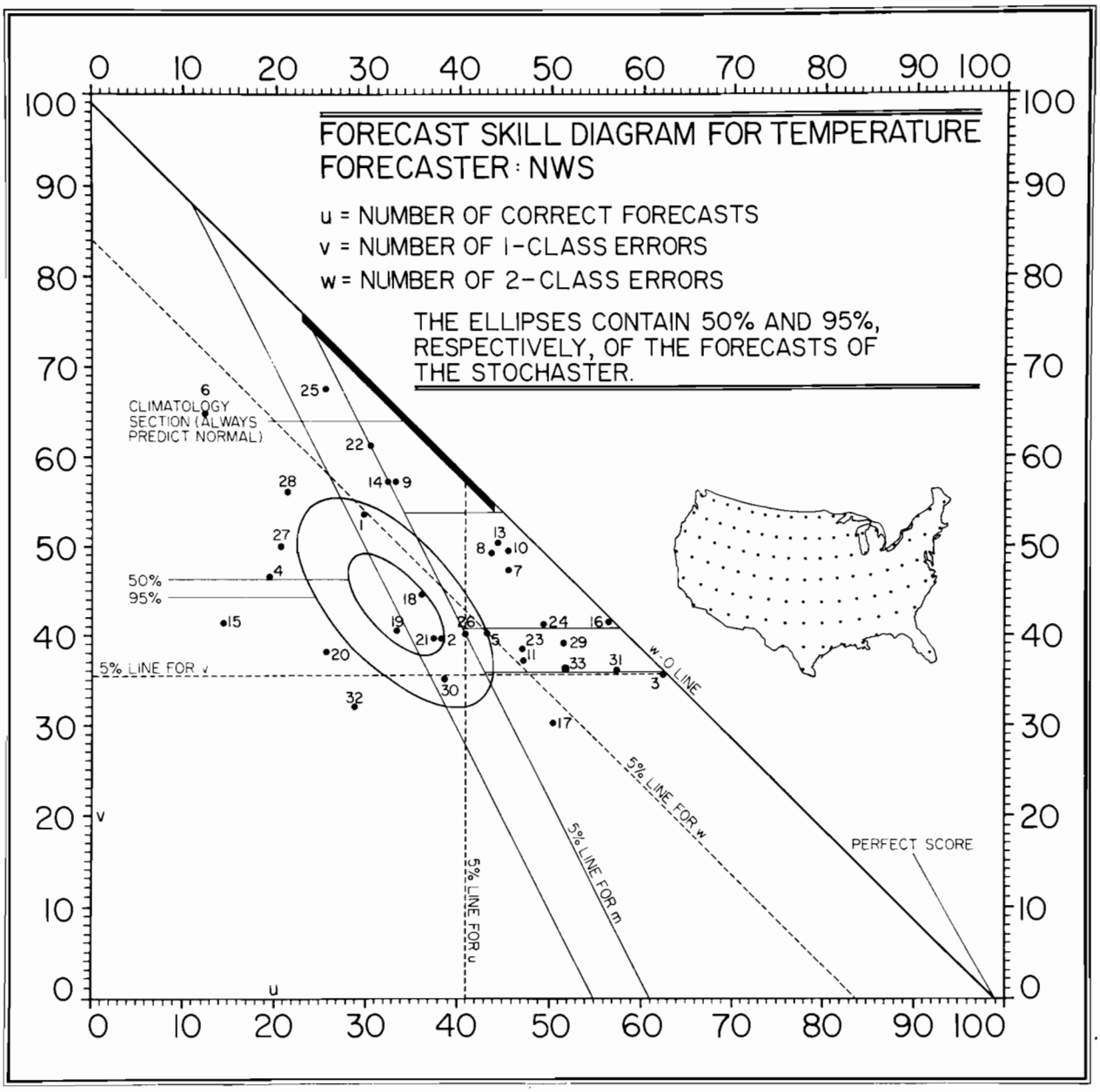
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: NWS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w=0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.7

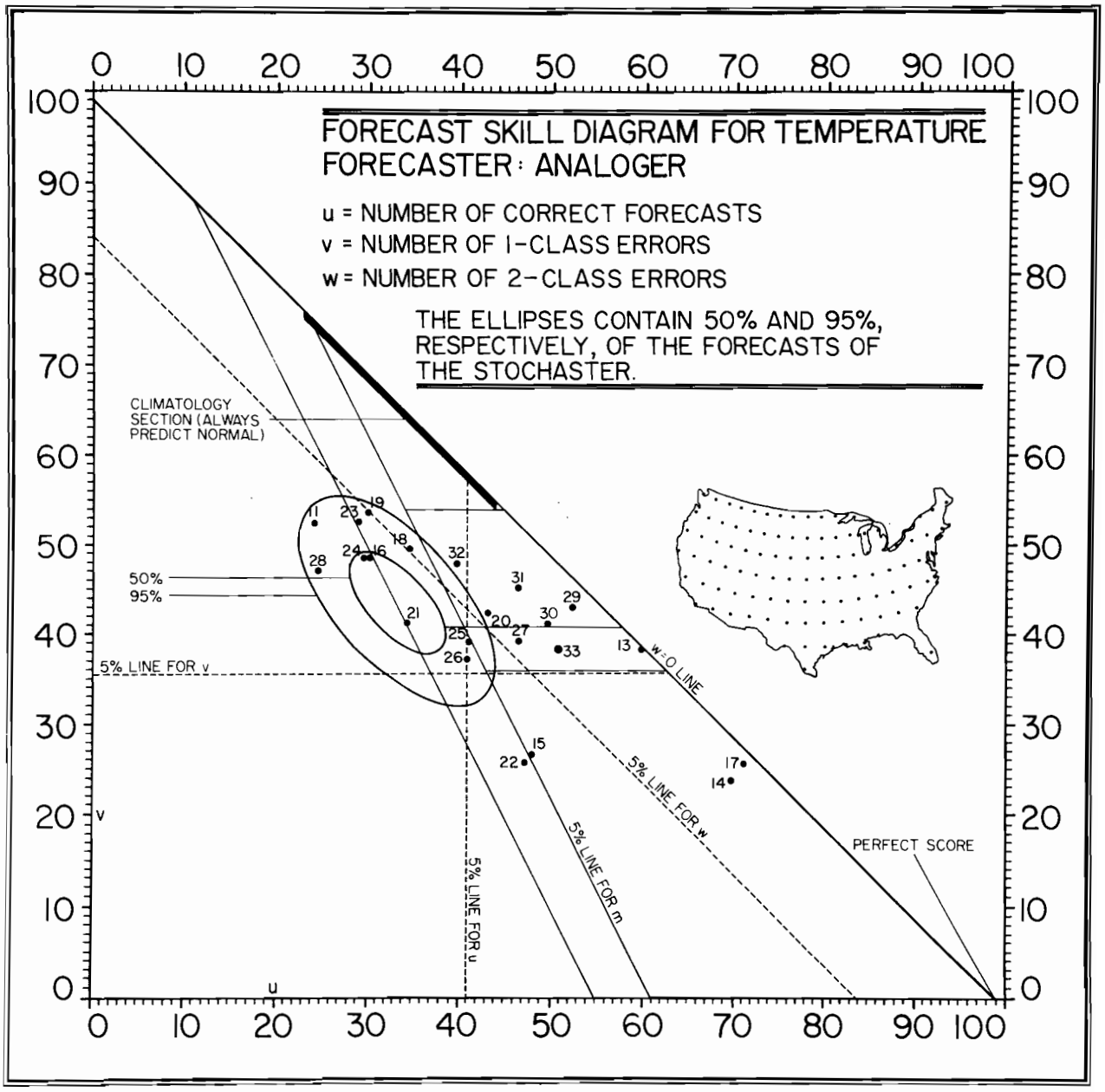
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: ANALOGER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.8

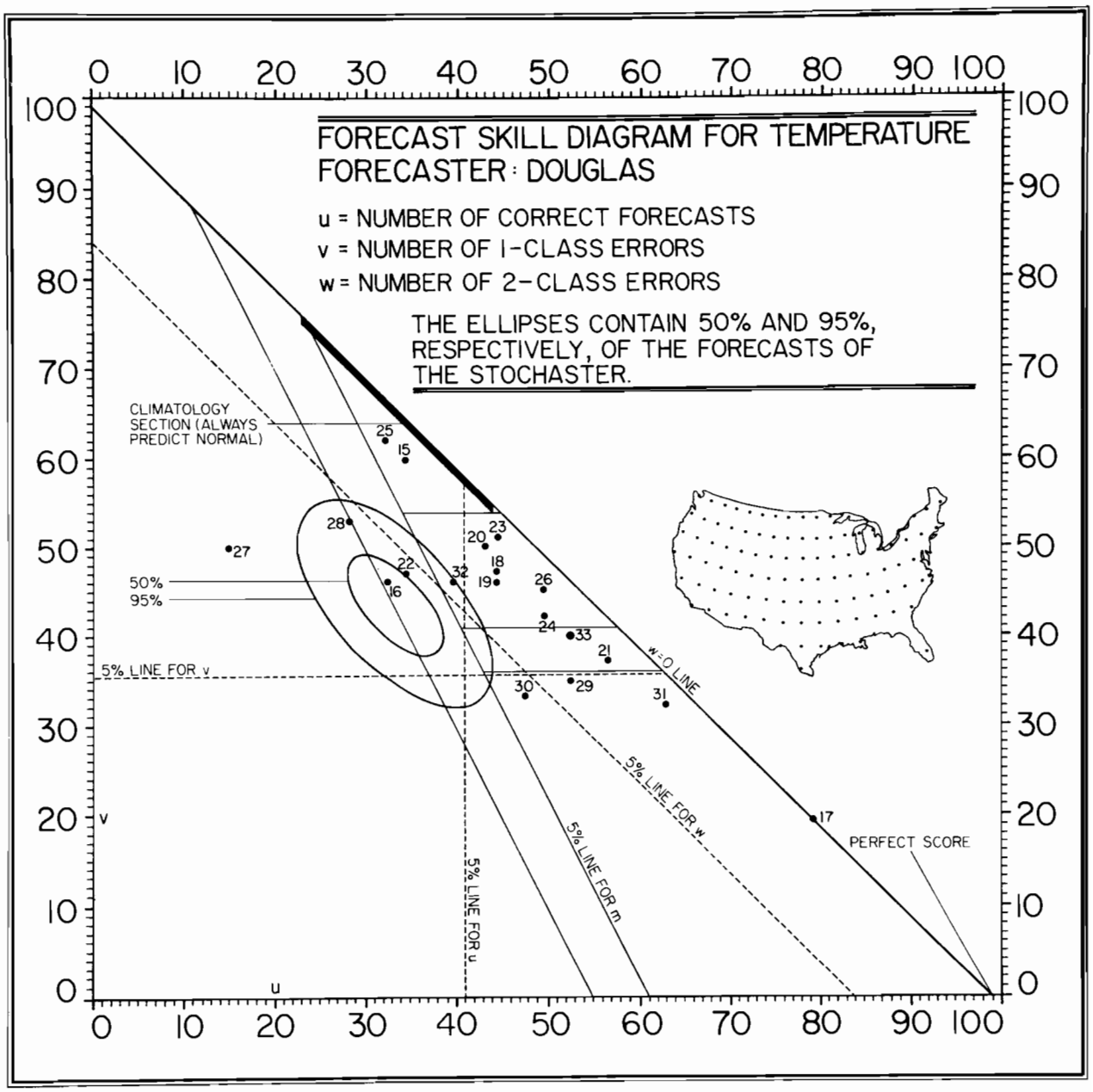
FORECAST SKILL DIAGRAM FOR TEMPERATURE
FORECASTER: DOUGLAS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.9

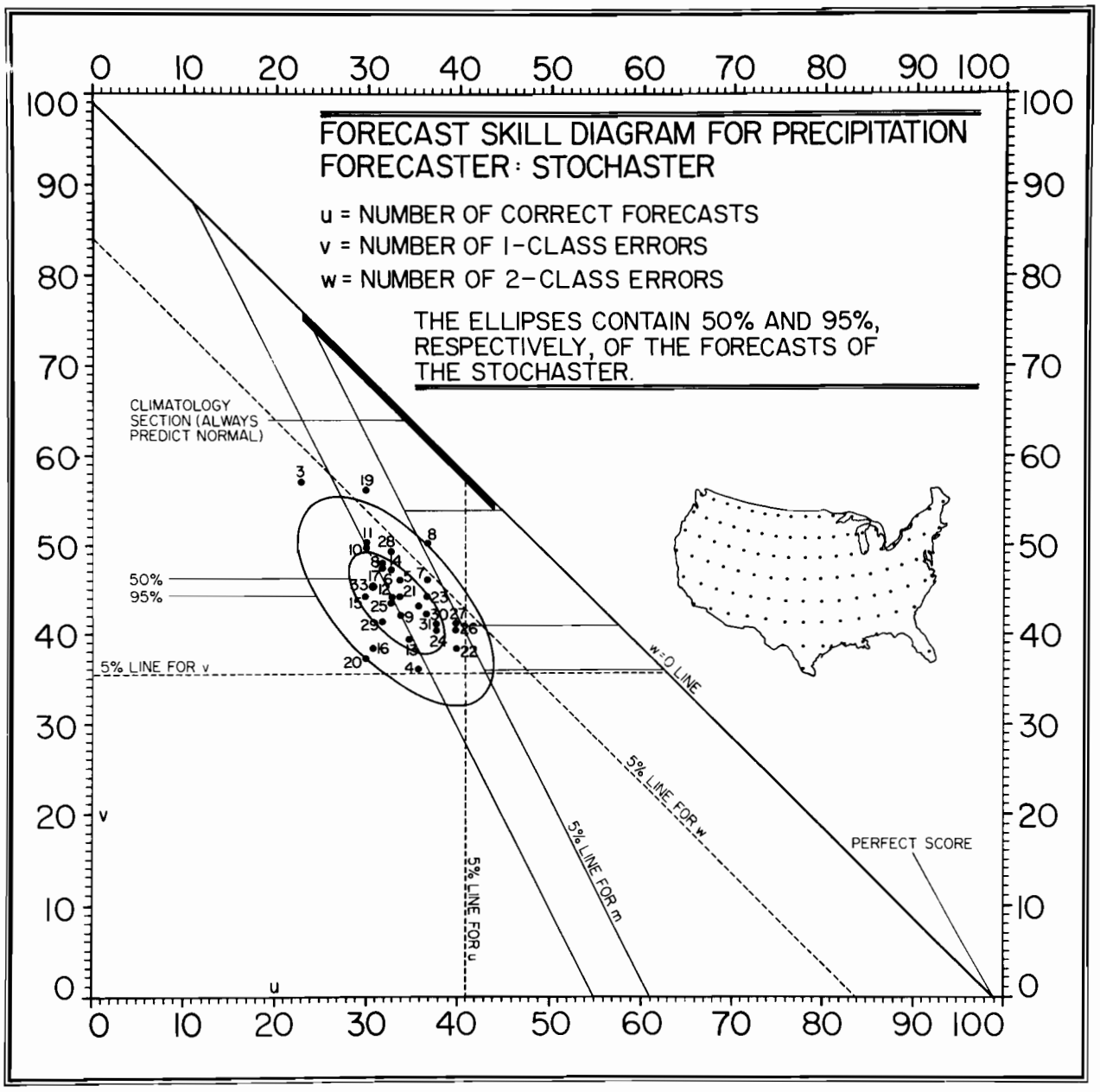
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: STOCHASTER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w=0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.10

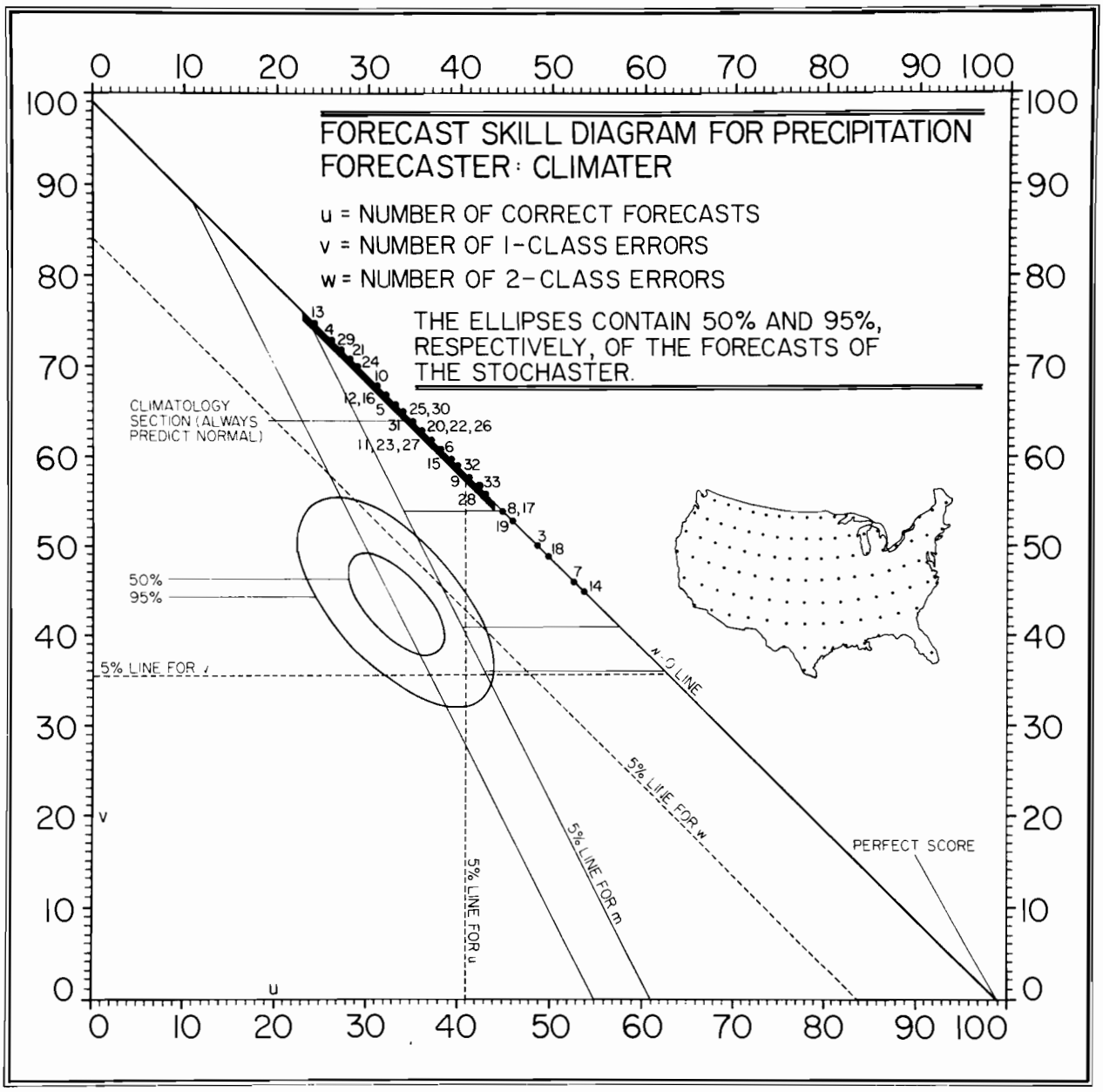
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: CLIMATER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
N=0 LINE
PERFECT SCORE
13
4
29
21
24
10
12,16
5
25,30
31
20,22,26
11,23,27
6
15
32
9
33
28
8,17
19
3
18
7
14
0 10 20 30 40 50 60 70 80 90 100

Fig 6.11

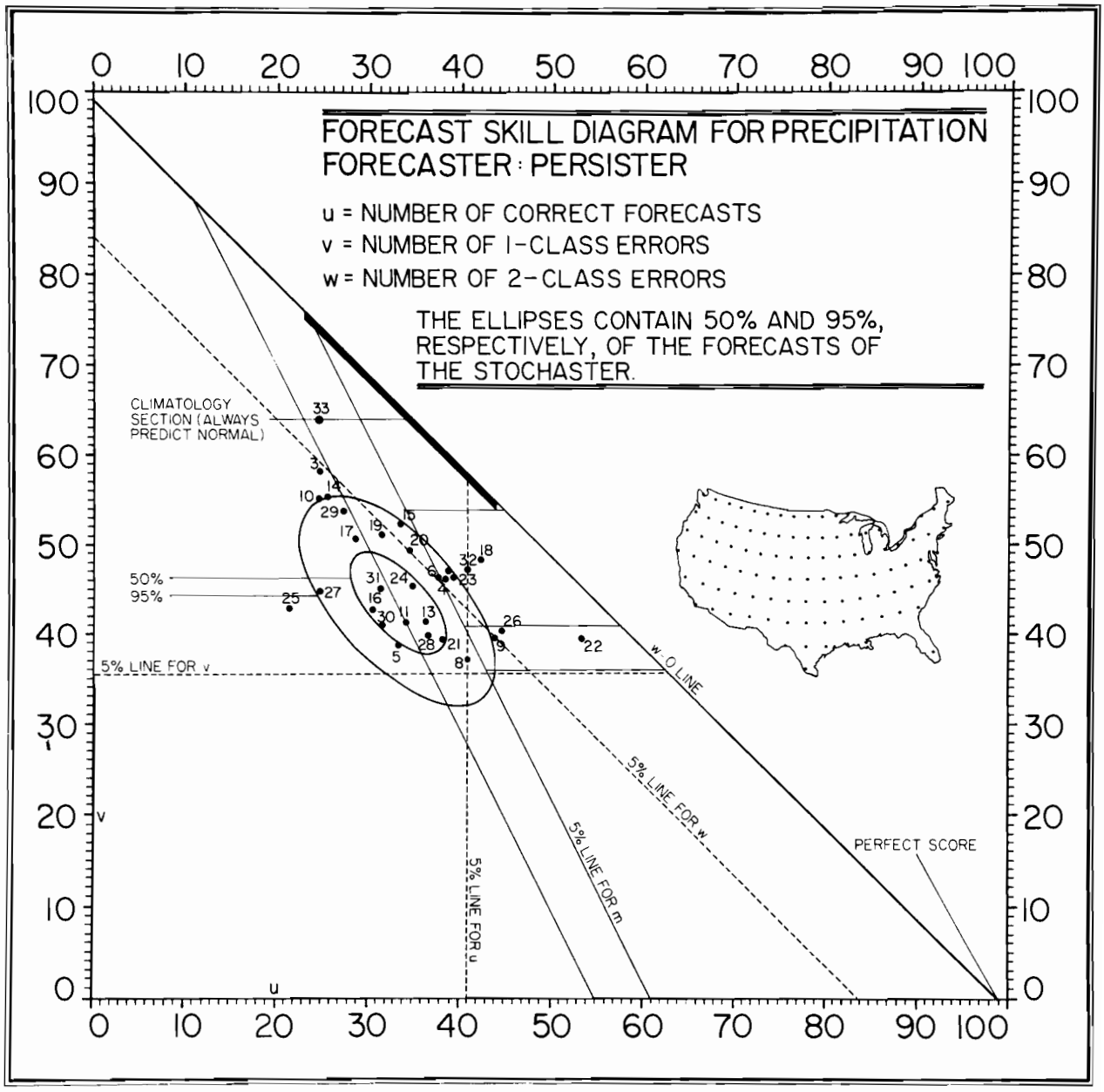
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: PERSISTER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w=0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.12

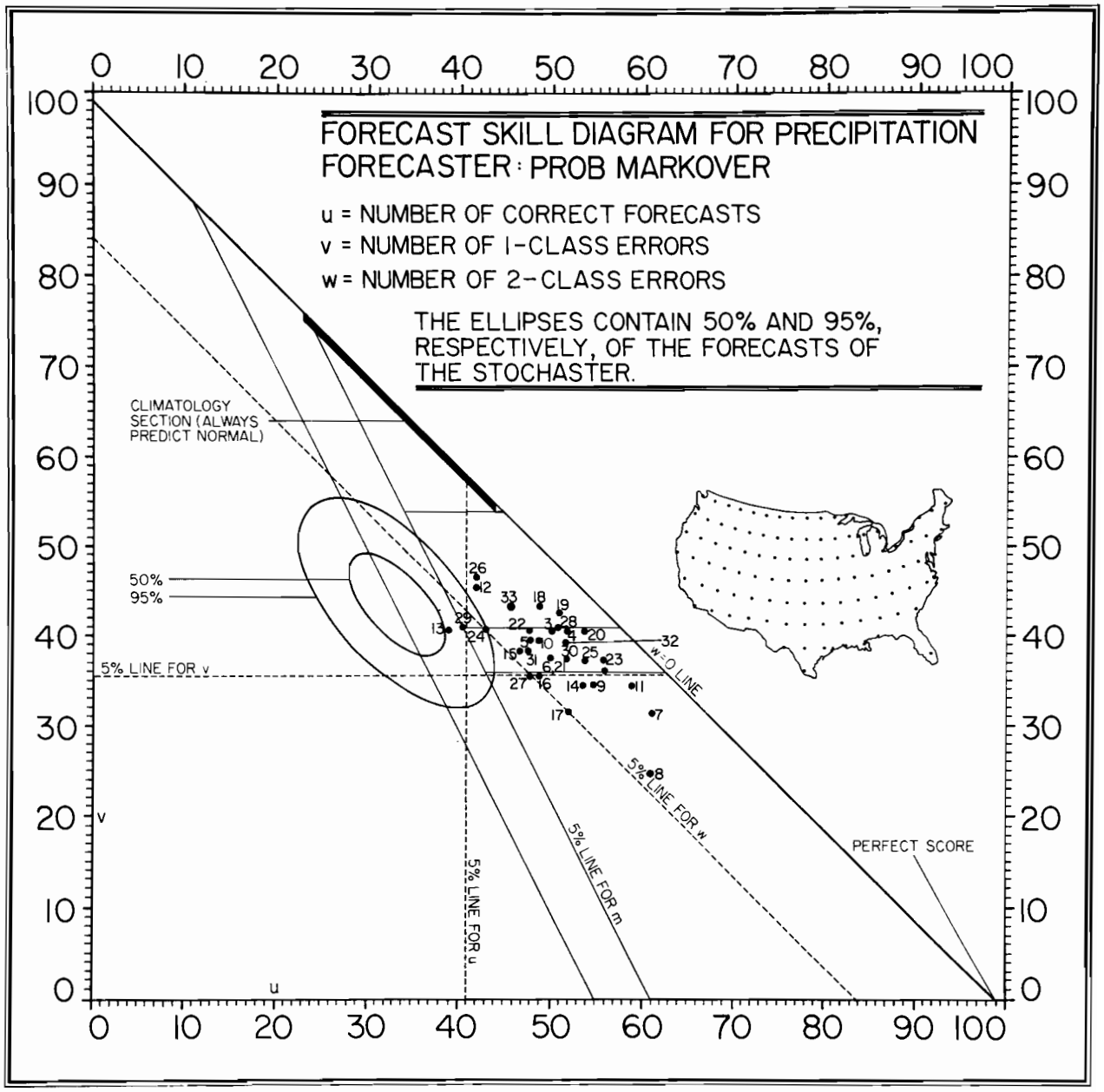
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: PROB MARKOVER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.13

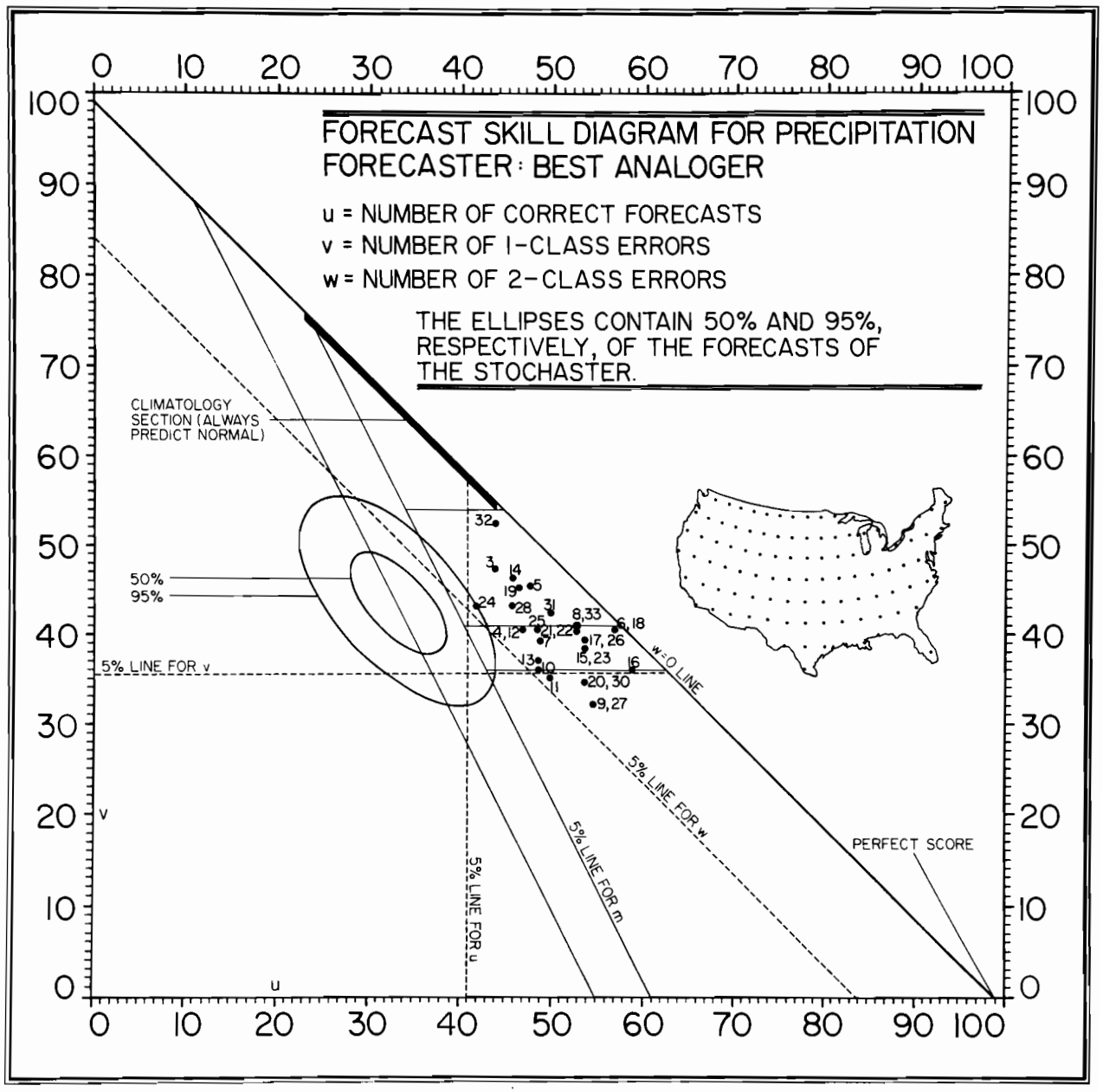
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: BEST ANALOGER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.14

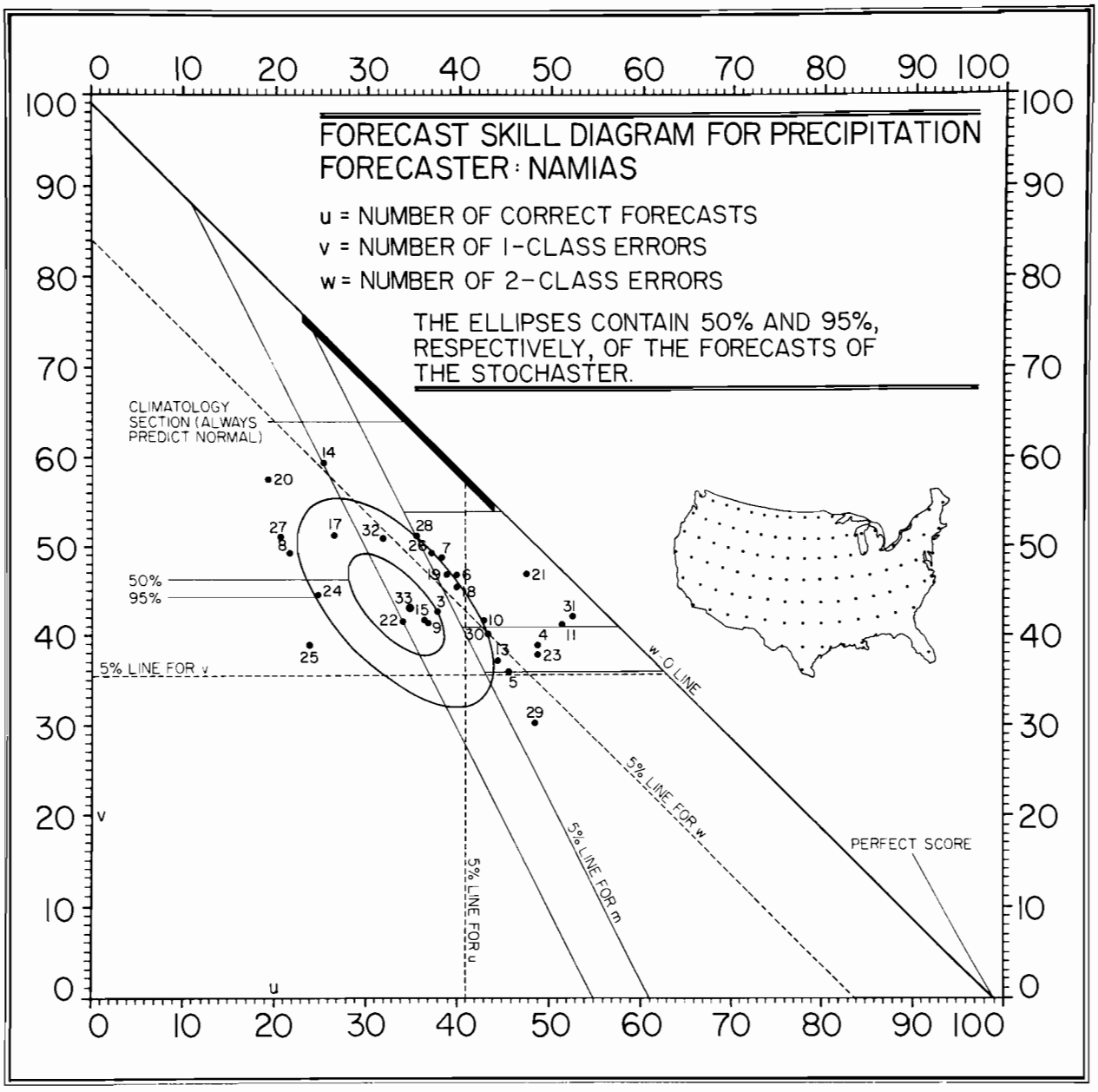
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: NAMIAS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w = 0 LINE
PERFECT SCORE
u
v
0 10 20 30 40 50 60 70 80 90 100

Fig 6.15

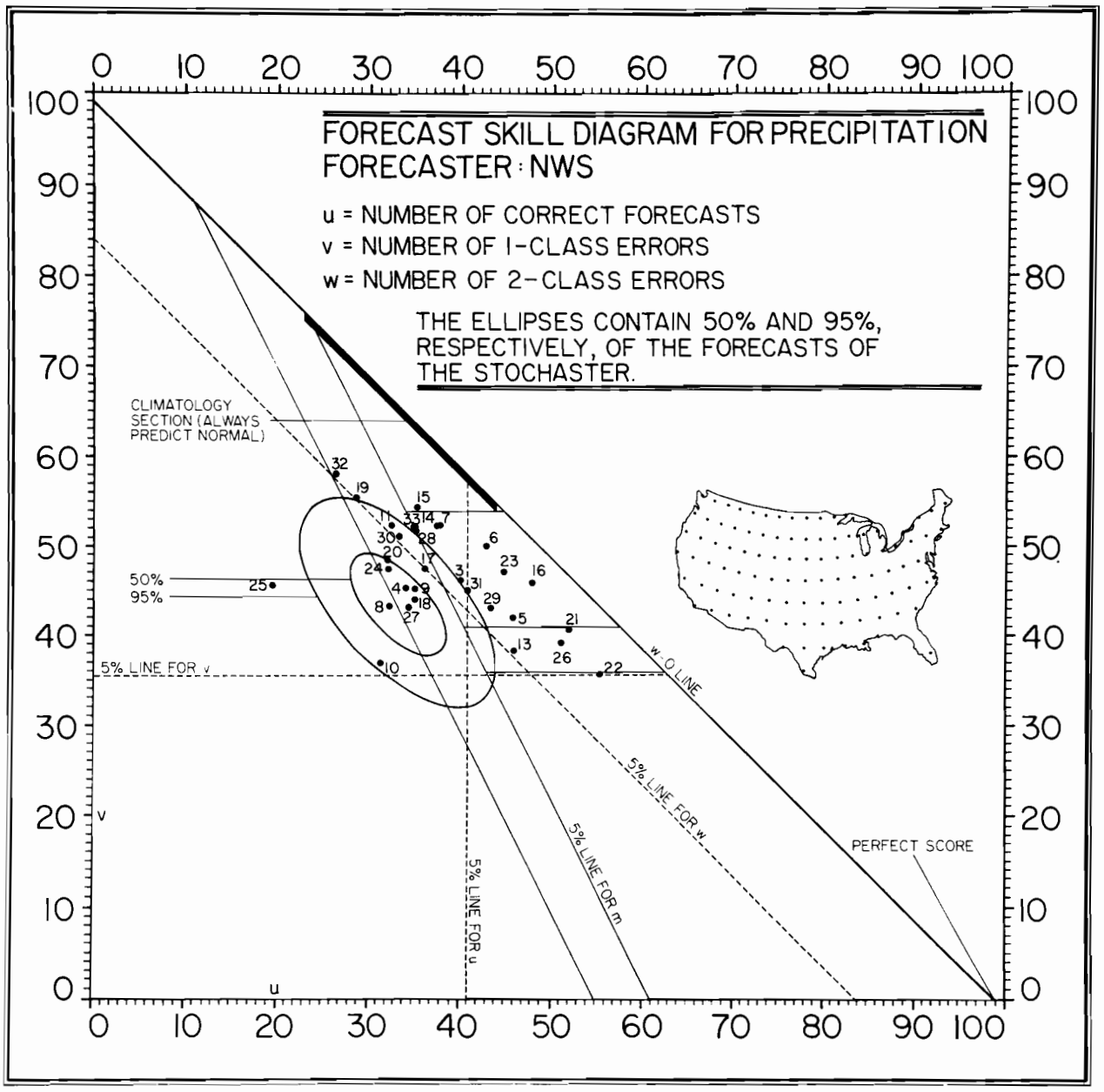
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: NWS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
w=0 LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.16

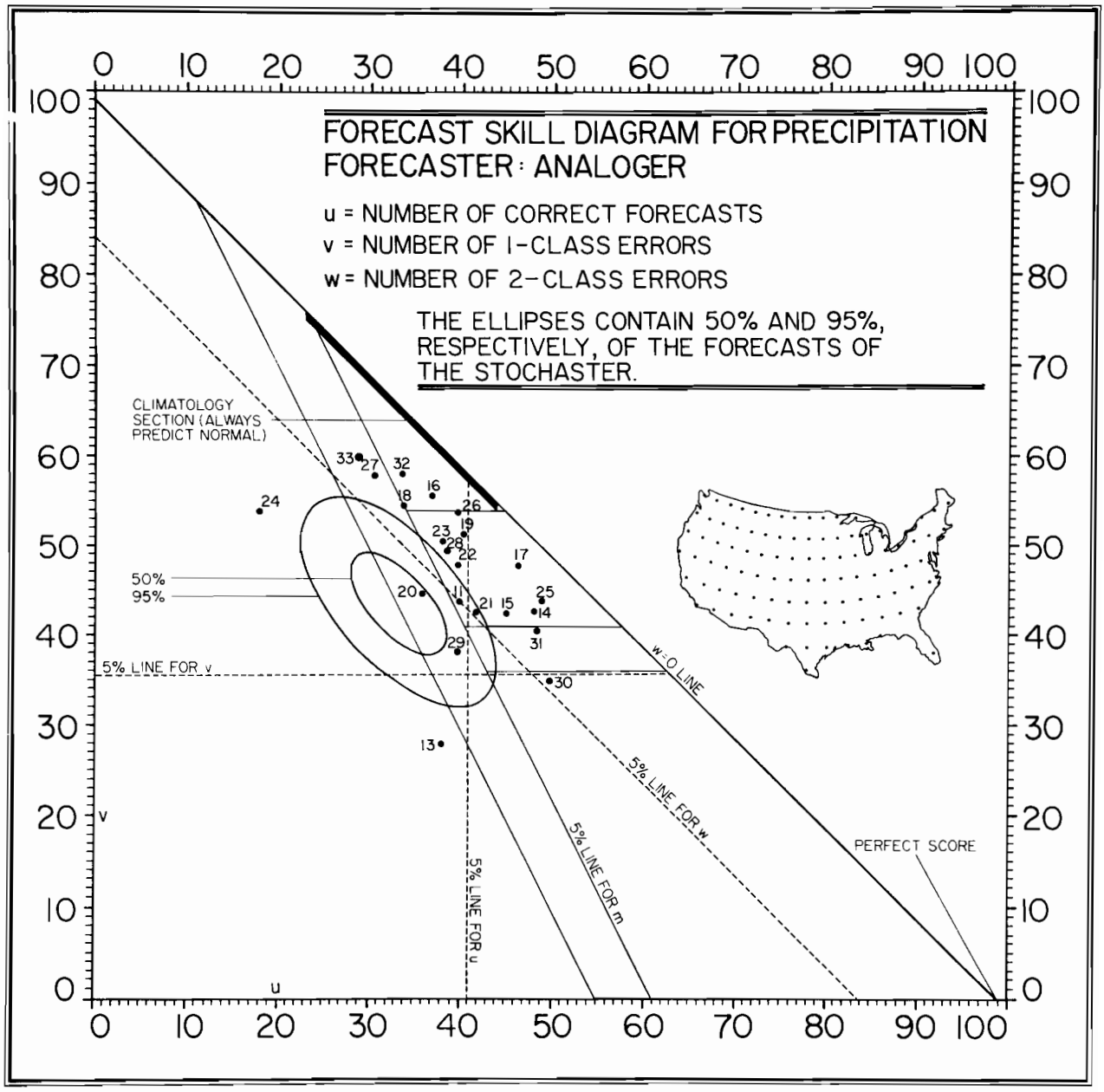
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: ANALOGER
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
w=0 LINE
5% LINE FOR w
5% LINE FOR m
5% LINE FOR u
PERFECT SCORE
u
v
0 10 20 30 40 50 60 70 80 90 100

Fig 6.17

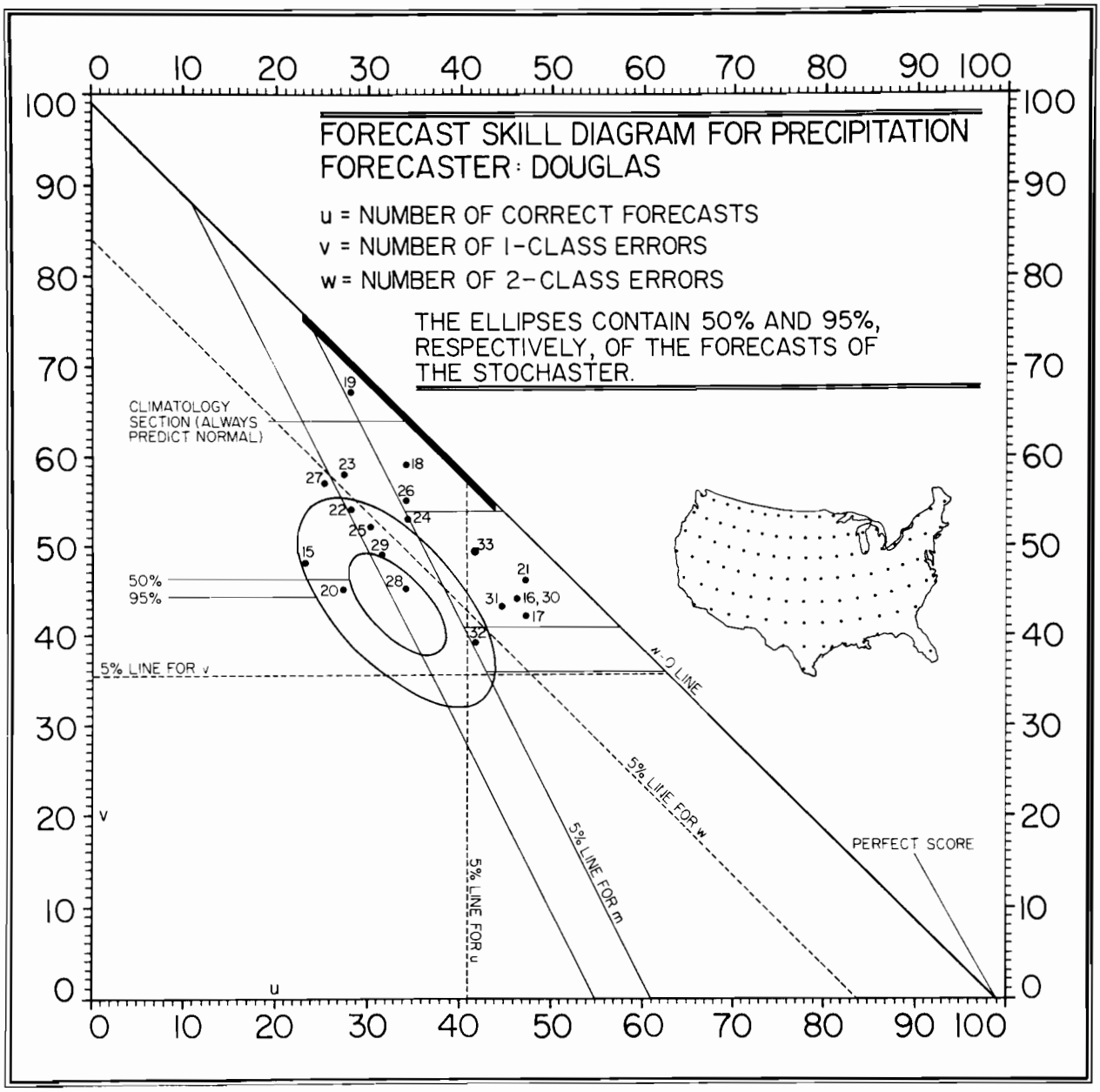
FORECAST SKILL DIAGRAM FOR PRECIPITATION
FORECASTER: DOUGLAS
u = NUMBER OF CORRECT FORECASTS
v = NUMBER OF 1-CLASS ERRORS
w = NUMBER OF 2-CLASS ERRORS
THE ELLIPSES CONTAIN 50% AND 95%, RESPECTIVELY, OF THE FORECASTS OF THE STOCHASTER.
CLIMATOLOGY SECTION (ALWAYS PREDICT NORMAL)
50%
95%
5% LINE FOR v
5% LINE FOR u
5% LINE FOR m
5% LINE FOR w
N-O LINE
PERFECT SCORE
v
u
0 10 20 30 40 50 60 70 80 90 100

Fig 6.18

7. Forecast Ranking

7.1 Partial Order in the uv Diagram

Forecast ranking is a simple matter when the forecasts are expressed by a single number, such as the number u of 0-class errors. Then the forecasts can be linearly ordered along a line from worse to better, i.e., from smaller to larger u values. This simple ranking, unfortunately, produces an incomplete view of a forecaster's skill, or of the predictability of an event derived from such a simple skill score. For, a forecast is essentially a statement about a complex, two-dimensional map of anticipated temperature or precipitation patterns. A more realistic ranking of forecast skills using terciled field values should use at least two parameters. In the present study we adopt an arbitrarily chosen two-parameter skill score. The first of the parameters is v, the number of 1-class errors between prediction and observation on the 99-point map. The second parameter is the moment $m = v + 2w$ of the forecast. The moment has a simple geometric meaning, which may be seen by using Fig. 3.2. In that figure, first we lay a transparency of the predicted map over the observed map and assign +1, 0, -1 respectively to the A, N, B points on each map. Next, we take the difference of the integers at each of the nine points, and then the absolute magnitude of these differences. A moment's thought will show that the sum of these absolute values of differences is $m = v + 2w$. In the case of the present example where $v = 2$, and $w = 4$, we have $m = 10$. Thus m is seen to be a fairly natural measure of the distance between two maps*. By using both v and m we can obtain a good idea of how closely a forecast map matches its observed map. Clearly, the smaller v and m are, the better the forecast. A perfect forecast will have $v = 0$, $m = 0$.

Now that we have the two parameters v and m to measure the skill of a forecast, some experimentation shows that we can no longer arrange all forecast skills along a single line. Moreover, we can have two forecasts respectively represented by (v', m') and (v, m) where on the one hand $v' < v$ but on the other $m' > m$. That is, these points (imagined to lie in the uv plane) cannot be ordered. Thus, in the v-sense (v', m') is more skillful than (v, m). But in the m-sense, the reverse is true. It can be shown that there is no way to order all the points in the uv diagram so that every pair of points has a defined ordering, and where we still can use the properties of linear ordering. Therefore we must give up some of these ordering properties so as to have a more realistic two-parameter skill-ranking scheme. We will give up the requirement that every point pair (v', m'), (v, m) can be ordered. We then make the following:

Definition. Let $f_1 = (u_1, v_1, w_1)$, $f_2 = (u_2, v_2, w_2)$ be two forecast skill scores of some state of the weather system expressed in tercile form. Let $m_1 = v_1 + 2w_1$ and $m_2 = v_2 + 2w_2$ be the moments of these two forecasts. Then we write

---

* This measure m of distance is called the 'Manhattan metric', since it emulates the way a New Yorker will total his mileage when moving about an essentially ideal rectangular gridwork of midtown Manhattan streets, where the north-south blocks are twice the length of the east-west blocks. The reader will have noted that, for all its naturalness, m is but one of an infinite number of possible measures of distance between two maps.

$$'f_2 \leqq f_1' \text{ or } 'f_1 \geqq f_2'$$

if and only if $m_1 \leqq m_2$ and $v_1 \leqq v_2$.

We read '$f_2 \leqq f_1$' or '$f_1 \geqq f_2$' as saying 'forecast skill f_1 is greater than or equal to forecast skill f_2.' It is readily seen that the relation $\leqq$ is a partial ordering* of the points in the uv diagram. We will write '$f_2 < f_1$' if $f_2 \leqq f_1$ and $f_2 \neq f_1$.

Observe that v and m were used to define the three star regions of the uv diagram in Fig. 4.2. Thus the value m = 76 first of all divides the diagram into two regions. The region with points having $m \leqq 76$ lies to the right of the line m = 76. The Stochaster has very nearly the probability 0.052 of falling in that region. The probabilities of the Stochaster falling in the various starred regions are also shown in that diagram. Notice the values of v that are used to define these regions.

7.2 Illustrations of Partial Ordering of Forecasts

We now apply the preceding partial ordering to the ranking of the forecasts of various forecasters during the eight year period under study. Consider Fig. 7.1, which gives the forecaster rankings for temperature during the winter of 1982. For example, point WS has coordinates (u, v, w) = (52, 36, 11) generated by the Weather Service's winter 1982 forecast (see season 33 (1/82), Table in §12). This is connected, by the partial ordering, to the Analoger's point AN with coordinates (51, 38, 10).

The arrow on the line segment connecting WS and AN acts like the relation $\leqq$. Thus, we find AN < WS. Observe also that JN < PR < WS, and hence by transitivity, that JN <WS. Also observe that JN < AN and JN < AD. Thus Namias' winter 1982 forecast was less skillful than these other forecasts. Observe also that the forecasts of AN, AD were ** forecasts, while that of WS was a *** forecast. The rankings of the winter 1982 precipitation forecasts are shown in Fig. 7.2. Note that ST < JN, but that JN cannot be ranked relative to the other three human forecasters: on the one hand JN has a smaller v value than the others, and so he has higher skill in this sense; on the other, JN's m value is greater than those of the others.†

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* That is, $\leqq$, for every f_1, f_2, f_3, as defined, is reflexive ($f_1 \leqq f_1$), antisymmetric ($f_2 \leqq f_1$ and $f_1 \leqq f_2$ imply $f_1 = f_2$), and transitive ($f_1 \leqq f_2$ and $f_2 \leqq f_3$ imply $f_1 \leqq f_3$). Thus while not every pair f_1,f_2 can be ordered, for those that can, we may use the properties of linear ordering.

† We emphasize that the present ordering scheme is basically arbitrary. Once this ordering (or ranking) scheme is clear to the reader, he may wish to experiment with other two-parameter schemes. For example we could say that '$f_2 \leqq f_1$', if and only if $v_1 \leqq v_2$ and $u_2 \leqq u_1$. Another possibility is that '$f_2 \leqq f_1$' if and only if $v_1 \leqq v_2$ and $w_1 \leqq w_2$. Some experimentation will show that these produce different partial orderings of the uv diagram's points. Still other two parameter schemes exist, each producing a different ordering of the points. In all, there are six distinct ordering schemes possible using u, v, w, and m in suitable pairs.

The overall rankings of the temperature forecasts for the period 1974-82 are shown in Fig. 7.3, while the rankings of the precipitation forecasts are in Fig. 7.4. In the temperature rankings, both AN and AD are forecasters of maximal skill, while in the precipitation diagram, JN, WS, and AN are forecasters of maximal skill. Observe that in each diagram both AN and AD have significantly small m values (on the 5% level).

It should be noted (see Tables in §13) that the standard deviations of the average locations of these connecting lines are still rather large, so that, until more forecasts are collected (perhaps another 33 seasons), these rankings are tentative and not statistically significant.

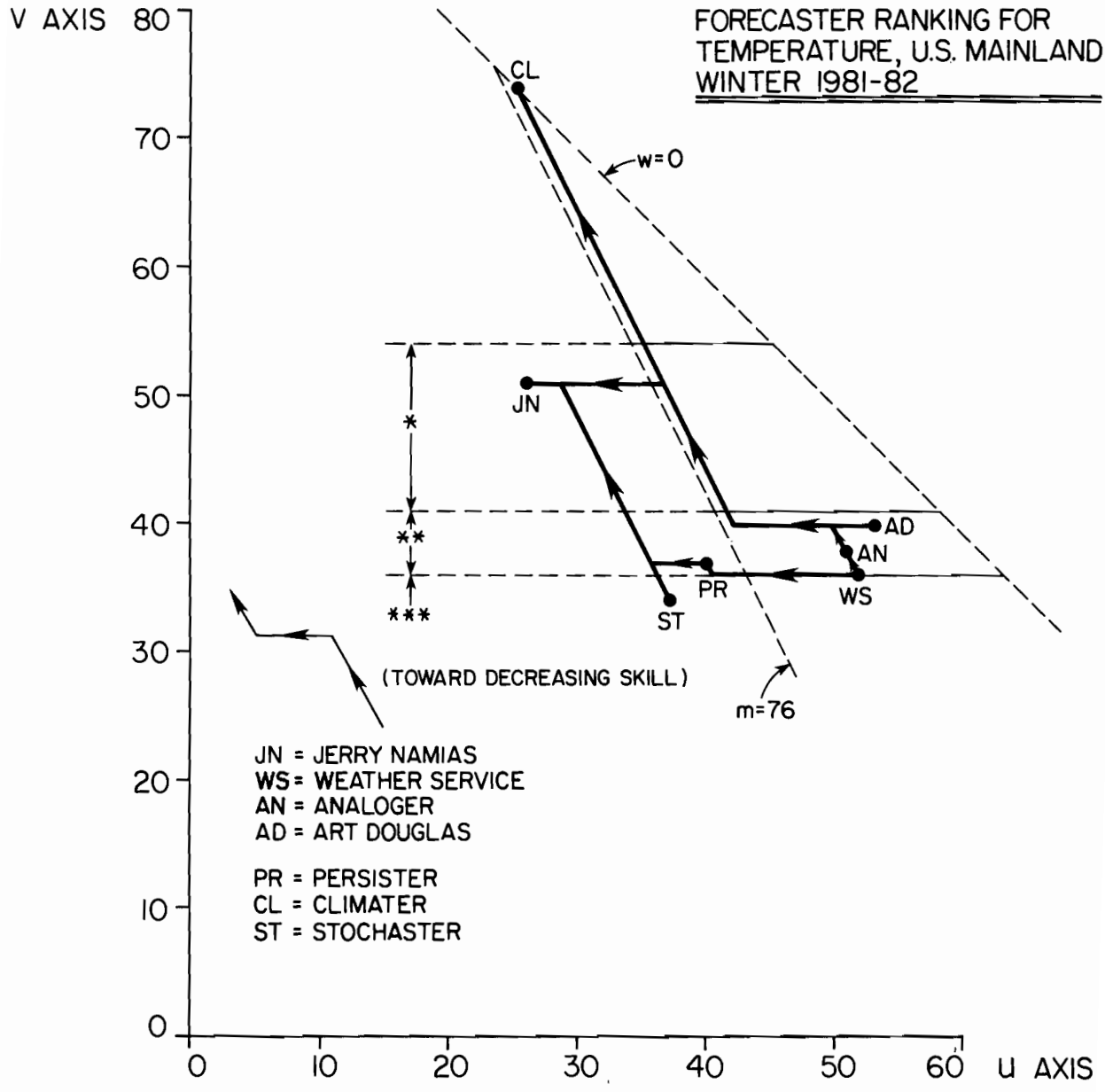
FORECASTER RANKING FOR
TEMPERATURE, U.S. MAINLAND
WINTER 1981-82
V AXIS
u AXIS
0
10
20
30
40
50
60
70
80
CL
w=0
JN
AD
AN
PR
WS
ST
*
**
***
(TOWARD DECREASING SKILL)
m=76
JN = JERRY NAMIAS
WS = WEATHER SERVICE
AN = ANALOGER
AD = ART DOUGLAS
PR = PERSISTER
CL = CLIMATER
ST = STOCHASTER

Fig 7.1

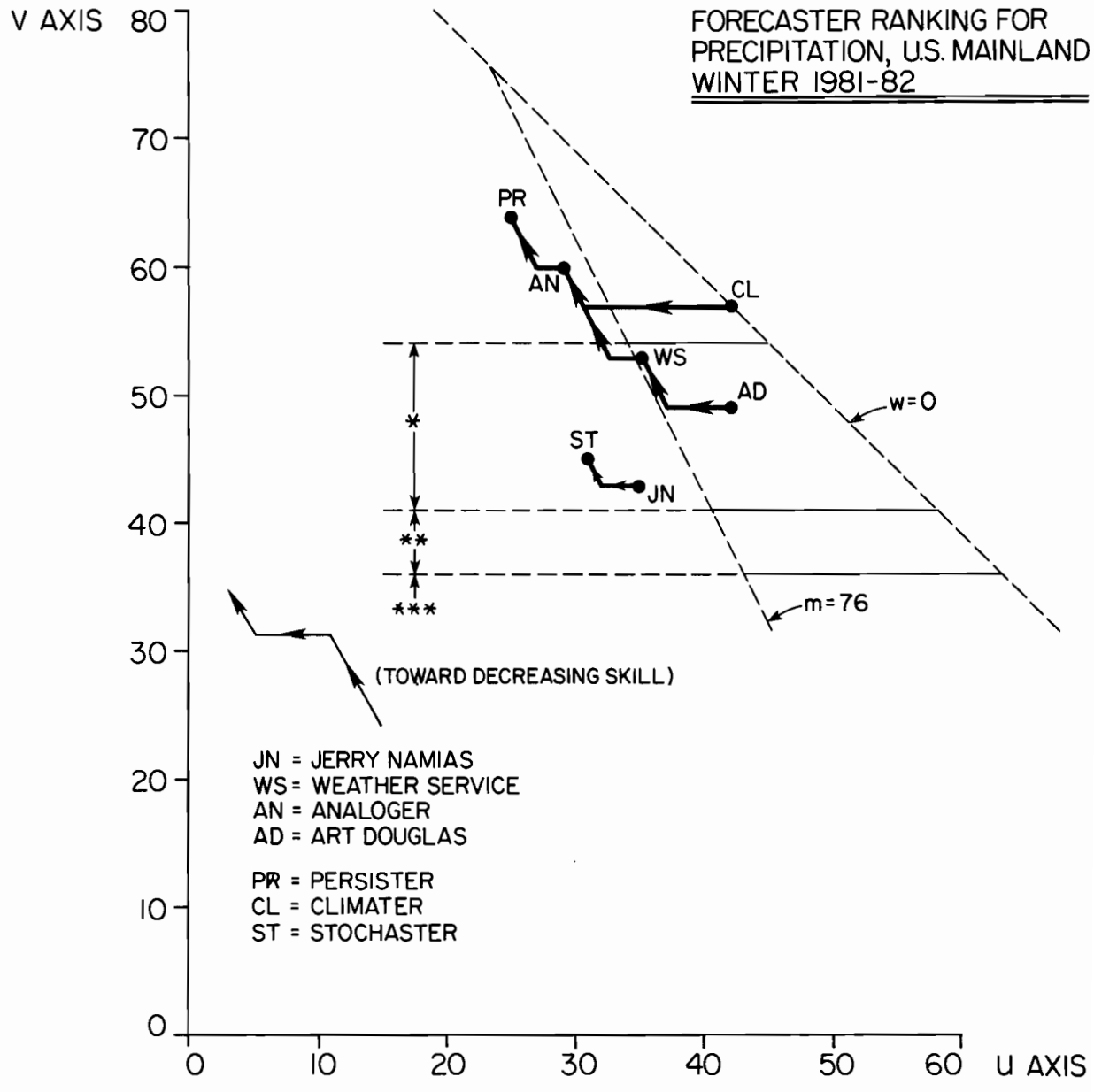
FORECASTER RANKING FOR
PRECIPITATION, U.S. MAINLAND
WINTER 1981-82
V AXIS
U AXIS
0
10
20
30
40
50
60
70
80
PR
AN
CL
WS
AD
ST
JN
w=0
m=76
*
**
***
(TOWARD DECREASING SKILL)
JN = JERRY NAMIAS
WS = WEATHER SERVICE
AN = ANALOGER
AD = ART DOUGLAS
PR = PERSISTER
CL = CLIMATER
ST = STOCHASTER

Fig 7.2

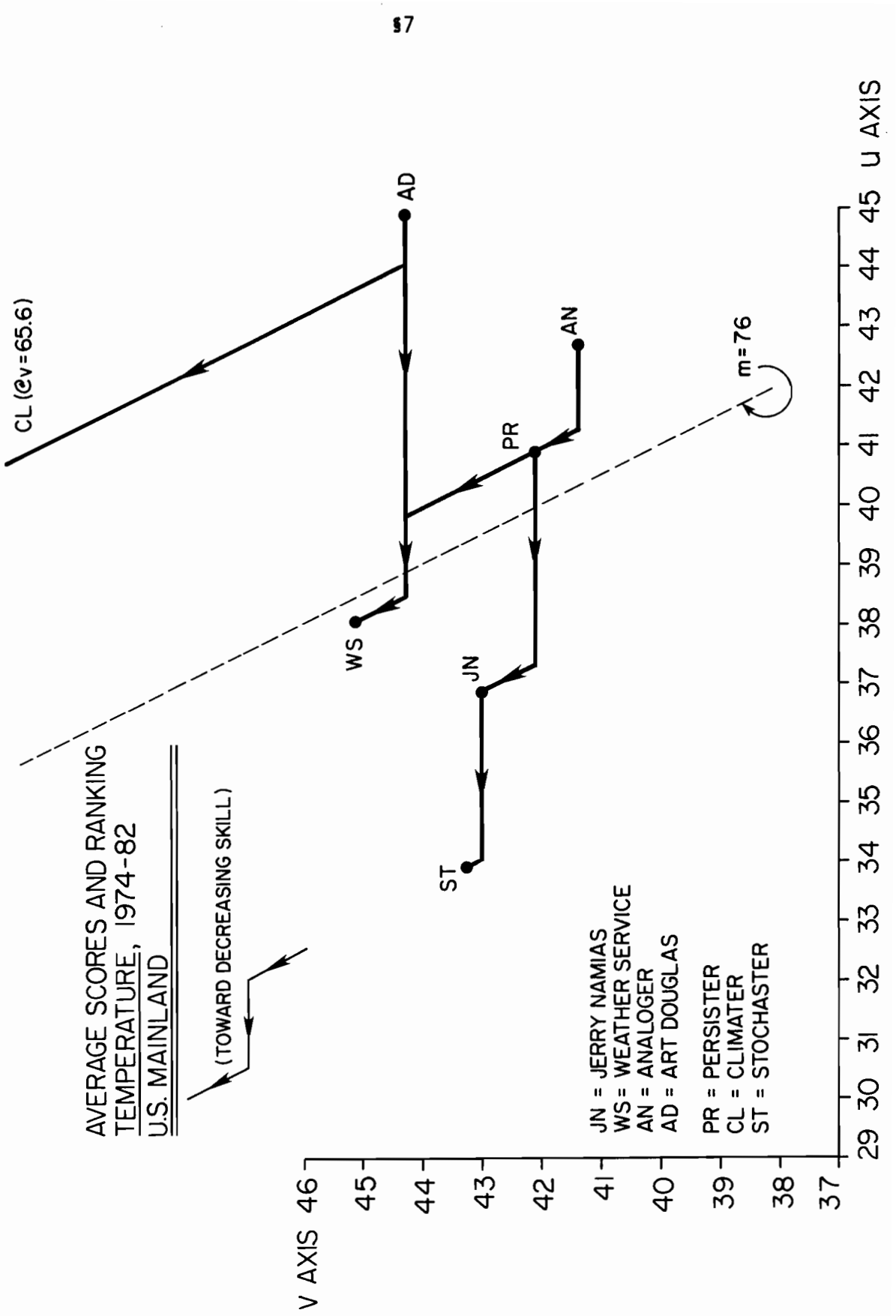
AVERAGE SCORES AND RANKING
TEMPERATURE, 1974-82
U.S. MAINLAND
(TOWARD DECREASING SKILL)
CL (ev=65.6)
AD
AN
PR
WS
JN
ST
m=76
JN = JERRY NAMIAS
WS= WEATHER SERVICE
AN = ANALOGER
AD = ART DOUGLAS
PR = PERSISTER
CL = CLIMATER
ST = STOCHASTER
V AXIS 46 45 44 43 42 41 40 39 38 37
U AXIS 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45

Fig 7.3

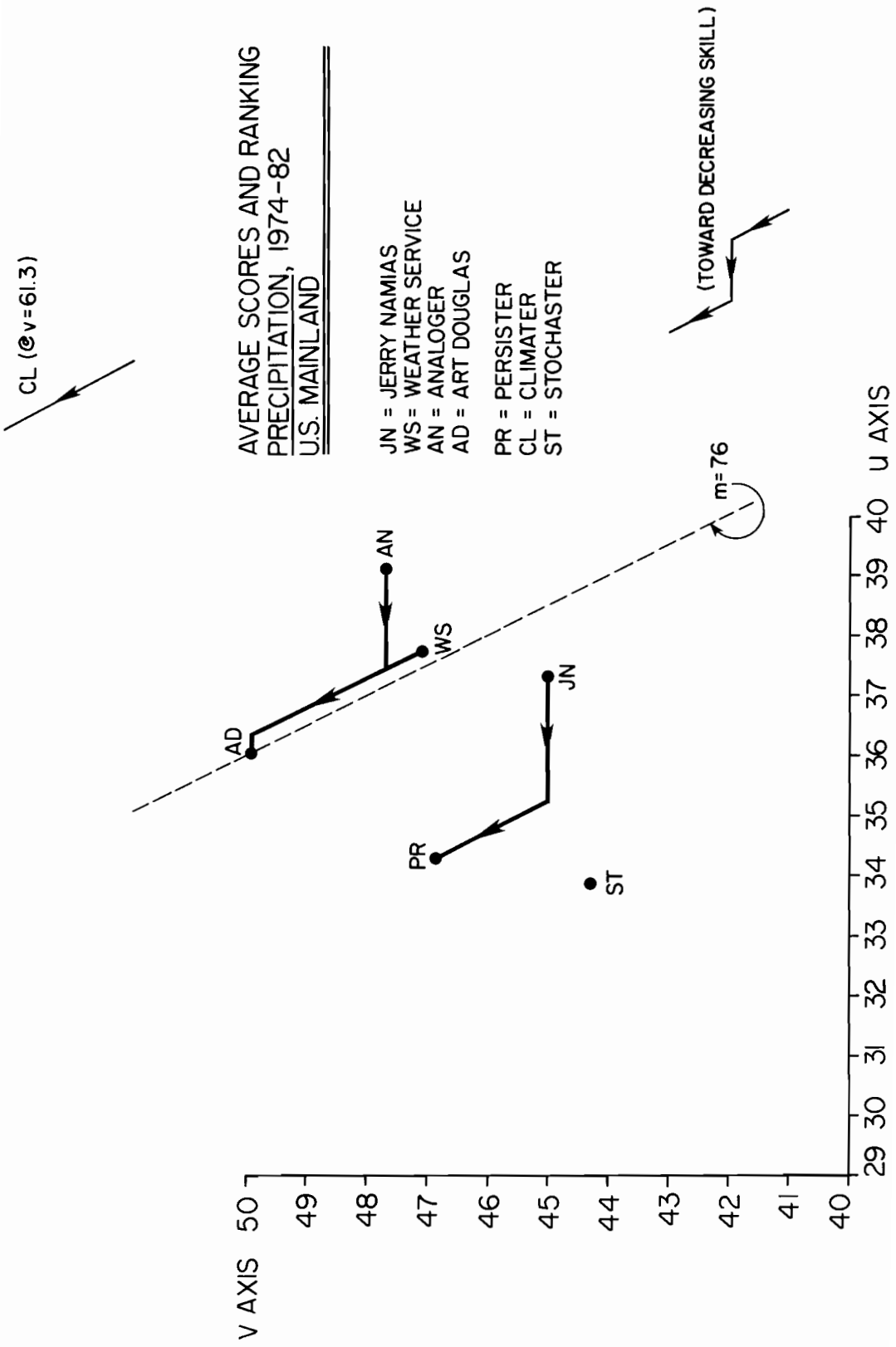
AVERAGE SCORES AND RANKING
PRECIPITATION, 1974-82
U.S. MAINLAND
JN = JERRY NAMIAS
WS = WEATHER SERVICE
AN = ANALOGER
AD = ART DOUGLAS
PR = PERSISTER
CL = CLIMATER
ST = STOCHASTER
CL (@v=61.3)
(TOWARD DECREASING SKILL)
m=76
AN
WS
AD
JN
PR
ST
V AXIS 50 49 48 47 46 45 44 43 42 41 40
U AXIS 29 30 31 32 33 34 35 36 37 38 39 40

Fig 7.4

8. Predictability Ranking

8.1 Temperature

Using the preceding ranking scheme, we can make some tentative statements about the predictability of winter temperature or precipitation patterns over the U.S. mainland during 1978-82. This is illustrated for temperature in Fig. 8.1, where each plotted point has (u,v) coordinates obtained by averaging the (u,v) coordinates of the four human forecasters. Thus the point labeled '1980' is the result of averaging the winter 1980 (u,v) scores of Namias, the Weather Service, the Analoger, and Douglas (see season 25, listed in §12). For that season they had accumulated among them 2 stars and 0 pluses, and this is shown also in the figure. By finding these averages for each of the winters 1978-1982 inclusive, we obtain the five points shown, along with the stars and pluses accumulated by the four humans for each season forecast. Then, using the partial ordering defined in §7, we can order the predictability of winter temperatures as an arithmetic consensus among the four forecasters, as shown in the diagram. Thus the winter temperature of 1978 was the most predictable, on the average, of the five winter temperatures, while that of 1980 was the least predictable. The winter temperature of 1982 was less predictable than that of 1978 or 1981, but more predictable than that of 1980.* The circled 'ST' locates the Stochaster's average point.

8.2 Precipitation

Precipitation predictability for winter in the period 1978-82 is shown in Fig. 8.2. Thus, it is seen that the winter 1982 precipitation pattern was on average the least predictable of those of 1978, 1979, 1981, with winter 1980 precipitation predictability not directly orderable with <u>all</u> the others, but only with 1979 and 1981.

8.3 Seasonal Predictability

We turn next to the relative predictability of temperature as function of season, as shown in fig. 8.3. For example the fall point has (u,v) coordinates which are the averages of the (u,v) coordinates of the four human forecasters' results for each of the fall seasons from 1974-82 (see the Table in §14). The consensus then is that winter temperature patterns on average were the most predictable, and fall temperature patterns the least predictable. Strictly, the spring and summer points are not ordered in the diagram; however, the sampling variability at present is high enough to possibly reverse the order of these lines in the next few seasons (examine the standard deviations

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* It may be well to remind the reader (as we did in the abstract), that our conclusions are based on the performances of a small set of forecasters over a limited space-time domain. As a corollary of this, such phrases as "less predictable," and "more predictable," etc. are to be taken respectively as equivalent to "less well predicted" and "better predicted" within the setting of the present forecasters. In other words, our conclusions, while phrased occasionally as <u>absolute</u> assertions about predictability, are of course <u>relative</u> to the present set of forecasters, in the context of the Stochaster's uv diagram, and using the v, m ranking scheme defined in Sec. 7.

for v and m in the Table of §14). Once again, these predictability results, as diagrammed, are understood to hold only for the period 1974-82 over the U.S. mainland.

The average precipitation predictability as a function of season is shown in Fig. 8.4. Within possible sampling errors, the ordering of predictability: fall < summer < spring < winter, is again plausible, so that both temperature and precipitation tend, on the average, to decrease in predictability from winter, through the seasonal sequence, to fall, in the present data set.

8.4 Individual Effects on Ranking

The conclusions just stated, it must be emphasized, are obtained by averaging the scores of the four human forecasters. If we plot the seasonal scores of the individual forecasters, we obtain somewhat different conclusions, reflecting the individual abilities of each forecaster. These orderings for temperature are shown in Figs. 8.5 to 8.11. It is seen that the influences of the Analoger and Douglas on the average in the Fig. 8.3 results are strong. The influences of Namias and the Weather Service in that Figure tend to cancel each other. Observe in particular that Namias' season-averaged temperature scores in Fig. 8.5 strictly are not orderable; but the tendency there is to have two separate orderings, namely: winter < spring, and fall < summer. On the other hand, for the Weather Service in Fig. 8.6, summer temperature was maximally predictable, as well as winter, in the ways shown on the diagram.

The orderings of temperature predictability as seen through the Climater and Persister are shown in Figs. 8.9, 8.10. Notice how the Climater's sequence can be linearly ordered, in that it takes place along the line w = 0. For him, summer temperature was the most, and winter temperature was the least predictable. Individually, then, each forecaster (even for the Analoger-Douglas general agreement) tends to have his own natural sequence of temperature predictability as a function of season.

8.5 Some Hypotheses

In order to make a definite hypothesis for temperature predictability, as a function of season, we will choose the orderings in Fig. 8.3, using the average scores of the four human forecasters (see also Fig. 10.2). We will keep in mind, however, that the ultimate seasonal predictability ordering for temperature by high-skill forecasters may very well be different (e.g., perhaps in time it may even look like that of the Best Analoger in Fig. 8.11).

Finally, we will hypothesize, for future testing, that the predictability of precipitation in the four seasons (as seen through the scores of the human forecasters) is again in the order: fall < summer < spring < winter, as suggested in Fig. 8.4. Further evidence for this ranking is given in Fig. 10.3.

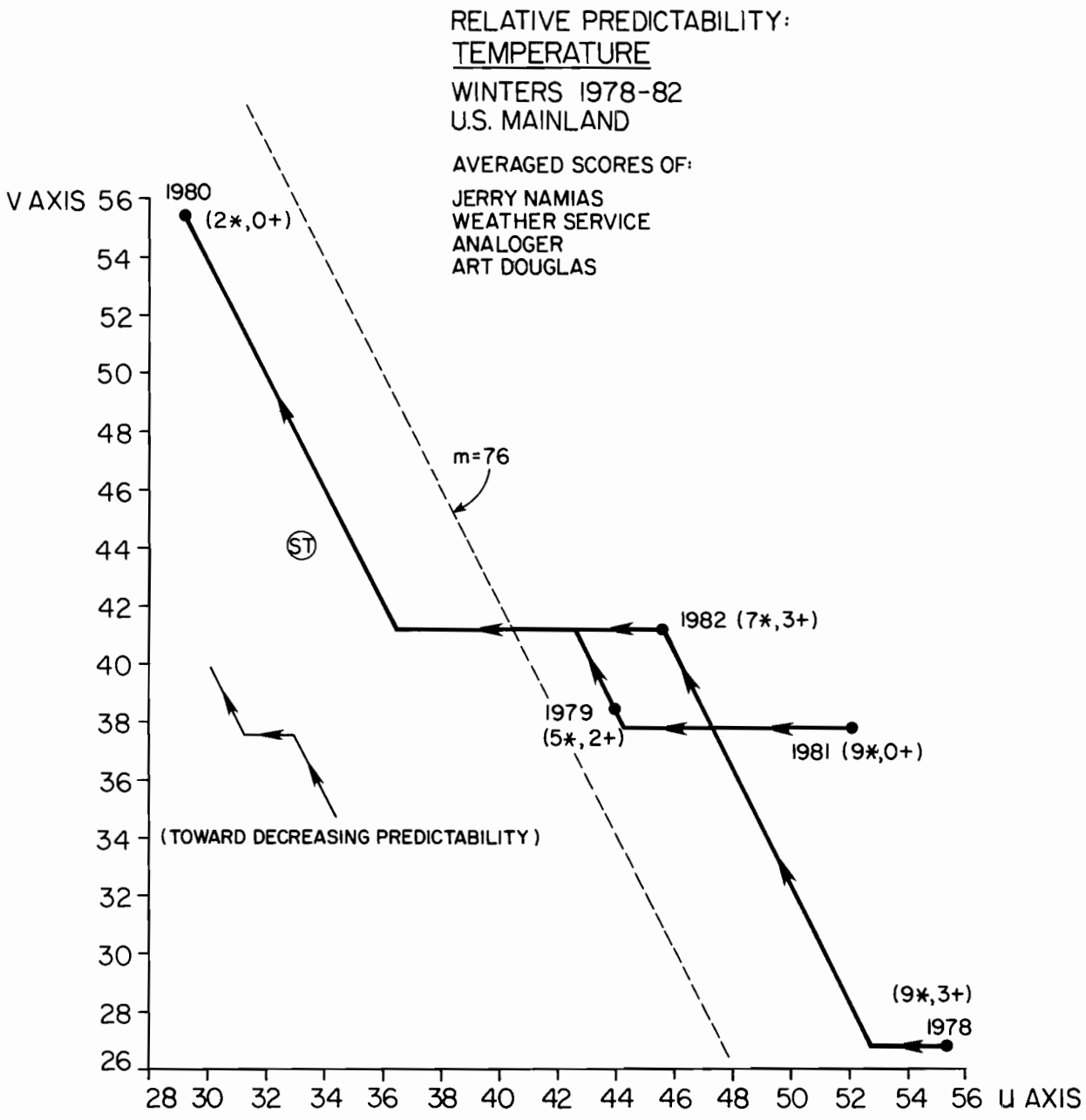
RELATIVE PREDICTABILITY:
TEMPERATURE
WINTERS 1978-82
U.S. MAINLAND
AVERAGED SCORES OF:
JERRY NAMIAS
WEATHER SERVICE
ANALOGER
ART DOUGLAS
V AXIS
56
54
52
50
48
46
44
42
40
38
36
34
32
30
28
26
28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 U AXIS
1980
(2*,0+)
m=76
ST
1982 (7*,3+)
1979
(5*,2+)
1981 (9*,0+)
(TOWARD DECREASING PREDICTABILITY)
(9*,3+)
1978

Fig 8.1

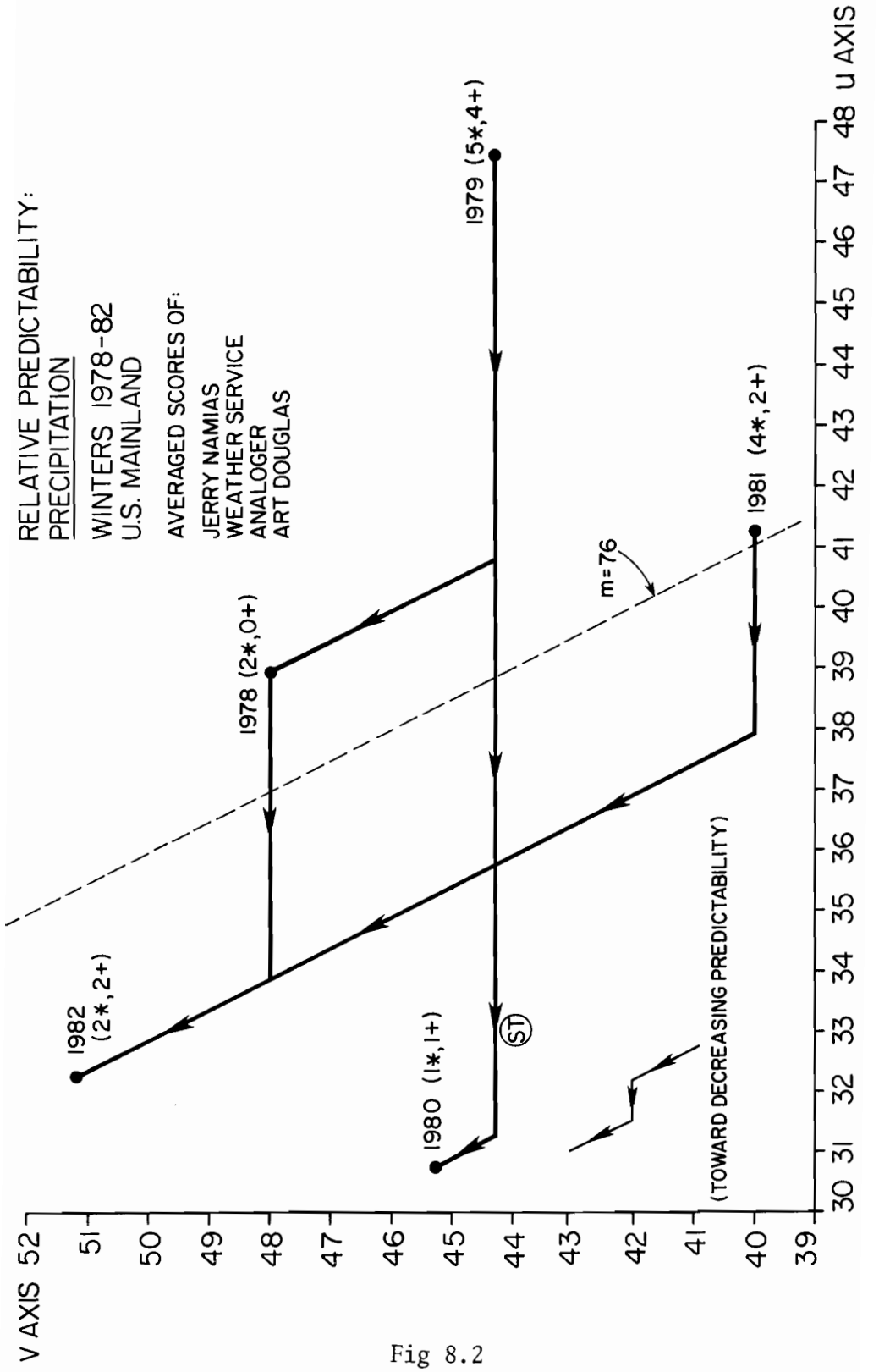
RELATIVE PREDICTABILITY:
PRECIPITATION
WINTERS 1978-82
U.S. MAINLAND
AVERAGED SCORES OF:
JERRY NAMIAS
WEATHER SERVICE
ANALOGER
ART DOUGLAS
1979 (5*,4+)
1978 (2*,0+)
1981 (4*,2+)
1982 (2*,2+)
1980 (1*,1+)
ST
m=76
(TOWARD DECREASING PREDICTABILITY)
V AXIS 52 51 50 49 48 47 46 45 44 43 42 41 40 39
30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 U AXIS

Fig 8.2

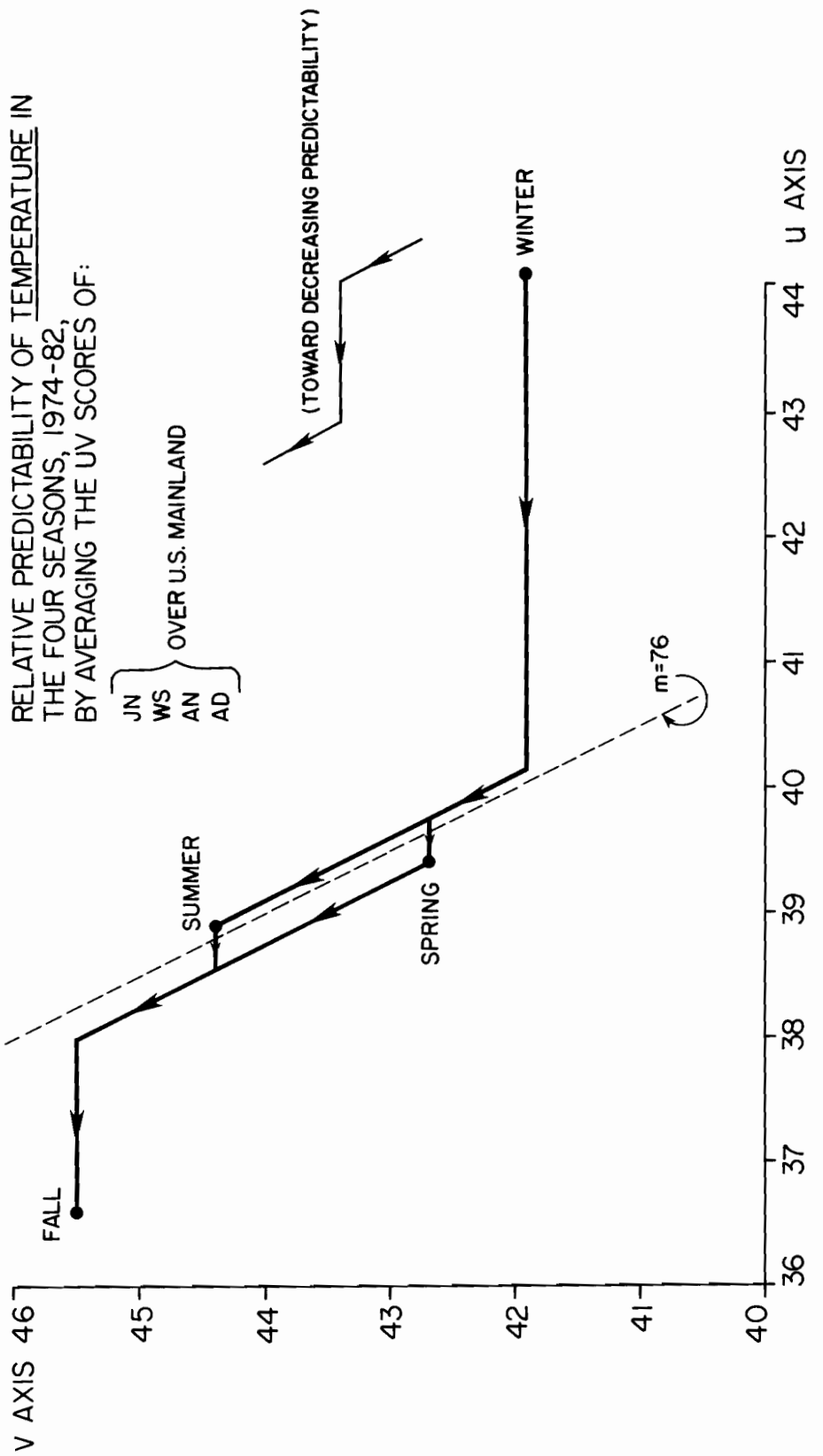
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
JN
WS
AN
AD
OVER U.S. MAINLAND
(TOWARD DECREASING PREDICTABILITY)
WINTER
SUMMER
SPRING
FALL
m=76
V AXIS 46
45
44
43
42
41
40
36
37
38
39
40
41
42
43
44 U AXIS

Fig 8.3

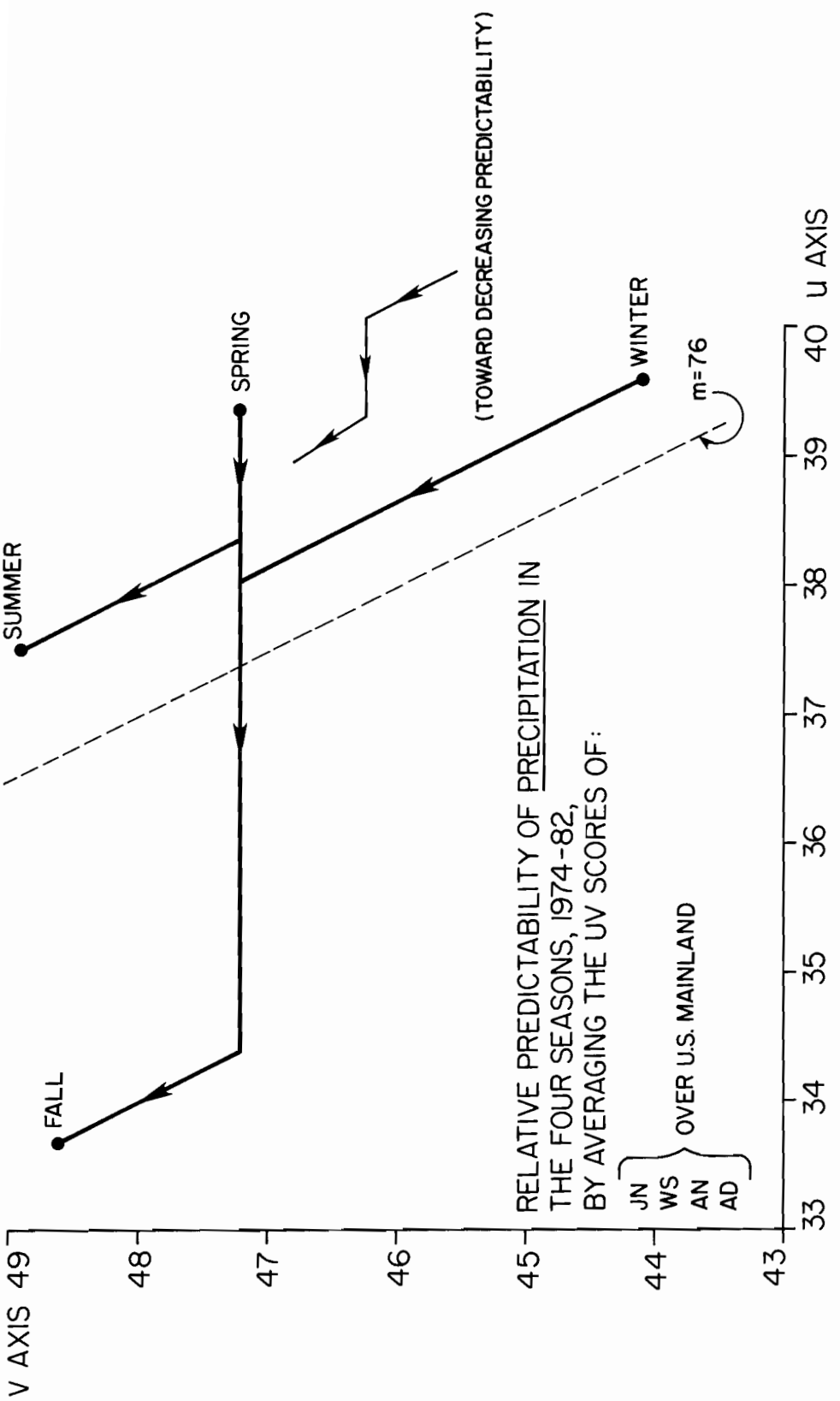
SUMMER
SPRING
WINTER
FALL
(TOWARD DECREASING PREDICTABILITY)
m=76
RELATIVE PREDICTABILITY OF PRECIPITATION IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
JN
WS
AN
AD
OVER U.S. MAINLAND
V AXIS 49
48
47
46
45
44
43
33
34
35
36
37
38
39
40 U AXIS

Fig 8.4

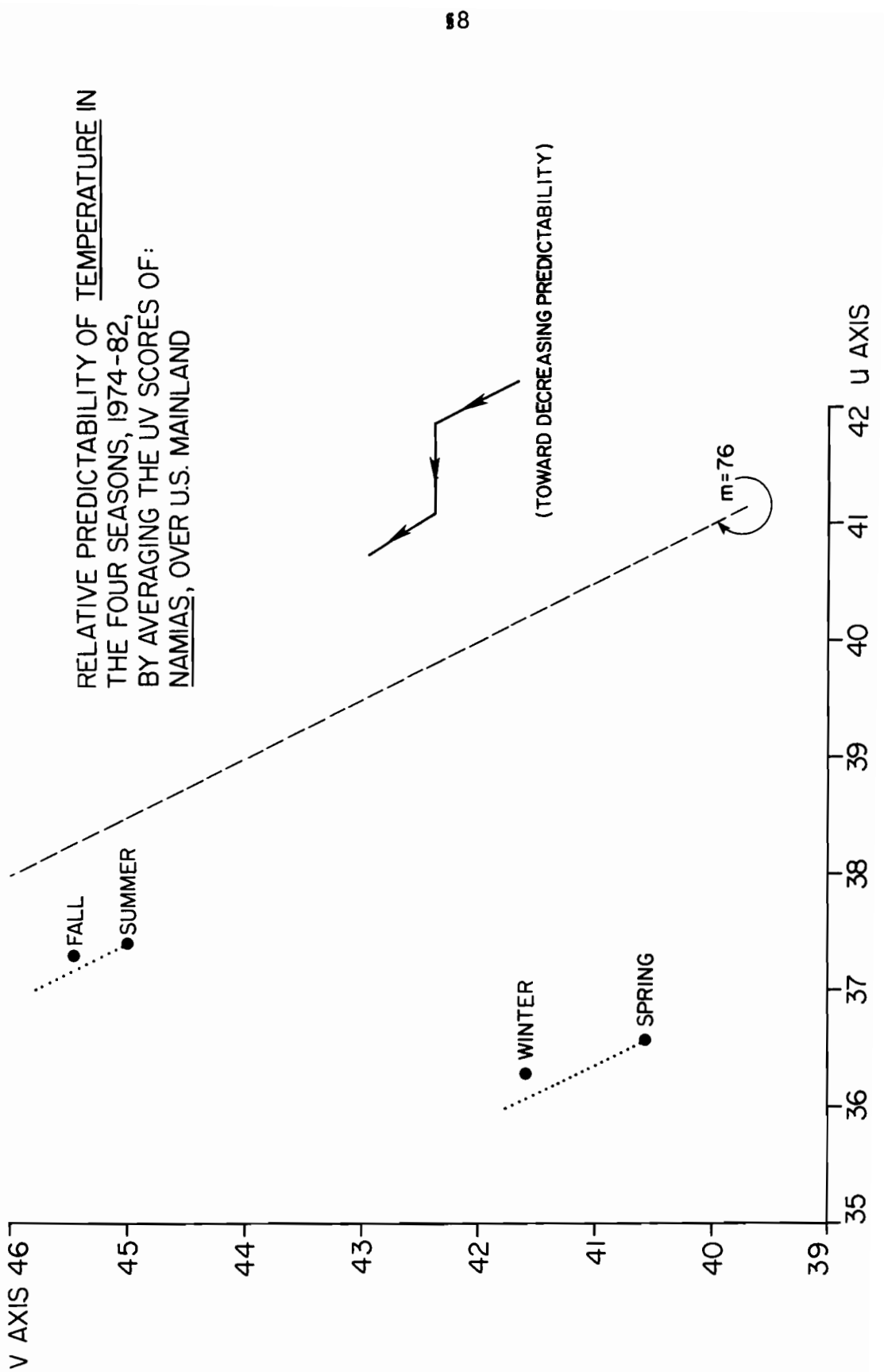
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
NAMIAS, OVER U.S. MAINLAND
(TOWARD DECREASING PREDICTABILITY)
m=76
FALL
SUMMER
WINTER
SPRING
V AXIS 46
45
44
43
42
41
40
39
35
36
37
38
39
40
41
42 U AXIS

Fig 8.5

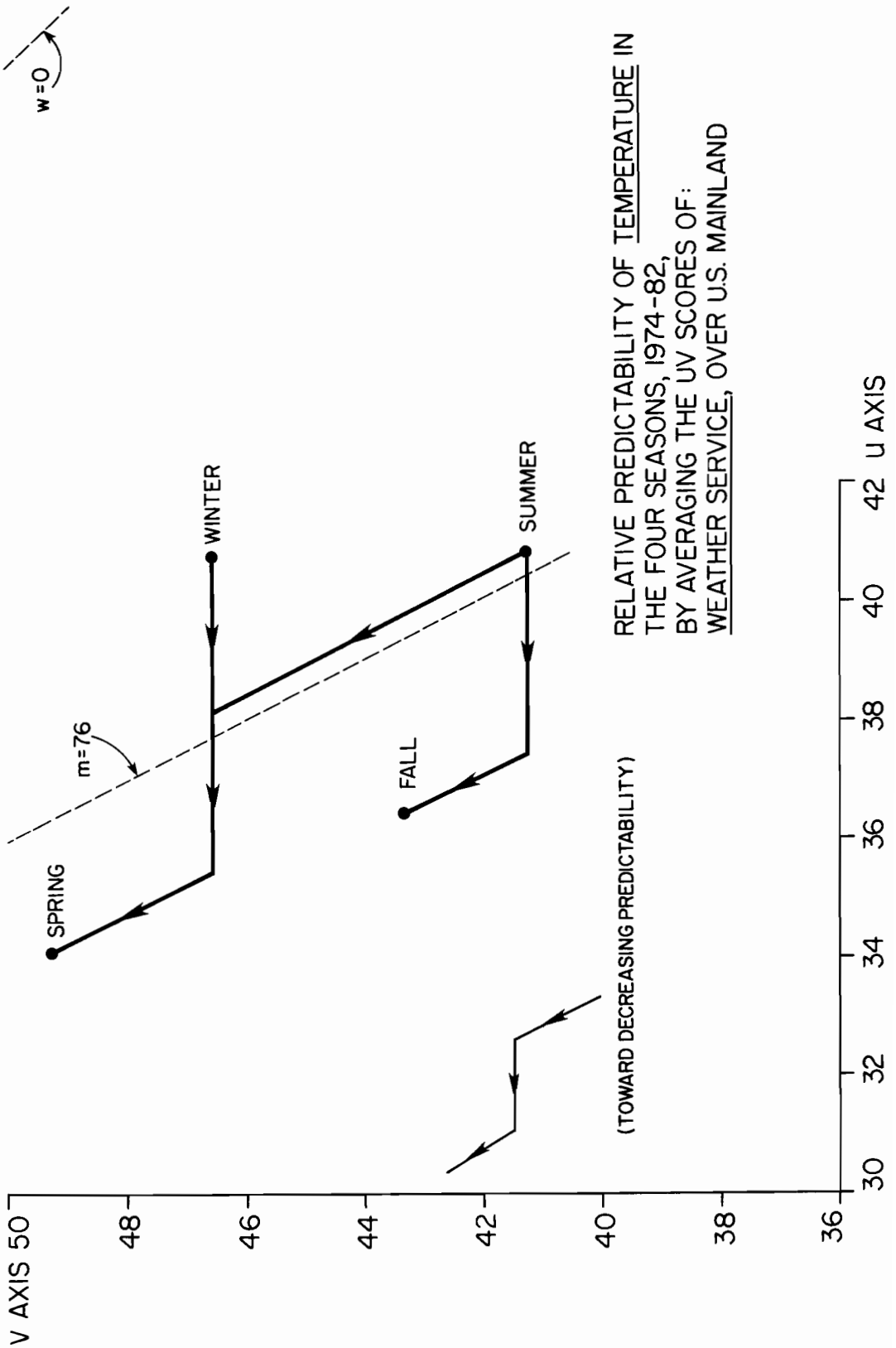
w=0
WINTER
SUMMER
m=76
SPRING
FALL
RELATIVE PREDICTABILITY OF TEMPERATURE IN THE FOUR SEASONS, 1974-82, BY AVERAGING THE UV SCORES OF: WEATHER SERVICE, OVER U.S. MAINLAND
(TOWARD DECREASING PREDICTABILITY)
V AXIS 50
48
46
44
42
40
38
36
30
32
34
36
38
40
42 U AXIS

Fig 8.6

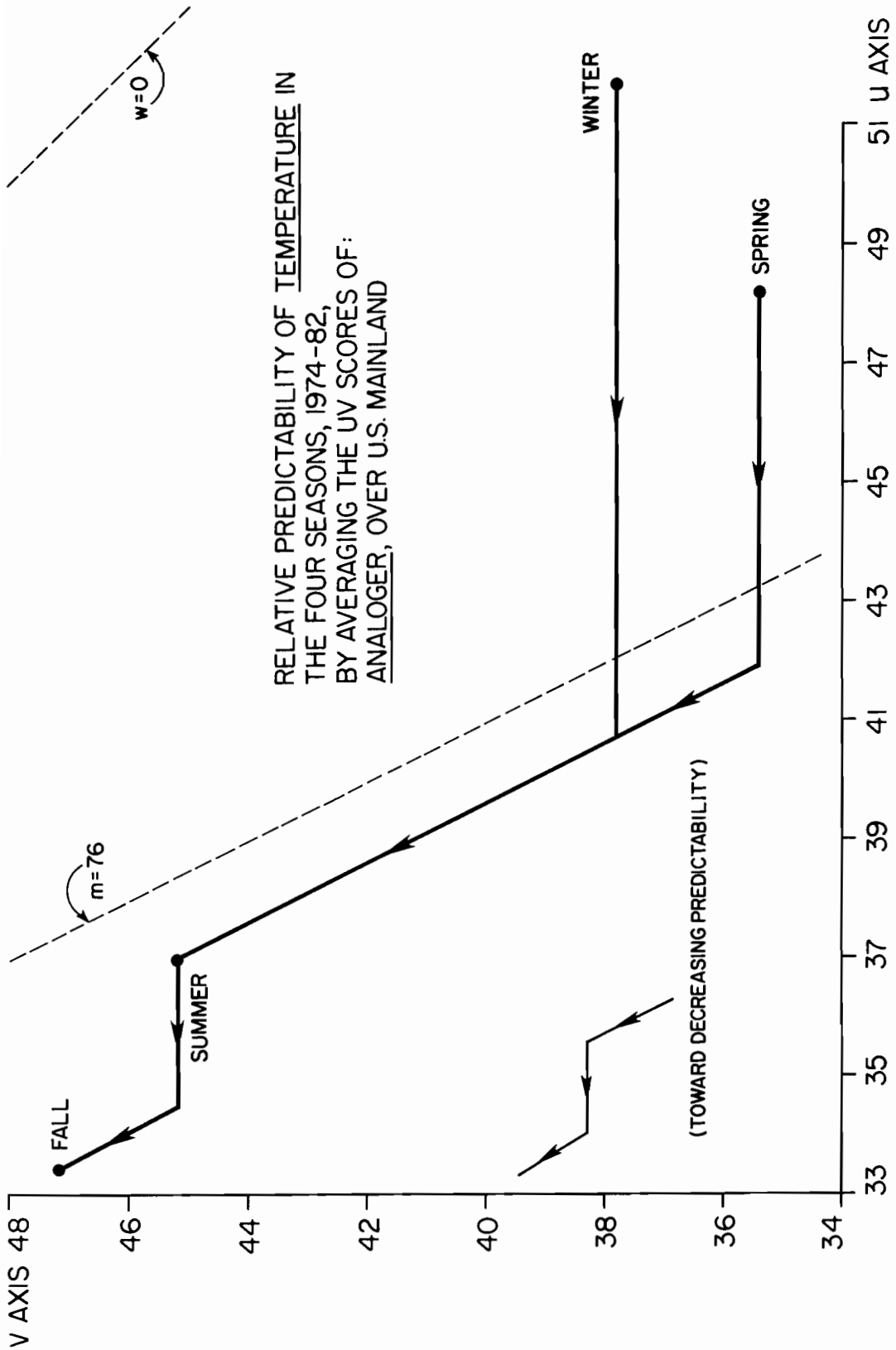
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
ANALOGER, OVER U.S. MAINLAND
w=0
m=76
WINTER
SPRING
SUMMER
FALL
(TOWARD DECREASING PREDICTABILITY)
V AXIS 48
46
44
42
40
38
36
34
33
35
37
39
41
43
45
47
49
51 U AXIS

Fig 8.7

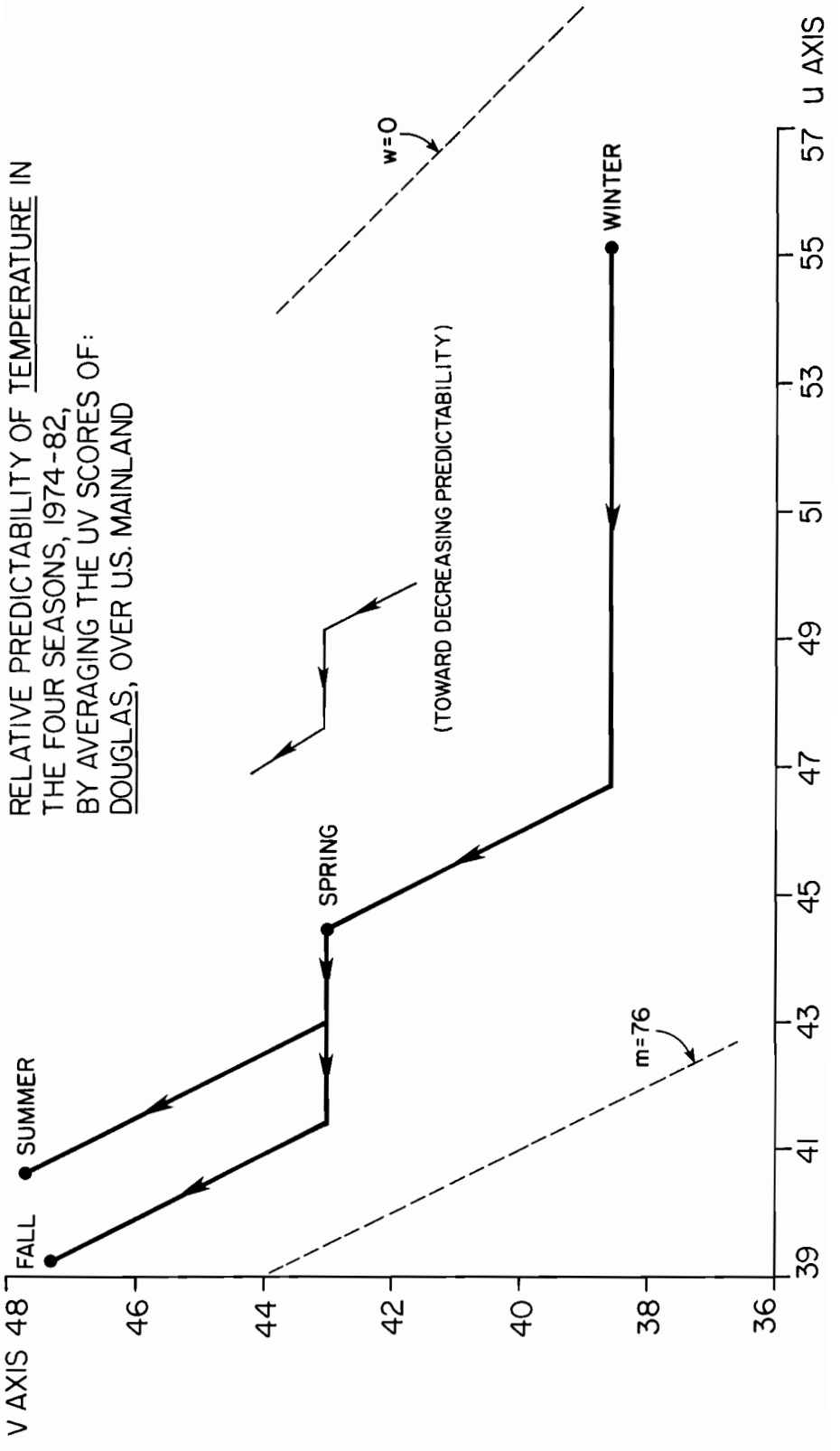
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
DOUGLAS, OVER U.S. MAINLAND
V AXIS
U AXIS
SUMMER
FALL
SPRING
WINTER
w=0
m=76
(TOWARD DECREASING PREDICTABILITY)
48
46
44
42
40
38
36
39
41
43
45
47
49
51
53
55
57

Fig 8.8

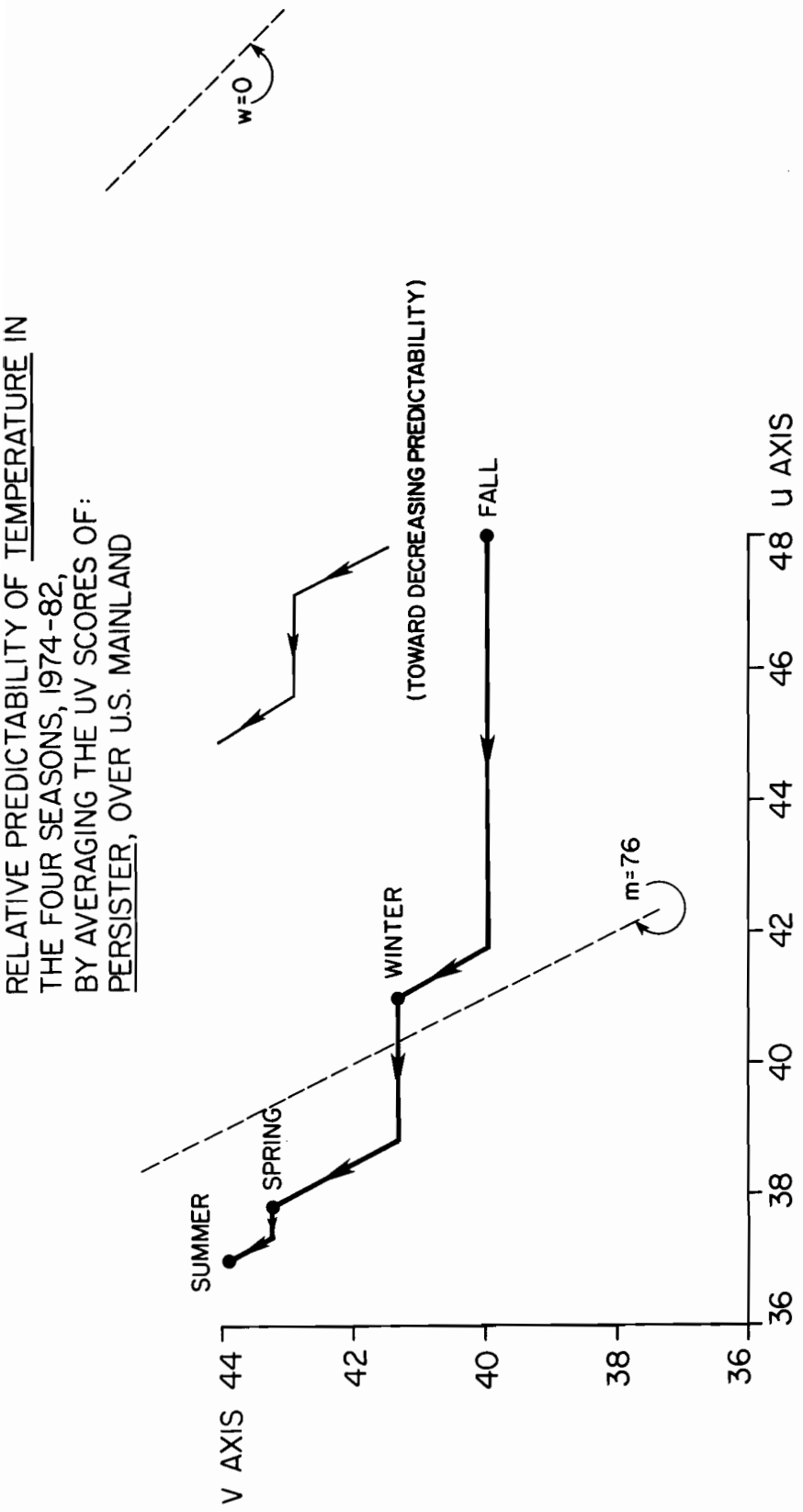
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
PERSISTER, OVER U.S. MAINLAND
w=0
(TOWARD DECREASING PREDICTABILITY)
FALL
WINTER
SPRING
SUMMER
m=76
V AXIS 44
42
40
38
36
36
38
40
42
44
46
48 U AXIS

Fig 8.9

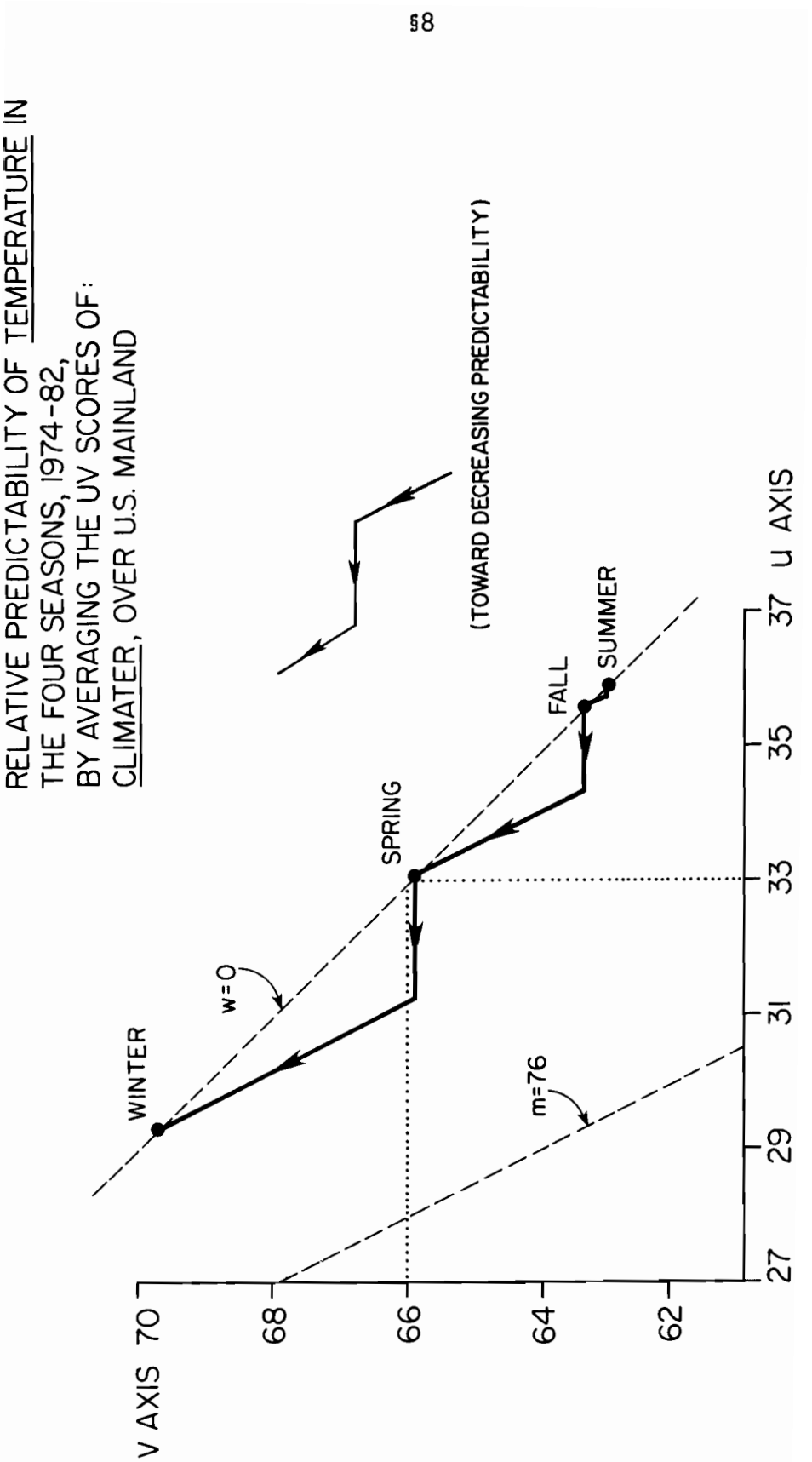
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
CLIMATER, OVER U.S. MAINLAND
(TOWARD DECREASING PREDICTABILITY)
WINTER
SPRING
FALL
SUMMER
w=0
m=76
V AXIS 70
68
66
64
62
27
29
31
33
35
37 U AXIS

Fig 8.10

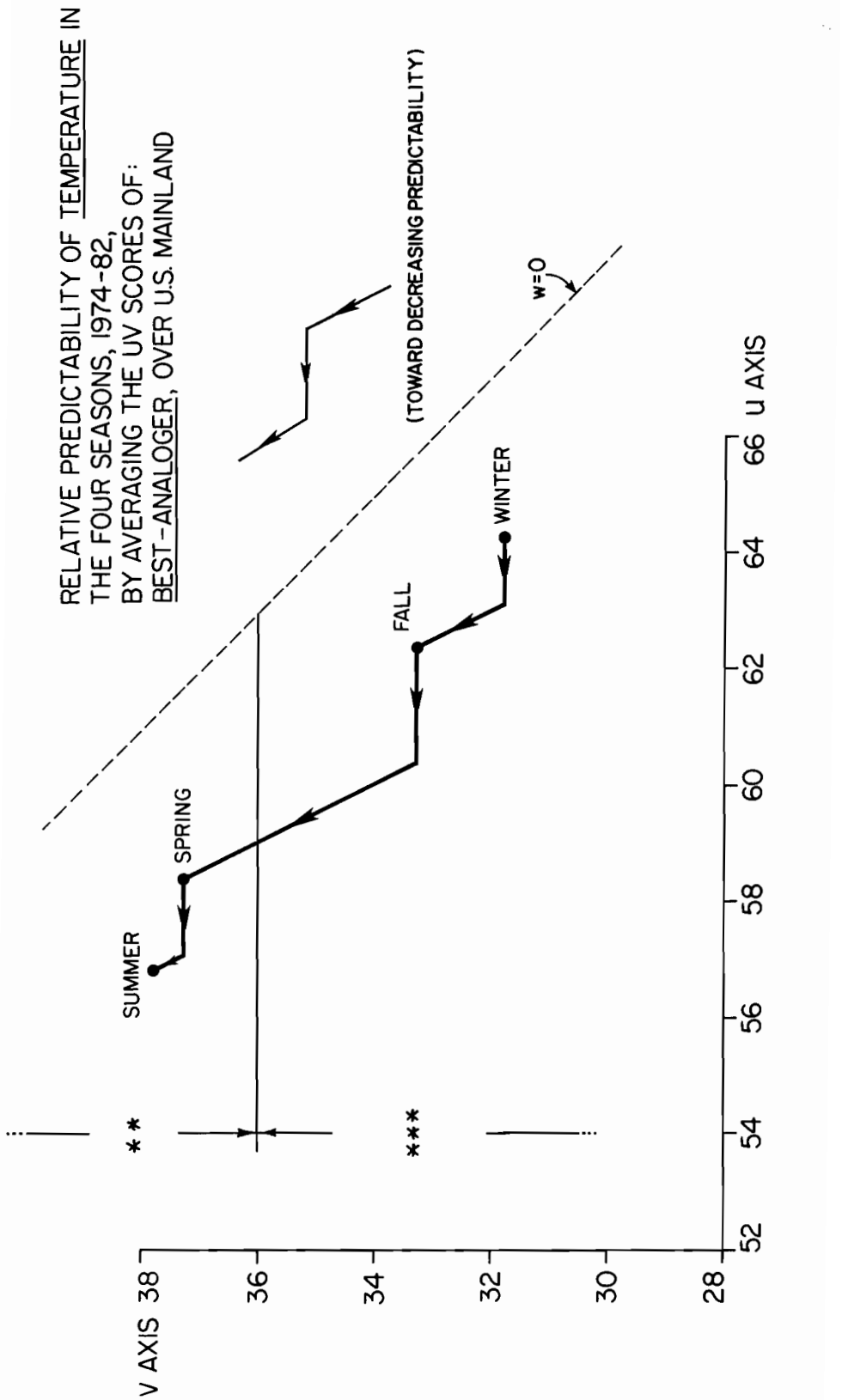
RELATIVE PREDICTABILITY OF TEMPERATURE IN
THE FOUR SEASONS, 1974-82,
BY AVERAGING THE UV SCORES OF:
BEST-ANALOGER, OVER U.S. MAINLAND
(TOWARD DECREASING PREDICTABILITY)
w=0
SUMMER
SPRING
FALL
WINTER
**
***
V AXIS 38
36
34
32
30
28
52
54
56
58
60
62
64
66 U AXIS

Fig 8.11

9. Local Skill

We consider now the manner in which forecast skill for each season, and as averaged over the results of the four human forecasters, varies with location from point to point over the 99-point map. We shall use the Stochaster as a benchmark to detect and gauge any unusually high forecast skill at each point.

On average the Stochaster has 1/3 of his forecasts correct at a fixed point. Thus, out of 30 tries he will on average obtain 10 correct forecasts. Higher counts of correct scores will occur less frequently. It is easy to determine that only 10% of his tries will on average have u as high or higher than 13. Hence if a human forecaster obtains 13 or more correct out of 30 tries we could say with confidence 90% that his performance is non-Stochaster-like. Now, in the case of Fig. 9.1, for the winter season, we have a total of 29 temperature forecasts made by all human forecasters combined. If we pool their u scores, we can ask if that total is significant on the 90% level, relative to the Stochaster's score resulting from 29 of his own tries at forecasting. A simple calculation shows that about 13 correct forecasts will be needed for that confidence level. Since, in our data records, the total of the pooled human temperature forecasts varies with season, we give this figure (i.e., 13) as a percentage of 29, namely 43%. Hence the critical u percentage for Fig. 9.1 is 43 for the 90% confidence level. Thus at point 1 (Seattle) 34% of the pooled forecasts there were correct, at point 2, 38% were correct, and so on, for each of the 99 points. Stippled regions show where the percentage of correct forecasts was at or above the critical percentage of 43. Thus we can say, with confidence 90%, that winter temperature forecast skill was significantly high at each the points of most of the western and eastern thirds of the country, for the period 1974-82, and as reflected through the pooled skills of the four human forecasters.

The reader may now leaf through the remaining three season temperature skill summaries (Figs. 9.2-9.4) and see how the shaded area of local skills shifts and somewhat decreases as we go through spring, summer, and fall. Figure 9.5 of the figure sequence combines all seasons and all forecasters, giving a total of 105 temperature forecasts at each of the 99 points. This figure gives a sort of grand average of the distribution of local temperature forecast skills over the U.S. mainland. The diagram shows a definite concentration of temperature predictability in the western and eastern thirds of the U.S. mainland, with a region of less predictability in the central portion of the map. These conclusions are in broad agreement with those of Barnett* (1981) where it is found that high skill regions are on the west coast and southeastern United States; moreover, once again the central region of the mainland is a low-skill area. There is also broad agreement with Madden and Shea† (1978) and their potential predictability index; and finally with the general conclusions in Barnett and Preisendorfer (1978, op. cit.). In this way we see that our conclusions, based on the present relatively limited data set, have some corroboration by more extensive, and independent studies of temperature predictability over the U.S. mainland. (Our choice of

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* Barnett, T. P., "Statistical Prediction of North American Air Temperatures from Pacific Predictors," *Mon. Wea. Rev. 109*, 1021 (1981).

† Madden, R. A., and Shea, D. J., "Estimates of the Natural Variability to time averaged temperatures over the United States," *Mon. Wea. Rev. 106*, 1695 (1978).

the 90% confidence level is simply to obtain a balance between a relatively fragmented, sparsely shaded map (when we use say 95%) and a relatively mostly-shaded map (when we use say 85%).)

The second sequence of Figs. 9.6-9.10 gives the local distribution of precipitation forecast skills for each season. Also given is a final combined summary of all seasons and all human precipitation forecasts. Note that in Figure 9.10 there is a definite decrease in density of local precipitation forecast skill as we move eastward over the mainland.

U-PERCENTAGES FØR TEMPERATURE
SUM ØF HUMAN FØRECASTERS (29 FØRECASTS MADE)
WINTER (1974-1982)
U CRITICAL = 43 FØR THE 90 PERCENT CØNFIDENCE LEVEL

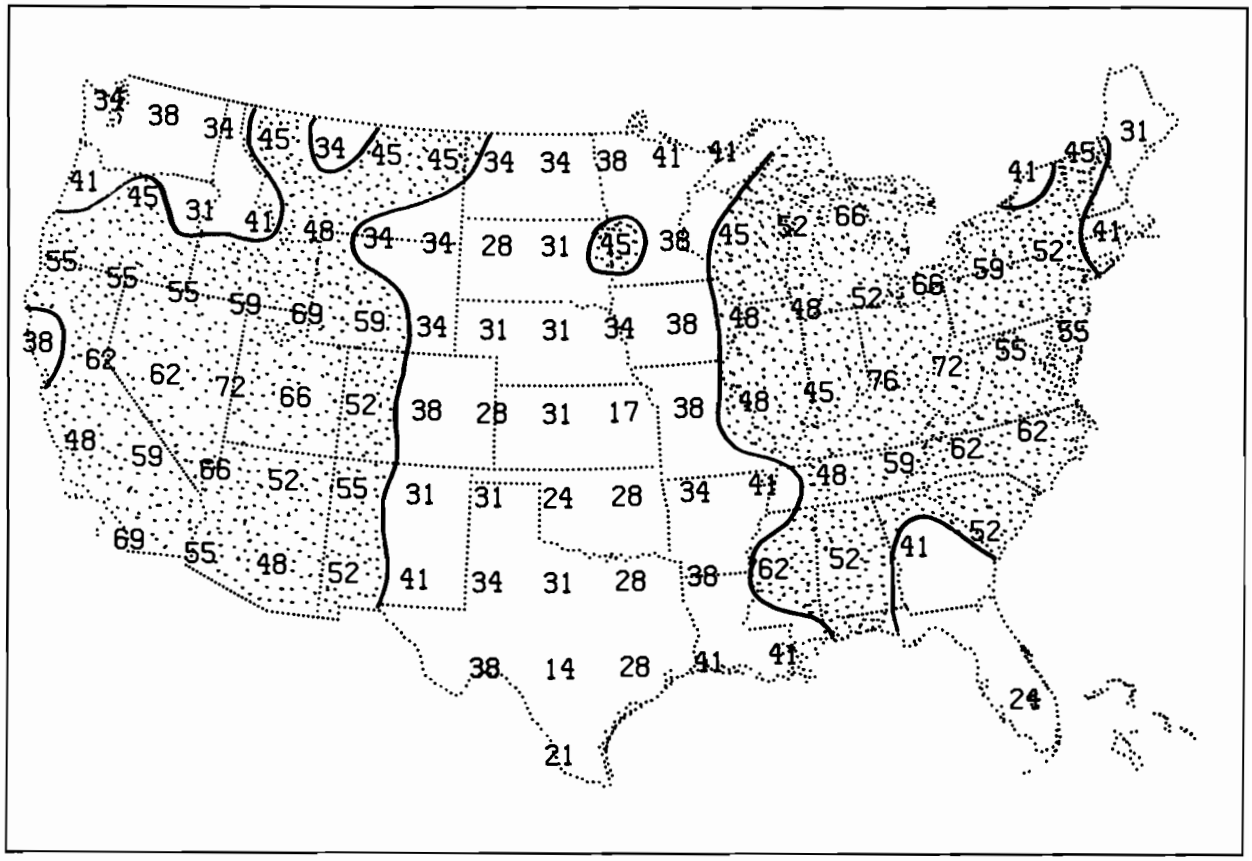

Fig 9.1

U-PERCENTAGES FØR TEMPERATURE
SUM ØF HUMAN FØRECASTERS (25 FØRECASTS MADE)
SPRING (1974-1982)
U CRITICAL = 44 FØR THE 90 PERCENT CØNFIDENCE LEVEL

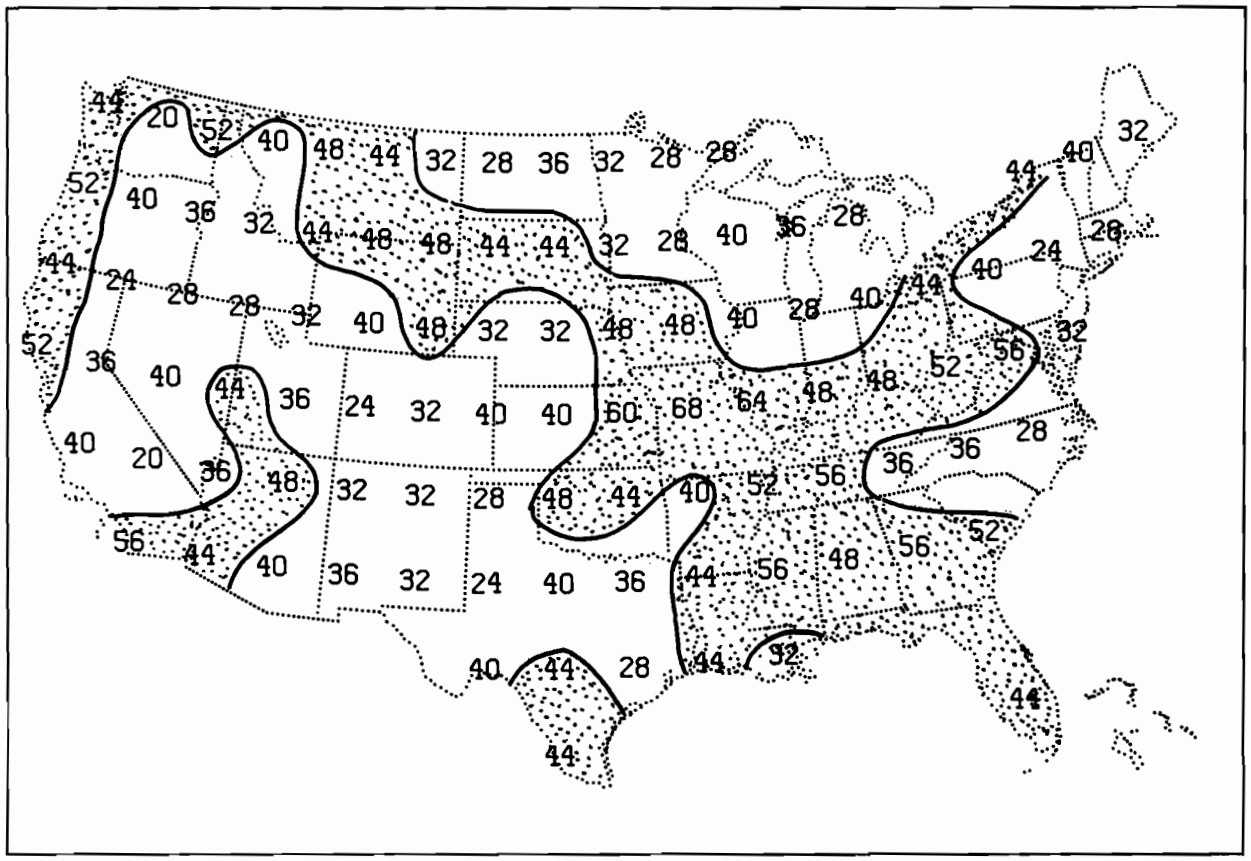

Fig 9.2

U-PERCENTAGES FØR TEMPERATURE
SUM ØF HUMAN FØRECASTERS (27 FØRECASTS MADE)
SUMMER (1974-1982)
U CRITICAL = 43 FØR THE 90 PERCENT CØNFIDENCE LEVEL

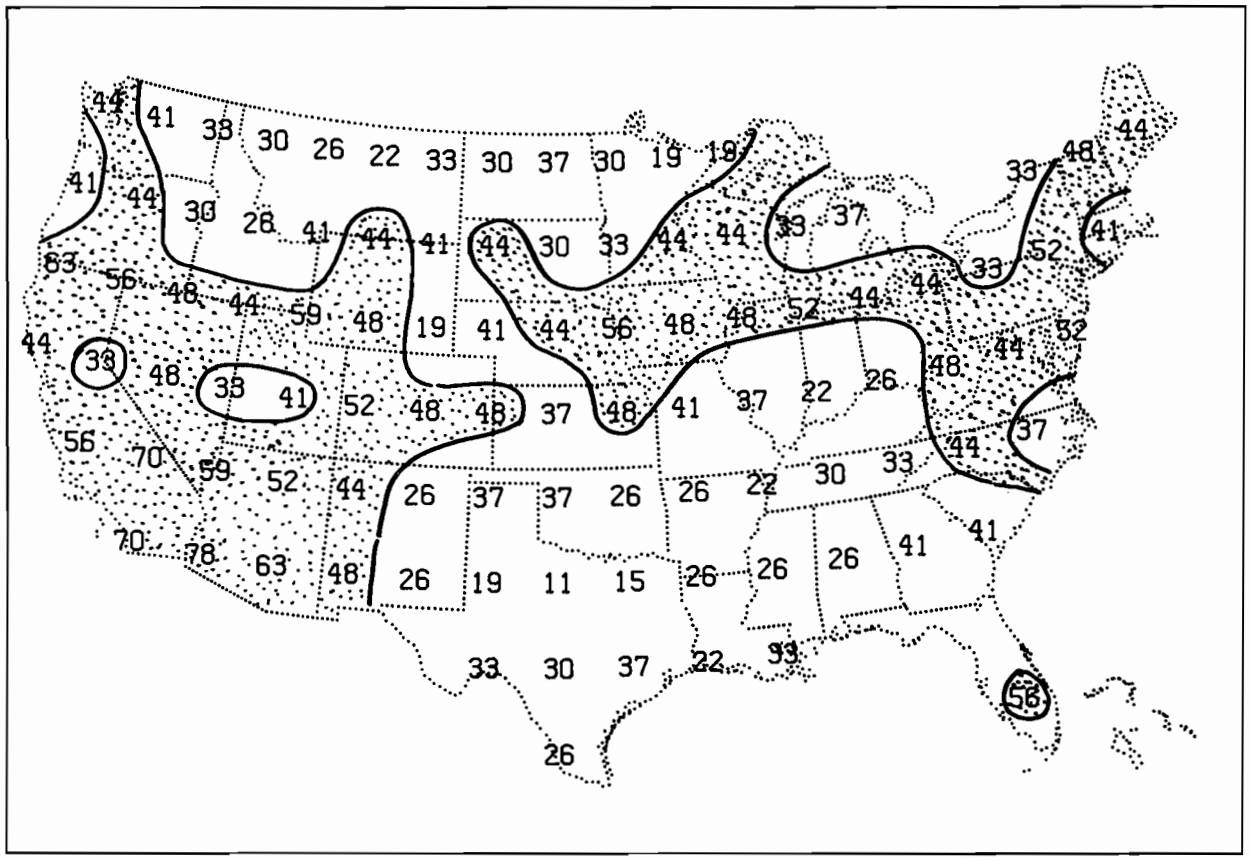

Fig 9.3

U-PERCENTAGES FØR TEMPERATURE
SUM ØF HUMAN FØRECASTERS (24 FØRECASTS MADE)
FALL (1974-1982)
U CRITICAL = 44 FØR THE 90 PERCENT CØNFIDENCE LEVEL

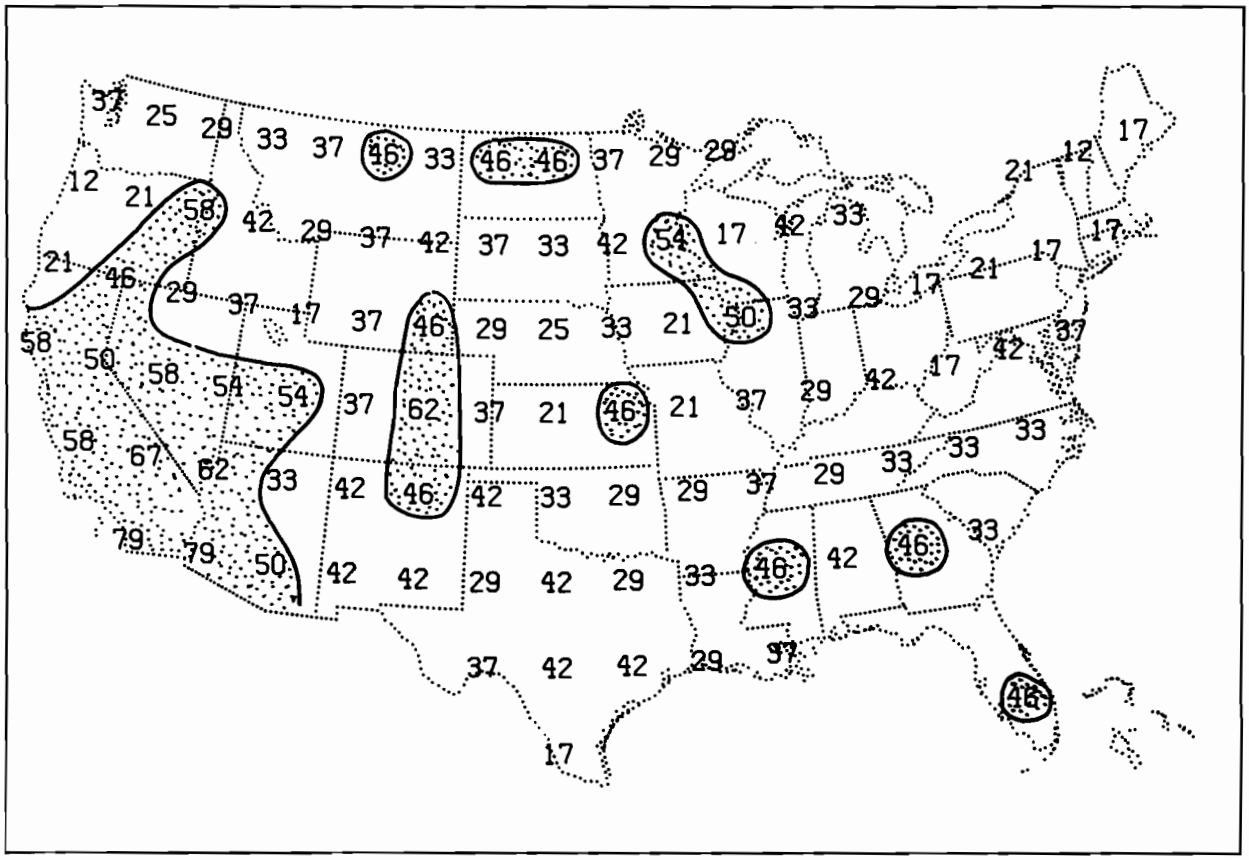

Fig 9.4

U-PERCENTAGES FØR TEMPERATURE
SUM ØF HUMAN FØRECASTERS (105 FØRECASTS MADE)
ALL SEASØNS CØMBINED (1974-1982)
U CRITICAL = 39 FØR THE 90 PERCENT CØNFIDENCE LEVEL

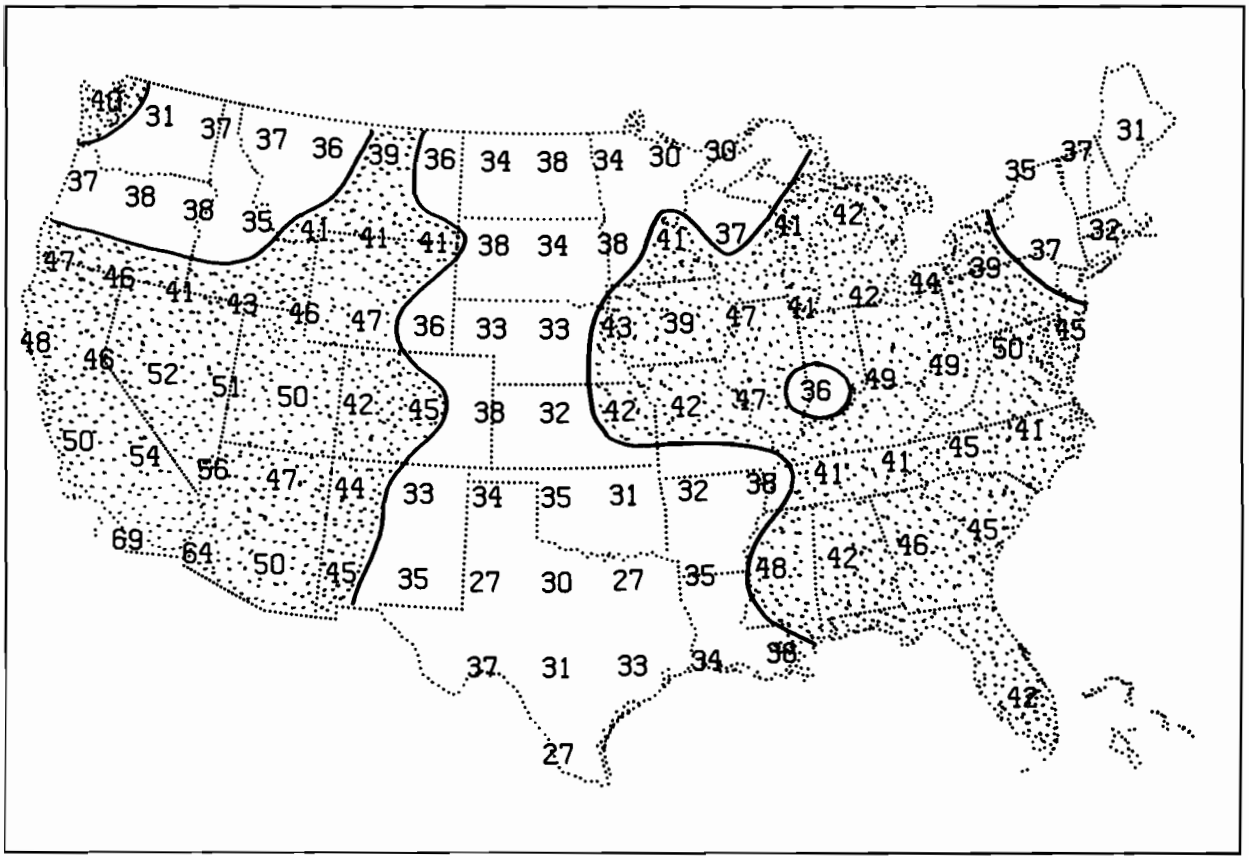

Fig 9.5

U-PERCENTAGES FØR PRECIPITATIØN
SUM ØF HUMAN FØRECASTERS (27 FØRECASTS MADE)
WINTER (1974-1982)
U CRITICAL = 43 FØR THE 90 PERCENT CØNFIDENCE LEVEL

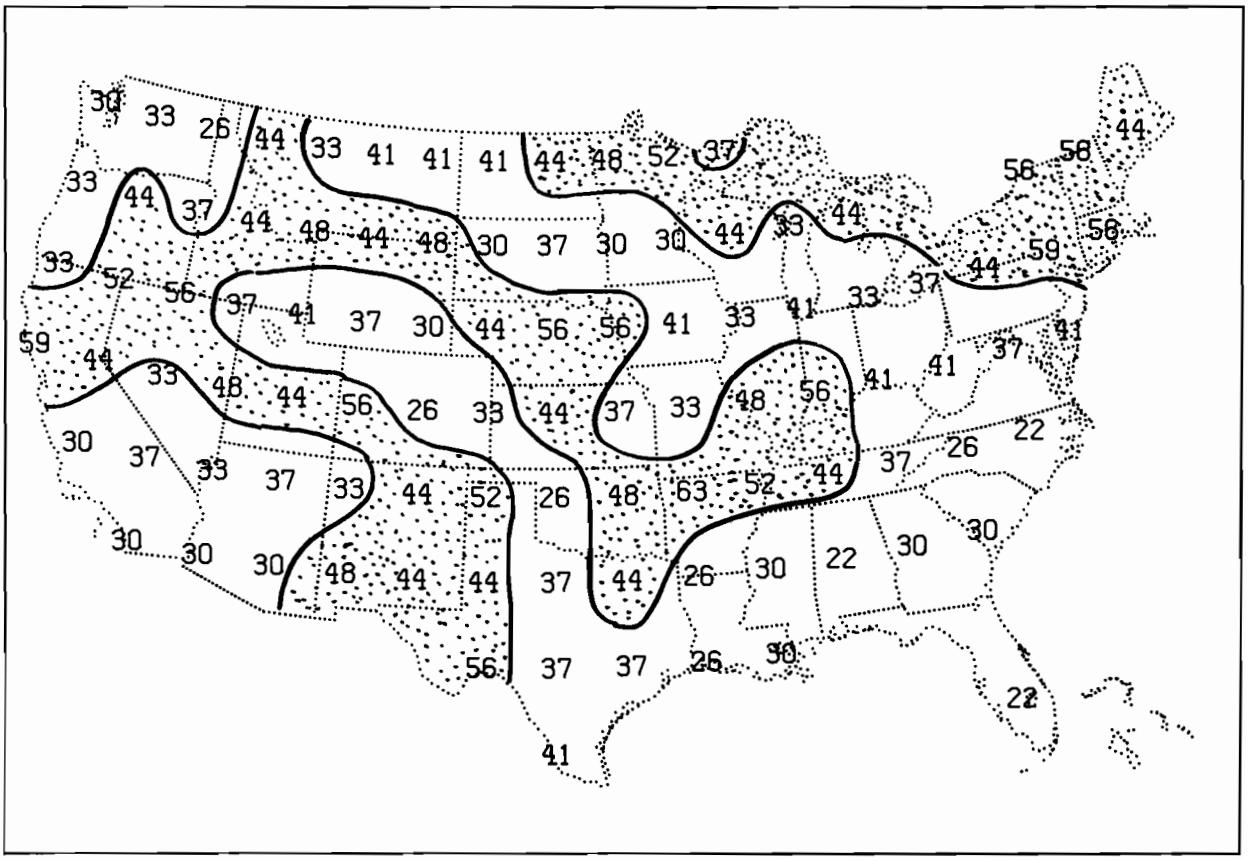

Fig 9.6

U-PERCENTAGES FØR PRECIPITATIØN
SUM ØF HUMAN FØRECASTERS (23 FØRECASTS MADE)
SPRING (1974-1982)
U CRITICAL = 44 FØR THE 90 PERCENT CØNFIDENCE LEVEL

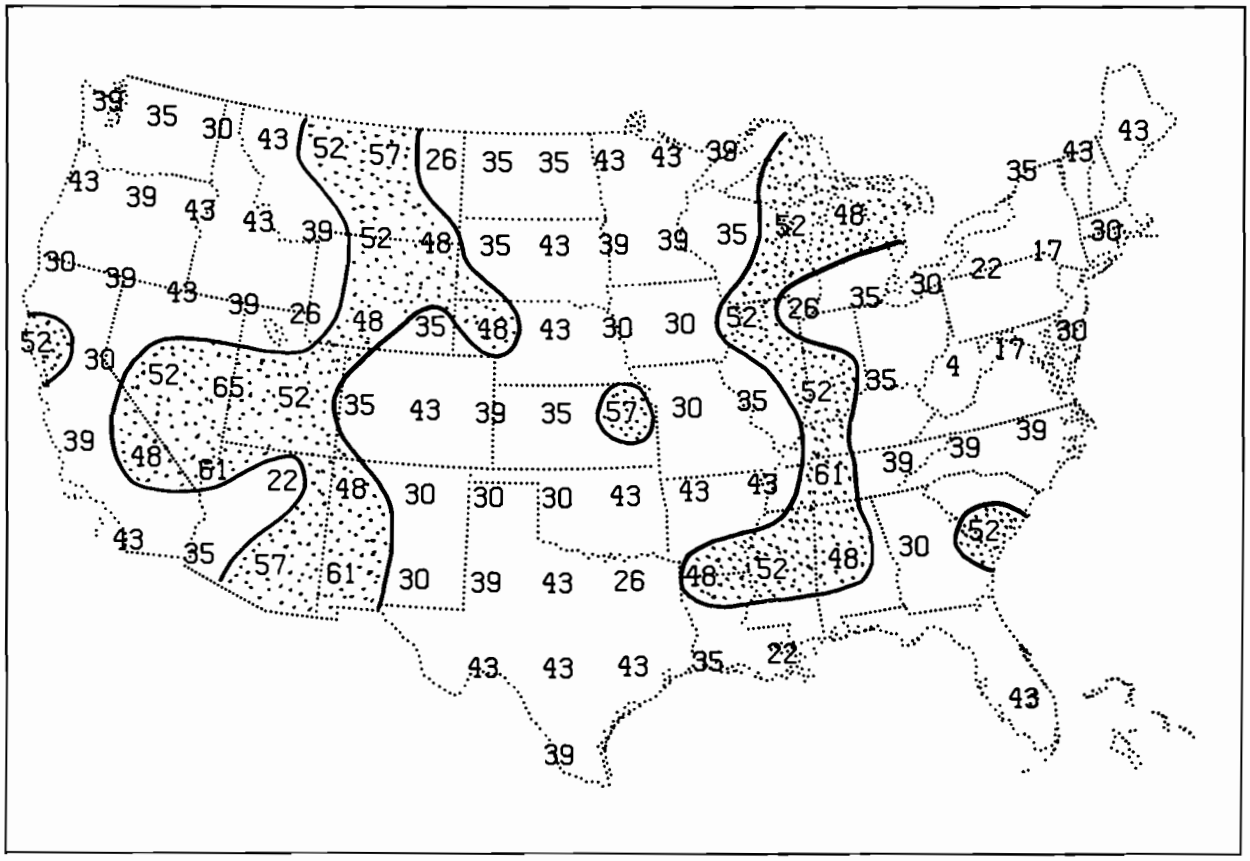

Fig 9.7

U-PERCENTAGES FØR PRECIPITATIØN
SUM ØF HUMAN FØRECASTERS (27 FØRECASTS MADE)
SUMMER (1974-1982)
U CRITICAL = 43 FØR THE 90 PERCENT CØNFIDENCE LEVEL

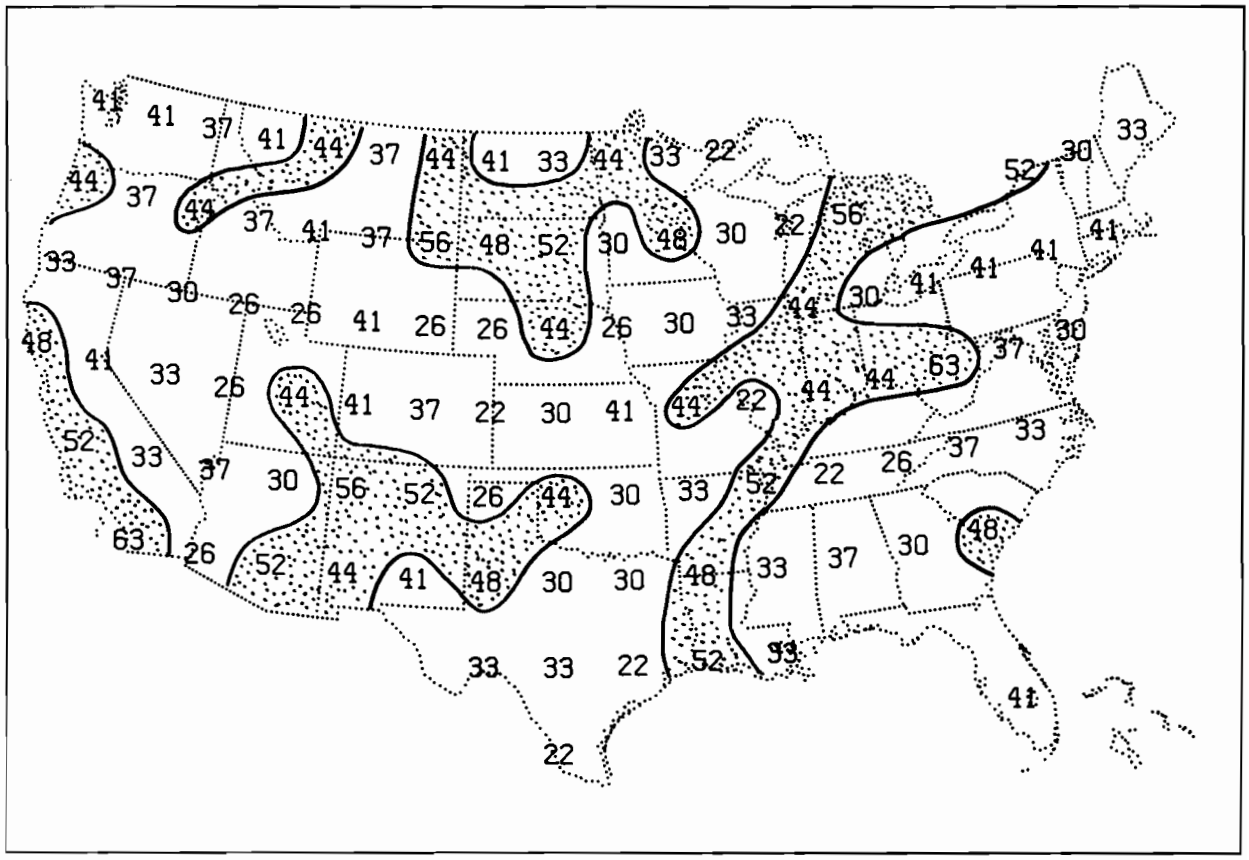

Fig 9.8

U-PERCENTAGES FØR PRECIPITATIØN
SUM ØF HUMAN FØRECASTERS (24 FØRECASTS MADE)
FALL (1974-1982)
U CRITICAL = 44 FØR THE 90 PERCENT CØNFIDENCE LEVEL

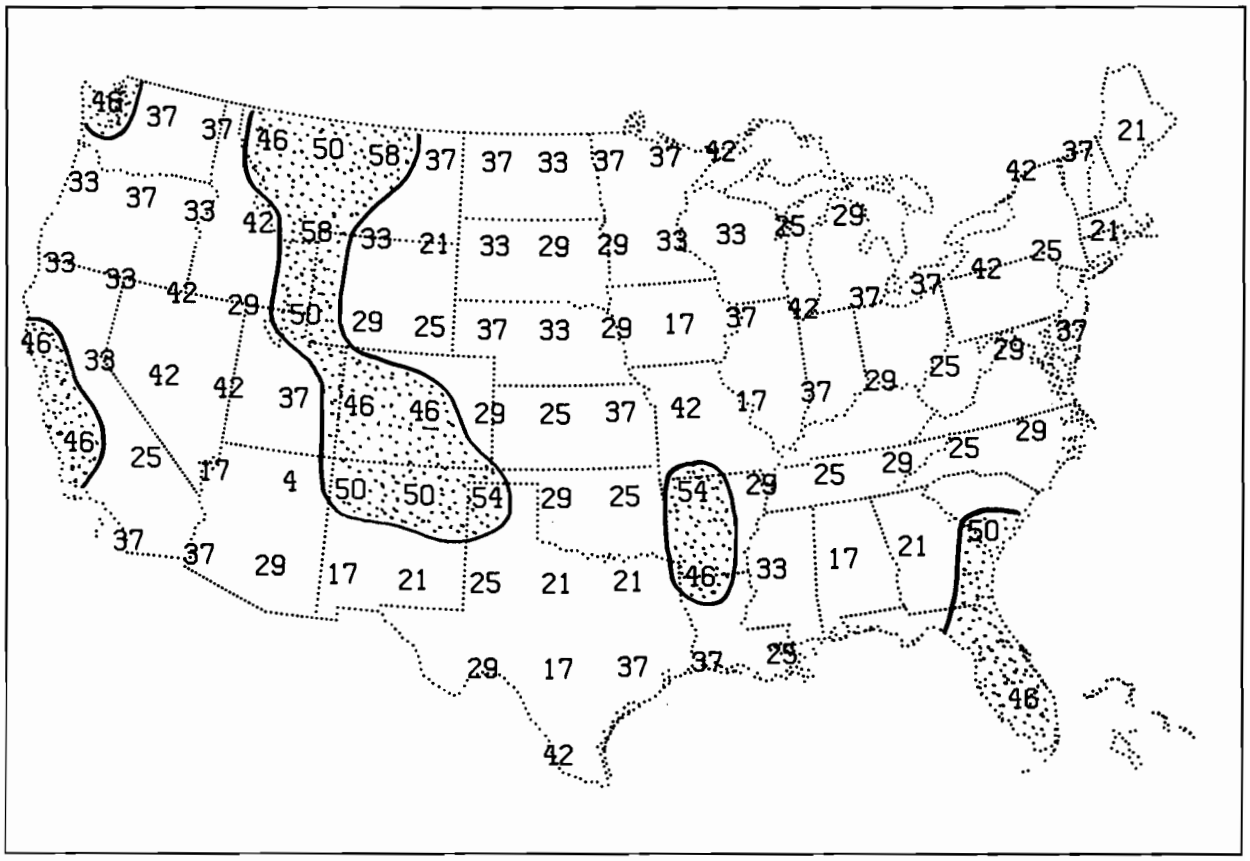

Fig 9.9

U-PERCENTAGES FØR PRECIPITATIØN
SUM ØF HUMAN FØRECASTERS (101 FØRECASTS MADE)
ALL SEASØNS CØMBINED (1974-1982)
U CRITICAL = 39 FØR THE 90 PERCENT CØNFIDENCE LEVEL

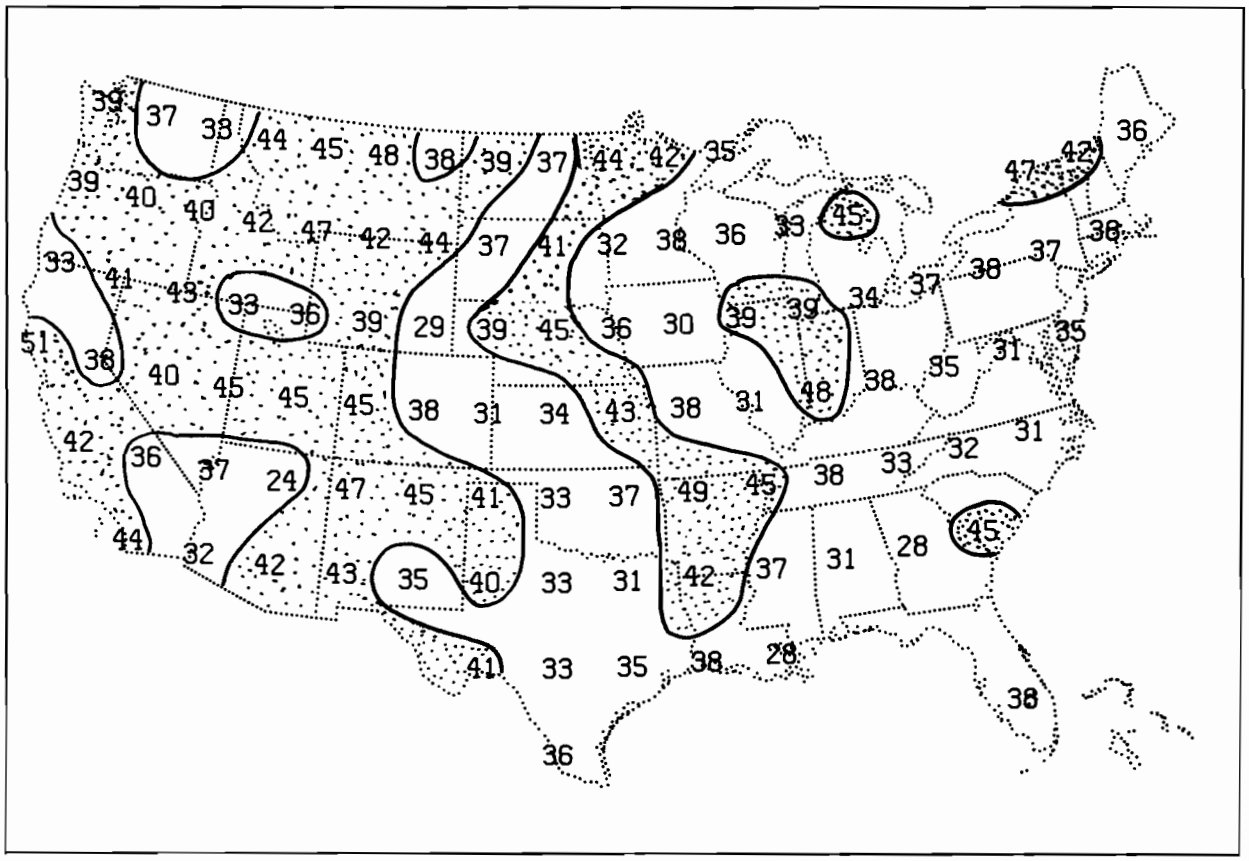

Fig 9.10

10. Regional Skill

We now approach the study of the geographic distribution of forecast skill from another direction. We partition the mainland U.S. into ten climatic regions, as shown in Fig. 10.1. The numbers in parentheses after each region name give the total number of points in the region. The numbered points are those of the 99 point verification set, and serve to identify each region for computer-statistics work*. (A listing of these points is given in §16.)

10.1 Regional Stochaster

In order to gauge whether a forecaster performs well or badly in one of the climate regions, we compare his performance with that of the Stochaster. Thus consider a climate region with n points, as compared to the number N of points in the whole U.S. mainland (For example the Pacific Coast has n = 6 points. As usual, in this work, N = 99). Suppose the Stochaster performs a great many forecasts over the U.S. mainland. We are interested in the distribution of the number of his correct forecasts in the climate region, relative to his number of correct forecasts over the whole U.S. mainland. Thus let u, U, respectively be the number of correct forecasts in the region of n points and the whole U.S. mainland region of N points. We now select the subset of the Stochaster's set of forecasts that have some fixed national U score. Looking over this particular subset we see how the Stochaster's u-scores are distributed. It is easily shown (See Sec. 16.2) that these regional u-scores, for a fixed U, n, and N, follow a hypergeometric distribution. In particular, under these conditions, it is at least intuitively clear that the Stochaster's average u-score in the climate region is (n/N)U. This of course may be deduced from the hypergeometric distribution. We can, moreover, use the hypergeometric distribution to find for a given n-point region and national U score, the critical u-value†, call it 'u_c', for the (say) 90% confidence level. We are now ready to apply this critical value to any other forecaster. Thus if another forecaster performs a forecast, and his correct-score over the nation is U, and over the given climate region his score is u, then his forecast over the climate region is, by definition, <u>significant</u> on the 90% level if $u_c \leqq u$. This procedure is the basis for the figures 10.2, 10.3, which are compiled as follows:

10.2 Temperature and Precipitation Results

For each season (say, winter) we collected the temperature u-scores of the four human forecasters. For Fig. 10.2, in particular, we pooled the numbers of correct (winter, say) temperature scores occurring in each region.

---

* The choice of these regions is partially based on some work by Namias, J., "Persistence of U.S. Seasonal Temperatures up to One Year," *Mon. Wea. Rev. 106*:1557 (1978). The choice was also influenced by a later, similar partitioning by Art Douglas (private communication). The present definitions are a compromise among these sources and the authors.

† The theory of these critical u-values is outlined in §16, along with that of the hypergeometric distribution. We note in passing that the variance of the stochaster's u may be estimated using $\sigma^2(u) = n(U/N)(1-U/N)[(N-n)/(N-1)]$, which also may be deduced from the hypergeometric distribution.

We then compared each of these pooled regional u-scores with the Stochaster's 90% critical u-value u_c (as found above) for that region. To each region (for a given season, say winter) was then assigned the number of significant forecasts in that region. We then accumulated such significant forecasts over all (winter) seasons. We next ordered the climate regions so that the 1st in order was the region with the most accumulated significant (say, winter) temperature u-scores, and so on down to the 10th in order, with the least accumulations. Each column (winter, say) then lists the regions in order of decreasing temperature predictability for its associated season. Thus winter temperature, e.g., was found to be most predictable in SWD (Southwestern Desert), and least predictable in GUC (Gulf Coast). The other region rankings for other seasons listed in the figure can be deciphered similarly with the help of the map in Fig. 10.1. The combined-season ranking (obtained by pooling all significant forecaster u-scores over all seasons) is shown in the first column of Fig. 10.2. Thus, the temperature on average was best predicted in SWD, PAC, and NPL, while it was least well predicted in SPL, GUC, and ATC.

Still another ranking of temperature predictability by season (recall earlier rankings in §7) is given by the boxed numbers below the main table in Fig. 10.2. Thus the winter season collected 23.4% of all pooled significant u-score regional forecasts over the whole mainland, while fall collected only 14.6% of the correct regional forecasts. This corroborates our rankings, found in a different way, in §7.

Figure 10.3 summarizes in an exactly similar manner the regional rankings for predictability of precipitation. Thus, for winter, regions SWD, GRL, NGB rank highest in precipitation predictability, while precipitation is least predictable in the regions ATC, GUC, PAC. For combined seasons: The precipitation on average was best predicted in SWD, GRL, NGB, while it was least well predicted in SPL, ATC, GUC.

The boxed numbers below the table in Fig. 10.3 give another ranking (cf. §7) of precipitation predictability by season, now by means of regional u-scores. Thus once again winter precipitation was best predicted while fall precipitation was the least well predicted. Comparing the boxed percentages for both temperature and precipitation, we see from still another view (cf. closing lines of §6) that precipitation on average is less predictable than temperature.

Figures 10.4, 10.5 summarize graphically the ranking of regions by temperature and precipitation predictability, and are drawn from the data listed in the first columns in Figs. 10.2, 10.3.

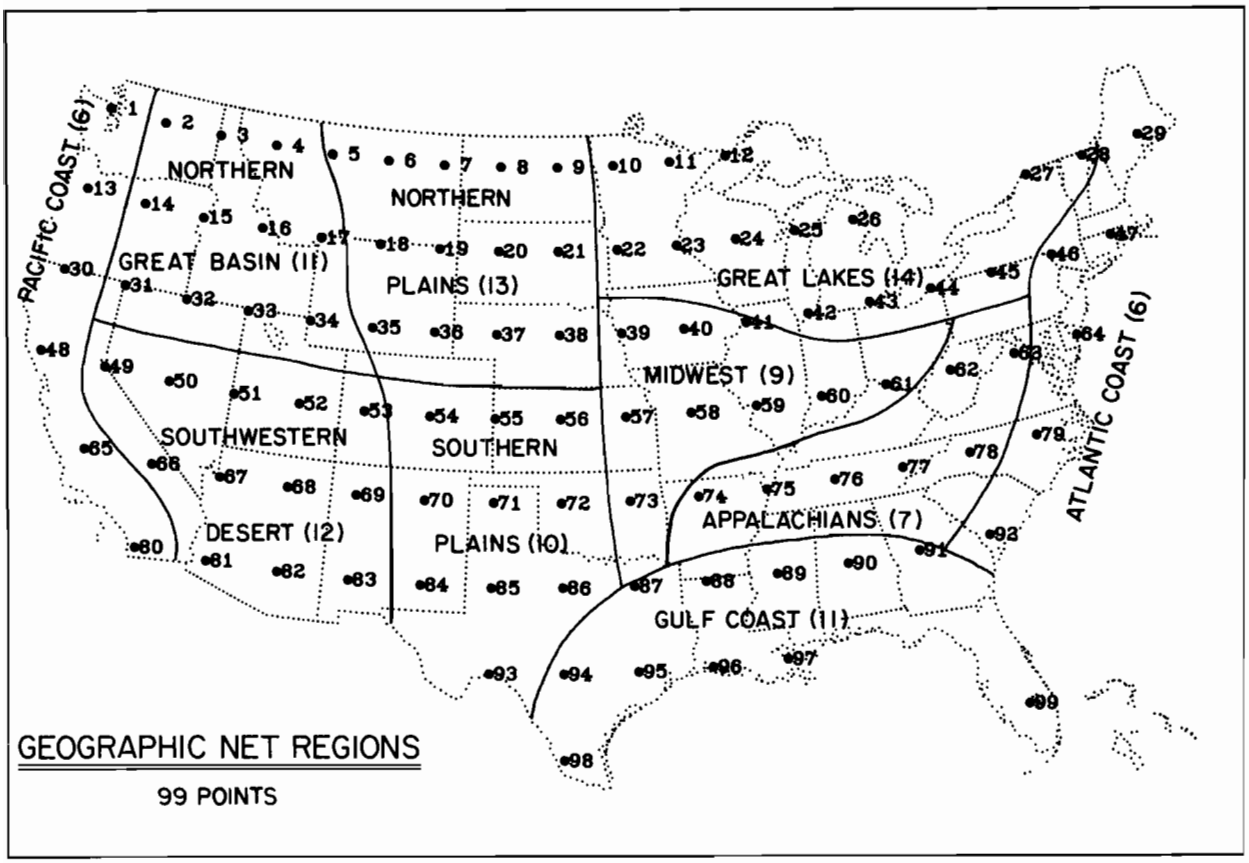
PACIFIC COAST (6)
NORTHERN
NORTHERN
GREAT BASIN (11)
PLAINS (13)
GREAT LAKES (14)
MIDWEST (9)
ATLANTIC COAST (6)
SOUTHWESTERN
SOUTHERN
DESERT (12)
PLAINS (10)
APPALACHIANS (7)
GULF COAST (11)
GEOGRAPHIC NET REGIONS
99 POINTS

Fig 10.1

RANKING THE TEN U.S. MAINLAND CLIMATE REGIONS BY TEMPERATURE PREDICTABILITY
FOR PERIOD 1974-1982 VIA SEASONS
(USING SCORES OF THE FOUR HUMAN FORECASTERS)

REGION	RANKING					AVERAGE RANK OVER SEASONS
	COMBINED SEASONS	WINTER	SPRING	SUMMER	FALL	
PAC	2	5	4	2	3	3.5
NGB	5	4	9	3	8	6.0
SWD	1	1	2	1	1	1.3
NPL	3	6	3	8	2	4.8
SPL	8	7	8	5	5	6.3
GRL	4	2	7	6	4	4.8
MDW	7	9	1	9	6	6.3
APP	6	3	5	10	10	7.0
GUC	9	10	6	7	7	7.5
ATC	10	8	10	4	9	7.8

18.9	23.4	21.6	17.0	14.6

(RELATIVE PREDICTABILITY OF TEMPERATURE BY SEASON
—VIA PERCENT OF SIGNIFICANT FORECASTS BY HUMAN FORECASTERS)

Fig 10.2

RANKING THE TEN U.S. MAINLAND CLIMATE REGIONS BY PRECIPITATION PREDICTABILITY
FOR PERIOD 1974-1982 VIA SEASONS
(USING SCORES OF THE FOUR HUMAN FORECASTERS)

REGION	RANKING					AVERAGE RANK OVER SEASONS
	COMBINED SEASONS	WINTER	SPRING	SUMMER	FALL	
PAC	7	10	4	2	4	5.0
NGB	3	3	3	10	2	5.3
SWD	1	1	1	4	5	2.8
NPL	4	6	5	1	3	3.8
SPL	8	7	9	9	6	7.8
GRL	2	2	2	5	1	2.5
MDW	5	4	6	3	7	5.0
APP	6	5	7	6	9	6.8
GUC	10	9	8	7	8	8.0
ATC	9	8	10	8	10	9.0
	13.3	17.8	12.6	12.6	8.7	

(RELATIVE PREDICTABILITY OF PRECIPITATION BY SEASON
—VIA PERCENT OF SIGNIFICANT FORECASTS BY HUMAN FORECASTERS)

Fig 10.3

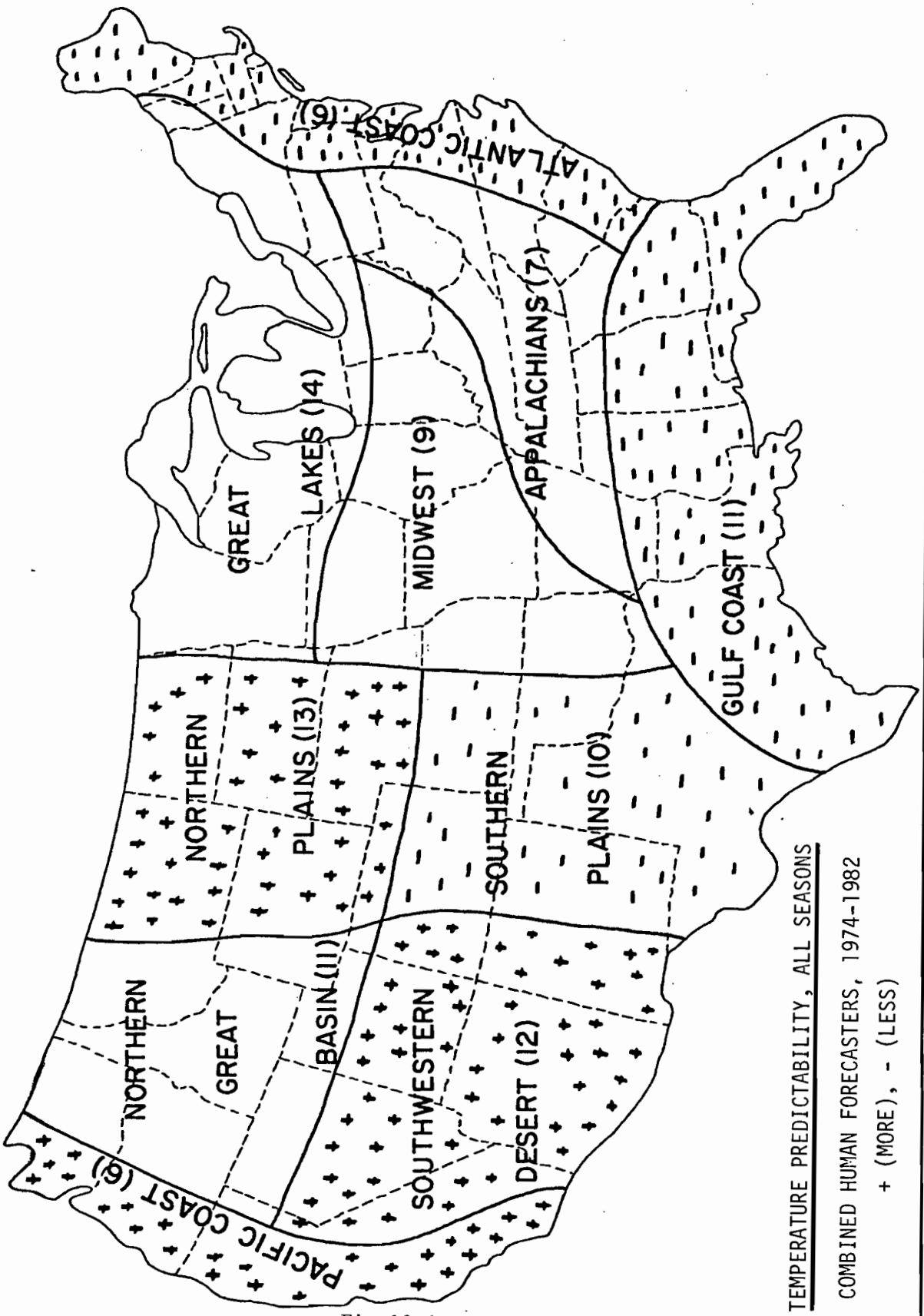
ATLANTIC COAST (6)
APPALACHIANS (7)
GREAT LAKES (14)
MIDWEST (9)
GULF COAST (11)
NORTHERN PLAINS (13)
SOUTHERN PLAINS (10)
NORTHERN GREAT BASIN (11)
SOUTHWESTERN DESERT (12)
PACIFIC COAST (6)
TEMPERATURE PREDICTABILITY, ALL SEASONS
COMBINED HUMAN FORECASTERS, 1974-1982
+ (MORE), - (LESS)

Fig 10.4

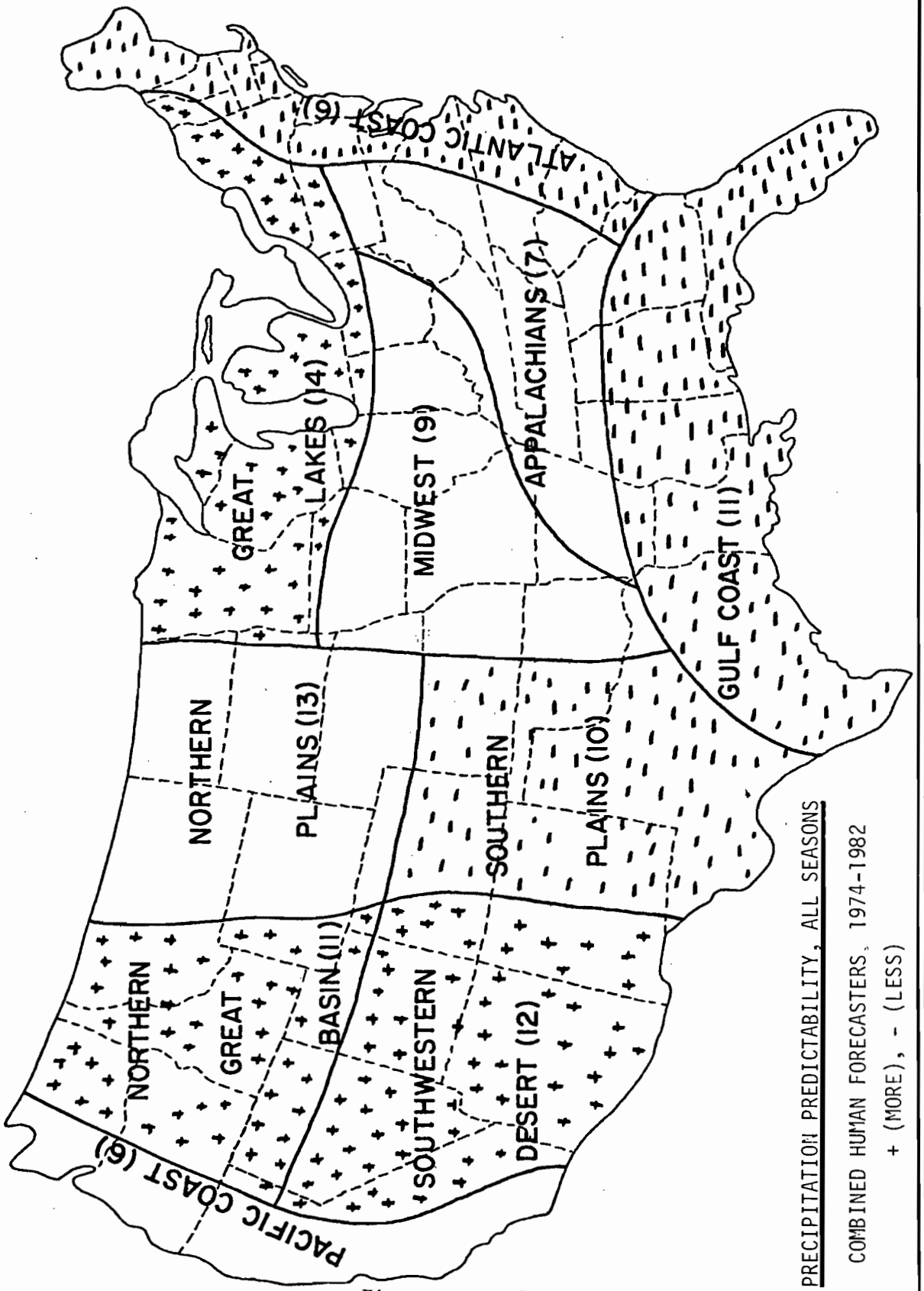
ATLANTIC COAST (6)
APPALACHIANS (7)
GREAT LAKES (14)
MIDWEST (9)
GULF COAST (11)
NORTHERN PLAINS (13)
SOUTHERN PLAINS (10)
NORTHERN GREAT BASIN (11)
SOUTHWESTERN DESERT (12)
PACIFIC COAST (6)
PRECIPITATION PREDICTABILITY, ALL SEASONS
COMBINED HUMAN FORECASTERS, 1974-1982
+ (MORE), - (LESS)

Fig 10.5

11. Forecast Uniformity

Consider the case of a forecaster who does well on the Pacific Coast but not well on the Atlantic Coast. If he consistently performs in this way, then we can with confidence use his forecasts in the Pacific Coast and simply ignore those on the Atlantic Coast. It is of some interest, then, to find an index of the uniformity in space of a forecaster's skill. One such index can be based on the regional scores described in §10. Thus, we would check off those of the 10 regions in which his forecast was significant for a given season. We would keep a record of those significant regions, season after season, to see eventually if a pattern of regional skill developed. This in fact is done in the tables of §16, 17 below. However, it is desirable to have a simpler index of the spatial uniformity of a forecaster's skill, something as compact as the u, v, w scores of his forecasts, if possible.

One simple solution of this problem would be as follows. We divide the 10 climatic regions into two sets: the West and the East sets.* The West set contains, in the context of Fig. 10.1, PAC, NGB, SWD, NPL, SPL. The East set contains the remaining five regions. Now, when a forecaster produces a forecast, we tally the number of regions in the West set and in the East set for which his forecast is significant on the 10% level but not on the 90% level (for details, see §16). That is, his u value for that region must lie in the interval above the 10% u_c and below the 90% u_c. In other words, we look for ordinary or unspectacular regional forecasts: those that are neither very bad nor very good over each of the regions. In this way when a forecaster makes a highly scored forecast over the whole nation, while at the same time that high score is distributed uniformly over the West set and the East set in the above sense, we would say that his forecast had uniformly distributed high skill.

The index of forecast uniformity that goes with the above West, East ordinary-forecast counts is an ordered pair of integers, such as '(3,4)'. This means that the forecast had 3 ordinary u-counts in the West set, and 4 in the East set. If, e.g., a temperature forecast has u = 61, v = 36, w = 2, and a uniformity index of (5,5), we would say that the forecast was of uniformly distributed high skill. On the other hand, a temperature forecast with u = 29, v = 54, w = 16, with a uniformity index of (5,5) would be of uniformly distributed low skill.

The pair of integers (a,b), with $1 \leqq a \leqq 5$, $1 \leqq b \leqq 5$ is the uniformity index (or form). It gives some added information beyond the triple (u, v, w) concerning the quality of a forecast. The uniformity index is listed under 'FORM' on all the main skill score tabulations, below, in Part III, to which we now turn.

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* We could just as well have divided the country into North and South sets.

PART III. THE RECORDS, 1974-82

12. Forecaster Temperature Scores for Each Season

12.1 Table Descriptions

The table of this section lists the u, v, w, and m temperature scores for each forecaster. The scores are grouped in seasons, in the way they naturally evolved over the eight year period 1974-82. Thus, season 1 is 1/74, i.e., winter 1974. (Recall that winter is assigned to the year in which January and February occur). Under each season we have listed three groups of forecasters: the list is headed by the four human forecasters (§2), then come the three benchmark forecasters (§4), and finally the six empirical forecasters (§5). The definitions of u, v, w, and m, along with stars and pluses, are given in §§3, 4. The definition of form is given in §11.

12.2 Recap of Definitions

Recall that: u, v, w are respectively the numbers of 0-, 1-, 2-class errors for a 99-point forecast over the U.S. mainland. Therefore u, v, w must always add up to 99. m (the moment) is a measure of distance between the predicted map and the observed map, and is v + 2w. The smaller m, the better the forecast. The smaller v and w, individually, the better the forecast. The larger u is (since it expresses the number of correct local forecasts) the better the forecast.* The stars, defined in §4, indicate levels of statistical significance. When, in a given season, neither the Persister nor the Climater earn a star, then any other forecaster who earns stars will have a plus assigned to his score. This is a well-earned bonus because any forecaster who makes a significant forecast when the given seasonal pattern was not significantly climatological nor persistent, deserves added recognition for anticipating a relatively unexpected weather pattern.

The form of a forecast (§11) is a simple index of its spatial uniformity. A uniform forecast has the form (5,5). If there is a high-u score and form is (5,5), that is a uniformly good forecast. A low-u score with a form of (5,5) is a uniformly bad forecast. A full 10-dimensional analysis of the form of a forecast is given in the tables of §§16, 17.

12.3 Examples of Analoger Predictions

The season next to each Analoger, in the lists of empirical forecasters below, gives the Analoger's prediction. For example, in season 1,

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* In particular, it will be well to recall (Sec. 6) that the following inequalities define the individual variables' 5% regions of significance: $41 \leqq u$, $v \leqq 36$, $w \leqq 15$, $m \leqq 76$. Thus, e.g., a u score of 41 or above is statistically significant, i.e., only in 5% of his attempts on average will the Stochaster achieve a u in the range $41 \leqq u \leqq 99$. Similarly, only 5% of the Stochaster's attempts on average will yield a v in the range $0 \leqq v \leqq 36$, and so on. The regions defined by these inequalities are indicated in the uv diagrams of §6.

namely 1/74, the Pure Analoger's prediction was the pattern of season 2/75, i.e., the pattern of the spring of 1975. To find this prediction, we started with the given observed temperature map of 4/73 (the fall of 1973), and searched through the entire record of observed temperature maps. (In this study, because of the limited supply of samples, we allowed the search to take place both futureward and pastward of a given observed season.) The analog to the 4/73 observed temperature pattern was found to be the temperature pattern of 1/75. By definition, the Pure Analoger's prediction is then the season 2/75 observed temperature pattern. Also for season 1, by definition, the Persistence Analoger's prediction is the season 1/75 observed temperature pattern. For the Best Analoger, by definition, for season 1, we searched through the entire record for the analog of season 1/74 (not season 4/73) observed temperature record, and found that to be the 2/79 observed temperature map.

12.4 Interpretations

Some general comments on the listed scores will now be made. Namias and the Weather Service begin the sequence of temperature forecasts in 1/74, to be joined later by the Analoger in 3/76, and Douglas in 3/77. From then on the four human forecasters accumulate a sufficient number of common forecasts to permit the analyses of predictability we discussed in Part II.

As the eye runs down the list of stars, one can see those seasons that were more or less predictable for the human forecasters. For example seasons 2/74, 2/79, 3/80, 4/80, just to mention four outstanding examples, were relatively unpredictable as regards temperature. On the other hand, seasons 1/77, 1/78, 1/81, 3/81, were relatively predictable, as regards temperature.

Observe that the empirical forecasters accumulate an impressive galaxy of stars, season after season, particularly the operable (Most) Probable Markover. The Best Analoger, the most impressive of the lot, is (recall §5.3) non-operable, and is included only to show potentialities of predictability in the record.

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	U	V	W	M	STARS	PLUS	FORM
SEASON 1 1/74							
JERRY NAMIAS	42	37	20	77			1.2
WEATHER SERV	28	55	16	87			4.5
PERSISTER	46	42	11	64	*		5.3
CLIMATER	51	48	0	48	*		3.2
STOCHASTER	39	44	16	76	*		4.2
PURE ANALOGER (2/75)	18	58	23	104			4.4
PERS ANALOGER (1/75)	42	53	4	61	*		3.1
BEST ANALOGER (2/79)	55	41	3	47	**		5.5
EMPR MARKOVER	42	46	11	68	*		5.5
PROB MARKOVER	61	32	6	44	***		5.4
HYBRIDER	56	36	7	50	***		2.5
SEASON 2 2/74							
JERRY NAMIAS	27	47	25	97			2.1
WEATHER SERV	38	40	21	82			2.2
PERSISTER	39	53	7	67	*		2.1
CLIMATER	28	71	0	71			3.1
STOCHASTER	27	45	27	99			5.4
PURE ANALOGER (3/79)	26	42	31	104			4.3
PERS ANALOGER (2/79)	26	66	7	80			4.3
BEST ANALOGER (3/80)	61	32	6	44	***		1.3
EMPR MARKOVER	39	33	27	87			5.5
PROB MARKOVER	35	49	15	79			3.4
HYBRIDER	35	59	5	69			3.0
SEASON 3 3/74							
JERRY NAMIAS	30	51	18	87			4.2
WEATHER SERV	62	36	1	38	***	+	4.5
PERSISTER	30	37	32	101			4.2
CLIMATER	29	70	0	70			3.3
STOCHASTER	35	42	22	86			4.5
PURE ANALOGER (4/80)	41	46	12	70	*	+	5.3
PERS ANALOGER (3/80)	30	31	38	107			3.1
BEST ANALOGER (1/81)	52	44	3	50	*	+	3.3
EMPR MARKOVER	49	31	19	69	***	+	4.4
PROB MARKOVER	76	35	8	51	***	+	4.4
HYBRIDER	44	43	22	87			1.3

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 4 4/74							
JERRY NAMIAS	42	45	12	69	*		3.3
WEATHER SERV	19	47	33	113			3.5
PERSISTER	51	42	6	54	*		4.2
CLIMATER	33	66	0	66			4.5
STOCHASTER	38	38	23	84			3.3
PURE ANALOGER (2/81)	22	49	28	105			3.3
PERS ANALOGER (1/81)	37	48	14	76	*		1.4
BEST ANALOGER (4/76)	67	32	0	32	***		4.5
EMPR MARKOVER	40	42	17	76	*		4.4
PROB MARKOVER	41	54	4	62	*		4.4
HYBRIDER	42	55	2	59			3.4
SEASON 5 1/75							
JERRY NAMIAS	46	48	5	58	*	+	4.3
WEATHER SERV	43	41	15	71	**	+	2.2
PERSISTER	22	49	28	105			2.3
CLIMATER	43	57	0	57			4.3
STOCHASTER	09	48	22	92			5.5
PURE ANALOGER (1/77)	21	40	38	116			3.3
PERS ANALOGER (4/76)	15	43	41	125			3.4
BEST ANALOGER (2/76)	61	36	2	40	***	+	5.5
EMPR MARKOVER	29	41	19	79			5.3
PROB MARKOVER	38	50	11	72	*	+	4.5
HYBRIDER	28	59	12	83			4.2
SEASON 6 2/75							
JERRY NAMIAS	70	29	0	29	***	+	4.4
WEATHER SERV	11	64	24	112			5.4
PERSISTER	28	51	20	91			3.3
CLIMATER	29	70	0	70			3.4
STOCHASTER	39	36	24	84			4.3
PURE ANALOGER (3/76)	34	49	16	81			3.4
PERS ANALOGER (2/76)	27	51	21	93			3.2
BEST ANALOGER (1/79)	64	33	2	37	***	+	3.3
EMPR MARKOVER	38	35	26	87			4.5
PROB MARKOVER	40	42	17	76	*	+	4.4
HYBRIDER	34	56	9	74			4.3

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 7 3/75							
JERRY NAMIAS	45	36	18	72	***	+	3.3
WEATHER SERV	45	48	6	60	*	+	3.3
PERSISTER	33	50	16	82			1.3
CLIMATER	41	58	0	58			4.2
STOCHASTER	29	47	23	93			4.4
PURE ANALOGER (2/79)	32	53	14	81			2.4
PERS ANALOGER (1/79)	35	43	21	85			3.3
BEST ANALOGER (3/76)	54	41	4	49	**	+	4.4
EMPR MARKOVER	47	40	12	64	**	+	4.5
PROB MARKOVER	48	48	3	54	*	+	5.3
HYBRIDER	31	63	5	73			3.4
SEASON 8 4/75							
JERRY NAMIAS	45	50	4	58	*		2.2
WEATHER SERV	43	50	6	62	*		4.4
PERSISTER	53	43	3	49	*		3.3
CLIMATER	58	41	0	41	**		4.4
STOCHASTER	31	56	13	82			5.5
PURE ANALOGER (4/76)	22	57	20	97			4.4
PERS ANALOGER (3/76)	32	60	7	74			5.5
BEST ANALOGER (2/76)	59	38	2	42	**		3.4
EMPR MARKOVER	41	48	11	70	*		4.4
PROB MARKOVER	52	45	2	49	*		4.5
HYBRIDER	54	41	4	49	**		4.4
SEASON 9 1/76							
JERRY NAMIAS	23	48	28	104			1.3
WEATHER SERV	33	58	8	74			2.3
PERSISTER	28	55	16	87			3.4
CLIMATER	27	72	0	72			4.3
STOCHASTER	28	40	31	102			5.4
PURE ANALOGER (3/76)	24	43	32	107			4.4
PERS ANALOGER (2/76)	42	49	8	65	*	+	1.5
BEST ANALOGER (2/81)	58	35	6	47	***	+	4.5
EMPR MARKOVER	41	36	22	80			4.4
PROB MARKOVER	45	43	11	65	*	+	3.4
HYBRIDER	27	64	8	80			3.3

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 1[illegible] 2/76							
JERRY NAMIAS	39	53	16	85			3.4
WEATHER SERV	45	50	4	58	*		3.4
PERSISTER	42	49	8	65	*		1.5
CLIMATER	50	49	0	49	*		4.4
STOCHASTER	31	53	15	83			4.4
PURE ANALOGER (3/81)	37	49	13	75	*		3.4
PERS ANALOGER (2/81)	37	50	12	74	*		3.4
BEST ANALOGER (1/75)	61	36	2	40	***		5.5
EMPR MARKOVER	44	40	15	70	**		3.5
PROP MARKOVER	56	35	8	51	***		2.5
HYBRIDER	46	50	3	56	*		3.4
SEASON 11 3/76							
JERRY NAMIAS	43	49	7	63	*		4.2
WEATHER SERV	47	38	14	66	**		2.4
ANALOGER	[illegible]3	53	23	99			5.5
PERSISTER	38	52	9	70	*		4.3
CLIMATER	38	61	0	61			4.4
STOCHASTER	41	40	18	76	**		2.4
PURE ANALOGER (2/75)	34	49	16	81			3.4
PERS ANALOGER (1/75)	33	50	16	82			3.2
BEST ANALOGER (3/75)	54	41	4	49	**		4.4
EMPR MARKOVER	41	39	18	77			5.5
PROP MARKOVER	53	37	9	55	**		3.5
HYBRIDER	39	53	7	67	*		3.4
SEASON 12 4/76							
WEATHER SERV	48	39	12	63	**	+	4.1
PERSISTER	4[illegible]	33	26	85			4.2
CLIMATER	9	9[illegible]	0	99			4.5
STOCHASTER	32	36	31	99			5.3
PURE ANALOGER (4/75)	32	57	2[illegible]	97			4.4
PERS ANALOGER (3/75)	33	42	24	99			3.3
BEST ANALOGER (1/78)	76	16	7	30	***	+	3.2
EMPR MARKOVER	4[illegible]	36	23	82			5.3
PROP MARKOVER	43	44	15	74	*	+	4.5
HYBRIDER	19	66	14	94			4.2

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 13 1/77							
JERRY NAMIAS	58	37	4	45	**		2.1
WEATHER SERV	47	51	1	53	*		4.2
ANALOGER	60	39	0	39	**		3.3
PERSISTER	64	33	2	37	***		1.0
CLIMATER	36	63	0	63			2.0
STOCHASTER	28	48	23	94			4.5
PURE ANALOGER (2/78)	39	51	9	69	*		5.4
PERS ANALOGER (1/78)	62	31	6	43	***		2.1
BEST ANALOGER (4/74)	66	31	2	35	***		4.5
EMPR MARKOVER	45	36	18	72	***		3.4
PROB MARKOVER	45	46	8	62	*		4.4
HYBRIDER	37	60	2	64			4.0
SEASON 14 2/77							
JERRY NAMIAS	37	37	25	87			1.1
WEATHER SERV	32	58	9	76			2.2
ANALOGER	69	23	7	37	***	+	4.2
PERSISTER	15	35	49	133			4.4
CLIMATER	15	84	0	84			4.4
STOCHASTER	34	39	26	91			3.5
PURE ANALOGER (1/75)	55	35	9	53	***	+	3.3
PERS ANALOGER (4/74)	14	40	45	130			3.4
BEST ANALOGER (2/76)	53	41	5	51	**	+	3.5
EMPR MARKOVER	41	34	24	82			5.5
PROB MARKOVER	31	48	20	88			2.3
HYBRIDER	13	67	19	105			4.5
SEASON 15 3/77							
JERRY NAMIAS	37	41	31	103			4.5
WEATHER SERV	14	42	43	128			5.3
ANALOGER	48	27	24	75	***	+	1.3
ART DOUGLAS	35	60	4	68			5.5
PERSISTER	31	44	24	92			2.2
CLIMATER	31	68	0	68			2.2
STOCHASTER	31	45	23	91			5.5
PURE ANALOGER (3/76)	18	41	40	121			2.2
PERS ANALOGER (2/76)	32	57	20	97			4.4
BEST ANALOGER (4/77)	55	38	6	50	**	+	3.5
EMPR MARKOVER	47	36	16	68	***	+	4.5
PROB MARKOVER	46	44	9	62	*	+	5.5
HYBRIDER	35	47	17	81			2.2

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 16 4/77							
WEATHER SERV	56	42	1	44	*		4.3
ANALOGER	30	49	20	89			3.4
ART DOUGLAS	33	46	20	86			3.4
PERSISTER	55	38	6	50	**		3.5
CLIMATER	43	56	0	56			4.4
STOCHASTER	19	57	27	103			4.4
PURE ANALOGER (1/78)	34	40	25	90			3.2
PERS ANALOGER (4/77)	99	0	0	0	***		5.5
BEST ANALOGER (3/78)	53	44	2	48	*		4.4
EMPR MARKOVER	41	42	16	74	*		4.4
PROP MARKOVER	58	37	4	45	**		4.5
HYBRIDER	66	31	2	35	***		1.3
SEASON 17 1/78							
JERRY NAMIAS	16	32	51	134			4.4
WEATHER SERV	50	31	18	67	***	+	1.2
ANALOGER	71	25	3	31	***	+	2.2
ART DOUGLAS	80	19	0	19	***	+	2.4
PERSISTER	34	40	25	90			3.2
CLIMATER	9	90	1	92			4.4
STOCHASTER	28	32	39	110			4.4
PURE ANALOGER (4/78)	23	42	34	110			2.3
PERS ANALOGER (3/76)	33	42	24	99			2.2
BEST ANALOGER (1/82)	73	24	2	28	***	+	3.4
EMPR MARKOVER	37	32	30	92			3.5
PROP MARKOVER	42	41	16	73	**	+	3.4
HYBRIDER	31	59	9	77			2.1
SEASON 18 2/78							
JERRY NAMIAS	54	44	31	106			4.5
WEATHER SERV	36	45	18	81			3.5
ANALOGER	74	50	15	80			2.2
ART DOUGLAS	45	47	7	61	*		2.4
PERSISTER	48	34	17	68	***		1.5
CLIMATER	15	64	0	64			4.4
STOCHASTER	30	49	20	89			4.5
PURE ANALOGER (4/73)	19	50	30	110			4.5
PERS ANALOGER (1/82)	43	42	14	70	*		3.5
BEST ANALOGER (1/81)	61	36	2	40	***		4.3
EMPR MARKOVER	41	38	20	78			5.5
PROP MARKOVER	61	28	11	50	***		3.5
HYBRIDER	41	48	10	68	*		3.5

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 19 3/78							
JERRY NAMIAS	30	47	22	91			3.4
WEATHER SERV	33	41	25	91			3.4
ANALOGER	29	54	16	86			3.3
ART DOUGLAS	45	46	8	62	*	+	3.4
PERSISTER	38	42	19	80			5.4
CLIMATER	43	56	0	56			5.5
STOCHASTER	35	44	20	84			5.3
PURE ANALOGER (2/81)	31	53	15	83			2.5
PERS ANALOGER (1/81)	32	44	23	90			2.4
BEST ANALOGER (4/78)	65	30	4	38	***	+	4.3
EMPR MARKOVER	45	37	17	71	**	+	5.5
PROB MARKOVER	48	40	11	62	**	+	4.4
HYBRIDER	42	44	13	70	*	+	3.5
SEASON 20 4/78							
JERRY NAMIAS	46	49	4	57	*		4.4
WEATHER SERV	25	39	35	109			4.2
ANALOGER	43	43	13	69	*		3.4
ART DOUGLAS	44	50	5	60	*		3.3
PERSISTER	65	30	4	38	***		4.3
CLIMATER	37	62	0	62			5.3
STOCHASTER	29	54	16	86			5.5
PURE ANALOGER (1/79)	25	43	31	105			2.3
PERS ANALOGER (4/78)	99	0	0	0	***		5.5
BEST ANALOGER (3/78)	65	30	4	38	***		4.3
EMPR MARKOVER	45	33	21	75	***		5.4
PROB MARKOVER	50	37	12	61	**		3.4
HYBRIDER	61	37	1	39	**		2.4
SEASON 21 1/79							
JERRY NAMIAS	48	35	16	67	***	+	0.2
WEATHER SERV	37	40	22	84			1.0
ANALOGER	34	42	23	88			1.1
ART DOUGLAS	57	37	5	47	**	+	1.1
PERSISTER	25	43	31	105			2.3
CLIMATER	6	93	0	93			5.5
STOCHASTER	35	30	34	98			5.5
PURE ANALOGER (4/78)	25	43	31	105			2.3
PERS ANALOGER (3/78)	18	49	32	113			2.3
BEST ANALOGER (2/75)	64	33	2	37	***	+	3.3
EMPR MARKOVER	35	34	30	94			4.3
PROB MARKOVER	19	60	20	100			5.5
HYBRIDER	16	65	18	101			3.3

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 22 2/79							
JERRY NAMIAS	34	41	24	89			1.3
WEATHER SERV	30	62	7	76			4.3
ANALOGER	47	26	26	78			4.3
ART DOUGLAS	35	47	17	81			2.5
PERSISTER	18	54	27	108			3.4
CLIMATER	56	43	0	43	*		4.2
STOCHASTER	33	50	16	82			5.5
PURE ANALOGER (3/75)	32	53	14	81			2.4
PERS ANALOGER (2/75)	33	47	19	85			2.5
BEST ANALOGER (1/74)	55	41	3	47	**		5.5
EMPR MARKOVER	30	56	13	82			5.4
PROP MARKOVER	55	39	5	49	**		4.4
HYBRIDER	38	41	20	81			1.2
SEASON 23 3/79							
JERRY NAMIAS	53	44	2	48	*		1.3
WEATHER SERV	47	39	13	65	**		2.4
ANALOGER	28	53	18	89			4.3
ART DOUGLAS	45	51	3	57	*		2.5
PERSISTER	47	48	4	56	*		4.1
CLIMATER	43	57	0	57			4.2
STOCHASTER	28	54	17	88			4.3
PURE ANALOGER (2/74)	26	42	31	104			4.3
PERS ANALOGER (1/74)	50	37	12	61	**		3.3
BEST ANALOGER (4/74)	56	39	4	47	**		4.3
EMPR MARKOVER	46	44	9	62	*		5.5
PROP MARKOVER	66	31	2	35	***		5.5
HYBRIDER	51	45	3	51	*		4.1
SEASON 24 4/79							
JERRY NAMIAS	45	41	13	67	**		3.3
WEATHER SERV	49	42	8	58	*		4.2
ANALOGER	29	49	21	91			3.4
ART DOUGLAS	50	42	7	56	*		4.4
PERSISTER	53	42	4	50	*		5.3
CLIMATER	44	55	0	55			3.5
STOCHASTER	33	46	20	86			4.2
PURE ANALOGER (1/75)	25	56	18	92			4.4
PERS ANALOGER (4/74)	45	45	9	63	*		5.4
BEST ANALOGER (3/79)	53	42	4	50	*		5.3
EMPR MARKOVER	46	43	10	63	*		4.4
PROP MARKOVER	61	37	2	41	**		5.5
HYBRIDER	48	49	2	53	*		5.4

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 25 1/80							
JERRY NAMIAS	18	52	29	110			3.5
WEATHER SERV	25	68	6	80			5.4
ANALOGER	41	40	18	76	**		3.2
ART DOUGLAS	33	62	4	70			3.2
PERSISTER	56	35	8	51	***		5.4
CLIMATER	47	52	0	52	*		4.3
STOCHASTER	30	54	15	84			5.5
PURE ANALOGER (4/79)	56	35	8	51	***		5.4
PERS ANALOGER (3/79)	34	57	8	73			4.4
BEST ANALOGER (2/81)	64	33	2	37	***		3.3
EMPR MARKOVER	38	48	13	74	*		4.5
PROB MARKOVER	57	37	5	47	**		2.4
HYBRIDER	59	36	4	44	***		5.3
SEASON 26 2/80							
JERRY NAMIAS	37	41	21	83			3.1
WEATHER SERV	41	40	18	76	**		2.3
ANALOGER	41	37	21	79			3.4
ART DOUGLAS	50	45	4	53	*		3.4
PERSISTER	47	41	11	63	**		3.4
CLIMATER	30	69	0	69			4.2
STOCHASTER	37	36	26	88			5.5
PURE ANALOGER (3/81)	28	51	20	91			3.4
PERS ANALOGER (2/81)	43	36	20	76	***		1.3
BEST ANALOGER (3/76)	48	46	5	56	*		4.4
EMPR MARKOVER	29	48	22	92			3.4
PROB MARKOVER	53	35	11	57	***		3.5
HYPRIDER	39	51	9	69	*		2.4
SEASON 27 3/80							
JERRY NAMIAS	24	46	29	104			2.3
WEATHER SERV	21	50	28	106			3.5
ANALOGER	47	39	13	65	**	+	3.3
ART DOUGLAS	15	50	34	118			3.5
PERSISTER	32	42	35	112			4.2
CLIMATER	21	79	0	79			3.3
STOCHASTER	31	42	26	94			4.5
PURE ANALOGER (4/76)	7	25	67	159			4.5
PERS ANALOGER (3/76)	23	42	34	110			2.3
BEST ANALOGER (2/74)	61	32	6	44	***	+	1.3
EMPR MARKOVER	35	42	22	86			4.5
PROB MARKOVER	23	59	17	93			3.3
HYBRIDER	31	55	13	81			2.2

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 28 4/80							
JERRY NAMIAS	14	42	43	128			5.5
WEATHER SERV	22	56	21	98			4.5
ANALOGER	25	47	27	101			4.3
ART DOUGLAS	29	53	17	87			3.4
PERSISTER	36	45	28	101			2.4
CLIMATER	33	66	0	66			5.4
STOCHASTER	30	43	26	95			5.5
PURE ANALOGER (3/74)	41	46	12	70	*	+	5.3
PERS ANALOGER (2/74)	30	49	20	89			4.4
BEST ANALOGER (4/81)	64	29	6	41	***	+	2.5
EMPR MARKOVER	48	36	15	66	***	+	4.4
PROB MARKOVER	63	29	7	43	***	+	4.4
HYBRIDER	43	45	11	67	*	+	5.4
SEASON 29 1/81							
JERRY NAMIAS	50	34	15	64	***		2.3
WEATHER SERV	52	39	8	55	**		2.3
ANALOGER	53	43	3	49	*		3.4
ART DOUGLAS	53	35	11	57	***		2.5
PERSISTER	54	36	9	54	***		4.4
CLIMATER	21	78	0	78			2.2
STOCHASTER	41	33	25	83			5.4
PURE ANALOGER (1/80)	39	34	26	86			3.3
PERS ANALOGER (4/81)	62	35	2	39	***		4.4
BEST ANALOGER (2/81)	65	29	5	39	***		3.2
EMPR MARKOVER	45	38	16	70	**		3.5
PROB MARKOVER	59	26	14	54	***		3.5
HYBRIDER	54	41	4	49	**		3.4
SEASON 30 2/81							
JERRY NAMIAS	34	33	32	97			1.3
WEATHER SERV	29	35	25	85			2.4
ANALOGER	50	41	8	57	**		2.1
ART DOUGLAS	48	33	18	69	***		2.3
PERSISTER	65	29	5	39	***		3.2
CLIMATER	23	77	0	77			3.4
STOCHASTER	29	41	29	99			5.4
PURE ANALOGER (3/81)	57	37	5	47	**		3.4
PERS ANALOGER (2/81)	99	0	0	0	***		5.5
BEST ANALOGER (1/80)	64	33	2	37	***		3.3
EMPR MARKOVER	52	30	17	64	***		4.5
PROB MARKOVER	67	26	6	38	***		4.2
HYBRIDER	63	34	2	38	***		0.2

TEMPERATURE	U	V	W	M	STARS	PLUS	FORM
SEASON 31 3/81							
JERRY NAMIAS	47	46	6	58	*		3.2
WEATHER SERV	58	36	5	46	***		3.4
ANALOGER	47	45	7	59	*		3.3
ART DOUGLAS	63	32	4	40	***		4.4
PERSISTER	57	37	5	47	**		3.4
CLIMATER	43	56	0	56			4.3
STOCHASTER	73	51	15	81			5.5
PURE ANALOGER (2/80)	28	51	20	91			3.4
PERS ANALOGER (1/80)	54	40	5	50	**		2.5
BEST ANALOGER (2/81)	57	37	5	47	**		3.4
EMPR MARKOVER	39	48	12	72	*		3.5
PROB MARKOVER	65	26	8	42	***		3.4
HYBRIDER	62	33	4	41	***		2.4
SEASON 32 4/81							
JERRY NAMIAS	32	46	21	88			3.4
WEATHER SERV	29	32	38	108			1.5
ANALOGER	40	48	11	70	*		4.3
ART DOUGLAS	40	46	13	72	*		3.3
PERSISTER	41	47	11	69	*		4.4
CLIMATER	28	71	0	71			4.3
STOCHASTER	32	42	25	92			3.4
PURE ANALOGER (3/81)	41	47	11	69	*		4.4
PERS ANALOGER (2/81)	57	32	10	52	***		3.3
BEST ANALOGER (1/81)	62	35	2	39	***		4.4
EMPR MARKOVER	45	38	16	70	**		4.5
PROB MARKOVER	51	43	5	53	*		3.4
HYBRIDER	47	46	6	58	*		3.2
SEASON 33 1/82							
JERRY NAMIAS	26	51	22	95			3.4
WEATHER SERV	52	36	11	58	***	+	2.3
ANALOGER	51	38	10	58	**	+	2.4
ART DOUGLAS	53	40	6	52	**	+	2.4
PERSISTER	40	37	22	81			3.3
CLIMATER	25	74	0	74			2.4
STOCHASTER	37	34	28	90			4.3
PURE ANALOGER (2/81)	26	35	38	111			3.3
PERS ANALOGER (1/81)	39	34	26	86			3.3
BEST ANALOGER (1/78)	73	24	2	28	***	+	3.4
EMPR MARKOVER	37	36	26	88			3.3
PROB MARKOVER	47	31	21	73	***	+	2.5
HYBRIDER	34	51	14	79			2.2

13. Seasonal Temperature Scores for Each Forecaster

In this section one can examine the forecast-skill history of each forecaster. Thus Namias' scores, e.g., are listed in the first table, and so on down the line of forecasters.

There does not seem to be any systematic increase or decrease of skill with time for any of the forecasters, human or otherwise. This matter could be investigated using rank-order statistics on the number of stars as a function of time, or any of several other schemes.

Individual patterns of the human forecasters are only beginning to emerge. On the other hand, some patterns of the benchmark and empirical forecasters seem to have formed. If we may be permitted some everyday informal characterizations, we would view: the Persister as a fairly skillful lazy genius; the Climater as a mediocre drudge; the Stochaster as the village idiot. Then there is also the occasionally brilliant and partially elusive family of non-human Analogers; the surprisingly skillful brothers Markover; and the somewhat disappointing Hybrider (the Frankenstein's monster, sewn together with the parts of his fellow empirical forecasters, but, alas, who doesn't have the expected strength of 10 'men'). The precise characterizations are embodied in the records of the tables, below, and the reader is free to form his own impressions of the relative skills of the various forecasters. As he can see, the relative skills really transcend mere verbal and numerical summary in a few simplistic indices.

FORECASTER: JERRY NAMIAS

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON	U	V	W	M	STARS	PLUS	FORM
1	1/74	42	37	20	77			1.2
2	2/74	27	47	25	97			2.1
3	3/74	30	51	18	87			4.2
4	4/74	42	45	12	69	*		3.3
5	1/75	46	48	5	58	*	+	4.3
6	2/75	70	29	0	29	***	+	4.4
7	3/75	45	36	18	72	***	+	3.3
8	4/75	45	50	4	58	*		2.2
9	1/76	23	48	28	104			1.3
10	2/76	30	53	16	85			3.4
11	3/76	43	49	7	63	*		4.2
13	1/77	58	37	4	45	**		2.1
14	2/77	37	37	25	87			1.1
15	3/77	27	41	31	103			4.5
17	1/78	16	32	51	134			4.4
18	2/78	24	44	31	106			4.5
19	3/78	30	47	22	91			3.4
20	4/78	46	49	4	57	*		4.4
21	1/79	48	35	16	67	***	+	0.2
22	2/79	34	41	24	89			1.3
23	3/79	53	44	2	48	*		1.3
24	4/79	45	41	13	67	**		3.3
25	1/80	18	52	29	110			3.5
26	2/80	37	41	21	83			3.1
27	3/80	24	46	29	104			2.3
28	4/80	14	42	43	128			5.5
29	1/81	50	34	15	64	***		2.3
30	2/81	34	33	32	97			1.3
31	3/81	47	46	6	58	*		3.2
32	4/81	32	46	21	88			3.4
33	1/82	26	51	22	95			3.4

THERE WERE 31 FORECASTS MADE

AVERAGE	36.9	43.0	19.2	81.3	.74	.13	2.7,3.0
STD DEV	12.8	6.5	12.1	24.2	1.06	.34	1.2,1.2

FORECASTER: WEATHER SERV

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON	U	V	W	M	STARS	PLUS	FORM
1	1/74	28	55	16	87			4.5
2	2/74	38	40	21	82			2.2
3	3/74	62	36	1	38	***	+	4.5
4	4/74	19	47	33	113			3.5
5	1/75	43	41	15	71	**	+	2.2
6	2/75	11	64	24	112			5.4
7	3/75	45	48	6	60	*	+	3.3
8	4/75	43	50	6	62	*		4.4
9	1/76	33	58	8	74			2.3
10	2/76	45	50	4	58	*		3.4
11	3/76	47	38	14	66	**		2.4
12	4/76	48	39	12	63	**	+	4.1
13	1/77	47	51	1	53	*		4.2
14	2/77	32	58	9	76			2.2
15	3/77	14	42	43	128			5.3
16	4/77	56	42	1	44	*		4.3
17	1/78	50	31	18	67	***	+	1.2
18	2/78	36	45	18	81			3.5
19	3/78	33	41	25	91			3.4
20	4/78	25	39	35	109			4.2
21	1/79	37	40	22	84			1.0
22	2/79	30	62	7	76			4.3
23	3/79	47	39	13	65	**		2.4
24	4/79	49	42	8	58	*		4.2
25	1/80	25	68	6	80			5.4
26	2/80	41	40	18	76	**		2.3
27	3/80	21	50	28	106			3.5
28	4/80	22	56	21	98			4.5
29	1/81	52	39	8	55	**		2.3
30	2/81	39	35	25	85			2.4
31	3/81	58	36	5	46	***		3.4
32	4/81	29	32	38	108			1.5
33	1/82	52	36	11	58	***	+	2.3
THERE WERE 33 FORECASTS MADE								
AVERAGE		38.1	45.2	15.8	76.7	.91	.18	3.0,3.3
STD DEV		12.9	9.5	11.1	22.1	1.10	.39	1.2,1.3

FORECASTER: ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
11 3/76	23	53	23	99			5.5
13 1/77	60	39	0	39	**		3.3
14 2/77	69	23	7	37	***	+	4.2
15 3/77	48	27	24	75	***	+	1.3
16 4/77	30	49	20	89			3.4
17 1/78	71	25	3	31	***	+	2.2
18 2/78	34	50	15	80			2.2
19 3/78	29	54	16	86			3.3
20 4/78	43	43	13	69	*		3.4
21 1/79	34	42	23	88			1.1
22 2/79	47	26	26	78			4.3
23 3/79	28	53	18	89			4.3
24 4/79	29	49	21	91			3.4
25 1/80	41	40	18	76	**		3.2
26 2/80	41	37	21	79			3.4
27 3/80	47	39	13	65	**	+	3.3
28 4/80	25	47	27	101			4.3
29 1/81	53	43	3	49	*		3.4
30 2/81	50	41	8	57	**		2.1
31 3/81	47	45	7	59	*		3.3
32 4/81	40	48	11	70	*		4.3
33 1/82	51	38	10	58	**	+	2.4
THERE WERE 22 FORECASTS MADE							
AVERAGE	42.7	41.4	14.9	71.1	1.05	.23	3.0,3.0
STD DEV	13.3	9.3	8.0	19.9	1.13	.43	1.0,1.0

FORECASTER: ART DOUGLAS

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
15 3/77	35	60	4	68			5.5
16 4/77	33	46	20	86			3.4
17 1/78	80	19	0	19	***	+	2.4
18 2/78	45	47	7	61	*		2.4
19 3/78	45	46	8	62	*	+	3.4
20 4/78	44	50	5	60	*		3.3
21 1/79	57	37	5	47	**	+	1.1
22 2/79	35	47	17	81			2.5
23 3/79	45	51	3	57	*		2.5
24 4/79	50	42	7	56	*		4.4
25 1/80	33	62	4	70			3.2
26 2/80	50	45	4	53	*		3.4
27 3/80	15	50	34	118			3.5
28 4/80	29	53	17	87			3.4
29 1/81	53	35	11	57	***		2.5
30 2/81	48	33	18	69	***		2.3
31 3/81	63	32	4	40	***		4.4
32 4/81	40	46	13	72	*		3.3
33 1/82	53	40	6	52	**	+	2.4
THERE WERE 19 FORECASTS MADE							
AVERAGE	44.9	44.3	9.8	63.9	1.21	.21	2.7,3.8
STD DEV	14.0	10.1	8.3	20.7	1.13	.42	.9,1.1

FORECASTER: PERSISTER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS FORM
1 1/74	46	42	11	64	*	5.3
2 2/74	39	53	7	67	*	2.1
3 3/74	30	37	32	101		4.2
4 4/74	51	42	6	54	*	4.2
5 1/75	22	49	28	105		2.3
6 2/75	28	51	20	91		3.3
7 3/75	33	50	16	82		1.3
8 4/75	53	43	3	49	*	3.3
9 1/76	28	55	16	87		3.4
10 2/76	42	49	8	65	*	1.5
11 3/76	38	52	9	70	*	4.3
12 4/76	40	33	26	85		4.2
13 1/77	64	33	2	37	***	1.0
14 2/77	15	35	49	133		4.4
15 3/77	31	44	24	92		2.2
16 4/77	55	38	6	50	**	3.5
17 1/78	34	40	25	90		3.2
18 2/78	48	34	17	68	***	1.5
19 3/78	38	42	19	80		5.4
20 4/78	65	30	4	38	***	4.3
21 1/79	25	43	31	105		2.3
22 2/79	18	54	27	108		3.4
23 3/79	47	48	4	56	*	4.1
24 4/79	53	42	4	50	*	5.3
25 1/80	56	35	8	51	***	5.4
26 2/80	47	41	11	63	**	3.4
27 3/80	22	42	35	112		4.2
28 4/80	26	45	28	101		2.4
29 1/81	54	36	9	54	***	4.4
30 2/81	65	29	5	39	***	3.2
31 3/81	57	37	5	47	**	3.4
32 4/81	41	47	11	69	*	4.4
33 1/82	40	37	22	81		3.3
THERE WERE 33 FORECASTS MADE						
AVERAGE	40.9	42.1	16.9	74.1	1.00	0.00 3.2,3.1
STD DEV	13.9	7.1	11.5	24.5	1.15	0.00 1.2,1.2

FORECASTER: CLIMATER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS FORM
1 1/74	51	48	0	48	*	3.2
2 2/74	28	71	0	71		3.1
3 3/74	29	70	0	70		3.2
4 4/74	33	66	0	66		4.5
5 1/75	42	57	0	57		4.3
6 2/75	29	70	0	70		3.4
7 3/75	41	58	0	58		4.2
8 4/75	58	41	0	41	**	4.4
9 1/76	27	72	0	72		4.3
10 2/76	50	49	0	49	*	4.4
11 3/76	38	61	0	61		4.4
12 4/76	9	90	0	90		4.5
13 1/77	36	63	0	63		2.0
14 2/77	15	84	0	84		4.4
15 3/77	31	68	0	68		2.2
16 4/77	43	56	0	56		4.4
17 1/78	9	90	0	90		4.4
18 2/78	35	64	0	64		4.4
19 3/78	43	56	0	56		5.5
20 4/78	37	62	0	62		5.3
21 1/79	6	93	0	93		5.5
22 2/79	56	43	0	43	*	4.2
23 3/79	42	57	0	57		4.2
24 4/79	44	55	0	55		3.5
25 1/80	47	52	0	52	*	4.3
26 2/80	30	69	0	69		4.2
27 3/80	20	79	0	79		3.3
28 4/80	33	66	0	66		5.4
29 1/81	21	78	0	78		2.2
30 2/81	22	77	0	77		3.4
31 3/81	43	56	0	56		4.3
32 4/81	28	71	0	71		4.3
33 1/82	25	74	0	74		2.4
THERE WERE 33 FORECASTS MADE						
AVERAGE	33.4	65.6	0.0	65.6	.18	0.00 3.7.3.3
STD DEV	13.1	13.1	0.0	13.1	.46	0.00 .9.1.2

FORECASTER: STOCHASTER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS FORM
1 1/74	39	44	16	76	*	4.2
2 2/74	27	45	27	99		5.4
3 3/74	35	42	22	86		4.5
4 4/74	38	38	23	84		3.3
5 1/75	29	48	22	92		5.5
6 2/75	39	36	24	84		4.3
7 3/75	29	47	23	93		4.4
8 4/75	30	56	13	82		5.5
9 1/76	28	40	31	102		5.4
10 2/76	31	53	15	83		4.4
11 3/76	41	40	18	76	**	2.4
12 4/76	32	36	31	98		5.7
13 1/77	28	48	23	94		4.5
14 2/77	34	39	26	91		3.5
15 3/77	31	45	23	91		5.5
16 4/77	19	57	23	103		4.4
17 1/78	28	32	39	110		4.4
18 2/78	30	49	20	89		4.5
19 3/78	35	44	20	84		5.3
20 4/78	29	54	16	86		5.5
21 1/79	35	30	34	98		5.5
22 2/79	33	50	16	82		5.5
23 3/79	28	54	17	88		4.3
24 4/79	33	46	21	86		4.2
25 1/80	30	54	15	84		5.5
26 2/80	37	36	24	88		5.5
27 3/80	31	42	26	94		4.5
28 4/80	30	43	26	95		5.5
29 1/81	41	33	25	83		5.4
30 2/81	29	41	29	99		5.4
31 3/81	33	51	15	81		5.5
32 4/81	32	42	25	92		3.4
33 1/82	37	34	28	90		4.3
THERE WERE 33 FORECASTS MADE						
AVERAGE	32.2	43.9	22.9	89.9	.09 0.00	4.3,4.2
STD DEV	4.7	7.3	6.0	7.9	.38 0.00	.8, .9

FORECASTER: PURE ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
1	1/74	(2/75)	18	58	23	104			4.4
2	2/74	(3/79)	26	42	31	104			4.3
3	3/74	(4/80)	41	46	12	70	*	+	5.3
4	4/74	(2/81)	22	49	28	105			3.3
5	1/75	(1/77)	21	40	38	116			3.3
6	2/75	(3/76)	34	49	16	81			3.4
7	3/75	(2/79)	32	53	14	81			2.4
8	4/75	(4/76)	22	57	20	97			4.4
9	1/76	(3/76)	24	43	32	107			4.4
10	2/76	(3/81)	37	49	13	75	*		3.4
11	3/76	(2/75)	34	49	16	81			3.4
12	4/76	(4/75)	22	57	20	97			4.4
13	1/77	(2/78)	39	51	9	69	*		5.4
14	2/77	(1/75)	55	35	8	53	***	+	3.3
15	3/77	(3/76)	18	41	40	121			2.2
16	4/77	(1/78)	34	40	25	90			3.2
17	1/78	(4/79)	23	42	34	110			2.3
18	2/78	(4/73)	19	50	31	110			4.5
19	3/78	(2/81)	31	53	15	83			2.5
20	4/78	(1/79)	25	43	31	105			2.3
21	1/79	(4/78)	25	43	31	105			2.3
22	2/79	(3/75)	32	53	14	81			2.4
23	3/79	(2/74)	26	42	31	104			4.3
24	4/79	(1/75)	25	56	18	99			4.4
25	1/80	(4/79)	56	35	8	51	***		5.4
26	2/80	(3/81)	28	51	20	91			3.4
27	3/80	(4/76)	7	25	67	159			4.5
28	4/80	(3/74)	41	46	12	70	*	+	5.3
29	1/81	(1/82)	39	34	26	86			3.3
30	2/81	(3/81)	57	37	5	47	**		3.4
31	3/81	(2/80)	28	51	20	91			3.4
32	4/81	(3/81)	41	47	11	69	*		4.4
33	1/82	(2/81)	26	35	38	111			3.3

THERE WERE 33 FORECASTS MADE

AVERAGE	30.5	45.5	22.9	91.4	.39	.09	3.3	3.4
STD DEV	11.3	7.8	12.5	22.5	.83	.29	1.0	.7

FORECASTER: PERS ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
1	1/74	(1/75)	42	53	4	61	*		3.1
2	2/74	(2/79)	26	66	7	80			4.3
3	3/74	(3/80)	30	31	38	107			3.1
4	4/74	(1/81)	37	48	14	76	*		1.4
5	1/75	(4/76)	15	43	41	125			3.4
6	2/75	(2/76)	27	51	21	93			3.2
7	3/75	(1/79)	35	43	21	85			3.3
8	4/75	(3/76)	32	60	7	74			5.5
9	1/76	(2/76)	42	49	8	65	*	+	1.5
10	2/76	(2/81)	37	50	12	74	*		3.4
11	3/76	(1/75)	33	50	16	82			3.2
12	4/76	(3/75)	33	42	24	90			3.3
13	1/77	(1/78)	62	31	6	43	***		2.1
14	2/77	(4/74)	14	40	45	130			3.4
15	3/77	(2/76)	22	57	20	97			4.4
16	4/77	(4/77)	99	0	0	0	***		5.5
17	1/78	(3/78)	33	42	24	90			2.2
18	2/78	(1/82)	43	42	14	70	*		3.5
19	3/78	(1/81)	32	44	23	90			2.4
20	4/78	(4/78)	99	0	0	0	***		5.5
21	1/79	(3/78)	18	49	32	113			2.3
22	2/79	(2/75)	33	47	19	85			2.5
23	3/79	(1/74)	50	37	12	61	**		3.3
24	4/79	(4/74)	45	45	9	63	*		5.4
25	1/80	(3/79)	34	57	8	73			4.4
26	2/80	(2/81)	43	36	20	76	***		1.3
27	3/80	(3/76)	23	42	34	110			2.3
28	4/80	(2/74)	30	49	20	89			4.4
29	1/81	(4/81)	62	35	2	39	***		4.4
30	2/81	(2/81)	99	0	0	0	***		5.5
31	3/81	(1/80)	54	40	5	50	**		2.5
32	4/81	(2/81)	57	32	10	52	***		3.3
33	1/82	(1/81)	39	34	26	86			3.3

THERE WERE 33 FORECASTS MADE

AVERAGE	41.8	40.8	16.4	73.6	.94	.03	3.1	3.5
STD DEV	21.9	15.5	12.1	31.7	1.22	.17	1.2	1.2

FORECASTER: BEST ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
1	1/74	(2/79)	55	41	3	47	**		5.5
2	2/74	(3/80)	61	32	6	44	***		1.3
3	3/74	(1/81)	52	44	3	50	*	+	3.3
4	4/74	(4/76)	67	32	0	32	***		4.5
5	1/75	(2/76)	61	36	2	40	***	+	5.5
6	2/75	(1/79)	64	33	2	37	***	+	3.3
7	3/75	(3/76)	54	41	4	49	**	+	4.4
8	4/75	(2/76)	59	38	2	42	**		3.4
9	1/76	(2/81)	58	35	6	47	***	+	4.5
10	2/76	(1/75)	61	36	2	40	***		5.5
11	3/76	(3/75)	54	41	4	49	**		4.4
12	4/76	(1/78)	76	16	7	30	***	+	3.2
13	1/77	(4/74)	66	31	2	35	***		4.5
14	2/77	(2/76)	53	41	5	51	**	+	3.5
15	3/77	(4/77)	55	38	6	50	**	+	3.5
16	4/77	(3/78)	53	44	2	48	*		4.4
17	1/78	(1/82)	73	24	2	28	***	+	3.4
18	2/78	(1/81)	61	36	2	40	***		4.3
19	3/78	(4/78)	65	30	4	38	***	+	4.3
20	4/78	(3/78)	65	30	4	38	***		4.3
21	1/79	(2/75)	64	33	2	37	***	+	3.3
22	2/79	(1/74)	55	41	3	47	**		5.5
23	3/79	(4/74)	56	39	4	47	**		4.3
24	4/79	(3/79)	53	42	4	50	*		5.3
25	1/80	(2/81)	64	33	2	37	***		3.3
26	2/80	(3/76)	48	46	5	56	*		4.4
27	3/80	(2/74)	61	32	6	44	***	+	1.3
28	4/80	(4/81)	64	29	6	41	***	+	2.5
29	1/81	(2/81)	65	29	5	39	***		3.3
30	2/81	(1/80)	64	33	2	37	***		3.3
31	3/81	(2/81)	57	37	5	47	**		3.4
32	4/81	(1/81)	62	35	2	39	***		4.4
33	1/82	(1/78)	73	24	2	28	***	+	3.4

THERE WERE 33 FORECASTS MADE

AVERAGE	60.6	34.9	3.5	41.9	2.48	.42	3.5,3.9
STD DEV	6.5	6.5	1.7	7.0	.71	.50	1.0,1.0

FORECASTER: EMPR MARKOVER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
1 1/74	42	46	11	68	*		5.5
2 2/74	39	33	27	87			5.5
3 3/74	49	31	19	69	***	+	4.4
4 4/74	40	42	17	76	*		4.4
5 1/75	39	41	19	79			5.3
6 2/75	38	35	26	87			4.5
7 3/75	47	40	12	64	**	+	4.5
8 4/75	40	48	11	70	*		4.4
9 1/76	41	36	22	80			4.4
10 2/76	44	40	15	70	**		3.5
11 3/76	41	39	19	77			5.5
12 4/76	40	36	23	82			5.3
13 1/77	45	36	18	72	***		3.4
14 2/77	41	34	24	82			5.5
15 3/77	47	36	16	68	***	+	4.5
16 4/77	41	42	16	74	*		4.4
17 1/78	37	32	30	92			3.5
18 2/78	41	38	20	78			5.5
19 3/78	45	37	17	71	**	+	5.5
20 4/78	45	33	21	75	***		5.4
21 1/79	35	34	30	94			4.3
22 2/79	30	56	13	82			5.4
23 3/79	46	44	9	62	*		5.5
24 4/79	46	43	10	63	*		4.4
25 1/80	38	48	13	74	*		4.5
26 2/80	29	48	22	92			3.4
27 3/80	35	42	22	86			4.5
28 4/80	48	36	15	66	***	+	4.4
29 1/81	45	38	16	70	**		3.5
30 2/81	52	30	17	64	***		4.5
31 3/81	39	48	12	72	*		3.5
32 4/81	45	38	16	70	**		4.5
33 1/82	37	36	26	88			3.3

THERE WERE 33 FORECASTS MADE

AVERAGE	41.4	39.3	18.3	75.9	1.09	.15	4.1,4.4
STD DEV	5.1	5.9	5.6	9.0	1.16	.36	.7, .7

FORECASTER: PROB MARKOVER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
1 1/74	61	32	6	44	***		5.4
2 2/74	35	49	15	79			3.4
3 3/74	56	35	8	51	***	+	4.4
4 4/74	41	54	4	62	*		4.4
5 1/75	38	50	11	72	*	+	4.5
6 2/75	40	42	17	76	*	+	4.4
7 3/75	48	48	3	54	*	+	5.3
8 4/75	52	45	2	49	*		4.5
9 1/76	45	43	11	65	*	+	3.4
10 2/76	56	35	8	51	***		2.5
11 3/76	53	37	9	55	**		3.5
12 4/76	40	44	15	74	*	+	4.5
13 1/77	45	46	8	62	*		4.4
14 2/77	31	48	20	88			2.3
15 3/77	46	44	9	62	*	+	5.5
16 4/77	58	37	4	45	**		4.5
17 1/78	42	41	16	73	**	+	3.4
18 2/78	60	28	11	50	***		3.5
19 3/78	48	40	11	62	**	+	4.4
20 4/78	50	37	12	61	**		3.4
21 1/79	19	60	21	100			5.5
22 2/79	55	39	5	49	**		4.4
23 3/79	66	31	2	35	***		5.5
24 4/79	60	37	2	41	**		5.5
25 1/80	57	37	5	47	**		2.4
26 2/80	53	35	11	57	***		3.5
27 3/80	23	59	17	93			3.3
28 4/80	63	29	7	43	***	+	4.4
29 1/81	59	26	14	54	***		3.5
30 2/81	67	26	6	38	***		4.2
31 3/81	65	26	8	42	***		3.4
32 4/81	51	43	5	53	*		3.4
33 1/82	47	31	21	73	***	+	2.5
THERE WERE 33 FORECASTS MADE							
AVERAGE	49.4	39.8	9.8	59.4	1.79	.33	3.6,4.3
STD DEV	11.7	9.9	5.5	16.0	1.05	.48	.9, .8

FORECASTER: HYBRIDER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
1 1/74	56	36	7	50	***		2.5
2 2/74	35	59	5	69			3.1
3 3/74	34	43	22	87			1.3
4 4/74	42	55	2	59			3.4
5 1/75	28	59	12	83			4.2
6 2/75	34	56	9	74			4.3
7 3/75	31	63	5	73			3.4
8 4/75	54	41	4	49	**		4.4
9 1/76	27	64	8	80			3.3
10 2/76	46	50	3	56	*		3.4
11 3/76	39	53	7	67	*		3.4
12 4/76	19	66	14	94			4.2
13 1/77	37	60	2	64			4.0
14 2/77	13	67	19	105			4.5
15 3/77	35	47	17	81			2.2
16 4/77	66	31	3	35	***		1.3
17 1/78	31	59	9	77			2.1
18 2/78	41	48	10	68	*		3.5
19 3/78	42	44	13	70	*	+	3.5
20 4/78	61	37	1	39	**		2.4
21 1/79	16	65	18	101			3.3
22 2/79	38	41	20	81			1.2
23 3/79	51	45	3	51	*		4.1
24 4/79	48	49	2	53	*		5.4
25 1/80	59	36	4	44	***		5.3
26 2/80	39	51	9	69	*		2.4
27 3/80	31	55	13	81			2.2
28 4/80	43	45	11	67	*	+	5.4
29 1/81	54	41	4	49	**		3.4
30 2/81	63	34	2	38	***		0.2
31 3/81	62	33	4	41	***		2.4
32 4/81	47	46	6	58	*		3.2
33 1/82	34	51	14	79			2.2
THERE WERE 33 FORECASTS MADE							
AVERAGE	41.1	49.4	8.5	66.4	.91	.06	2.8,3.0
STD DEV	13.5	10.4	6.0	18.2	1.10	.24	1.2,1.4

14. Average Temperature Scores for Each Season

One can see how well or poorly the 13 forecasters on average performed, by season, in the tables below. The averages over the human forecasters for each season are also given along with the standard deviations. In this way, the human forecasters, as a group, can have their collective average skill gauged relative to that of the various benchmark and empirical forecasters. All scores now are averaged over each type of season (e.g., winter) including stars, pluses, and forms. The number of season forecasts entering each average is shown in the right column. Thus Namias' forecast 9 winters, e.g., while the Analoger forecast 6 winters. It was this set of tables, e.g., which was the basis of Fig. 8.3. Considerably more information remains to be mined from these tables, than we have mined in the form of the above diagrams, skill rankings, and predictability orderings.

AVERAGES BY SEASON

TEMPERATURE ON THE GEOGRAPHIC GRID

WINTER

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	36.3	41.6	21.1	83.8	1.00	.22	2.22,3.00	9
WEATHER SERV	40.8	46.6	11.7	69.9	1.22	.33	2.56,2.67	9
ANALOGER	51.7	37.8	9.5	56.8	1.67	.33	2.33,2.67	6
ART DOUGLAS	55.2	38.6	5.2	49.0	2.00	.60	2.00,3.20	5
HUMAN AVERAGE	44.1	41.8	13.0	67.9	1.38	.34	2.31,2.86	29
HUMAN STD DEV	15.1	10.7	11.1	24.3	1.24	.48	1.17,1.30	
PERSISTER	41.0	41.1	16.9	74.9	1.11		3.11,2.89	9
CLIMATER	29.3	69.7	0.0	69.7	.22		3.33,2.89	9
STOCHASTER	32.8	40.3	25.9	92.1	.11	0.00	4.56,4.11	9
PURE ANALOGER	30.1	42.3	26.6	95.4	.44	0.00	3.44,3.44	9
PERS ANALOGER	38.6	43.7	16.8	77.2	.89	.11	2.67,3.00	9
BEST ANALOGER	64.3	31.8	2.9	37.6	2.89	.56	3.67,4.00	9
EMPR MARKOVER	39.9	38.6	20.6	79.7	.78	0.00	3.78,4.11	9
PROB MARKOVER	45.9	40.7	12.4	65.6	1.78	.44	3.44,4.44	9
HYBRIDER	38.0	52.3	9.7	69.7	.89	0.00	3.11,2.56	9

SPRING

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	36.6	40.6	21.9	84.1	.38	.13	2.38,2.75	8
WEATHER SERV	34.0	49.3	15.8	80.8	.38	0.00	2.88,3.38	8
ANALOGER	48.2	35.4	15.4	66.2	1.00	.20	3.00,2.40	5
ART DOUGLAS	44.5	43.0	11.5	66.0	1.25	0.00	2.25,4.00	4
HUMAN AVERAGE	39.4	42.7	16.9	76.6	.64	.08	2.64,3.08	25
HUMAN STD DEV	12.6	10.3	8.9	19.3	1.08	.28	1.08,1.29	
PERSISTER	37.8	43.3	18.0	79.3	1.25		2.50,3.50	8
CLIMATER	33.1	65.9	0.0	65.9	.25		3.63,3.13	8
STOCHASTER	32.5	43.6	22.9	89.4	0.00	0.00	4.38,4.38	8
PURE ANALOGER	36.0	45.8	17.3	80.3	.75	.13	3.13,3.88	8
PERS ANALOGER	40.3	41.5	17.3	76.0	1.00	0.00	3.00,3.88	8
BEST ANALOGER	58.4	37.3	3.4	44.0	2.50	.25	3.50,3.88	8
EMPR MARKOVER	39.3	39.3	20.5	80.3	.63	0.00	4.25,4.75	8
PROB MARKOVER	49.6	37.8	11.6	61.0	1.88	.13	3.13,4.00	8
HYBRIDER	38.6	50.8	9.6	70.0	.75	0.00	2.50,3.13	8

SUMMER

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	37.4	45.0	16.6	78.3	.75	.13	3.00,3.00	8
WEATHER SERV	40.9	41.3	16.9	75.0	1.38	.25	3.13,4.00	8
ANALOGER	37.0	45.2	16.8	78.8	1.00	.33	3.17,3.33	6
ART DOUGLAS	40.6	47.8	10.6	69.0	1.00	.20	3.40,4.60	5
HUMAN AVERAGE	38.9	44.4	15.6	75.7	1.04	.22	3.15,3.67	27
HUMAN STD DEV	13.6	7.5	11.2	23.8	1.16	.42	1.06,1.00	
PERSISTER	37.0	44.0	18.0	80.0	.50		3.38,2.63	8
CLIMATER	35.9	63.1	0.0	63.1	0.00		3.63,3.00	8
STOCHASTER	32.9	45.6	20.5	86.6	.25	0.00	4.13,4.25	8
PURE ANALOGER	27.1	45.0	26.9	98.8	.13	.13	3.13,3.75	8
PERS ANALOGER	34.9	43.0	21.1	85.3	.50	0.00	2.75,3.13	8
BEST ANALOGER	56.8	37.8	4.5	46.8	2.13	.63	3.25,3.63	8
EMPR MARKOVER	43.6	39.6	15.8	71.1	1.50	.50	4.25,4.88	8
PROB MARKOVER	50.6	40.0	8.4	56.8	1.88	.50	4.00,4.13	8
HYBRIDER	40.6	47.9	10.5	68.9	.75	.13	2.50,3.13	8

FALL

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	37.3	45.5	16.2	77.8	.83	0.00	3.33,3.50	6
WEATHER SERV	36.4	43.4	19.3	81.9	.63	.13	3.50,3.38	8
ANALOGER	33.4	47.2	18.4	84.0	.40	0.00	3.40,3.60	5
ART DOUGLAS	39.2	47.4	12.4	72.2	.60	0.00	3.20,3.60	5
HUMAN AVERAGE	36.6	45.5	16.9	79.3	.63	.04	3.38,3.50	24
HUMAN STD DEV	11.1	5.2	11.5	21.9	.65	.20	.82,1.06	
PERSISTER	48.0	40.0	11.0	62.0	1.13		3.63,3.25	8
CLIMATER	35.6	63.4	0.0	63.4	.25		4.13,4.13	8
STOCHASTER	30.4	46.5	22.1	90.8	0.00	0.00	4.25,3.88	8
PURE ANALOGER	29.0	49.4	20.6	90.6	.25	.13	3.63,3.38	8
PERS ANALOGER	54.0	34.5	10.5	55.5	1.38	0.00	3.88,4.13	8
BEST ANALOGER	62.4	33.3	3.4	40.0	2.38	.25	3.63,3.75	8
EMPR MARKOVER	43.1	39.8	16.1	72.0	1.50	.13	4.25,4.00	8
PROB MARKOVER	51.9	40.8	6.4	53.5	1.63	.25	3.88,4.50	8
HYBRIDER	47.5	46.3	5.3	56.8	1.25	.13	3.38,3.38	8

15. Average Temperature Scores for All Seasons

The table below combines and averages the temperature scores of each forecaster over all seasons, and hence over all his attempts, the number of which is shown in the right column. These tables formed the basis for Fig. 7.3. Thus, Namias' grand average temperature forecast score over the period 1974-82 is u = 36.9, v = 43.0, w = 19.2, with m = 81.3. The average number of his earned stars is .74, and pluses .13, with an average form of (2.68, 3.03) on the basis of 31 temperature forecasts in the period 1974-82. By contrast, the Stochaster's u, v, w values come close to his theoretical means of 33, 44, 22, respectively (recall Fig. 4.1), and a theoretical m average of 88. The expected number of stars by the Stochaster is very nearly 1 x 0.36 + 2 x .012 + 3 x .004 = .072. The Stochaster's expected form pair is (4,4). The expected pluses by the Stochaster are not easily reckoned since they depend on the as yet unknown parameters of the Climater and Persister.

AVERAGE SCORES (ALL SEASONS COMBINED)

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	36.9	43.0	19.2	81.3	.74	.13	2.68,3.03	31
WEATHER SERV	38.1	45.2	15.8	76.7	.91	.18	3.00,3.33	33
ANALOGER	42.7	41.4	14.9	71.1	1.05	.23	2.95,3.00	22
ART DOUGLAS	44.9	44.3	9.8	63.9	1.21	.21	2.74,3.84	19
PERSISTER	40.9	42.1	16.0	74.1	1.00	0.00	3.15,3.06	33
CLIMATER	33.4	65.6	0.0	65.6	.18	0.00	3.67,3.27	33
STOCHASTER	32.2	43.9	22.9	89.8	.09	0.00	4.33,4.15	33
PURE ANALOGER	30.5	45.5	22.9	91.4	.39	.09	3.33,3.61	33
PERS ANALOGER	41.8	40.8	16.4	73.6	.94	.03	3.06,3.52	33
BEST ANALOGER	60.6	34.9	3.5	41.9	2.48	.42	3.52,3.82	33
EMPR MARKOVER	41.4	39.3	18.3	75.9	1.09	.15	4.12,4.42	33
PROB MARKOVER	49.4	39.8	9.8	59.4	1.79	.33	3.61,4.27	33
HYBRIDER	41.1	49.4	8.5	66.4	.91	.06	2.88,3.03	33

16. Each Season: Significant Temperature Forecasts vs. Region

16.1 Definition of Climate Regions

The first table below defines the 10 climate regions of the U.S. mainland adopted in this study (cf. §10). The remaining tables list, by each season, the spatial patterns of significant forecasts over the 10 climate regions. The basis for the + and - symbols was verbally described in §10. We now add a few technical details.

16.2 Theory of Regional Stochaster

Let a typical region in the 10-climate region set have n points (These are listed in the first table below; e.g., Pacific Coast has n = 6.) Let the number of points in the U.S. mainland be N (E.g. N = 99 in the present study). Let the Stochaster make a forecast, and let his national score for the number of correct points be U, and of these let u be in the climate region of interest. For this given N we can count the number of ways these U correct national forecasts can be made; the number* is $\binom{N}{U}$. For this total fixed U, the number of ways u correct forecasts can fall in the region of interest is $\binom{n}{u}\binom{N-n}{U-u}$. The first factor is the number of ways the u correct forecasts can be made in the climate region regardless of correct forecasts outside it. For each of these interior forecasts the number of combinations of correct forecasts outside the region is given by the second factor. Hence the (hypergeometric) probability distribution of u, given U, is:

$$p_{n,N}(u|U) \equiv \binom{n}{u}\binom{N-n}{U-u}\binom{N}{U}^{-1}. \tag{16.1}$$

The limits on u's range for a given n, N, and U are

$$u_o \equiv \max[0, U-(N-n)] \leqq u \leqq n. \tag{16.2}$$

For a given $0 < \alpha < 1$ we can find the associated critical value $u_c(\alpha)$ using the formula

$$\sum_{u=u_o}^{u_c(\alpha)} p_{n,N}(u|U) = \alpha. \tag{16.3}$$

It should be noted that in (16.1) and (16.3) we have a conditional probability, conditional, that is, on U. Note also that u_c depends on both U and α. Moreover, if we consider the typical climate region, in its own right, with n points and a number u of current forecasts, the probability of the Stochaster obtaining this u when forecasting just over this climate region, is:

---

* This symbol stands for the number of combinations of N things taken U at a time. Thus $\binom{N}{U} = N!/U!(N-U)!$.

$$p_n(u) = \binom{n}{u} a_o^u (1 - a_o)^{n-u}, \tag{16.4}$$

where $a_o = 1/3$. If we let $n = N$, then we obtain the related probability $P_N(U)$ for the whole country. The connection between these two probabilities is readily shown to be:

$$p_n(u) = \sum_{U=u}^{(N-n)+u} p_{n,N}(u|U) p_N(U). \tag{16.5}$$

16.3 Construction of Tables

The preceding theory of the Stochaster's regional skill was applied to make the tables of this section, as follows. For each region, and for each forecast with a given U we used (16.3) to find $u_c(\alpha)$ for $\alpha = .1$ and also for $\alpha = .9$. For example, in season 1, Namias' U score was 42 (cf. §12). Then $u_c(.1)$, $u_c(.9)$ were reckoned via (16.3) for Pacific coast ($n = 6$). From the records, it was found that Namias' u for this region was less than $u_c(.1)$, and so a minus sign was placed under 'PAC' by Namias' name in the season 1 table below. This assignment of minuses continued for four minuses, as shown. Then for SPL, the u for the southern plains in Namias' 1/74 temperature forecast lay between $u_c(.1)$, $u_c(.9)$, and so no mark (a null mark) was made in the SPL column, and a contribution to the West set's form was chalked up. For GRL, the u in that region exceeded $u_c(.9)$ and so a plus was affixed. In this way the 1/74 forecast by Namias over each of the 10 climate regions was evaluated for significantly low, for indeterminate, or for significantly high skill in that region. A discussion of the way to view these plus, null, and minus marks, especially the null marks, is given in §11.

16.4 Interpretions

From the present tables, one can study how the forecast skill in a given season was distributed geographically. Thus in season 1 (1/74) it is clear that the collective skill over all forecasters was somewhat more in evidence in the East set (cf. §11) of climate regions. That is, in the East set, GRL, APP, GUC, and ATC each obtained three significantly high forecasts, while all those in the West set obtained only two (in SPL).

16.5 Nominal Significance Level

Note that the word 'nominal' is used in the caption below each table. This reflects the arithmetic fact that, in (16.3), the requirement that $u_c(\alpha)$ be an integer, of necessity causes the sum in (16.3) to exceed (in

our study) its nominal values* (α = .1, .9). This fact may occasionally have a slight effect on the resultant applications of the tables, such as the ranking of the climatic regions with respect to predictability of temperature, say. The smaller a climate region the more this effect is likely to be noticeable. However, for the purposes of this study, these effects are relatively minor and not of primary interest.

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* Inevitably α in (16.3) for α = 0.9, e.g., is bracketed by sums associated with two integer upper limits to the summation. We invariably chose the larger of the two upper limits. Therefore our actual upper critical u values tend to exceed the nominal upper critical value.

ANALYSIS BY GEOGRAPHICAL REGION

THE REGIONS ARE DEFINED AS FOLLOWS:

	REGION	NO PTS	POINTS OF THE GEOGRAPHIC GRID
1	PACIFIC COAST	6	1, 13, 30, 48, 65, 80,
2	NORTHERN GREAT BASIN	11	2, 3, 4, 14, 15, 16, 17, 31, 32, 33, 34,
3	SOUTHWESTERN DESERT	12	49, 50, 51, 52, 53, 66, 67, 68, 69, 81, 82, 83,
4	NORTHERN PLAINS	13	5, 6, 7, 8, 9, 18, 19, 20, 21, 35, 36, 37, 38,
5	SOUTHERN PLAINS	10	54, 55, 56, 70, 71, 72, 84, 85, 86, 93,
6	GREAT LAKES	14	10, 11, 12, 22, 23, 24, 25, 26, 27, 28, 42, 43, 44, 45,
7	MIDWEST	9	39, 40, 41, 57, 58, 59, 60, 61, 73,
8	APPALACHIANS	7	62, 63, 74, 75, 76, 77, 78,
9	GULF COAST	11	87, 88, 89, 90, 91, 94, 95, 96, 97, 98, 99,
10	ATLANTIC COAST	6	29, 46, 47, 64, 79, 92,

SEASON 1 1/74

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	-	-	-	-		+		+		+	1.2
WEATHER SERV					+						4.5
PERSISTER								+		+	5.3
CLIMATER		-			+	+		-		-	3.2
STOCHASTER				-		+	-		+		4.2
PURE ANALOGER		-							+		4.4
PERS ANALOGER	-			-		-		+	+	+	3.1
BEST ANALOGER											5.5
EMPR MARKOVER											5.5
PROB MARKOVER							+				5.4
HYBRIDER	-	-		-							2.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL H
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 2 2/74

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+		-		-	-	+	+	-		2.1
WEATHER SERV		-	-	-			+	+	+		2.2
PERSISTER		-	-		-	+	-	+		+	2.1
CLIMATER		+			-	+	-	-	-		3.1
STOCHASTER										+	5.4
PURE ANALOGER					-	+	-				4.3
PERS ANALOGER					-	+	-				4.3
BEST ANALOGER	-	-		-	+		+		+		1.3
EMPR MARKOVER											5.5
PROB MARKOVER		+			-	+					3.4
HYBRIDER			-		-	+	-	+	-	+	3.0

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL H
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 3 3/74

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+				-		-	+	4.2
WEATHER SERV		+									4.5
PERSISTER			+				-	-	-		4.2
CLIMATER		-			+	+		-			3.3
STOCHASTER					-						4.5
PURE ANALOGER						-			-		5.3
PERS ANALOGER		-	+			+	-	-	-		3.1
BEST ANALOGER		+	+			-	-				3.3
EMPR MARKOVER			+						-		4.4
PROB MARKOVER			+						-		4.4
HYBRIDER	-	-	+		+			-	-		1.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 4 4/74

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-		-		+	+				3.3
WEATHER SERV		-		+							3.5
PERSISTER					-	-	+		+		4.2
CLIMATER				+							4.5
STOCHASTER			+	-					-	+	3.3
PURE ANALOGER	+	+				-	-				3.3
PERS ANALOGER	+	+		-	-		-				1.4
BEST ANALOGER				-							4.5
EMPR MARKOVER		+								-	4.4
PROB MARKOVER	+					-					4.4
HYBRIDER	+	+							-		3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 5 1/75

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-				+			-		4.3
WEATHER SERV		+	+	-		-	-			+	2.2
PERSISTER			+	+	+	-			-		3.3
CLIMATER		+				-				-	4.3
STOCHASTER											5.5
PURE ANALOGER		+	+			-			-		3.3
PERS ANALOGER			+		+	-					3.4
BEST ANALOGER											5.5
EMPR MARKOVER						-		+			5.3
PROB MARKOVER	-										4.5
HYBRIDER					+	-	+	-			4.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 6 2/75

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+			-					4.4
WEATHER SERV						+					5.4
PERSISTER			+		+	-		-			3.3
CLIMATER			-	-					+		3.4
STOCHASTER					+		-			+	4.3
PURE ANALOGER			+	-					-		3.4
PERS ANALOGER				-	+	-	-		+		3.2
BEST ANALOGER		+		+					-	-	3.3
EMPR MARKOVER					+						4.5
PROB MARKOVER		-							+		4.4
HYBRIDER		-						-	+		4.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 7 3/75

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-		+		+			-		3.3
WEATHER SERV			-		+	-			+		3.3
PERSISTER	+	-	+		+	-			-		1.3
CLIMATER				+		-		+	-		4.2
STOCHASTER					-					+	4.4
PURE ANALOGER	-	+	-						-		2.4
PERS ANALOGER		-			+	-			+		3.3
BEST ANALOGER					+				+		4.4
EMPR MARKOVER				+							4.5
PROB MARKOVER								-		+	5.3
HYBRIDER		-	+						-		3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 8 4/75

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+		+	+	-		-		-	2.2
WEATHER SERV					+				-		4.4
PERSISTER		+	+					-	-		3.3
CLIMATER		+								-	4.4
STOCHASTER											5.5
PURE ANALOGER					+	-					4.4
PERS ANALOGER											5.5
BEST ANALOGER			+	-			-				3.4
EMPR MARKOVER		-						+			4.4
PROB MARKOVER				-							4.5
HYBRIDER	-							-			4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 9 1/76

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-	-	-	-	+		+			1.3
WEATHER SERV		+	+		-			+	-		2.3
PERSISTER				-	-	+					3.4
CLIMATER					-	+	-				4.3
STOCHASTER								+			5.4
PURE ANALOGER				+		+					4.4
PERS ANALOGER		-	-	+	-						1.5
BEST ANALOGER				+							4.5
EMPR MARKOVER		+				-					4.4
PROB MARKOVER		+			-		-				3.4
HYBRIDER				-	-	+	-				3.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 10 2/76

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	+		-					3.4
WEATHER SERV		+			-				-		3.4
PERSISTER		-	-	+	-						1.5
CLIMATER		+								-	4.4
STOCHASTER					+					-	4.4
PURE ANALOGER			-	+					+		3.4
PERS ANALOGER			-	+					+		3.4
BEST ANALOGER											5.5
EMPR MARKOVER			-	+							3.5
PROB MARKOVER			-	+	-						2.5
HYBRIDER			-	+					+		3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 11 3/76

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+				+	-		-		4.2
WEATHER SERV		-	-		+				+		2.4
ANALOGER											5.5
PERSISTER				+			-		-		4.3
CLIMATER				+					-		4.4
STOCHASTER			+	+	-		-				2.4
PURE ANALOGER			+	-					-		3.4
PERS ANALOGER		+		+		+		-	-		3.2
BEST ANALOGER					+				+		4.4
EMPR MARKOVER											5.5
PROB MARKOVER		-			+						3.5
HYBRIDER		+		+					-		3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 12 4/76

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
WEATHER SERV					+	-	+		+	-	4.1
PERSISTER		-				-		+	+		4.2
CLIMATER				+							4.5
STOCHASTER									-	+	5.3
PURE ANALOGER					+	-					4.4
PERS ANALOGER	-				+	-			+		3.3
BEST ANALOGER			-	-		+	+		+		3.2
EMPR MARKOVER							+	+			5.3
PROB MARKOVER			+								4.5
HYBRIDER				+		-		+	-		4.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 13 1/77

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-		-	-	+	+	+	+		2.1
WEATHER SERV		-				-		+	+		4.2
ANALOGER		+		-		+				-	3.3
PERSISTER		-	-	-	-	+	+	+	+	+	1.0
CLIMATER		+		+	+	-	-	-	-	-	2.6
STOCHASTER		+									4.5
PURE ANALOGER							+				5.4
PERS ANALOGER		-	-	-		+	+	+	+		2.1
BEST ANALOGER		-									4.5
EMPR MARKOVER	+				+	-					3.4
PROB MARKOVER				+		-					4.4
HYBRIDER					+	-	-	+	-	+	4.0

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 14 2/77

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+	-	+	-		-	+	+	+		1.1
WEATHER SERV	+	-		-			+	+		-	2.2
ANALOGER				+		-	+	+			4.2
PERSISTER		+				-					4.4
CLIMATER		+				-					4.4
STOCHASTER		-			+						3.5
PURE ANALOGER				-	-	+				+	3.3
PERS ANALOGER		+	+			-					3.4
BEST ANALOGER			-		-						3.5
EMPR MARKOVER											5.5
PROB MARKOVER	-	+		+			-	-			2.3
HYBRIDER		+									4.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 15 3/77

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS					+						4.5
WEATHER SERV							+			+	5.3
ANALOGER	+	+	+		-			-	-		1.3
ART DOUGLAS											5.5
PERSISTER	-		-		+	-		+	+		2.2
CLIMATER		-	-	+		+	+			-	2.2
STOCHASTER											5.5
PURE ANALOGER		-	-	+		+	+		-		2.2
PERS ANALOGER			-						+		4.4
BEST ANALOGER		-	+								3.5
EMPR MARKOVER				-							4.5
PROB MARKOVER											5.5
HYBRIDER		-	-	-		+	+	+			2.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 16 4/77

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
WEATHER SERV			+			-				-	4.3
ANALOGER			-	+					+		3.4
ART DOUGLAS				+	-					+	3.4
PERSISTER		-	+								3.5
CLIMATER			-			+					4.4
STOCHASTER				+					-		4.4
PURE ANALOGER			+	+		-		-	-		3.2
PERS ANALOGER											5.5
BEST ANALOGER		-						+			4.4
EMPR MARKOVER			+			-					4.4
PROB MARKOVER			+								4.5
HYBRIDER	+	+	+		-	+		-			1.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 17 1/78

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+			+					4.4
WEATHER SERV		-	+	+	-	+		-	-		1.2
ANALOGER			+	-	-	+	+	+			2.2
ART DOUGLAS			+	-	-	+					2.4
PERSISTER			+	+		-		-	-		3.2
CLIMATER		+								+	4.4
STOCHASTER			+					-			4.4
PURE ANALOGER		-	+	+			-		-		2.3
PERS ANALOGER	+		+	+			-	-	-		2.2
BEST ANALOGER	-	-					+				3.4
EMPR MARKOVER			+		-						3.5
PROB MARKOVER		+	+			-					3.4
HYBRIDER	+		+	+		-	-	-	-		2.1

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 18 2/78

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+										4.5
WEATHER SERV			+	-							3.5
ANALOGER			+	+	+		-	-		-	2.2
ART DOUGLAS	+		+	-			+				2.4
PERSISTER	+		+	-	-						1.5
CLIMATER			-					+			4.4
STOCHASTER		+									4.5
PURE ANALOGER					+						4.5
PERS ANALOGER			+	-							3.5
BEST ANALOGER			+			+	-				4.3
EMPR MARKOVER											5.5
PROB MARKOVER			+	-							3.5
HYBRIDER			+	-							3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 19 3/78

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	-						+	3.4
WEATHER SERV	+		+						-		3.4
ANALOGER			+	-					-	+	3.3
ART DOUGLAS	+	-							-		3.4
PERSISTER							-				5.4
CLIMATER											5.5
STOCHASTER									-	+	5.3
PURE ANALOGER	+		+	-							2.5
PERS ANALOGER	+		+	-						-	2.4
BEST ANALOGER			+			-			+		4.3
EMPR MARKOVER											5.5
PROB MARKOVER				-						+	4.4
HYBRIDER	+	-									3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 20 4/78

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+			-					4.4
WEATHER SERV			+			+	-		-		4.2
ANALOGER	-				-	+					3.4
ART DOUGLAS		+	+			-		-			3.3
PERSISTER			+			-			+		4.3
CLIMATER						+		-			5.3
STOCHASTER											5.5
PURE ANALOGER		+	-	+			-		-		2.3
PERS ANALOGER											5.5
BEST ANALOGER			+			-			+		4.3
EMPR MARKOVER										+	5.4
PROB MARKOVER		-	+				-				3.4
HYBRIDER	+	+	+						-		2.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 21 1/79

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+	+	+	+	-		-	-	-		0.2
WEATHER SERV	+	+		+	-	-	-	-	-	-	1.0
ANALOGER		+	-	+	-	+		-	-	-	1.1
ART DOUGLAS	-	+		+	+	+		-	-	-	1.1
PERSISTER		+	-	+			-		-		2.3
CLIMATER											5.5
STOCHASTER											5.5
PURE ANALOGER		+	-	+			-		-		2.3
PERS ANALOGER		+	-	+		+			-		2.3
BEST ANALOGER		+		+					-	-	3.3
EMPR MARKOVER	-						+			+	4.3
PROB MARKOVER											5.5
HYBRIDER		+		+		-				+	3.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 22 2/79

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	-		-	+	+		+			-	1.3
WEATHER SERV			-					+	-		4.3
ANALOGER	-								+	+	4.3
ART DOUGLAS	-	-			+						2.5
PERSISTER		-		+		+					3.4
CLIMATER	-					-	+		+		4.2
STOCHASTER											5.5
PURE ANALOGER	-	+	-						-		2.4
PERS ANALOGER	-	-	-								2.5
BEST ANALOGER											5.5
EMPR MARKOVER								-			5.4
PROB MARKOVER					+	-					4.4
HYBRIDER	-	-	-		+		+	-	+		1.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 23 3/79

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+	+		-	+	-	-				1.3
WEATHER SERV	+	+			-			-			2.4
ANALOGER			+				+	-			4.3
ART DOUGLAS	+	+			-						2.5
PERSISTER	+					-	+	-	-		4.1
CLIMATER	-					+	+		-		4.2
STOCHASTER	+						+	-			4.3
PURE ANALOGER					-	+	-				4.3
PERS ANALOGER				+	-			-	-		3.3
BEST ANALOGER		+				-				-	4.3
EMPR MARKOVER											5.5
PROB MARKOVER											5.5
HYBRIDER					-	+	+	-	-		4.1

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 24 4/79

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+			-					-	+	3.3
WEATHER SERV	+							-	+	-	4.2
ANALOGER		-	+				-				3.4
ART DOUGLAS			+					-			4.4
PERSISTER								-		-	5.3
CLIMATER			-		+						3.5
STOCHASTER			+			-		-	-		4.2
PURE ANALOGER					+			+			4.4
PERS ANALOGER								-			5.4
BEST ANALOGER								-		-	5.3
EMPR MARKOVER	+							-			4.4
PROB MARKOVER											5.5
HYBRIDER								-			5.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 25 1/80

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+			-							3.5
WEATHER SERV						-					5.4
ANALOGER			+		+	-	-		-		3.2
ART DOUGLAS	+		+			-			-	+	3.2
PERSISTER						-					5.4
CLIMATER			-				+		+		4.3
STOCHASTER											5.5
PURE ANALOGER						-					5.4
PERS ANALOGER					-		+				4.4
BEST ANALOGER			+		-	+	-				3.3
EMPR MARKOVER		+									4.5
PROB MARKOVER		+	+		-	-					2.4
HYBRIDER						-			+		5.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 26 2/80

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			-	-			+	+	+	-	3.1
WEATHER SERV	+	-		-		-			+		2.3
ANALOGER			-	+						-	3.4
ART DOUGLAS	-		+					-			3.4
PERSISTER			-	+		+					3.4
CLIMATER	+					-		-	+		4.2
STOCHASTER											5.5
PURE ANALOGER			-	+						+	3.4
PERS ANALOGER		+	-	+	-	+	-				1.3
BEST ANALOGER		-						+			4.4
EMPR MARKOVER			-	+						+	3.4
PROB MARKOVER			-	+							3.5
HYBRIDER		+	-	+		-					2.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 27 3/80

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+		-		-	+			-		2.3
WEATHER SERV			+		-						3.5
ANALOGER				-	-			+	+		3.3
ART DOUGLAS			+	+							3.5
PERSISTER					-	+			-	+	4.2
CLIMATER				+	-	+			-		3.3
STOCHASTER	+										4.5
PURE ANALOGER			+								4.5
PERS ANALOGER	+	+	-			+			-		2.3
BEST ANALOGER	-	-		-	+		+		+		1.3
EMPR MARKOVER			+								4.5
PROB MARKOVER			+		-	+	-				3.3
HYBRIDER	+	+			-	+			-	+	2.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 28 4/80

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS											5.5
WEATHER SERV		-									4.5
ANALOGER		-				+	-				4.7
ART DOUGLAS	+			-			-				3.4
PERSISTER		-	+	+			-				2.4
CLIMATER							+				5.4
STOCHASTER											5.5
PURE ANALOGER						-			-		5.3
PERS ANALOGER		+					-				4.4
BEST ANALOGER		+		+	-						2.5
EMPR MARKOVER					-	-					4.4
PROB MARKOVER					-				+		4.4
HYBRIDER										-	5.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 29 1/81

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+	+			-	-	-				2.3
WEATHER SERV	+	+			-	-	-				2.3
ANALOGER			+		-	-					3.4
ART DOUGLAS	+			+	-						2.5
PERSISTER				+				+			4.4
CLIMATER		-	-	-		+	+		+		2.2
STOCHASTER						-					5.4
PURE ANALOGER			+	-			-			+	3.3
PERS ANALOGER				+					-		4.4
REST ANALOGER			+	+		-			-	-	3.2
EMPR MARKOVER		-	+								3.5
PROB MARKOVER				+	-						3.5
HYBRIDER				+	-			+			3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 30 2/81

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	-	-	-		-	+	+				1.3
WEATHER SERV			-	+	-	+					2.4
ANALOGER	+		+	+		-	-	-		-	2.1
ART DOUGLAS			-	+	-	+			+		2.3
PERSISTER			+	+		-			-	-	3.2
CLIMATER			-	-					+		3.4
STOCHASTER									+		5.4
PURE ANALOGER		-	+				-				3.4
PERS ANALOGER											5.5
REST ANALOGER			+		-	+	-				3.3
EMPR MARKOVER					+						4.5
PROB MARKOVER			+			-	-			-	4.2
HYBRIDER	+	+	+	+	-	-	-			-	3.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 31 3/81

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+		+			-		-	-		3.2
WEATHER SERV	-		+				-				3.4
ANALOGER				-	-			+		+	3.3
ART DOUGLAS			+			-					4.4
PERSISTER		-	+				-				3.4
CLIMATER			-			+	+				4.3
STOCHASTER											5.5
PURE ANALOGER			-	+						+	3.4
PERS ANALOGER	+		+		-						2.5
BEST ANALOGER		-	+				-				3.4
EMPR MARKOVER			+	+							3.5
PROB MARKOVER		-	+				+				3.4
HYBRIDER	+	-	+				+				2.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 80(10) PERCENT CONFIDENCE LEVEL

SEASON 32 4/81

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	-						-	3.4
WEATHER SERV	+		+	-	-						1.5
ANALOGER				+				-		-	4.3
ART DOUGLAS			+	-			+			-	3.3
PERSISTER			+							-	4.4
CLIMATER				-			+		+		4.3
STOCHASTER			-	+				+			3.4
PURE ANALOGER			+							-	4.4
PERS ANALOGER		+		+		-				-	3.3
BEST ANALOGER				+					-		4.4
EMPR MARKOVER			+								4.5
PROB MARKOVER			+	+						-	3.4
HYBRIDER		+	+			-		-		-	3.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 80(10) PERCENT CONFIDENCE LEVEL

SEASON 33 1/82

TEMPERATURE ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS				-	+					+	3.4
WEATHER SERV		-	+	-		+		+			2.3
ANALOGER		-	+	-				+			2.4
ART DOUGLAS		-	+	-				+			2.4
PERSISTER			+	-					-	+	3.3
CLIMATER	+	+			+		-				2.4
STOCHASTER	+					-	+				4.3
PURE ANALOGER			+	-		-	-				3.3
PERS ANALOGER			+	-			-			+	3.3
BEST ANALOGER	-	-					+				3.4
EMPR MARKOVER			+	-		-	-				3.3
PROB MARKOVER	+		+	-							2.5
HYBRIDER			+	-	+	-	-			+	2.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL H
AT THE NOMINAL 95(10) PERCENT CONFIDENCE LEVEL

17. Each Forecaster: Significant Regional Temperature Forecasts vs. Season

17.1 Table Descriptions

The present tables reshuffle the information tabulated in §16. Now the work of each forecaster is displayed as a whole, over all seasons. The conventions for +, - are as in §16. We can now see at a glance when and where a given forecaster's efforts were significant in the sense of u-scores. Take, e.g., Namias' forecasts. Thus, as we see from his 'PCT SIG' row, over his set of 31 forecasts (cf. §13), on average he had more significant temperature forecasts in PAC, SWD, GRL, and MDW, with somewhat less skill in NGB, NPL, SPL, GUC and ATC. The APP region is somewhat intermediate in these ranges.

17.2 Expected Values of + Signs

The theoretical expected value of the number of + signs in each column of the Stochaster's table is 3 for the 33 trials displayed. Allowing for sampling fluctuations, and the effects mentioned in §16.5, these expectations are reasonably well realized. So, in the various tables, fluctuations above 9 percent ($\cong$ 3/33 x 100) indicate better than chance results. The precise critical values at the nominal 10%, 90% levels were obtained via (16.3).

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: JERRY NAMIAS

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1 1/74	-	-	-	-		+		+		+	1.2
2 2/74	+		-		-	-	+	+	-		2.1
3 3/74			+				-		-	+	4.2
4 4/74		-		-		+	+				3.3
5 1/75		-				+			-		4.3
6 2/75			+			-					4.4
7 3/75		-		+		+			-		3.3
8 4/75		+		+	+	-		-		-	2.2
9 1/76		-	-	-	-	+		+			1.3
10 2/76			+	+		-					3.4
11 3/76		+				+	-		-		4.2
13 1/77		-		-	-	+	+	+	+		2.1
14 2/77	+	-	+	-		-	+	+	+		1.1
15 3/77					+						4.5
17 1/78			+			+					4.4
18 2/78	+										4.5
19 3/78			+	-						+	3.4
20 4/78			+			-					4.4
21 1/79	+	+	+	+	-		-	-	-		0.2
22 2/79	-		-	+	+		+			-	1.3
23 3/79	+	+		-	+	-	-				1.3
24 4/79	+			-					-	+	3.3
25 1/80	+			-							3.5
26 2/80			-	-			+	+	+	-	3.1
27 3/80	+		-		-	+			-		3.3
28 4/80											5.5
29 1/81	+	+			-	-	-				2.3
30 2/81	-	-	-		-	+	+				1.3
31 3/81	+		+			-		-	-		3.2
32 4/81			+	-						-	3.4
33 1/82				-	+					+	3.4
PCT SIG FOR +	32	16	32	16	16	32	23	19	10	16	2.68.3.03

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: WEATHER SERV

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NCB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1 1/74					+						4.5
2 2/74		-	-	-			+	+	+		2.2
3 3/74		+									4.5
4 4/74		-		+							3.5
5 1/75		+	+	-		-	-			+	2.2
6 2/75						+					5.4
7 3/75			-		+	-			+		3.3
8 4/75					+				-		4.4
9 1/76		+	+		-			+	-		2.3
10 2/76		+			-				-		3.4
11 3/76		-	-		+				+		2.4
12 4/76					+	-	+		+	-	4.1
13 1/77		-				-		+	+		4.2
14 2/77	+	-		-			+	+		-	2.2
15 3/77							+			+	5.3
16 4/77			+			-				-	4.3
17 1/78		-	+	+	-	+		-	-		1.2
18 2/78			+	-							3.5
19 3/78	+		+						-		3.4
20 4/78			+			+	-		-		4.2
21 1/79	+	+		+	-	-	-	-	-	-	1.3
22 2/79			-					+	-		4.3
23 3/79	+	+			-			-			2.4
24 4/79	+							-	+	-	4.2
25 1/80						-					5.4
26 2/80	+	-		-		-			+		2.3
27 3/80			+		-						3.5
28 4/80		-									4.5
29 1/81	+	+			-	-	-				2.3
30 2/81			-	+	-	+					2.4
31 3/81	-		+				-				3.4
32 4/81	+		+	-	-						1.5
33 1/82		-	+	-		+		+			2.3
PCT SIG FOR +	24	21	33	12	15	15	12	18	21	6	3.00,3.33

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON		PAC	NCR	SWD	NPL	SPL	CRL	MDW	APP	CUC	ATC	FOR*
11	3/76											5.5
13	1/77		+		-		+				-	3.3
14	2/77				+		-	+	+			4.2
15	3/77	+	+	+		-			-	-		1.3
16	4/77			-	+					+		3.4
17	1/78			+	-	-	+	+	+			2.2
18	2/78			+	+	+		-	-		-	2.2
19	3/78			+	-					-	+	3.3
20	4/78	-				-	+					3.4
21	1/79		+	-	+	-	+		-	-	-	1.1
22	2/79	-								+	+	4.3
23	3/79			+				+	-			4.3
24	4/79		-	+				-				3.4
25	1/80			+		+	-	-		-		3.2
26	2/80			-	+						-	3.4
27	3/80				-	-			+	+		3.3
28	4/80		-				+	-				4.3
29	1/81			+		-	-					3.4
30	2/81	+		+	+		-	-	-		-	2.1
31	3/81				-	-			+		+	3.3
32	4/81				+				-		-	4.3
33	1/82		-	+	-				+			2.4
PCT SIG FOR +		9	14	45	32	9	23	14	23	14	14	2.95,3.09

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: ART DOUGLAS

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
15 3/77											5.5
16 4/77				+	-					+	3.4
17 1/78			+	-	-	+					2.4
18 2/78	+		+	-			+				2.4
19 3/78	+	-							-		3.4
20 4/78		+	+			-		-			3.3
21 1/79	-	+		+	+	+		-	-	-	1.1
22 2/79	-	-			+						2.5
23 3/79	+	+			-						2.5
24 4/79			+					-			4.4
25 1/80	+		+			-			-	+	3.2
26 2/80	-		+					-			3.4
27 3/80			+	+							3.5
28 4/80	+			-			-				3.4
29 1/81	+			+	-						2.5
30 2/81			-	+	-	+			+		2.3
31 3/81			+			-					4.4
32 4/81			+	-			+			-	3.3
33 1/82		-	+	-				+			2.4
PCT SIG FOR +	32	16	53	26	11	16	11	5	5	11	2.74,3.84

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PERSISTER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74								+		+	5.3
2	2/74		-	-		-	+	-	+		+	2.1
3	3/74			+				-	-	-		4.2
4	4/74					-	-	+		+		4.2
5	1/75			+	+	+	-			-		2.3
6	2/75			+		+	-		-			3.3
7	3/75	+	-	+		+	-			-		1.3
8	4/75		+	+					-	-		3.3
9	1/76				-	-	+					3.4
10	2/76		-	-	+	-						1.5
11	3/76				+			-		-		4.3
12	4/76		-				-		+	+		4.2
13	1/77		-	-	-	-	+	+	+	+	+	1.0
14	2/77		+				-					4.4
15	3/77	-		-		+	-		+	+		2.2
16	4/77		-	+								3.5
17	1/78			+	+		-		-	-		3.2
18	2/78	+		+	-	-						1.5
19	3/78							-				5.4
20	4/78			+			-			+		4.3
21	1/79		+	-	+			-		-		2.3
22	2/79		-		+		+					3.4
23	3/79	+					-	+	-	-		4.1
24	4/79								-		-	5.3
25	1/80						-					5.4
26	2/80			-	+		+					3.4
27	3/80					-	+			-	+	4.2
28	4/80		-	+	+			-				2.4
29	1/81				+				+			4.4
30	2/81			+	+		-			-	-	3.2
31	3/81		-	+				-				3.4
32	4/81			+							-	4.4
33	1/82			+	-					-	+	3.3
PCT SIG FOR +		9	9	42	30	12	18	9	18	15	15	3.15,3.06

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: CLIMATER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74		-			+	+		-		-	3.2
2	2/74		+			-	+	-	-	-		3.1
3	3/74		-			+	+		-			3.3
4	4/74				+							4.5
5	1/75		+				-				-	4.3
6	2/75			-	-					+		3.4
7	3/75				+		-		+	-		4.2
8	4/75		+								-	4.4
9	1/76					-	+	-				4.3
10	2/76		+								-	4.4
11	3/76				+					-		4.4
12	4/76				+							4.5
13	1/77		+		+	+	-	-	-	-	-	2.8
14	2/77		+				-					4.4
15	3/77		-	-	+		+	+			-	2.2
16	4/77			-			+					4.4
17	1/78		+								+	4.4
18	2/78			-					+			4.4
19	3/78											5.5
20	4/78						+		-			5.3
21	1/79											5.5
22	2/79	-					-	+		+		4.2
23	3/79	-					+	+		-		4.2
24	4/79			-		+						3.5
25	1/80			-				+		+		4.3
26	2/80	+					-		-	+		4.2
27	3/80				+	-	+			-		3.3
28	4/80							+				5.4
29	1/81		-	-	-		+	+		+		2.2
30	2/81			-	-					+		3.4
31	3/81			-			+	+				4.3
32	4/81				-			+		+		4.3
33	1/82	+	+			+		-				2.4
PCT SIG FOR +		6	24	0	21	15	33	24	6	21	3	3.67,3.27

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL II
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: STOCHASTER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1 1/74				-		+	-		+		4.2
2 2/74										+	5.4
3 3/74					-						4.5
4 4/74			+	-					-	+	3.3
5 1/75											5.5
6 2/75					+		-			+	4.3
7 3/75					-					+	4.4
8 4/75											5.5
9 1/76								+			5.4
10 2/76					+					-	4.4
11 3/76			+	+	-		-				2.4
12 4/76									-	+	5.3
13 1/77		+									4.5
14 2/77		-			+						3.5
15 3/77											5.5
16 4/77				+					-		4.4
17 1/78			+					-			4.4
18 2/78		+									4.5
19 3/78									-	+	5.3
20 4/78											5.5
21 1/79											5.5
22 2/79											5.5
23 3/79	+						+	-			4.3
24 4/79			+			-		-	-		4.2
25 1/80											5.5
26 2/80											5.5
27 3/80	+										4.5
28 4/80											5.5
29 1/81						-					5.4
30 2/81									+		5.4
31 3/81											5.5
32 4/81			-	+				+			3.4
33 1/82	+					-	+				4.3
PCT SIG FOR +	9	6	12	5	9	3	6	6	6	18	4.33,4.15

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 99(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PURE ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74	(2/75)		-							+		4.4
2	2/74	(3/79)					-	+	-				4.3
3	3/74	(4/80)						-			-		5.3
4	4/74	(2/81)	+	+				-	-				3.3
5	1/75	(1/77)		+	+			-			-		3.3
6	2/75	(3/76)			+	-					-		3.4
7	3/75	(2/79)	-	+	-						-		2.4
8	4/75	(4/76)					+	-					4.4
9	1/76	(3/76)				+		+					4.4
10	2/76	(3/81)			-	+					+		3.4
11	3/76	(2/75)			+	-					-		3.4
12	4/76	(4/75)					+	-					4.4
13	1/77	(2/78)							+				5.4
14	2/77	(1/75)				-	-	+				+	3.3
15	3/77	(3/76)		-	-	+		+	+		-		2.2
16	4/77	(1/78)			+	+		-		-	-		3.2
17	1/78	(4/78)		-	+	+			-		-		2.3
18	2/78	(4/73)					+						4.5
19	3/78	(2/81)	+		+	-							2.5
20	4/78	(1/79)		+	-	+			-		-		2.3
21	1/79	(4/78)		+	-	+			-		-		2.3
22	2/79	(3/75)	-	+	-						-		2.4
23	3/79	(2/74)					-	+	-				4.3
24	4/79	(1/75)					+			+			4.4
25	1/80	(4/79)						-					5.4
26	2/80	(3/81)			-	+						+	3.4
27	3/80	(4/76)			+								4.5
28	4/80	(3/74)						-			-		5.3
29	1/81	(1/82)			+	-			-			+	3.3
30	2/81	(3/81)		-	+				-				3.4
31	3/81	(2/80)			-	+						+	3.4
32	4/81	(3/81)			+							-	4.4
33	1/82	(2/81)			+	-		-	-				3.3
PCT SIG FOR +			6	18	33	27	12	15	6	3	6	12	3.33,3.61

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PERS ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74 (1/75)	-			-		-		+	+	+	3.1
2	2/74 (2/79)					-	+	-				4.3
3	3/74 (3/80)		-	+			+	-	-	-		3.1
4	4/74 (1/81)	+	+		-	-		-				1.4
5	1/75 (4/76)			+		+	-					3.4
6	2/75 (2/76)				-	+	-	-		+		3.2
7	3/75 (1/79)		-			+	-			+		3.3
8	4/75 (3/76)											5.5
9	1/76 (2/76)		-	-	+	-						1.5
10	2/76 (2/81)			-	+					+		3.4
11	3/76 (1/75)		+		+		+		-	-		3.2
12	4/76 (3/75)	-				+	-			+		3.3
13	1/77 (1/78)		-	-	-		+	+	+	+		2.1
14	2/77 (4/74)		+	+			-					3.4
15	3/77 (2/76)			-						+		4.4
16	4/77 (4/77)											5.5
17	1/78 (3/78)	+		+	+			-	-	-		2.2
18	2/78 (1/82)			+	-							3.5
19	3/78 (1/81)	+		+	-						-	2.4
20	4/78 (4/78)											5.5
21	1/79 (3/78)		+	-	+		+			-		2.3
22	2/79 (2/75)	-	-	-								2.5
23	3/79 (1/74)				+	-			-	-		3.3
24	4/79 (4/74)								-			5.4
25	1/80 (3/79)					-		+				4.4
26	2/80 (2/81)		+	-	+	-	+	-				1.3
27	3/80 (3/76)	+	+	-			+			-		2.3
28	4/80 (2/74)		+					-				4.4
29	1/81 (4/81)				+					-		4.4
30	2/81 (2/81)											5.5
31	3/81 (1/80)	+		+		-						2.5
32	4/81 (2/81)		+		+		-				-	3.3
33	1/82 (1/81)			+	-			-			+	3.3
PCT SIG FOR +		15	24	24	27	12	21	6	6	21	6	3.06,3.52

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: BEST ANALOGER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74	(2/79)											5.5
2	2/74	(3/80)	-	-		-	+		+		+		1.3
3	3/74	(1/81)		+	+			-	-				3.3
4	4/74	(4/76)				-							4.5
5	1/75	(2/76)											5.5
6	2/75	(1/79)		+		+					-	-	3.3
7	3/75	(3/76)					+				+		4.4
8	4/75	(2/76)			+	-			-				3.4
9	1/76	(2/81)				+							4.5
10	2/76	(1/75)											5.5
11	3/76	(3/75)					+				+		4.4
12	4/76	(1/78)			-	-		+	+		+		3.2
13	1/77	(4/74)		-									4.5
14	2/77	(2/76)			-		-						3.5
15	3/77	(4/77)		-	+								3.5
16	4/77	(3/78)		-						+			4.4
17	1/78	(1/82)	-	-					+				3.4
18	2/78	(1/81)			+			+	-				4.3
19	3/78	(4/78)			+			-			+		4.3
20	4/78	(3/78)			+			-			+		4.3
21	1/79	(2/75)		+		+					-	-	3.3
22	2/79	(1/74)											5.5
23	3/79	(4/74)		+				-				-	4.3
24	4/79	(3/79)								-		-	5.3
25	1/80	(2/81)			+		-	+	-				3.3
26	2/80	(3/76)		-						+			4.4
27	3/80	(2/74)	-	-		-	+		+		+		1.3
28	4/80	(4/81)		+		+	-						2.5
29	1/81	(2/81)			+	+		-			-	-	3.2
30	2/81	(1/80)			+		-	+	-				3.3
31	3/81	(2/81)		-	+				-				3.4
32	4/81	(1/81)				+					-		4.4
33	1/82	(1/78)	-	-					+				3.4
PCT SIG FOR +			0	15	30	18	12	12	15	6	21	0	3.52,3.82

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: EMPR MARKOVER

TEMPERATURE ON THE GEOGRAPHIC GRID

	SEASON	PAC	NCB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1	1/74											5.5
2	2/74											5.5
3	3/74			+						-		4.4
4	4/74		+								-	4.4
5	1/75						-		+			5.3
6	2/75					+						4.5
7	3/75				+							4.5
8	4/75		-						+			4.4
9	1/76		+				-					4.4
10	2/76			-	+							3.5
11	3/76											5.5
12	4/76							+	+			5.3
13	1/77	+				+	-					3.4
14	2/77											5.5
15	3/77				-							4.5
16	4/77			+			-					4.4
17	1/78			+		-						3.5
18	2/78											5.5
19	3/78											5.5
20	4/78										+	5.4
21	1/79	-						+			+	4.3
22	2/79								-			5.4
23	3/79											5.5
24	4/79	+							-			4.4
25	1/80		+									4.5
26	2/80			-	+						+	3.4
27	3/80			+								4.5
28	4/80					-	-					4.4
29	1/81		-	+								3.5
30	2/81					+						4.5
31	3/81			+	+							3.5
32	4/81			+								4.5
33	1/82			+	-		-	-				3.3
PCT SIG FOR +		6	9	24	12	9	9	6	9	3	9	4.12 4.42

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PROB MARKOVER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NGP	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FOR*
1 1/74							+				5.4
2 2/74		+			-	+					3.4
3 3/74			+						-		4.4
4 4/74	+					-					4.4
5 1/75	-										4.5
6 2/75		-							+		4.4
7 3/75								-		+	5.3
8 4/75				-							4.5
9 1/76		+			-		-				3.4
10 2/76			-	+	-						2.5
11 3/76		-			+						3.5
12 4/76			+								4.5
13 1/77				+		-					4.4
14 2/77	-	+		+			-	-			2.3
15 3/77											5.5
16 4/77			+								4.5
17 1/78		+	+			-					3.4
18 2/78			+	-							3.5
19 3/78				-						+	4.4
20 4/78		-	+				-				3.4
21 1/79											5.5
22 2/79					+	-					4.4
23 3/79											5.5
24 4/79											5.5
25 1/80		+	+		-	-					2.4
26 2/80			-	+							3.5
27 3/80			+		-	+	-				3.3
28 4/80					-				+		4.4
29 1/81				+	-						3.5
30 2/81			+			-	-			-	4.2
31 3/81		-	+				+				3.4
32 4/81			+	+						-	3.4
33 1/82	+		+	-							2.5
PCT SIG FOR +	6	15	36	18	6	6	6	0	6	6	3.61.4.27

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: HYBRIDER

TEMPERATURE ON THE GEOGRAPHIC GRID

SEASON	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
1 1/74	-	-		-							2.5
2 2/74			-		-	+	-	+	-	+	3.0
3 3/74	-	-	+		+			-	-		1.3
4 4/74	+	+							-		3.4
5 1/75					+	-	+	-			4.2
6 2/75		-						-	+		4.3
7 3/75		-	+						-		3.4
8 4/75	-							-			4.4
9 1/76				-	-	+	-				3.3
10 2/76			-	+					+		3.4
11 3/76		+		+					-		3.4
12 4/76				+		-		+	-		4.2
13 1/77					+	-	-	+	-	+	4.0
14 2/77		+									4.5
15 3/77		-	-	-		+	+	+			2.2
16 4/77	+	+	+		-	+		-			1.3
17 1/78	+		+	+		-	-	-	-		2.1
18 2/78			+	-							3.5
19 3/78	+	-									3.5
20 4/78	+	+	+						-		2.4
21 1/79		+		+		-				+	3.3
22 2/79	-	-	-		+		+	-	+		1.2
23 3/79					-	+	+	-	-		4.1
24 4/79								-			5.4
25 1/80						-			+		5.3
26 2/80		+	-	+		-					2.4
27 3/80	+	+			-	+			-	+	2.2
28 4/80										-	5.4
29 1/81				+	-			+			3.4
30 2/81	+	+	+	+	-	-	-			-	2.2
31 3/81	+	-	+				+				2.4
32 4/81		+	+			-		-		-	3.2
33 1/82			+	-	+	-	-			+	2.2
PCT SIG FOR +	24	30	36	24	15	18	15	15	12	15	2.88,3.03

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

18. Forecaster Precipitation Scores for Each Season

18.1 Table Descriptions

The general comments of §12 are applicable here, as this section and §12 are exactly parallel in content, as far as the records go. There are only minor differences, as, e.g., the precipitation record beginning with season 3 rather than season 1.

18.2 Interpretations

Glancing down through the records, we see that seasons 20 (4/78) and 27 (3/80) are conspicuous by the absence of stars, indicating difficult-to-predict precipitation in these seasons. On the other hand, precipitation in seasons 28 (4/80), 30 (2/81) and 31 (3/81) was relatively easy to predict. The empirical forecasters, as in the case of the temperature records, are once again relatively skillful, compared to the human forecasters.

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	U	V	W	M	STARS	PLUS	FORM
SEASON 3 3/74							
JERRY NAMIAS	38	43	18	79			2.3
WEATHER SERV	40	47	12	71	*		4.3
PERSISTER	24	59	16	91			4.4
CLIMATER	49	50	0	50	*		5.4
STOCHASTER	23	57	19	95			5.5
PURE ANALOGER (1/78)	27	54	18	90			3.5
PERS ANALOGER (4/77)	25	47	27	101			4.5
REST ANALOGER (3/78)	44	47	8	63	*		4.5
EMPR MARKOVER	39	44	16	76	*		4.4
PROB MARKOVER	52	40	9	58	**		3.4
HYBRIDER	39	41	19	79			4.5

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 4 4/74							
JERRY NAMIAS	49	40	10	60	**		5.5
WEATHER SERV	34	46	19	84			2.4
PERSISTER	38	47	14	75	*		5.4
CLIMATER	26	73	0	73			5.5
STOCHASTER	36	36	27	90			5.4
PURE ANALOGER (4/78)	40	42	17	76	*		5.4
PERS ANALOGER (3/78)	27	52	20	92			5.4
BEST ANALOGER (4/76)	47	40	12	64	**		3.4
EMPR MARKOVER	30	50	19	88			5.5
PROB MARKOVER	52	40	7	54	**		4.4
HYBRIDER	38	57	4	65			5.5
SEASON 5 1/75							
JERRY NAMIAS	46	36	17	70	***	+	3.3
WEATHER SERV	46	46	7	60	*	+	3.3
PERSISTER	33	39	27	93			4.5
CLIMATER	33	66	0	66			5.3
STOCHASTER	35	45	19	83			5.5
PURE ANALOGER (1/77)	22	45	32	109			2.4
PERS ANALOGER (4/76)	27	35	37	109			5.4
BEST ANALOGER (4/77)	48	45	6	57	*	+	4.4
EMPR MARKOVER	35	46	18	82			4.4
PROB MARKOVER	48	39	12	63	**	+	5.3
HYBRIDER	32	50	17	84			5.5
SEASON 6 2/75							
JERRY NAMIAS	41	47	12	71	*		2.3
WEATHER SERV	42	52	5	62	*		5.5
PERSISTER	38	47	14	75	*		4.5
CLIMATER	28	61	0	61			5.5
STOCHASTER	34	46	19	84			4.3
PURE ANALOGER (1/78)	36	53	10	73	*		3.4
PERS ANALOGER (4/77)	41	46	12	70	*		4.3
BEST ANALOGER (2/78)	57	40	2	44	**		5.5
EMPR MARKOVER	45	40	14	68	**		4.4
PROB MARKOVER	50	37	12	61	**		4.4
HYBRIDER	48	47	4	55	*		4.4

PRECIPITATION	U	V	W	M	STARS	PLUS FORM
SEASON 7 3/75						
JERRY NAMIAS	76	51	12	75	*	3.5
WEATHER SERV	37	54	8	70	*	5.5
PERSISTER	39	47	13	73	*	4.3
CLIMATER	53	46	0	46	*	4.5
STOCHASTER	37	46	16	78		5.4
PURE ANALOGER (3/78)	36	53	10	73	*	3.5
PERS ANALOGER (2/78)	40	45	14	73	*	4.4
BEST ANALOGER (2/80)	49	39	11	61	**	3.3
EMPR MARKOVER	45	40	14	68	**	5.4
PROB MARKOVER	61	31	7	45	***	4.5
HYBRIDER	53	36	10	56	***	3.5
SEASON 8 4/75						
JERRY NAMIAS	21	50	28	106		3.5
WEATHER SERV	32	44	23	90		5.5
PERSISTER	42	42	15	72	*	5.3
CLIMATER	45	54	0	54	*	4.3
STOCHASTER	32	48	19	86		5.2
PURE ANALOGER (3/80)	36	42	21	84		3.4
PERS ANALOGER (2/80)	49	37	13	63	**	4.4
BEST ANALOGER (1/82)	53	41	5	51	**	3.5
EMPR MARKOVER	43	37	19	75	**	2.5
PROB MARKOVER	61	24	14	52	***	3.5
HYBRIDER	59	35	5	45	***	4.5
SEASON 9 1/76						
JERRY NAMIAS	37	43	19	81		5.3
WEATHER SERV	75	46	18	82		4.1
PERSISTER	44	40	15	70	**	4.4
CLIMATER	41	58	0	58		2.3
STOCHASTER	34	42	23	88		4.5
PURE ANALOGER (2/74)	36	47	16	79		2.4
PERS ANALOGER (1/82)	39	47	13	73	*	3.3
BEST ANALOGER (3/80)	55	32	12	56	***	2.4
EMPR MARKOVER	41	37	21	79		4.4
PROB MARKOVER	55	34	10	54	***	2.4
HYBRIDER	47	42	11	62	*	3.2

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 10 2/76							
JERRY NAMIAS	45	40	14	68	**	+	3.3
WEATHER SERV	30	38	31	100			5.4
PERSISTER	24	56	19	94			4.5
CLIMATER	31	68	0	68			4.5
STOCHASTER	30	49	20	89			4.5
PURE ANALOGER (4/80)	30	52	17	86			4.5
PERS ANALOGER (3/80)	43	40	16	72	**	+	5.5
BEST ANALOGER (1/81)	49	36	14	64	***	+	5.5
EMPR MARKOVER	44	43	12	67	*	+	5.4
PROB MARKOVER	49	39	11	61	**	+	4.4
HYBRIDER	28	57	14	85			4.4
SEASON 11 3/76							
JERRY NAMIAS	52	41	6	53	**	+	4.3
WEATHER SERV	32	53	14	81			5.4
ANALOGER	40	43	16	75	*	+	2.5
PERSISTER	34	42	23	88			3.4
CLIMATER	37	62	0	62			5.5
STOCHASTER	30	50	19	88			5.4
PURE ANALOGER (2/81)	50	35	14	63	***	+	3.4
PERS ANALOGER (1/81)	36	46	17	80			3.5
BEST ANALOGER (2/81)	50	35	14	63	***	+	3.4
EMPR MARKOVER	43	42	14	70	*	+	5.5
PROB MARKOVER	59	34	6	46	***	+	3.4
HYBRIDER	45	45	9	63	*	+	3.5
SEASON 12 4/76							
WEATHER SERV	37	38	24	86			4.4
PERSISTER	36	47	16	79			1.3
CLIMATER	32	67	0	67			4.3
STOCHASTER	33	44	22	88			4.4
PURE ANALOGER (3/81)	32	41	26	93			4.4
PERS ANALOGER (2/81)	45	38	16	79	**	+	2.4
BEST ANALOGER (4/74)	47	40	12	64	**	+	3.4
EMPR MARKOVER	38	37	24	85			5.4
PROB MARKOVER	42	45	12	69	*	+	5.5
HYBRIDER	38	48	13	74	*	+	5.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 13 1/77							
JERRY NAMIAS	45	37	17	71	**	+	2.2
WEATHER SERV	47	38	14	66	**	+	3.4
ANALOGER	38	29	32	93			3.4
PERSISTER	36	42	21	84			3.3
CLIMATER	24	75	0	75			3.4
STOCHASTER	35	39	25	89			5.4
PURE ANALOGER (1/75)	22	45	32	109			2.4
PERS ANALOGER (4/74)	34	42	23	88			4.5
BEST ANALOGER (1/81)	49	37	13	63	**	+	3.3
EMPR MARKOVER	38	41	20	81			5.4
PROB MARKOVER	39	40	20	80			4.5
HYBRIDER	30	55	14	83			4.4
SEASON 14 2/77							
JERRY NAMIAS	25	60	14	88			5.4
WEATHER SERV	37	54	8	70	*		3.3
ANALOGER	48	43	8	59	*		5.5
PERSISTER	25	56	18	92			4.3
CLIMATER	54	45	0	45	*		3.3
STOCHASTER	33	47	19	85			5.4
PURE ANALOGER (2/81)	28	56	15	86			5.3
PERS ANALOGER (1/81)	29	53	17	87			4.5
BEST ANALOGER (4/81)	46	46	7	60	*		5.5
EMPR MARKOVER	49	42	8	58	*		4.5
PROB MARKOVER	54	34	11	56	***		4.5
HYBRIDER	54	33	12	57	***		3.5
SEASON 15 3/77							
JERRY NAMIAS	37	42	20	82			3.3
WEATHER SERV	74	56	9	74			4.5
ANALOGER	45	43	11	65	*	+	4.4
ART DOUGLAS	24	48	27	102			4.3
PERSISTER	33	53	13	79			4.4
CLIMATER	39	60	0	60			4.2
STOCHASTER	30	44	25	94			5.5
PURE ANALOGER (1/82)	37	41	21	83			3.3
PERS ANALOGER (4/81)	42	51	6	63	*	+	5.4
BEST ANALOGER (3/79)	54	38	7	52	**	+	4.4
EMPR MARKOVER	44	38	17	72	**	+	4.4
PROB MARKOVER	47	38	14	66	**	+	5.4
HYBRIDER	45	45	9	63	*	+	4.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 16 4/77							
WEATHER SERV	49	46	4	54	*	+	5.5
ANALOGER	36	56	7	70			3.4
ART DOUGLAS	47	44	8	60	*	+	4.4
PERSISTER	30	43	26	95			4.3
CLIMATER	32	67	0	67			4.5
STOCHASTER	31	38	30	98			5.2
PURE ANALOGER (4/79)	42	43	14	71	*	+	4.4
PERS ANALOGER (3/79)	34	41	24	89			3.2
REST ANALOGER (2/74)	59	36	4	44	***	+	5.5
EMPR MARKOVER	43	34	22	78			4.5
PROB MARKOVER	49	35	15	65	***	+	3.4
HYBRIDER	49	38	12	62	**	+	5.3
SEASON 17 1/78							
JERRY NAMIAS	26	54	19	92			4.5
WEATHER SERV	36	48	15	78			3.3
ANALOGER	46	48	5	58	*		5.4
ART DOUGLAS	48	42	9	60	*		3.5
PERSISTER	28	51	20	91			3.3
CLIMATER	45	54	0	54	*		5.3
STOCHASTER	32	47	20	87			5.4
PURE ANALOGER (3/74)	27	54	18	90			3.5
PERS ANALOGER (2/74)	31	51	17	85			5.5
REST ANALOGER (2/80)	54	39	6	51	**		5.3
EMPR MARKOVER	45	42	12	66	*		4.5
PROB MARKOVER	52	31	16	63	***		5.3
HYBRIDER	44	41	14	69	**		4.4
SEASON 18 2/78							
JERRY NAMIAS	40	46	13	72	*		2.3
WEATHER SERV	35	45	19	83			3.4
ANALOGER	33	55	11	77			4.4
ART DOUGLAS	35	59	5	69			5.5
PERSISTER	42	49	8	65	*		5.5
CLIMATER	50	49	0	49	*		4.3
STOCHASTER	37	50	12	74	*		3.5
PURE ANALOGER (3/80)	16	63	20	103			5.5
PERS ANALOGER (2/80)	35	54	10	74	*		4.5
REST ANALOGER (2/75)	57	40	2	44	**		5.5
EMPR MARKOVER	35	51	13	77			5.5
PROB MARKOVER	49	43	7	57	*		4.3
HYBRIDER	35	52	12	76	*		5.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 19 3/78							
JERRY NAMIAS	39	47	13	73	*		4.3
WEATHER SERV	28	56	15	86			5.3
ANALOGER	40	52	7	66	*		5.5
ART DOUGLAS	29	67	3	73			5.5
PERSISTER	31	52	16	84			3.4
CLIMATER	46	53	0	53	*		1.3
STOCHASTER	30	56	13	82			5.4
PURE ANALOGER (3/75)	36	53	10	73	*		3.5
PERS ANALOGER (2/75)	33	44	22	88			5.5
BEST ANALOGER (3/81)	47	45	7	59	*		4.5
EMPR MARKOVER	42	40	17	74	**		5.5
PROP MARKOVER	51	42	6	54	*		5.5
HYBRIDER	39	55	5	65			3.5
SEASON 20 4/78							
JERRY NAMIAS	19	58	22	102			4.5
WEATHER SERV	32	49	18	85			3.5
ANALOGER	36	45	18	81			4.4
ART DOUGLAS	28	45	26	97			4.5
PERSISTER	34	50	15	80			3.4
CLIMATER	36	63	0	63			4.3
STOCHASTER	30	37	32	101			4.5
PURE ANALOGER (4/81)	44	42	13	68	*	+	4.5
PERS ANALOGER (3/81)	36	43	20	83			4.3
BEST ANALOGER (2/81)	54	34	11	56	***	+	4.5
EMPR MARKOVER	41	43	15	73	*	+	4.4
PROP MARKOVER	54	40	5	50	**	+	5.5
HYBRIDER	47	47	5	57	*	+	4.4
SEASON 21 1/79							
JERRY NAMIAS	48	47	4	55	*	+	3.3
WEATHER SERV	52	41	6	53	**	+	3.3
ANALOGER	42	43	14	71	*	+	3.2
ART DOUGLAS	48	46	5	56	*	+	4.3
PERSISTER	38	40	21	82			4.2
CLIMATER	28	71	0	71			4.3
STOCHASTER	34	44	21	86			5.5
PURE ANALOGER (3/81)	21	55	23	101			4.5
PERS ANALOGER (2/81)	38	42	19	80			3.3
BEST ANALOGER (2/79)	53	40	6	52	**	+	2.5
EMPR MARKOVER	41	35	23	81			5.5
PROP MARKOVER	50	37	12	61	**	+	4.4
HYBRIDER	27	53	19	91			4.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 22 2/79							
JERRY NAMIAS	34	42	23	88			4.5
WEATHER SERV	56	36	7	50	***		4.2
ANALOGER	40	48	11	70	*		2.4
ART DOUGLAS	29	54	16	86			4.3
PERSISTER	53	40	6	52	**		2.5
CLIMATER	36	63	0	63			3.3
STOCHASTER	40	38	21	80			4.5
PURE ANALOGER (3/79)	39	47	13	73	*		5.3
PERS ANALOGER (2/79)	99	0	0	0	***		5.5
BEST ANALOGER (1/79)	53	40	6	52	**		2.5
EMPR MARKOVER	47	33	23	79			4.5
PROB MARKOVER	48	40	11	62	**		5.2
HYBRIDER	60	32	7	46	***		4.3
SEASON 23 3/79							
JERRY NAMIAS	49	39	11	61	**		3.3
WEATHER SERV	45	48	6	60	*		3.4
ANALOGER	38	51	10	71	*		5.5
ART DOUGLAS	28	58	13	84			4.5
PERSISTER	39	47	13	73	*		5.3
CLIMATER	37	62	0	62			3.4
STOCHASTER	37	44	18	80			4.4
PURE ANALOGER (2/79)	39	47	13	73	*		5.3
PERS ANALOGER (1/79)	34	45	20	85			5.3
BEST ANALOGER (3/77)	54	38	7	52	**		4.4
EMPR MARKOVER	44	43	12	67	*		5.5
PROB MARKOVER	56	37	6	49	**		5.4
HYBRIDER	50	41	8	57	**		3.4
SEASON 24 4/79							
JERRY NAMIAS	24	45	30	105			5.4
WEATHER SERV	32	48	19	86			3.4
ANALOGER	17	55	27	109			5.4
ART DOUGLAS	35	53	11	75	*	+	3.3
PERSISTER	75	46	18	82			3.5
CLIMATER	29	70	0	70			4.4
STOCHASTER	38	40	21	82			5.5
PURE ANALOGER (4/77)	42	43	14	71	*	+	4.4
PERS ANALOGER (3/77)	39	42	18	78			4.4
BEST ANALOGER (4/77)	42	43	14	71	*	+	4.4
EMPR MARKOVER	40	41	19	77			2.5
PROB MARKOVER	47	40	16	72	**	+	5.4
HYBRIDER	36	52	11	74	*	+	4.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 25 1/80							
JERRY NAMIAS	24	39	36	111			3.4
WEATHER SERV	19	46	34	114			4.4
ANALOGER	49	44	6	56	*	+	4.4
ART DOUGLAS	31	52	16	84			4.3
PERSISTER	21	43	35	113			3.5
CLIMATER	34	65	0	65			4.3
STOCHASTER	33	43	23	89			3.5
PURE ANALOGER (1/78)	49	37	13	63	**	+	4.3
PERS ANALOGER (4/77)	22	36	41	118			4.5
BEST ANALOGER (2/81)	49	40	10	60	**	+	4.3
EMPR MARKOVER	44	39	16	71	**	+	5.4
PROB MARKOVER	54	37	8	53	**	+	5.5
HYPRIDER	37	42	20	82			4.3
SEASON 26 2/80							
JERRY NAMIAS	37	49	13	75	*		3.2
WEATHER SERV	51	39	9	57	**		4.5
ANALOGER	41	54	5	64	*		3.3
ART DOUGLAS	35	55	9	73			4.3
PERSISTER	45	40	14	68	**		4.2
CLIMATER	36	63	0	63			5.3
STOCHASTER	41	45	14	73			5.3
PURE ANALOGER (3/81)	22	47	30	107			4.5
PERS ANALOGER (2/81)	51	36	12	60	***		2.2
BEST ANALOGER (1/78)	54	39	6	51	**		5.3
EMPR MARKOVER	39	36	24	84			5.5
PROB MARKOVER	42	46	11	68	*		5.4
HYPRIDER	26	57	16	89			3.4
SEASON 27 3/80							
JERRY NAMIAS	21	51	27	105			4.5
WEATHER SERV	35	43	21	85			2.4
ANALOGER	31	58	10	78			5.4
ART DOUGLAS	26	57	16	89			5.3
PERSISTER	25	45	28	103			4.5
CLIMATER	37	62	0	62			1.4
STOCHASTER	40	41	18	77			4.5
PURE ANALOGER (2/78)	16	63	25	103			5.5
PERS ANALOGER (1/78)	26	56	17	99			4.5
BEST ANALOGER (1/76)	55	32	12	56	***	+	2.4
EMPR MARKOVER	37	46	16	78			5.5
PROB MARKOVER	48	35	16	67	***	+	3.5
HYPRIDER	31	51	17	85			2.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 28 4/80							
JERRY NAMIAS	36	51	12	75	*	+	5.5
WEATHER SERV	35	52	12	76	*	+	5.4
ANALOGER	39	50	10	70	*	+	4.5
ART DOUGLAS	35	45	19	83			5.4
PERSISTER	37	40	22	84			5.4
CLIMATER	43	56	0	56			5.5
STOCHASTER	33	49	17	83			5.5
PURE ANALOGER (2/76)	30	52	17	86			4.5
PERS ANALOGER (1/76)	36	44	19	82			5.4
BEST ANALOGER (3/78)	46	43	10	63	*	+	4.4
EMPR MARKOVER	37	51	11	73	*	+	5.5
PROB MARKOVER	51	41	7	55	**	+	4.5
HYBRIDER	33	55	11	77			4.3
SEASON 29 1/81							
JERRY NAMIAS	49	30	20	70	***	+	2.1
WEATHER SERV	44	43	12	67	*	+	2.4
ANALOGER	40	38	21	80			3.3
ART DOUGLAS	32	49	18	85			2.4
PERSISTER	28	54	17	88			3.3
CLIMATER	27	72	0	72			2.4
STOCHASTER	32	41	26	93			5.4
PURE ANALOGER (4/78)	36	49	14	77			3.5
PERS ANALOGER (3/78)	36	55	8	71			4.3
BEST ANALOGER (3/81)	52	34	13	60	***	+	4.3
EMPR MARKOVER	45	41	13	67	**	+	5.3
PROB MARKOVER	40	41	18	77			4.5
HYBRIDER	26	61	12	85			2.4
SEASON 30 2/81							
JERRY NAMIAS	44	40	15	70	**	+	4.2
WEATHER SERV	34	51	14	79			4.4
ANALOGER	50	35	14	63	***	+	5.4
ART DOUGLAS	47	44	8	60	*	+	2.3
PERSISTER	32	41	26	93			4.4
CLIMATER	34	65	0	65			5.4
STOCHASTER	37	42	20	82			4.4
PURE ANALOGER (4/81)	41	41	17	75	**	+	4.4
PERS ANALOGER (3/80)	24	55	20	95			5.3
BEST ANALOGER (4/78)	54	34	11	56	***	+	4.5
EMPR MARKOVER	36	43	20	83			5.3
PROB MARKOVER	52	37	10	57	**	+	5.5
HYBRIDER	39	48	12	72	*	+	4.4

PRECIPITATION	U	V	W	M	STARS	PLUS	FORM
SEASON 31 3/81							
JERRY NAMIAS	53	42	4	50	*	+	3.4
WEATHER SERV	41	45	13	71	*	+	4.4
ANALOGER	49	41	9	59	**	+	5.3
ART DOUGLAS	45	44	10	64	*	+	5.4
PERSISTER	32	45	22	89			1.3
CLIMATER	35	64	0	64			4.4
STOCHASTER	38	41	20	81			5.4
PURE ANALOGER (1/79)	21	55	23	101			4.5
PERS ANALOGER (4/78)	36	43	20	83			4.3
BEST ANALOGER (3/79)	50	42	7	56	*	+	4.5
EMPR MARKOVER	36	44	19	82			5.5
PROP MARKOVER	48	38	13	64	**	+	3.4
HYBRIDER	47	43	9	61	*	+	3.5
SEASON 32 4/81							
JERRY NAMIAS	33	51	15	81			4.3
WEATHER SERV	27	58	14	86			4.5
ANALOGER	34	58	7	72			4.4
ART DOUGLAS	42	39	18	75	**		5.4
PERSISTER	41	47	11	69	*		5.4
CLIMATER	41	59	0	59			4.5
STOCHASTER	35	43	20	93			5.3
PURE ANALOGER (4/79)	25	49	25	99			4.5
PERS ANALOGER (3/79)	46	41	12	65	**		4.5
BEST ANALOGER (2/78)	44	52	3	58	*		2.3
EMPR MARKOVER	37	44	18	80			4.5
PROP MARKOVER	52	39	8	55	**		4.4
HYBRIDER	37	49	13	75	*		4.5
SEASON 33 1/82							
JERRY NAMIAS	35	43	21	85			4.5
WEATHER SERV	35	53	11	75	*	+	4.4
ANALOGER	29	60	10	80			4.5
ART DOUGLAS	42	49	8	65	*	+	4.2
PERSISTER	25	64	10	84			5.5
CLIMATER	42	57	0	57			3.5
STOCHASTER	31	45	23	91			5.5
PURE ANALOGER (3/78)	35	50	14	78			4.4
PERS ANALOGER (2/78)	40	48	11	70	*	+	5.4
BEST ANALOGER (4/75)	53	41	5	51	**	+	3.5
EMPR MARKOVER	48	38	13	64	**	+	3.4
PROP MARKOVER	46	43	10	63	*	+	5.4
HYBRIDER	32	61	6	73			4.3

19. Seasonal Precipitation Scores for Each Forecaster

This section parallels §13, now for precipitation.

FORECASTER: JERRY NAMIAS

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
3 3/74	38	43	18	79			2.3
4 4/74	49	40	10	60	**		5.5
5 1/75	46	36	17	70	***	+	3.3
6 2/75	40	47	12	71	*		2.3
7 3/75	36	51	12	75	*		3.5
8 4/75	21	50	28	106			3.5
9 1/76	37	43	19	81			5.3
10 2/76	45	40	14	68	**	+	3.3
11 3/76	52	41	6	53	**	+	4.3
13 1/77	45	37	17	71	**	+	2.2
14 2/77	25	60	14	88			5.4
15 3/77	37	42	20	82			3.3
17 1/78	26	54	19	92			4.5
18 2/78	40	46	13	72	*		2.3
19 3/78	39	47	13	73	*		4.3
20 4/78	19	58	22	102			4.5
21 1/79	48	47	4	55	*	+	3.3
22 2/79	34	42	23	88			4.5
23 3/79	49	39	11	61	**		0.3
24 4/79	24	45	30	105			5.4
25 1/80	24	39	36	111			3.4
26 2/80	37	49	13	75	*		3.2
27 3/80	21	51	27	105			4.5
28 4/80	36	51	12	75	*	+	5.5
29 1/81	49	31	20	70	***	+	2.1
30 2/81	44	41	15	70	**	+	4.2
31 3/81	53	42	4	50	*	+	3.4
32 4/81	33	51	15	81			4.3
33 1/82	35	43	21	85			4.5
THERE WERE 29 FORECASTS MADE							
AVERAGE	37.3	45.0	16.7	78.4	.90	.31	3.4,3.6
STD DEV	10.0	6.7	7.4	16.3	.98	.47	1.2,1.2

FORECASTER: WEATHER SERV

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
3 3/74	40	47	12	71	*		4,3
4 4/74	34	46	19	84			2,4
5 1/75	46	46	7	60	*	+	3,3
6 2/75	42	52	5	62	*		5,5
7 3/75	37	54	8	70	*		5,5
8 4/75	32	44	23	90			5,5
9 1/76	35	46	18	82			4,1
10 2/76	30	38	31	100			5,4
11 3/76	32	53	14	81			5,4
12 4/76	37	38	24	86			4,4
13 1/77	47	38	14	66	**	+	3,4
14 2/77	37	54	8	70	*		3,3
15 3/77	34	56	9	74			4,5
16 4/77	49	46	4	54	*	+	5,5
17 1/78	36	48	15	78			3,3
18 2/78	35	45	19	83			3,4
19 3/78	28	56	15	86			5,3
20 4/78	32	48	18	85			3,5
21 1/79	52	41	6	53	**	+	3,3
22 2/79	56	36	7	50	***		4,2
23 3/79	45	48	6	60	*		3,4
24 4/79	32	48	19	86			3,4
25 1/80	19	46	34	114			4,4
26 2/80	51	39	9	57	**		4,5
27 3/80	35	43	21	85			2,4
28 4/80	35	52	12	76	*	+	5,4
29 1/81	44	43	12	67	*	+	2,4
30 2/81	34	51	14	79			4,4
31 3/81	41	45	13	71	*	+	4,4
32 4/81	27	58	14	86			4,5
33 1/82	35	53	11	75	*	+	4,4
THERE WERE 31 FORECASTS MADE							
AVERAGE	37.7	47.1	14.2	75.5	.65	.26	3.8,3.9
STD DEV	8.1	5.9	7.3	14.2	.89	.44	1.0, .9

FORECASTER: ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
11 3/76	40	43	16	75	*	+	2.5
13 1/77	38	29	32	93			3.4
14 2/77	48	43	8	59	*		5.5
15 3/77	45	43	11	65	*	+	4.4
16 4/77	36	56	7	70			3.4
17 1/78	46	48	5	58	*		5.4
18 2/78	33	55	11	77			4.4
19 3/78	40	52	7	66	*		5.5
20 4/78	36	45	18	81			4.4
21 1/79	42	43	14	71	*	+	3.2
22 2/79	40	48	11	70	*		2.4
23 3/79	38	51	10	71	*		5.5
24 4/79	17	55	27	109			5.4
25 1/80	49	44	6	56	*	+	4.4
26 2/80	40	54	5	64	*		3.3
27 3/80	31	58	10	78			5.4
28 4/80	39	50	10	70	*	+	4.5
29 1/81	40	38	21	80			3.7
30 2/81	50	35	14	63	***	+	5.4
31 3/81	49	41	9	59	**	+	5.3
32 4/81	34	58	7	72			4.4
33 1/82	29	60	10	80			4.5
THERE WERE 22 FORECASTS MADE							
AVERAGE	39.1	47.7	12.2	72.1	.73	.32	4.0 4.0
STD DEV	7.7	8.1	7.0	12.2	.77	.48	1.0 .8

FORECASTER: ART DOUGLAS

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
15 3/77	24	48	27	102			4.3
16 4/77	47	44	8	60	*	+	4.4
17 1/78	48	42	9	60	*		3.5
18 2/78	35	59	5	69			5.5
19 3/78	29	67	3	73			5.5
20 4/78	28	45	24	97			4.5
21 1/79	48	46	5	56	*	+	4.3
22 2/79	29	54	16	86			4.3
23 3/79	28	58	13	84			4.5
24 4/79	35	53	11	75	*	+	3.3
25 1/80	31	52	16	84			4.3
26 2/80	35	55	9	73			4.3
27 3/80	26	57	16	89			5.3
28 4/80	35	45	19	83			5.4
29 1/81	32	49	18	85			2.4
30 2/81	47	44	8	60	*	+	2.3
31 3/81	45	44	10	64	*	+	5.4
32 4/81	42	39	18	75	**		5.4
33 1/82	42	49	8	65	*	+	4.2
THERE WERE 19 FORECASTS MADE							
AVERAGE	36.1	50.0	12.9	75.8	.47	.32	4.0 3.7
STD DEV	8.2	7.1	6.8	13.2	.61	.48	.9 .9

FORECASTER: PERSISTER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS FORM
3 3/74	24	59	16	91		4.4
4 4/74	38	47	14	75	*	5.4
5 1/75	33	39	27	93		4.5
6 2/75	38	47	14	75	*	4.5
7 3/75	39	47	13	73	*	4.3
8 4/75	42	42	15	72	*	5.3
9 1/76	44	40	15	70	**	4.4
10 2/76	24	56	19	94		4.5
11 3/76	34	42	23	88		3.4
12 4/76	36	47	16	79		1.3
13 1/77	36	42	21	84		3.3
14 2/77	25	56	18	99		4.3
15 3/77	33	53	13	79		4.4
16 4/77	30	43	26	95		4.3
17 1/78	28	51	20	91		3.3
18 2/78	42	49	8	65	*	5.5
19 3/78	31	52	16	84		3.4
20 4/78	34	50	15	80		3.4
21 1/79	38	40	21	82		4.2
22 2/79	53	40	6	52	**	2.5
23 3/79	39	47	13	73	*	5.3
24 4/79	35	46	18	82		3.5
25 1/80	21	43	35	113		3.5
26 2/80	45	40	14	68	**	4.2
27 3/80	25	45	29	103		4.5
28 4/80	37	40	22	84		5.4
29 1/81	28	54	17	88		3.3
30 2/81	32	41	26	93		4.4
31 3/81	32	45	22	89		1.3
32 4/81	41	47	11	69	*	5.4
33 1/82	25	64	10	84		5.5
THERE WERE 31 FORECASTS MADE						
AVERAGE	34.3	46.9	17.8	82.6	.42	0.00 3.7 3.8
STD DEV	7.3	6.3	6.4	12.1	.67	0.00 1.1 .9

FORECASTER: CLIMATER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS FORM
3 3/74	49	50	0	50	*	5.4
4 4/74	26	73	0	73		5.5
5 1/75	33	66	0	66		5.3
6 2/75	38	61	0	61		5.5
7 3/75	53	46	0	46	*	4.5
8 4/75	45	54	0	54	*	4.3
9 1/76	41	58	0	58		2.3
10 2/76	31	68	0	68		4.5
11 3/76	37	62	0	62		5.5
12 4/76	32	67	0	67		4.3
13 1/77	24	75	0	75		3.4
14 2/77	54	45	0	45	*	3.3
15 3/77	39	60	0	60		4.2
16 4/77	32	67	0	67		4.5
17 1/78	45	54	0	54	*	5.3
18 2/78	50	49	0	49	*	4.3
19 3/78	46	53	0	53	*	1.3
20 4/78	36	63	0	63		4.3
21 1/79	28	71	0	71		4.3
22 2/79	36	63	0	63		3.3
23 3/79	37	62	0	62		3.4
24 4/79	29	70	0	70		4.4
25 1/80	34	65	0	65		4.3
26 2/80	36	63	0	63		5.3
27 3/80	37	62	0	62		1.4
28 4/80	43	56	0	56		5.5
29 1/81	27	72	0	72		2.4
30 2/81	34	65	0	65		5.4
31 3/81	35	64	0	64		4.4
32 4/81	40	59	0	59		4.5
33 1/82	42	57	0	57		3.5

THERE WERE 31 FORECASTS MADE

AVERAGE	37.7	61.3	0.0	61.3	.23	0.00	3.8,3.8
STD DEV	7.8	7.8	0.0	7.8	.43	0.00	1.1, .9

FORECASTER: STOCHASTER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON	U	V	W	M	STARS	PLUS	FORM
3	3/74	23	57	19	95			5.5
4	4/74	36	36	27	90			5.4
5	1/75	35	45	19	83			5.5
6	2/75	34	46	19	84			4.3
7	3/75	37	46	16	78			5.4
8	4/75	32	48	19	86			5.2
9	1/76	34	42	23	88			4.5
10	2/76	30	49	20	89			4.5
11	3/76	30	50	19	88			5.4
12	4/76	33	44	22	88			4.4
13	1/77	35	39	25	89			5.4
14	2/77	33	47	19	85			5.4
15	3/77	30	44	25	94			5.5
16	4/77	31	38	30	98			5.2
17	1/78	32	47	20	87			5.4
18	2/78	37	50	12	74	*		3.5
19	3/78	30	56	13	82			5.4
20	4/78	30	37	32	101			4.5
21	1/79	34	44	21	86			5.5
22	2/79	40	38	21	80			4.5
23	3/79	37	44	18	80			4.4
24	4/79	38	40	21	82			5.5
25	1/80	33	43	23	89			3.5
26	2/80	40	40	19	78			5.3
27	3/80	40	41	18	77			4.5
28	4/80	33	49	17	83			5.5
29	1/81	32	41	26	93			5.4
30	2/81	37	42	20	82			4.4
31	3/81	38	41	20	81			5.4
32	4/81	36	43	20	83			5.3
33	1/82	31	45	23	91			5.5
THERE WERE 31 FORECASTS MADE								
AVERAGE		33.9	44.3	20.8	85.9	.03	0.00	4.6,4.2
STD DEV		3.7	5.0	4.3	6.3	.18	0.00	.6, .9

FORECASTER: PURE ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
3	3/74	(1/78)	27	54	18	90			3.5
4	4/74	(4/78)	40	42	17	76	*		5.4
5	1/75	(1/77)	22	45	32	109			2.4
6	2/75	(1/78)	36	53	10	73	*		3.4
7	3/75	(3/78)	36	53	10	73	*		3.5
8	4/75	(3/80)	36	42	21	84			3.4
9	1/76	(2/74)	36	47	16	79			2.4
10	2/76	(4/80)	30	52	17	86			4.5
11	3/76	(2/81)	50	35	14	63	***	+	3.4
12	4/76	(3/81)	32	41	26	93			4.4
13	1/77	(1/75)	22	45	32	109			2.4
14	2/77	(2/81)	28	56	15	86			5.3
15	3/77	(1/82)	37	41	21	83			3.3
16	4/77	(4/79)	42	43	14	71	*	+	4.4
17	1/78	(3/74)	27	54	18	90			3.5
18	2/78	(3/80)	16	63	20	103			5.5
19	3/78	(3/75)	36	53	10	73	*		3.5
20	4/78	(4/81)	44	42	13	68	*	+	4.5
21	1/79	(3/81)	21	55	23	101			4.5
22	2/79	(3/79)	39	47	13	73	*		5.3
23	3/79	(2/79)	39	47	13	73	*		5.3
24	4/79	(4/77)	42	43	14	71	*	+	4.4
25	1/80	(1/78)	49	37	13	63	**	+	4.3
26	2/80	(3/81)	22	47	30	107			4.5
27	3/80	(2/78)	16	63	20	103			5.5
28	4/80	(2/76)	30	52	17	86			4.5
29	1/81	(4/78)	36	49	14	77			3.5
30	2/81	(4/80)	41	41	17	75	**	+	4.4
31	3/81	(1/79)	21	55	23	101			4.5
32	4/81	(4/79)	25	49	25	99			4.5
33	1/82	(3/78)	35	50	14	78			4.4

THERE WERE 31 FORECASTS MADE

AVERAGE	32.7	48.3	18.1	84.4	.52	.19	3.7	4.3
STD DEV	9.1	6.9	6.1	13.9	.77	.40	.9	.7

FORECASTER: PERS ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
3	3/74	(4/77)	25	47	27	101			4.5
4	4/74	(3/78)	27	52	20	99			5.4
5	1/75	(4/76)	27	35	37	109			5.4
6	2/75	(4/77)	41	46	12	70	*		4.3
7	3/75	(2/78)	40	45	14	73	*		4.4
8	4/75	(2/80)	49	37	13	63	**		4.4
9	1/76	(1/82)	39	47	13	73	*		3.3
10	2/76	(3/80)	43	40	16	72	**	+	5.5
11	3/76	(1/81)	36	46	17	80			3.5
12	4/76	(2/81)	45	38	16	70	**	+	2.4
13	1/77	(4/74)	34	42	23	88			4.5
14	2/77	(1/81)	29	53	17	87			4.5
15	3/77	(4/81)	42	51	6	63	*	+	5.4
16	4/77	(3/79)	34	41	24	89			3.2
17	1/78	(2/74)	31	51	17	85			5.5
18	2/78	(2/80)	35	54	10	74	*		4.5
19	3/78	(2/75)	33	44	22	88			5.5
20	4/78	(3/81)	36	43	20	83			4.3
21	1/79	(2/81)	38	42	19	80			3.3
22	2/79	(2/79)	99	0	0	0	***		5.5
23	3/79	(1/79)	34	45	20	85			5.3
24	4/79	(3/77)	39	42	18	78			4.4
25	1/80	(4/77)	22	36	41	118			4.5
26	2/80	(2/81)	51	36	12	60	***		2.2
27	3/80	(1/78)	26	56	17	90			4.5
28	4/80	(1/76)	36	44	19	82			5.4
29	1/81	(3/78)	36	55	5	71			4.3
30	2/81	(3/80)	24	55	20	95			5.3
31	3/81	(4/78)	36	43	20	83			4.3
32	4/81	(3/79)	46	41	12	65	**		4.5
33	1/82	(2/78)	40	48	11	70	*	+	5.4

THERE WERE 31 FORECASTS MADE

AVERAGE	37.8	43.7	17.5	78.6	.65	.13	4.1,4.3
STD DEV	13.4	10.1	8.0	19.7	.95	.34	.9,1.3

FORECASTER: BEST ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		U	V	W	M	STARS	PLUS	FORM
3	3/74	(3/78)	44	47	8	63	*		4.5
4	4/74	(4/76)	47	40	12	64	**		3.4
5	1/75	(4/77)	48	45	6	57	*	+	4.4
6	2/75	(2/78)	57	40	2	44	**		5.5
7	3/75	(2/80)	49	39	11	61	**		3.3
8	4/75	(1/82)	53	41	5	51	**		3.5
9	1/76	(3/80)	55	32	12	56	***		2.4
10	2/76	(1/81)	49	36	14	64	***	+	5.5
11	3/76	(2/81)	50	35	14	63	***	+	3.4
12	4/76	(4/74)	47	40	12	64	**	+	3.4
13	1/77	(1/81)	49	37	13	63	**	+	3.3
14	2/77	(4/81)	46	46	7	60	*		5.5
15	3/77	(3/79)	54	38	7	52	**	+	4.4
16	4/77	(2/74)	59	36	4	44	***	+	5.5
17	1/78	(2/80)	54	39	6	51	**		5.3
18	2/78	(2/75)	57	40	2	44	**		5.5
19	3/78	(3/81)	47	45	7	59	*		4.5
20	4/78	(2/81)	54	34	11	56	***	+	4.5
21	1/79	(2/79)	53	40	6	52	**	+	2.5
22	2/79	(1/79)	53	40	6	52	**		2.5
23	3/79	(3/77)	54	38	7	52	**		4.4
24	4/79	(4/77)	42	43	14	71	*	+	4.4
25	1/80	(2/81)	49	40	10	60	**	+	4.3
26	2/80	(1/78)	54	39	6	51	**		5.3
27	3/80	(1/76)	55	32	12	56	***	+	2.4
28	4/80	(3/78)	46	43	10	63	*	+	4.4
29	1/81	(3/80)	52	34	13	60	***	+	4.3
30	2/81	(4/78)	54	34	11	56	***	+	4.5
31	3/81	(3/79)	50	42	7	56	*	+	4.5
32	4/81	(2/78)	44	52	3	58	*		2.3
33	1/82	(4/75)	53	41	5	51	**	+	3.5

THERE WERE 31 FORECASTS MADE

AVERAGE	50.9	39.6	8.5	56.6	2.00	.55	3.7	4.2
STD DEV	4.3	4.5	3.7	6.5	.73	.51	1.0	.9

FORECASTER: FMPR MARKOVER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORP
3 3/74	39	44	16	76	*		4.4
4 4/74	30	50	19	88			5.5
5 1/75	35	46	18	82			4.4
6 2/75	45	40	14	68	**		4.4
7 3/75	45	40	14	68	**		5.4
8 4/75	43	37	19	75	**		2.5
9 1/76	41	37	21	79			4.4
10 2/76	44	43	12	67	*	+	5.4
11 3/76	43	42	14	70	*	+	5.5
12 4/76	38	37	24	85			5.4
13 1/77	38	41	23	81			5.4
14 2/77	49	42	8	58	*		4.5
15 3/77	44	38	17	72	**	+	4.4
16 4/77	43	34	22	78			4.5
17 1/78	45	42	12	66	*		4.5
18 2/78	35	51	13	77			5.5
19 3/78	42	40	17	74	**		5.5
20 4/78	41	43	15	73	*	+	4.4
21 1/79	41	35	23	81			5.5
22 2/79	43	33	23	79			4.5
23 3/79	44	43	12	67	*		5.5
24 4/79	40	41	18	77			2.5
25 1/80	44	39	16	71	**	+	5.4
26 2/80	39	36	24	84			5.5
27 3/80	37	46	16	78			5.5
28 4/80	37	51	11	73	*	+	5.5
29 1/81	45	41	13	67	**	+	5.3
30 2/81	36	43	20	83			5.3
31 3/81	36	44	19	82			5.5
32 4/81	37	44	18	80			4.5
33 1/82	48	38	13	64	**	+	3.4
THERE WERE 31 FORECASTS MADE							
AVERAGE	40.9	41.3	16.8	74.9	.77	.26	4.4 4.5
STD DEV	4.3	4.5	4.2	7.1	.84	.44	.8 .6

FORECASTER: PROB MARKOVER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
3 3/74	50	40	9	58	**		3,4
4 4/74	52	40	7	54	**		4,4
5 1/75	48	39	12	63	**	+	5,3
6 2/75	50	37	12	61	**		4,4
7 3/75	61	31	7	45	***		4,5
8 4/75	61	24	14	52	***		3,5
9 1/76	55	34	10	54	***		2,4
10 2/76	49	39	11	61	**	+	4,4
11 3/76	59	34	6	46	***	+	3,4
12 4/76	42	45	12	69	*	+	5,5
13 1/77	39	40	20	80			4,5
14 2/77	54	34	11	56	***		4,5
15 3/77	47	38	14	66	**	+	5,4
16 4/77	49	35	15	65	***	+	3,4
17 1/78	52	31	16	63	***		5,3
18 2/78	49	43	7	57	*		4,3
19 3/78	51	42	6	54	*		5,5
20 4/78	54	40	5	50	**	+	5,5
21 1/79	50	37	12	61	**	+	4,4
22 2/79	48	40	11	62	**		5,2
23 3/79	56	37	6	49	**		5,4
24 4/79	43	40	16	72	**	+	5,4
25 1/80	54	37	8	53	**	+	5,5
26 2/80	42	46	11	68	*		5,4
27 3/80	48	35	16	67	***	+	3,5
28 4/80	51	41	7	55	**	+	4,5
29 1/81	40	41	18	77			4,5
30 2/81	52	37	10	57	**	+	5,5
31 3/81	48	38	13	64	**	+	3,4
32 4/81	52	39	8	55	**		4,4
33 1/82	46	43	10	63	*	+	5,4
THERE WERE 31 FORECASTS MADE							
AVERAGE	50.1	38.0	11.8	59.9	1.97	.48	4.2,4.2
STD DEV	5.5	4.4	3.9	8.3	.84	.51	.9, .8

FORECASTER: HYBRIDER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	U	V	W	M	STARS	PLUS	FORM
3 3/74	39	41	19	79			3.5
4 4/74	38	57	4	65			5.5
5 1/75	32	50	17	84			5.5
6 2/75	48	47	4	55	*		4.4
7 3/75	53	36	10	56	***		3.5
8 4/75	59	35	5	45	***		4.5
9 1/76	47	42	10	62	*		3.2
10 2/76	28	57	14	85			4.4
11 3/76	45	45	9	63	*	+	3.5
12 4/76	38	48	13	74	*	+	5.4
13 1/77	30	55	14	83			4.4
14 2/77	54	33	12	57	***		3.5
15 3/77	45	45	9	63	*	+	4.4
16 4/77	49	38	12	62	**	+	5.3
17 1/78	44	41	14	69	**		4.4
18 2/78	35	52	12	76	*		5.4
19 3/78	39	55	5	65			3.5
20 4/78	47	47	5	57	*	+	4.4
21 1/79	27	53	19	91			4.4
22 2/79	60	32	7	46	***		4.3
23 3/79	50	41	8	57	**		3.4
24 4/79	36	52	11	74	*	+	4.4
25 1/80	37	42	20	82			4.3
26 2/80	26	57	16	89			3.4
27 3/80	31	51	17	85			2.4
28 4/80	33	55	11	77			4.3
29 1/81	26	61	12	85			2.4
30 2/81	39	48	12	72	*	+	4.4
31 3/81	47	43	9	61	*	+	3.5
32 4/81	37	49	13	75	*		4.5
33 1/82	32	61	6	73			4.3
THERE WERE 31 FORECASTS MADE							
AVERAGE	40.4	47.4	11.3	69.9	.94	.26	3.7,4.1
STD DEV	9.5	8.1	4.5	12.5	1.03	.44	.8, .8

20. Average Precipitation Scores for Each Season

This section parallels §14, now for precipitation.

AVERAGES BY SEASON

PRECIPITATION ON THE GEOGRAPHIC GRID

WINTER

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	38.8	41.1	19.1	79.4	1.13	.50	3.25,3.25	8
WEATHER SERV	39.3	45.1	14.6	74.4	.88	.63	3.25,3.25	8
ANALOGER	40.7	43.7	14.7	73.0	.50	.33	3.67,3.67	6
ART DOUGLAS	40.2	47.6	11.2	79.0	.60	.40	3.40,3.40	5
HUMAN AVERAGE	39.6	44.1	15.3	74.7	.81	.48	3.37,3.37	27
HUMAN STD DEV	8.7	6.9	8.6	15.8	.92	.51	.84,1.11	
PERSISTER	31.6	46.6	20.8	88.1	.25		3.63,3.75	8
CLIMATER	34.3	64.8	0.0	64.8	.13		3.50,3.50	8
STOCHASTER	33.3	43.3	22.5	88.3	0.00	0.00	4.63,4.63	8
PURE ANALOGER	31.0	47.8	20.3	88.3	.25	.13	3.00,4.25	8
PERS ANALOGER	33.4	44.5	21.1	86.8	.25	.13	4.13,4.00	8
BEST ANALOGER	51.6	38.5	8.9	56.3	2.13	.75	3.38,3.75	8
EMPR MARKOVER	42.1	39.9	17.0	73.9	.88	.38	4.38,4.13	8
PROB MARKOVER	48.0	37.8	13.3	64.3	1.63	.50	4.25,4.13	8
HYBRIDER	34.4	50.6	14.0	78.6	.38	0.00	3.75,3.63	8

SPRING

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	37.9	46.3	14.9	76.0	1.00	.29	3.29,3.14	7
WEATHER SERV	40.7	45.0	13.3	71.6	1.00	0.00	4.00,3.86	7
ANALOGER	42.2	47.0	9.8	66.6	1.20	.20	3.80,4.00	5
ART DOUGLAS	36.5	53.0	9.5	72.0	.25	.25	3.75,3.50	4
HUMAN AVERAGE	39.4	47.2	12.3	71.9	.91	.17	3.70,3.61	23
HUMAN STD DEV	7.7	7.4	6.1	11.7	.95	.39	1.06, .99	
PERSISTER	37.0	47.0	15.0	77.0	.86		3.86,4.14	7
CLIMATER	39.9	59.1	0.0	59.1	.29		4.14,3.71	7
STOCHASTER	35.9	44.6	18.6	81.7	.14	0.00	4.14,4.14	7
PURE ANALOGER	30.3	51.3	17.4	86.1	.57	.14	4.29,4.14	7
PERS ANALOGER	46.0	40.6	12.4	65.4	1.43	.14	4.14,4.00	7
BEST ANALOGER	52.9	39.3	6.9	53.0	2.14	.29	4.43,4.71	7
EMPR MARKOVER	41.6	41.1	16.3	73.7	.57	.14	4.57,4.43	7
PROB MARKOVER	49.1	39.4	10.4	60.3	1.86	.29	4.43,3.86	7
HYBRIDER	41.4	46.6	11.0	68.6	1.29	.14	3.86,4.00	7

SUMMER

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	40.6	44.5	13.9	72.3	.88	.25	2.88,3.63	8
WEATHER SERV	36.5	50.3	12.3	74.8	.50	.13	4.00,4.00	8
ANALOGER	40.5	48.0	10.5	69.0	1.00	.50	4.33,4.33	6
ART DOUGLAS	30.4	54.8	13.8	82.4	.20	.20	4.60,4.00	5
HUMAN AVERAGE	37.5	48.9	12.6	74.1	.67	.26	3.85,3.96	27
HUMAN STD DEV	8.4	6.9	6.1	13.0	.68	.45	1.26, .85	
PERSISTER	32.1	48.8	18.1	85.0	.25		3.50,3.75	8
CLIMATER	41.6	57.4	0.0	57.4	.38		3.38,3.88	8
STOCHASTER	33.1	47.4	18.5	84.4	0.00	0.00	4.75,4.38	8
PURE ANALOGER	32.8	50.1	16.1	82.4	.75	.13	3.63,4.38	8
PERS ANALOGER	34.0	47.1	17.9	82.9	.25	.13	4.25,4.25	8
BEST ANALOGER	50.4	39.5	9.1	57.8	1.88	.50	3.50,4.25	8
EMPR MARKOVER	41.3	42.1	15.6	73.4	1.13	.25	4.75,4.63	8
PROB MARKOVER	52.5	36.9	9.6	56.1	2.25	.50	3.88,4.38	8
HYPRIDER	43.6	44.6	10.8	66.1	1.00	.38	3.00,4.63	8

FALL

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	30.3	49.2	19.5	88.2	.50	.17	4.33,4.50	6
WEATHER SERV	34.8	47.6	16.6	80.9	.25	.25	3.88,4.50	8
ANALOGER	32.4	52.8	13.8	80.4	.20	.20	4.00,4.20	5
ART DOUGLAS	37.4	45.2	16.4	78.0	.80	.40	4.20,4.00	5
HUMAN AVERAGE	33.7	48.6	16.7	82.0	.42	.25	4.08,4.33	24
HUMAN STD DEV	8.4	5.9	7.3	14.6	.65	.44	.88, .64	
PERSISTER	36.6	45.3	17.1	79.5	.38		3.88,3.75	8
CLIMATER	35.4	63.6	0.0	63.6	.13		4.25,4.13	8
STOCHASTER	33.6	41.9	23.5	88.9	0.00	0.00	4.75,3.75	8
PURE ANALOGER	36.4	44.3	18.4	81.0	.50	.38	4.00,4.38	8
PERS ANALOGER	39.0	42.3	17.8	77.8	.75	.13	3.88,3.75	8
BEST ANALOGER	49.0	41.1	8.9	58.9	1.88	.63	3.50,4.25	8
EMPR MARKOVER	38.6	42.1	18.3	78.6	.50	.25	3.88,4.75	8
PROB MARKOVER	50.5	38.0	10.5	59.0	2.13	.63	4.13,4.50	8
HYBRIDER	42.1	47.6	9.3	66.1	1.13	.50	4.38,4.13	8

21. Average Precipitation Scores for All Seasons

This section parallels §15, now for precipitation.

AVERAGE SCORES (ALL SEASONS COMBINED)

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	U	V	W	M	STARS	PLUS	FORM	NO FCST
JERRY NAMIAS	37.3	45.0	16.7	78.4	.90	.31	3.38,3.59	29
WEATHER SERV	37.7	47.1	14.2	75.5	.65	.26	3.77,3.90	31
ANALOGER	39.1	47.7	12.2	72.1	.73	.32	3.95,4.05	22
ART DOUGLAS	36.1	50.0	12.9	75.8	.47	.32	4.00,3.74	19
PERSISTER	34.3	46.9	17.8	82.6	.42	0.00	3.71,3.84	31
CLIMATER	37.7	61.3	0.0	61.3	.23	0.00	3.81,3.81	31
STOCHASTER	33.9	44.3	20.8	85.9	.03	0.00	4.58,4.23	31
PURE ANALOGER	32.7	48.3	18.1	84.4	.52	.19	3.71,4.29	31
PERS ANALOGER	37.8	43.7	17.5	78.6	.65	.13	4.10,4.00	31
BEST ANALOGER	50.9	39.6	8.5	56.6	2.00	.55	3.68,4.23	31
EMPR MARKOVER	40.9	41.3	16.8	74.9	.77	.26	4.39,4.48	31
PROB MARKOVER	50.1	38.0	11.0	59.9	1.97	.48	4.16,4.23	31
HYBRIDER	40.4	47.4	11.3	69.9	.94	.26	3.74,4.10	31

22. Each Season: Significant Precipitation Forecasts vs. Region

This section parallels §16, now for precipitation.

ANALYSIS BY GEOGRAPHICAL REGION

THE REGIONS ARE DEFINED AS FOLLOWS:

	REGION	NO PTS	POINTS OF THE GEOGRAPHIC GRID
1	PACIFIC COAST	6	1, 13, 30, 48, 65, 80,
2	NORTHERN GREAT BASIN	11	2, 3, 4, 14, 15, 16, 17, 31, 32, 33, 34,
3	SOUTHWESTERN DESERT	12	49, 50, 51, 52, 53, 66, 67, 68, 69, 81, 82, 83,
4	NORTHERN PLAINS	13	5, 6, 7, 8, 9, 18, 19, 20, 21, 35, 36, 37, 38,
5	SOUTHERN PLAINS	10	54, 55, 56, 70, 71, 72, 84, 85, 86, 93,
6	GREAT LAKES	14	10, 11, 12, 22, 23, 24, 25, 26, 27, 28, 42, 43, 44, 45,
7	MIDWEST	9	39, 40, 41, 57, 58, 59, 60, 61, 73,
8	APPALACHIANS	7	62, 63, 74, 75, 76, 77, 78,
9	GULF COAST	11	87, 88, 89, 90, 91, 94, 95, 96, 97, 98, 99,
10	ATLANTIC COAST	6	29, 46, 47, 64, 79, 92,

SEASON 3 3/74

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-		+	-	+	+				2.3
WEATHER SERV					+		-		+		4.3
PERSISTER			+						+		4.4
CLIMATER							-				5.4
STOCHASTER											5.5
PURE ANALOGER		-			+						3.5
PERS ANALOGER					-						4.5
BEST ANALOGER			+								4.5
EMPR MARKOVER	+						-				4.4
PROB MARKOVER		-		+			-				3.4
HYBRIDER			-	+							3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 4 4/74

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS											5.5
WEATHER SERV		-	-	-					+		2.4
PERSISTER							-				5.4
CLIMATER											5.5
STOCHASTER						-					5.4
PURE ANALOGER						-					5.4
PERS ANALOGER										+	5.4
BEST ANALOGER		+			-	+					3.4
EMPR MARKOVER											5.5
PROB MARKOVER			-						+		4.4
HYBRIDER											5.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 5 1/75

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+				+		-	-			3.3
WEATHER SERV			-	-		+	+				3.3
PERSISTER	-										4.5
CLIMATER						-		+			5.3
STOCHASTER											5.5
PURE ANALOGER		-	+	+			-				2.4
PERS ANALOGER									+		5.4
BEST ANALOGER					-		+				4.4
EMPR MARKOVER	+									-	4.4
PROB MARKOVER						-			+		5.3
HYBRIDER											5.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 6 2/75

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+		+	-		-		+			2.3
WEATHER SERV											5.5
PERSISTER			-								4.5
CLIMATER											5.5
STOCHASTER			+			-			-		4.3
PURE ANALOGER			+		+			-			3.4
PERS ANALOGER			-			-		+			4.3
BEST ANALOGER											5.5
EMPR MARKOVER			-							+	4.4
PROB MARKOVER				-			+				4.4
HYBRIDER				-				+			4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 7 3/75

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			-	+							3.5
WEATHER SERV											5.5
PERSISTER			-			+			+		4.3
CLIMATER				+							4.5
STOCHASTER						+					5.4
PURE ANALOGER	-			+							3.5
PERS ANALOGER			-			+					4.4
BEST ANALOGER		+	-				+	-			3.3
EMPR MARKOVER								-			5.4
PROB MARKOVER			-								4.5
HYBRIDER			-	+							3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 8 4/75

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+			-						3.5
WEATHER SERV											5.5
PERSISTER								-	+		5.3
CLIMATER	+							-	-		4.3
STOCHASTER							+	-		-	5.2
PURE ANALOGER	+		+							-	3.4
PERS ANALOGER				-					+		4.4
BEST ANALOGER	-		+								3.5
EMPR MARKOVER			+	-	-						2.5
PROB MARKOVER	+		+								3.5
HYBRIDER				-							4.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 9 1/76

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS						+		-			5.3
WEATHER SERV			+			+	-	-	-		4.1
PERSISTER	+							-			4.4
CLIMATER	+	+			-				-	-	2.3
STOCHASTER		+									4.5
PURE ANALOGER		+		-	+	+					2.4
PERS ANALOGER			+	-		+	-				3.3
BEST ANALOGER			-	-	+		-				2.4
EMPR MARKOVER			-			+					4.4
PROB MARKOVER	+	+			-				-		2.4
HYBRIDER	+	+				+	-	-			3.2

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 10 2/76

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+		+						-	-	3.3
WEATHER SERV							+				5.4
PERSISTER					+						4.5
CLIMATER					+						4.5
STOCHASTER	+										4.5
PURE ANALOGER			-								4.5
PERS ANALOGER											5.5
BEST ANALOGER											5.5
EMPR MARKOVER									+		5.4
PROB MARKOVER		-								+	4.4
HYBRIDER			-			+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 11 3/76

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+							-		-	4.3
WEATHER SERV										-	5.4
ANALOGER	+	+	-								2.5
PERSISTER		-		+				+			3.4
CLIMATER											5.5
STOCHASTER										+	5.4
PURE ANALOGER	-				+		-				3.4
PERS ANALOGER		-			+						3.5
BEST ANALOGER	-				+		-				3.4
EMPR MARKOVER											5.5
PROB MARKOVER				+	+	-					3.4
HYBRIDER		-			+						3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 12 4/76

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
WEATHER SERV				-			-				4.4
PERSISTER	-	-	+		-	+				-	1.3
CLIMATER					+	-				+	4.3
STOCHASTER				+						-	4.4
PURE ANALOGER	-								+		4.4
PERS ANALOGER	+	-			-				+		2.4
BEST ANALOGER		+			-	+					3.4
EMPR MARKOVER									+		5.4
PROB MARKOVER											5.5
HYBRIDER										-	5.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 13 1/77

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+		-	-		+		+	-	3.2
WEATHER SERV			+		-			-			3.4
ANALOGER	-	-				+					3.4
PERSISTER		+			-		+	-			3.3
CLIMATER		-			-	+					3.4
STOCHASTER									+		5.4
PURE ANALOGER		-	+	+			-				2.4
PERS ANALOGER			-								4.5
BEST ANALOGER		+	+			-		+			3.3
EMPR MARKOVER									+		5.4
PROB MARKOVER		-									4.5
HYBRIDER		-				+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 14 2/77

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS										+	5.4
WEATHER SERV		-	+			+	-				3.3
ANALOGER											5.5
PERSISTER		-				-		+			4.3
CLIMATER		+		+		-		-			3.3
STOCHASTER						-					5.4
PURE ANALOGER							-		+		5.3
PERS ANALOGER				-							4.5
BEST ANALOGER											5.5
EMPR MARKOVER		+									4.5
PROB MARKOVER		+									4.5
HYBRIDER		+		+							3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 15 3/77

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	-			-	+			3.3
WEATHER SERV			+								4.5
ANALOGER				+				+			4.4
ART DOUGLAS				+		-			+		4.3
PERSISTER					+	-					4.4
CLIMATER				-			-	+	+		4.2
STOCHASTER											5.5
PURE ANALOGER		-		-		+	+				3.3
PERS ANALOGER									-		5.4
BEST ANALOGER				+					-		4.4
EMPR MARKOVER				-		+					4.4
PROB MARKOVER						+					5.4
HYBRIDER				-		+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 16 4/77

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
WEATHER SERV											5.5
ANALOGER		+			+		-				3.4
ART DOUGLAS					-			+			4.4
PERSISTER					-	+	+				4.3
CLIMATER		+									4.5
STOCHASTER						+		-		-	5.2
PURE ANALOGER				-		+					4.4
PERS ANALOGER		+			-	-	+	+			3.2
BEST ANALOGER											5.5
EMPR MARKOVER	-										4.5
PROB MARKOVER		+			-				+		3.4
HYBRIDER								+	-		5.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 17 1/78

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+									4.5
WEATHER SERV		+	-			+			-		3.3
ANALOGER										+	5.4
ART DOUGLAS			-	+							3.5
PERSISTER			-	-		+				+	3.3
CLIMATER							+			-	5.3
STOCHASTER									+		5.4
PURE ANALOGER		-			+						3.5
PERS ANALOGER											5.5
BEST ANALOGER								-	-		5.3
EMPR MARKOVER					+						4.5
PROB MARKOVER									-	-	5.3
HYBRIDER			-			+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 18 2/78

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	-	-		+		-			+		3.3
WEATHER SERV	-		-			+					3.4
ANALOGER				+		-					4.4
ART DOUGLAS											5.5
PERSISTER											5.5
CLIMATER			-			+			+		4.3
STOCHASTER	+		-								3.5
PURE ANALOGER											5.5
PERS ANALOGER			+								4.5
BEST ANALOGER											5.5
EMPR MARKOVER											5.5
PROB MARKOVER					+	+	-				4.3
HYBRIDER						+					5.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 19 3/78

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	+					-	+				4.3
WEATHER SERV							+	+			5.3
ANALOGER											5.5
ART DOUGLAS											5.5
PERSISTER			-		+				+		3.4
CLIMATER	-	-	-	+			+	+			1.3
STOCHASTER							-				5.4
PURE ANALOGER	-			+							3.5
PERS ANALOGER											5.5
BEST ANALOGER	+										4.5
EMPR MARKOVER											5.5
PROP MARKOVER											5.5
HYBRIDER	-			+							3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 20 4/78

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS					+						4.5
WEATHER SERV	+	-									3.5
ANALOGER				+						-	4.4
ART DOUGLAS		+									4.5
PERSISTER			-		+					+	3.4
CLIMATER		+				+				-	4.3
STOCHASTER				-							4.5
PURE ANALOGER				-							4.5
PERS ANALOGER				-			+			+	4.3
BEST ANALOGER					+						4.5
EMPR MARKOVER		+						-			4.4
PROP MARKOVER											5.5
HYBRIDER		+								+	4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 21 1/79

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	+		-	-				3.3
WEATHER SERV		-			-		+	+			3.3
ANALOGER			-	-			+	+		+	3.2
ART DOUGLAS					-		+	+			4.3
PERSISTER				+				-	-	-	4.2
CLIMATER			-				+	-			4.3
STOCHASTER											5.5
PURE ANALOGER					+						4.5
PERS ANALOGER	+		+				-			-	3.3
BEST ANALOGER		-	+	-							2.5
EMPR MARKOVER											5.5
PROB MARKOVER			-				+				4.4
HYBRIDER					+	+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 22 2/79

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS					-						4.5
WEATHER SERV			+			-	-			-	4.2
ANALOGER		+	-		-	+					2.4
ART DOUGLAS					-	-		+			4.3
PERSISTER		-	+	-							2.5
CLIMATER		+		+				-	-		3.3
STOCHASTER			-								4.5
PURE ANALOGER									+	-	5.3
PERS ANALOGER											5.5
BEST ANALOGER		-	+	-							2.5
EMPR MARKOVER			-								4.5
PROB MARKOVER						+	+	-			5.2
HYBRIDER			-				+	+			4.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 23 3/79

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS	-	-	-	+	+		+		+		6.3
WEATHER SERV		-			-		+				3.4
ANALOGER											5.5
ART DOUGLAS		-									4.5
PERSISTER									+	-	5.3
CLIMATER	+	+					-				3.4
STOCHASTER					+	-					4.4
PURE ANALOGER									+	-	5.3
PERS ANALOGER								+		-	5.3
BEST ANALOGER				+					-		4.4
EMPR MARKOVER											5.5
PROB MARKOVER								-			5.4
HYBRIDER	+		-							-	3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 24 4/79

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS						+					5.4
WEATHER SERV			-	+						-	3.4
ANALOGER						+					5.4
ART DOUGLAS			+	-		-			+		7.3
PERSISTER				+	-						3.5
CLIMATER				-		+					4.4
STOCHASTER											5.5
PURE ANALOGER				-		+					4.4
PERS ANALOGER				+						-	4.4
BEST ANALOGER				-		+					4.4
EMPR MARKOVER		+		+	-						2.5
PROB MARKOVER						+					5.4
HYBRIDER				-		+					4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 25 1/80

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+	+			-					3.4
WEATHER SERV				+		+					4.4
ANALOGER		+								-	4.4
ART DOUGLAS			-			+		+			4.3
PERSISTER			-	+							3.5
CLIMATER			-					-	+		4.3
STOCHASTER	-	+									3.5
PURE ANALOGER			+					-		-	4.3
PERS ANALOGER		+									4.5
BEST ANALOGER				+			-			+	4.3
EMPR MARKOVER						-					5.4
PROB MARKOVER											5.5
HYBRIDER			+					-		-	4.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 26 2/80

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		-			+	+	+		-		3.2
WEATHER SERV		-									4.5
ANALOGER		+	+					-	-		3.3
ART DOUGLAS			+			+			-		4.3
PERSISTER					+			-	-	-	4.2
CLIMATER							+		-		5.3
STOCHASTER							+			-	5.3
PURE ANALOGER					+						4.5
PERS ANALOGER		+	+	+				-	-	-	2.2
BEST ANALOGER								-	-		5.3
EMPR MARKOVER											5.5
PROB MARKOVER						-					5.4
HYBRIDER	+				+				-		3.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 27 3/80

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS				+							4.5
WEATHER SERV	+			-	-	+					2.4
ANALOGER										+	5.4
ART DOUGLAS						+			-		5.3
PERSISTER	+										4.5
CLIMATER	+	+	+	-					-		1.4
STOCHASTER		-									4.5
PURE ANALOGER											5.5
PERS ANALOGER				-							4.5
BEST ANALOGER			-	-	+		-				2.4
EMPR MARKOVER											5.5
PROB MARKOVER		+			-						3.5
HYBRIDER	+	+		-					-		2.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 28 4/80

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS											5.5
WEATHER SERV							-				5.4
ANALOGER	+										4.5
ART DOUGLAS							+				5.4
PERSISTER									-		5.4
CLIMATER											5.5
STOCHASTER											5.5
PURE ANALOGER			-								4.5
PERS ANALOGER							+				5.4
BEST ANALOGER				-				+			4.4
EMPR MARKOVER											5.5
PROB MARKOVER	-										4.5
HYBRIDER			-				+		-		4.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 29 1/81

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS		+	+	+			-	-	-	-	2.1
WEATHER SERV		-	+		+				-		2.4
ANALOGER		-	-				+	+			3.3
ART DOUGLAS		+	+	-					-		2.4
PERSISTER			+		+	-				+	3.3
CLIMATER	+		+	-				-			2.4
STOCHASTER										+	5.4
PURE ANALOGER		-	-								3.5
PERS ANALOGER			+					-		+	4.3
BEST ANALOGER		-				-			+		4.3
EMPR MARKOVER								-		+	5.3
PROB MARKOVER		-									4.5
HYBRIDER	+			-	+					+	2.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 30 2/81

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+					-	+	-	4.2
WEATHER SERV			+						-		4.4
ANALOGER								-			5.4
ART DOUGLAS		+	+		-		-	-			2.3
PERSISTER		-								+	4.4
CLIMATER						+					5.4
STOCHASTER				-			-				4.4
PURE ANALOGER					+	-					4.4
PERS ANALOGER						-		+			5.3
BEST ANALOGER					+						4.5
EMPR MARKOVER							-			+	5.3
PROB MARKOVER											5.5
HYBRIDER					+			+			4.4

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 31 3/81

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			+	-						-	3.4
WEATHER SERV	+								-		4.4
ANALOGER						-				+	5.3
ART DOUGLAS										+	5.4
PERSISTER	-	-		-	+				+	+	1.3
CLIMATER		+								-	4.4
STOCHASTER								+			5.4
PURE ANALOGER					+						4.5
PERS ANALOGER				-			+			+	4.3
BEST ANALOGER	-										4.5
EMPR MARKOVER											5.5
PROP MARKOVER		+		-			-				3.4
HYBRIDER		+	-								3.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 32 4/81

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS			-			+	+				4.3
WEATHER SERV				+							4.5
ANALOGER			+			-					4.4
ART DOUGLAS						+					5.4
PERSISTER							+				5.4
CLIMATER				+							4.5
STOCHASTER									+	-	5.3
PURE ANALOGER	+										4.5
PERS ANALOGER		+									4.5
BEST ANALOGER		+	+		+	-				-	2.3
EMPR MARKOVER	+										4.5
PROP MARKOVER			+			-					4.4
HYBRIDER				+							4.5

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

SEASON 33 1/82

PRECIPITATION ON THE GEOGRAPHIC GRID

FORECASTER	PAC	NGR	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
JERRY NAMIAS					+						4.5
WEATHER SERV			+				-				4.4
ANALOGER	+										4.5
ART DOUGLAS					+	+	-			+	4.2
PERSISTER											5.5
CLIMATER	-				+						3.5
STOCHASTER											5.5
PURE ANALOGER	+									-	4.4
PERS ANALOGER						+					5.4
BEST ANALOGER	-		+								3.5
EMPR MARKOVER	-	+				+					3.4
PROB MARKOVER						+					5.4
HYBRIDER	-					+			-		4.3

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

23. Each Forecaster: Significant Regional Precipitation Forecasts vs. Season.

This section parallels §17, now for precipitation.

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: JERRY NAMIAS

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74		-		+	-	+	+				2.3
4 4/74											5.5
5 1/75	+				+		-	-			3.3
6 2/75	+		+	-		-		+			2.3
7 3/75			-	+							3.5
8 4/75		+			-						3.5
9 1/76						+		-			5.3
10 2/76	+		+						-	-	3.3
11 3/76	+							-		-	4.3
13 1/77		+		-	-		+		+	-	2.2
14 2/77										+	5.4
15 3/77			+	-			-	+			3.3
17 1/78		+									4.5
18 2/78	-	-		+		-			+		2.3
19 3/78	+					-	+				4.3
20 4/78					+						4.5
21 1/79			+	+		-	-				3.3
22 2/79					-						4.5
23 3/79	-	-	-	+	+		+		+		0.3
24 4/79						+					5.4
25 1/80		+	+			-					3.4
26 2/80		-			+	+	+		-		3.2
27 3/80				+							4.5
28 4/80											5.5
29 1/81		+	+	+			-	-	-	-	2.1
30 2/81			+					-	+	-	4.2
31 3/81			+	-						-	3.4
32 4/81			-			+	+				4.3
33 1/82					+						4.5
PCT SIG FOR +	17	17	28	24	17	17	21	7	14	3	3.38.3.59

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: WEATHER SERV

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74					+		-		+		4.3
4 4/74		-	-	-					+		2.4
5 1/75			-	-		+	+				3.3
6 2/75											5.5
7 3/75											5.5
8 4/75											5.5
9 1/76			+			+	-	-	-		4.1
10 2/76							+				5.4
11 3/76										-	5.4
12 4/76				-			-				4.4
13 1/77			+		-			-			3.4
14 2/77		-	+			+	-				3.3
15 3/77			+								4.5
16 4/77											5.5
17 1/78		+	-			+			-		3.3
18 2/78	-		-			+					3.4
19 3/78							+	+			5.3
20 4/78	+	-									3.5
21 1/79		-			-		+	+			3.3
22 2/79			+			-	-			-	4.2
23 3/79		-			-		+				3.4
24 4/79			-	+						-	3.4
25 1/80				+		+					4.4
26 2/80		-									4.5
27 3/80	+			-	-	+					2.4
28 4/80							-				5.4
29 1/81		-	+		+				-		2.4
30 2/81			+						-		4.4
31 3/81	+								-		4.4
32 4/81				+							4.5
33 1/82			+				-				4.4
PCT SIG FOR +	10	3	26	10	6	23	16	6	6	0	3.77,3.90

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASO'	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
11 3/75	+	+	-								2.5
13 1/77	-	-				+					3.4
14 2/77											5.5
15 3/77				+				+			4.4
16 4/77		+			+		-				3.4
17 1/78										+	5.4
18 2/78				+		-					4.4
19 3/78											5.5
20 4/78				+						-	4.4
21 1/79			-	-			+	+		+	3.2
22 2/79		+	-		-	+					2.4
23 3/79											5.5
24 4/79						+					5.4
25 1/80		+								-	4.4
26 2/80		+	+					-	-		3.3
27 3/80										+	5.4
28 4/80	+										4.5
29 1/81		-	-				+	+			3.3
30 2/81								-			5.4
31 3/81						-				+	5.3
32 4/81			+			-					4.4
33 1/82	+										4.5
PCT SIG FOR +	14	23	9	14	5	14	9	14	0	18	3.95.4.05

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: ART DOUGLAS

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
15 3/77				+		-			+		4.3
16 4/77					-			+			4.4
17 1/78			-	+							3.5
18 2/78											5.5
19 3/78											5.5
20 4/78		+									4.5
21 1/79					-		+	+			4.3
22 2/79					-	-		+			4.3
23 3/79		-									4.5
24 4/79			+	-		-			+		3.3
25 1/80			-			+		+			4.3
26 2/80			+			+			-		4.3
27 3/80						+			-		5.3
28 4/80							+				5.4
29 1/81		+	+	-					-		2.4
30 2/81		+	+		-		-	-			2.3
31 3/81										+	5.4
32 4/81						+					5.4
33 1/82					+	+	-			+	4.2
PCT SIG FOR +	0	16	21	11	5	26	11	21	11	11	4.00,3.74

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PERSISTER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74			+						+		4.4
4 4/74							-				5.4
5 1/75	-										4.5
6 2/75			-								4.5
7 3/75			-			+			+		4.3
8 4/75								-	+		5.3
9 1/76	+							-			4.4
10 2/76					+						4.5
11 3/76		-		+				+			3.4
12 4/76	-	-	+		-	+				-	1.3
13 1/77		+			-		+	-			3.3
14 2/77		-				-		+			4.3
15 3/77					+	-					4.4
16 4/77					-	+	+				4.3
17 1/78			-	-		+				+	3.3
18 2/78											5.5
19 3/78			-		+				+		3.4
20 4/78			-		+					+	3.4
21 1/79				+				-	-	-	4.2
22 2/79		-	+	-							2.5
23 3/79									+	-	5.3
24 4/79				+	-						3.5
25 1/80			-	+							3.5
26 2/80					+			-	-	-	4.2
27 3/80	+										4.5
28 4/80									-		5.4
29 1/81			+		+	-				+	3.3
30 2/81		-								+	4.4
31 3/81	-	-		-	+				+	+	1.3
32 4/81							+				5.4
33 1/82											5.5
PCT SIG FOR +	6	3	13	13	23	13	10	6	19	16	3.71,3.84

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: CLIMATER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74							-				5.4
4 4/74											5.5
5 1/75						-		+			5.3
6 2/75											5.5
7 3/75				+							4.5
8 4/75	+							-	-		4.3
9 1/76	+	+			-				-	-	2.3
10 2/76					+						4.5
11 3/76											5.5
12 4/76					+	-				+	4.3
13 1/77		-			-	+					3.4
14 2/77		+		+		-		-			3.3
15 3/77				-			-	+	+		4.2
16 4/77		+									4.5
17 1/78							+			-	5.3
18 2/78			-			+			+		4.7
19 3/78	-	-	-	+			+	+			1.3
20 4/78		+				+				-	4.3
21 1/79			-				+	-			4.3
22 2/79		+		+				-	-		3.3
23 3/79	+	+					-				3.4
24 4/79				-		+					4.4
25 1/80			-					-	+		4.3
26 2/80							+		-		5.3
27 3/80	+	+	+	-					-		1.4
28 4/80											5.5
29 1/81	+		+	-				-			2.4
30 2/81						+					5.4
31 3/81		+								-	4.4
32 4/81				+							4.5
33 1/82	-				+						3.5
PCT SIG FOR +	16	26	6	16	10	16	13	10	10	3	3.81,3.81

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: STOCHASTER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NCB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74											5.5
4 4/74						-					5.4
5 1/75											5.5
6 2/75			+			-			-		4.3
7 3/75						+					5.4
8 4/75							+	-		-	5.2
9 1/76		+									4.5
10 2/76	+										4.5
11 3/76										+	5.4
12 4/76				+						-	4.4
13 1/77									+		5.4
14 2/77						-					5.4
15 3/77											5.5
16 4/77						+		-		-	5.2
17 1/78									+		5.4
18 2/78	+		-								3.5
19 3/78							-				5.4
20 4/78				-							4.5
21 1/79											5.5
22 2/79			-								4.5
23 3/79					+	-					4.4
24 4/79											5.5
25 1/80	-	+									3.5
26 2/80							+			-	5.3
27 3/80		-									4.5
28 4/80											5.5
29 1/81										+	5.4
30 2/81				-			-				4.4
31 3/81								+			5.4
32 4/81									+	-	5.3
33 1/82											5.5
PCT SIG FOR +	6	6	3	3	3	6	6	3	10	6	4.58,4.23

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PURE ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3	3/74	(1/78)		-			+						3,5
4	4/74	(4/78)						-					5,4
5	1/75	(1/77)		-	+	+			-				2,4
6	2/75	(1/78)			+		+			-			3,4
7	3/75	(3/78)	-			+							3,5
8	4/75	(3/80)	+		+							-	3,4
9	1/76	(2/74)		+		-	+	+					2,4
10	2/76	(4/80)			-								4,5
11	3/76	(2/81)	-				+		-				3,4
12	4/76	(3/81)	-								+		4,4
13	1/77	(1/75)		-	+	+			-				2,4
14	2/77	(2/81)							-		+		5,3
15	3/77	(1/82)		-		-		+	+				3,3
16	4/77	(4/79)				-		+					4,4
17	1/78	(3/74)		-			+						3,5
18	2/78	(3/80)											5,5
19	3/78	(3/75)	-			+							3,5
20	4/78	(4/81)				-							4,5
21	1/79	(3/81)					+						4,5
22	2/79	(3/79)									+	-	5,3
23	3/79	(2/79)									+	-	5,3
24	4/79	(4/77)				-		+					4,4
25	1/80	(1/78)			+					-		-	4,3
26	2/80	(3/81)					+						4,5
27	3/80	(2/78)											5,5
28	4/80	(2/76)			-								4,5
29	1/81	(4/78)		-	-								3,5
30	2/81	(4/80)					+	-					4,4
31	3/81	(1/79)					+						4,5
32	4/81	(4/79)	+										4,5
33	1/82	(3/78)	+									-	4,4
PCT SIG FOR +			10	3	16	13	29	13	3	6	13	0	3,71,4,29

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PERS ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		PAC	NOB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3	3/74	(4/77)					-						4.5
4	4/74	(3/78)										+	5.4
5	1/75	(4/76)									+		5.4
6	2/75	(4/77)			-			-		+			4.3
7	3/75	(2/78)			-			+					4.4
8	4/75	(2/80)				-					+		4.4
9	1/76	(1/82)			+	-		+	-				3.3
10	2/76	(3/80)											5.5
11	3/76	(1/81)		-			+						3.5
12	4/76	(2/81)	+	-			-				+		2.4
13	1/77	(4/74)			-								4.5
14	2/77	(1/81)				-							4.5
15	3/77	(4/81)									-		5.4
16	4/77	(3/79)		+			-	-	+	+			3.2
17	1/78	(2/74)											5.5
18	2/78	(2/80)			+								4.5
19	3/78	(2/75)											5.5
20	4/78	(3/81)				-			+			+	4.3
21	1/79	(2/81)	+		+				-			-	3.3
22	2/79	(2/79)											5.5
23	3/79	(1/79)								+		-	5.3
24	4/79	(3/77)				+						-	4.4
25	1/80	(4/77)		+									4.5
26	2/80	(2/81)		+	+	+				-	-	-	2.2
27	3/80	(1/78)				-							4.5
28	4/80	(1/76)							+				5.4
29	1/81	(3/78)			+					-		+	4.3
30	2/81	(3/80)						-		+			5.3
31	3/81	(4/78)				-			+			+	4.3
32	4/81	(3/79)		+									4.5
33	1/82	(2/78)						+					5.4
PCT SIG FOR +			6	13	16	6	3	10	13	13	10	13	4.10,4.00

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: BEST ANALOGER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON		PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3	3/74	(3/78)			+								4.5
4	4/74	(4/76)		+			-	+					3.4
5	1/75	(4/77)					-		+				4.4
6	2/75	(2/78)											5.5
7	3/75	(2/80)		+	-				+	-			3.3
8	4/75	(1/82)	-		+								3.5
9	1/76	(3/80)			-	-	+		-				2.4
10	2/76	(1/81)											5.5
11	3/76	(2/81)	-				+		-				3.4
12	4/76	(4/74)		+			-	+					3.4
13	1/77	(1/81)		+	+			-		+			3.3
14	2/77	(4/81)											5.5
15	3/77	(3/79)				+					-		4.4
16	4/77	(2/74)											5.5
17	1/78	(2/80)								-	-		5.3
18	2/78	(2/75)											5.5
19	3/78	(3/81)	+										4.5
20	4/78	(2/81)					+						4.5
21	1/79	(2/79)		-	+	-							2.5
22	2/79	(1/79)		-	+	-							2.5
23	3/79	(3/77)				+					-		4.4
24	4/79	(4/77)				-		+					4.4
25	1/80	(2/81)				+			-			+	4.3
26	2/80	(1/78)								-	-		5.3
27	3/80	(1/76)			-	-	+		-				2.4
28	4/80	(3/78)				-				+			4.4
29	1/81	(3/80)		-				-			+		4.3
30	2/81	(4/78)					+						4.5
31	3/81	(3/79)	-										4.5
32	4/81	(2/78)		+	+		+	-				-	2.3
33	1/82	(4/75)	-		+								3.5
PCT SIG FOR +			3	16	23	10	19	10	6	6	3	3	3.68,4.23

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: EMPR MARKOVER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	S+D	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74	+						-				4.4
4 4/74											5.5
5 1/75	+									-	4.4
6 2/75			-							+	4.4
7 3/75								-			5.4
8 4/75			+	-	-						2.5
9 1/76			-			+					4.4
10 2/76									+		5.4
11 3/76											5.5
12 4/76									+		5.4
13 1/77									+		5.4
14 2/77		+									4.5
15 3/77				-		+					4.4
16 4/77	-										4.5
17 1/78					+						4.5
18 2/78											5.5
19 3/78											5.5
20 4/78		+						-			4.4
21 1/79											5.5
22 2/79			-								4.5
23 3/79											5.5
24 4/79		+		+	-						2.5
25 1/80						-					5.4
26 2/80											5.5
27 3/80											5.5
28 4/80											5.5
29 1/81								-		+	5.3
30 2/81							-			+	5.3
31 3/81											5.5
32 4/81	+										4.5
33 1/82	-	+				+					3.4
PCT SIG FOR +	12	13	3	3	3	10	0	0	10	10	4.39,4.48

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: PROB MARKOVER

PRECIPITATION ON THE GEOGRAPHIC GRID

SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3 3/74		-		+			-				3,4
4 4/74			-						+		4,4
5 1/75						-			+		5,3
6 2/75				-			+				4,4
7 3/75			-								4,5
8 4/75	+		+								3,5
9 1/76	+	+			-				-		2,4
10 2/76		-								+	4,4
11 3/76				+	+	-					3,4
12 4/76											5,5
13 1/77		-									4,5
14 2/77		+									4,5
15 3/77						+					5,4
16 4/77		+			-				+		3,4
17 1/78									-	-	5,3
18 2/78					+	+	-				4,3
19 3/78											5,5
20 4/78											5,5
21 1/79			-				+				4,4
22 2/79						+	+	-			5,2
23 3/79								-			5,4
24 4/79						+					5,4
25 1/80											5,5
26 2/80						-					5,4
27 3/81		+			-						3,5
28 4/81	-										4,5
29 1/81		-									4,5
30 2/81											5,5
31 3/81		+		-			-				3,4
32 4/81			+			-					4,4
33 1/82						+					5,4
PCT SIG FOR +	6	16	6	6	6	16	10	0	10	3	4.16,4.23

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 80(10) PERCENT CONFIDENCE LEVEL

ANALYSIS BY GEOGRAPHICAL REGION

FORECASTER: HYBRIDER

PRECIPITATION ON THE GEOGRAPHIC GRID

	SEASON	PAC	NGB	SWD	NPL	SPL	GRL	MDW	APP	GUC	ATC	FORM
3	3/74			-	+							3.5
4	4/74											5.5
5	1/75											5.5
6	2/75				-				+			4.4
7	3/75			-	+							3.5
8	4/75				-							4.5
9	1/76	+	+				+	-	-			3.2
10	2/76			-			+					4.4
11	3/76		-			+						3.5
12	4/76										-	5.4
13	1/77		-				+					4.4
14	2/77		+		+							3.5
15	3/77				-		+					4.4
16	4/77								+	-		5.3
17	1/78			-			+					4.4
18	2/78						+					5.4
19	3/78	-			+							3.5
20	4/79		+								+	4.4
21	1/79					+	+					4.4
22	2/79			-				+	+			4.3
23	3/79	+		-							-	3.4
24	4/79				-		+					4.4
25	1/80			+					-		-	4.3
26	2/80	+				+				-		3.4
27	3/80	+	+		-					-		2.4
28	4/80			-				+		-		4.3
29	1/81	+			-	+					+	2.4
30	2/81					+			+			4.4
31	3/81		+	-								3.5
32	4/81				+							4.5
33	1/82	-					+			-		4.3
PCT SIG FOR +		16	16	3	16	16	29	6	13	0	6	3.74.4.10

+(-) INDICATES SIGNIFICANCE OF THE REGIONAL U
AT THE NOMINAL 90(10) PERCENT CONFIDENCE LEVEL

24. Gallery of Predicted and Observed Temperature Patterns

24.1 Visually Good Forecasts

The temperature patterns the forecasters tried to anticipate in this study are displayed below. There are 34 maps: four for each year from 1974-81 inclusive, and two odd maps: one for fall 1973 and one for winter 1982. At the end of this set are displayed the best temperature predictions by the four human forecasters, in the sense of the rankings of §7.

By intercomparing a predicted map with its observed associate, and noting the u, v, w, m, and star scores going with the pair, a feeling for the goodness of fit of the two images can be obtained as carried in these scores. For example, Namias' excellent spring 1975 forecast had u = 70, v = 29, w = 0 and m = 29, with ***, +, and form (4,4). Looking at the two maps shows extensive regions of 0-class errors (correct point predictions) in the West and Midwest. Also, in the Gulf Coast and Atlantic Coast there is again an extensive 0-class error region. There are no 2-class errors in this forecast and so the distance between them is m = v + 2w = v = 29.

It is interesting to note that both the Analoger's and Douglas' best prediction was winter 1978. The resemblances among the two predicted patterns and the observed pattern are remarkable. The Analoger's scores for this match are: u = 71, v = 25, w = 3, m = 31, ***, +, and form is (2,2). On the other hand, Douglas' scores are u = 80, u = 19, w = 0, m = 19, ***, +, and form is (2,4). (These comparisons are drawn from the Table in §12, for season 17 (1/78).) Of these two forecasts, Douglas' is somewhat the better, all around, as can be seen by direct visual inspection of the maps or comparing u's, v's etc. of the two score sets.

It should be clear that when scores have u values in the upper 60's and 70's and beyond, the predicted maps will obviously resemble the observed maps. That is, no long and reasoned intercomparisons are necessary to discern the degree of resemblance. Thus in the uv diagrams of §6, the 'lower half' of the *** region, i.e., that subset defined by $m \leqq 76$, $v \leqq 20$, will contain points whose associated predicted maps strongly resemble their observed maps. Eventually, after more examples will have been collected in the forthcoming years, this region, or one akin to it, could be designated as the **** region of forecasting excellence.* Observe that, for sufficiently high u-values, the other values of v, w, and m will automatically be small (since we always have u + v + w = 99 and m = v + 2w), so that for outstandingly good forecasts with, say, $70 \leqq u$, nothing much more needs to be said about the high quality of such forecasts.

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* This region could also be defined with specific practical criteria in mind. For example, the **** region could be that region in which a forecaster's score must fall so as to permit decisions, to stockpile winter fuels or make crop plantings, with a specified (say 80%) level of confidence.

Another, single-indicator of quality in this high-skill area of the uv diagram can be used, e.g., $m \leqq 30$. On the other hand, note that v by itself cannot be used, since the region defined by $v \leqq 20$, say, extends all across the bottom of the uv diagram. Similarly w by itself is insufficient for a single-value description of goodness of prediction. Of the two single descriptors, u and m, the former is conceptually simpler but the latter is mathematically more natural (recall from Sec. 7.1 that m is the absolute distance between two maps).

24.2 Asymptotic Distributions of u and m

It can be shown that both u and m, for the Stochaster's scores, are distributed nearly in a gaussian manner. Thus for n = 99,

$$\frac{u - 33}{4.69} \sim N(0,1) \tag{24.1}$$

and

$$\frac{m - 88}{7.33} \sim N(0,1). \tag{24.2}$$

Here 'N(0,1)' denotes a normal distribution of zero mean, unit variance. It follows that the region discussed in paragraph 24.1, i.e., the region in the uv diagram for which $70 \leqq u$, has a probability of 10^{-15} for the Stochaster to visit it. Similarly the region defined in paragraph 24.1 by $m \leqq 30$, has a probability of 10^{-15} for a Stochaster visit.

As a simple empirical check on the means 33, 88 of u and m, used above in (24.1), (24.2), see the Stochaster's table in §13. Also, as a check on the standard deviation of u and m in (24.1), (24.2), the same table may be consulted. The theoretical formulas for these latter quantities are found via:

$$\sigma_u^2 = na_o(1-a_o) = 22 \tag{24.3}$$

$$\sigma_m^2 = n[(a_1-4a_2) - (a_1 - 2a_2)^2] \tag{24.4}$$

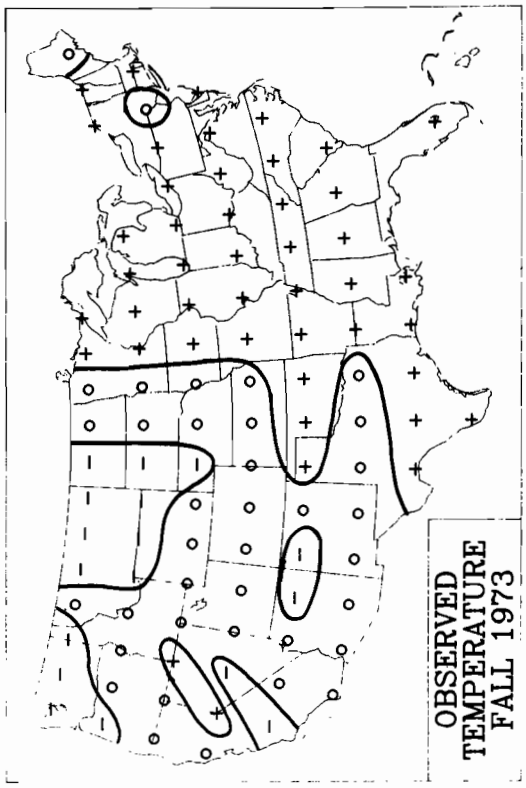
$$= 53.77$$

where $a_o = 1/3$, $a_1 = 4/9$, $a_2 = 2/9$. Similar observations can be made for v and w, resulting in the respective versions of (24.1) for these variables.

24.3 Best Analoger as a Criterion of High Skill

Some further experience in the connections between skill scores u, v, w, m and observed/prediction map visual matches can be obtained by perusing the Best Analoger's tables in §13 and §19. For example, in §13, the prediction for season 4/74 was season 4/76. Looking at these two observed maps shows what a u = 67 or m = 32 match could look like. Using the results in (24.1), (24.2) we can say that for the Stochaster to attain one such match on average, he would have to make many separate experimental runs on the order of 10^{15} trials each. Another match probability on the order of 10^{-15} is that in the Best Analoger's 1/78 prediction, which was 1/82, season 17 in his table of §13.

Despite these extraordinarily high skills of the Best Analoger, relative to the Stochaster, we should exercise some caution in using him exclusively as a criterion of high skill. Indeed, he is skillful relative to the Stochaster; but this is perhaps somewhat analogous to the case of a bright student who racks up a high scholastic average in college, and upon graduation and entering the real world, finds his artificially accumulated skills to be useless in the practical arena. A realistic evaluation of the Best Analoger's (and other forecaster) skills is touched upon in the preceding footnote.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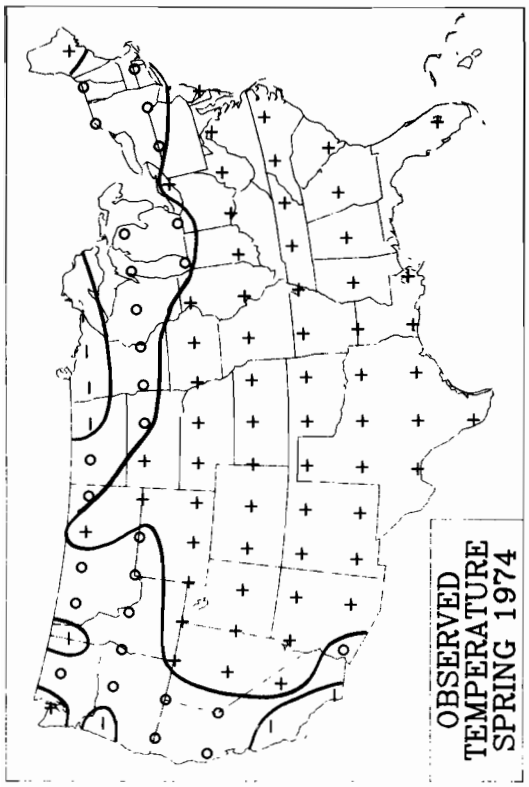
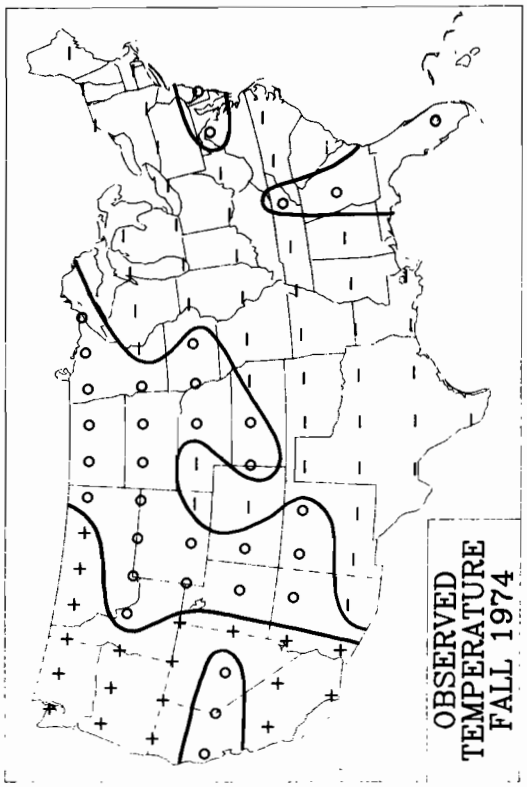
TEMPERATURE
FALL 1973


OBSERVED
TEMPERATURE
SPRING 1974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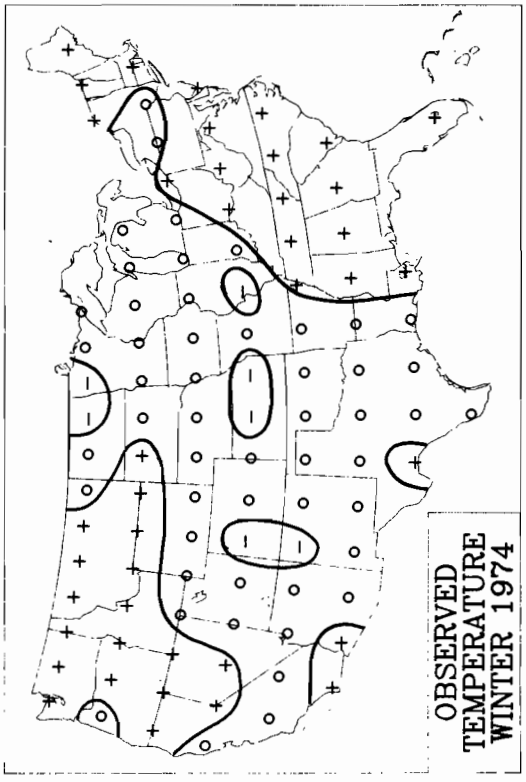
TEMPERATURE
FALL 1974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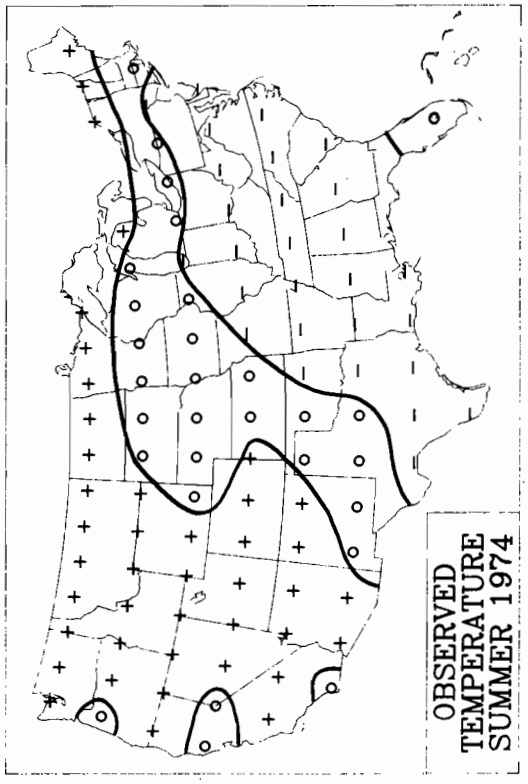
WINTER 1974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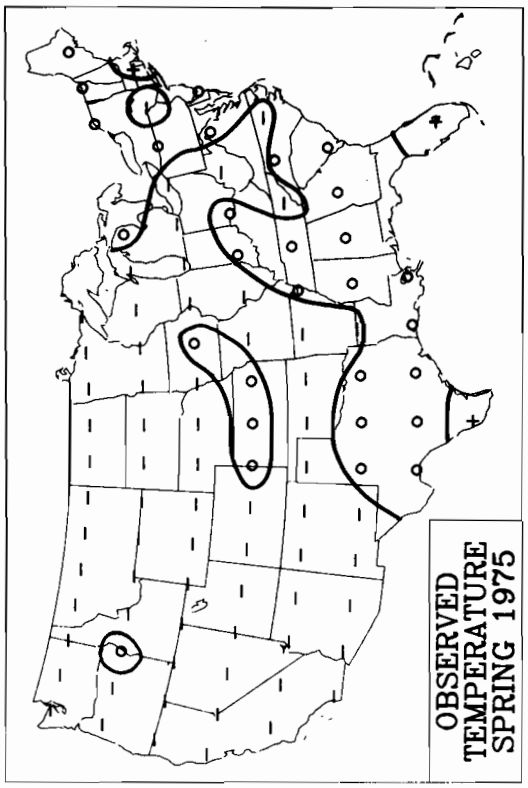
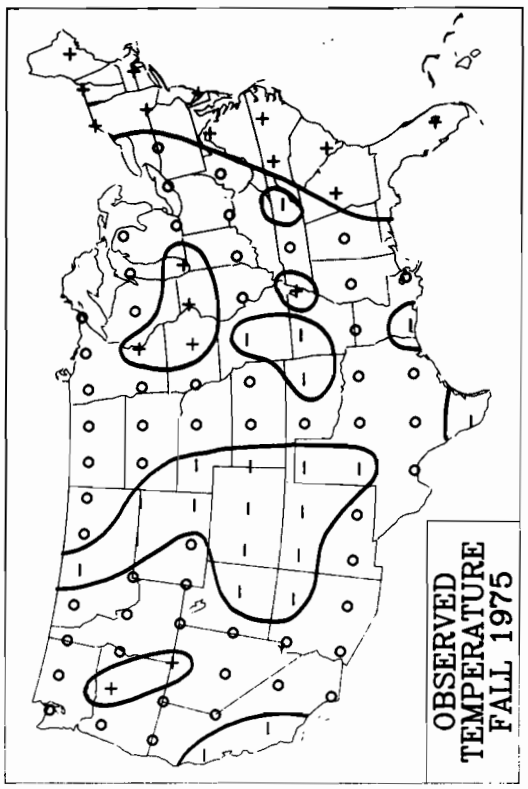
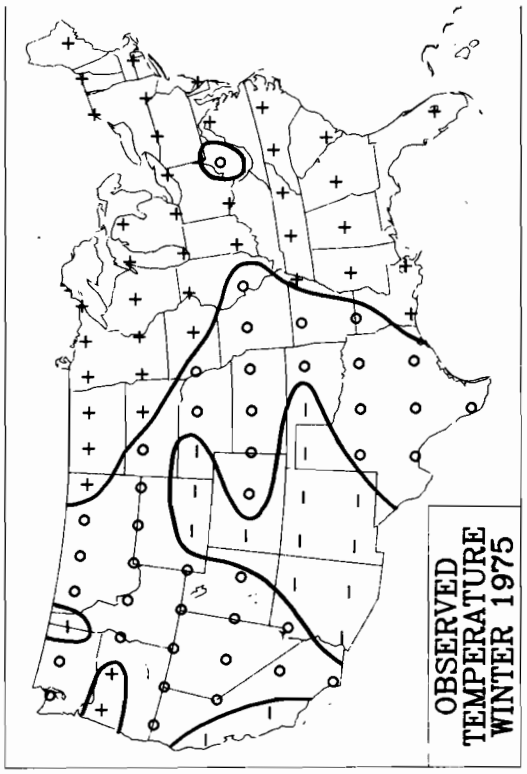
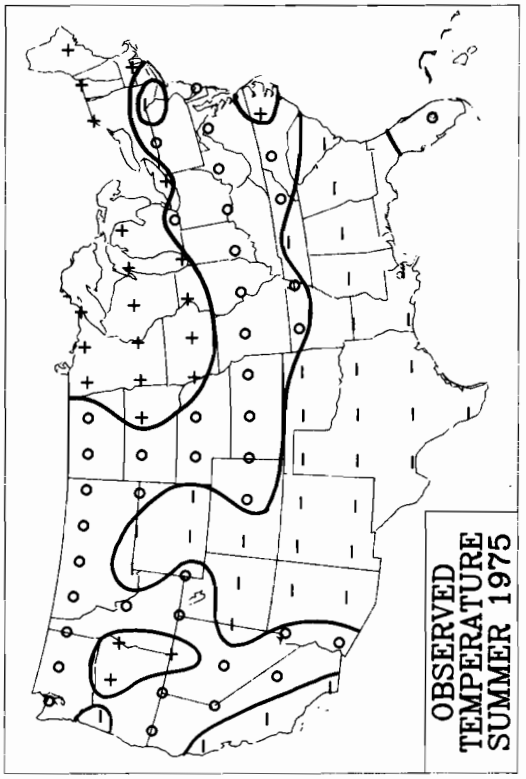

OBSERVED
TEMPERATURE
SPRING 1975


OBSERVED
TEMPERATURE
FALL 1975


OBSERVED
TEMPERATURE
WINTER 1975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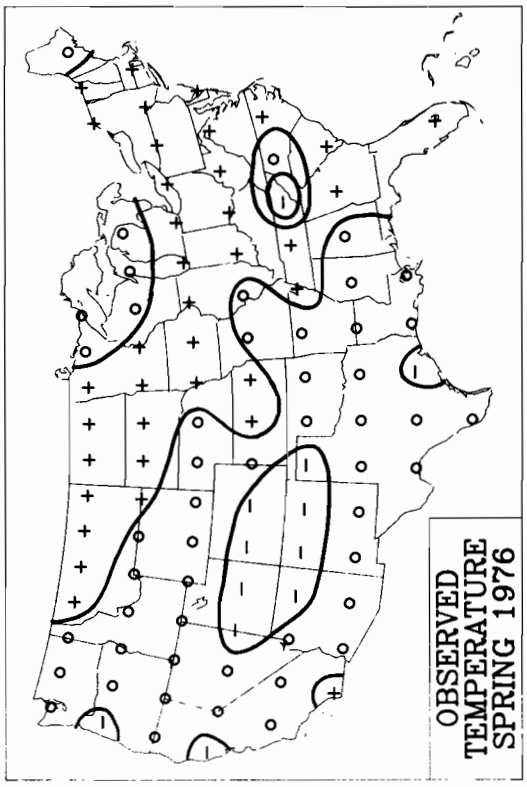
TEMPERATURE
SUMMER 1975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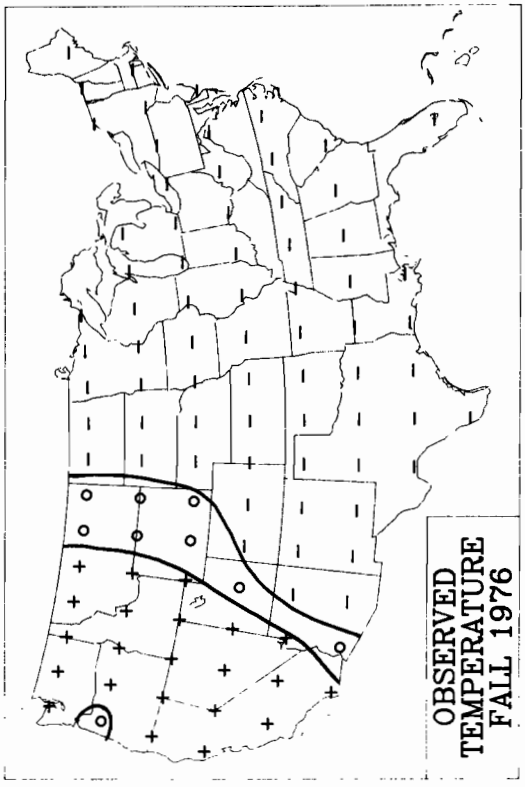
SPRING 1976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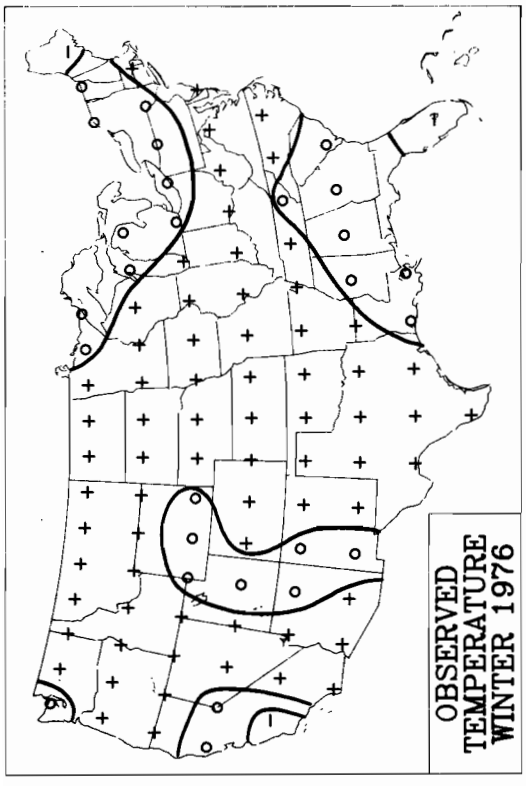
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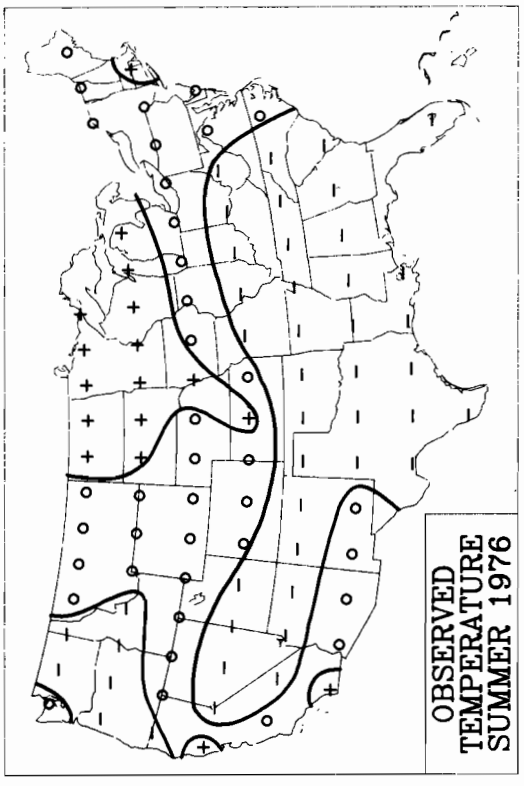
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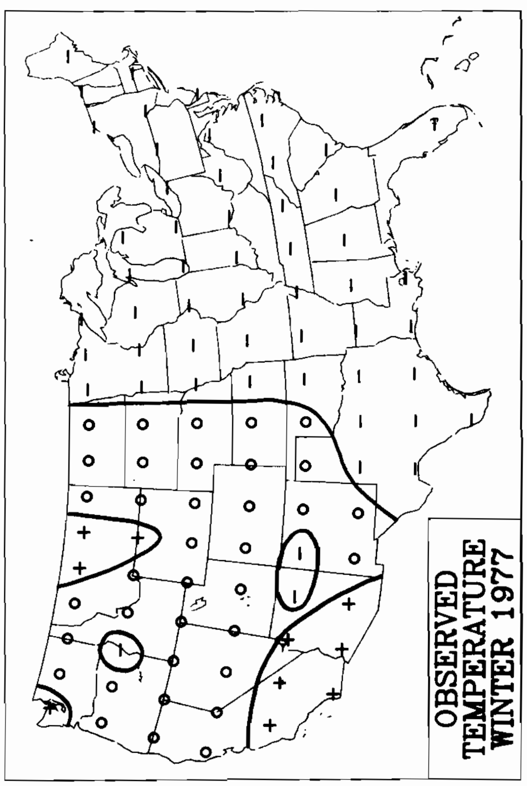
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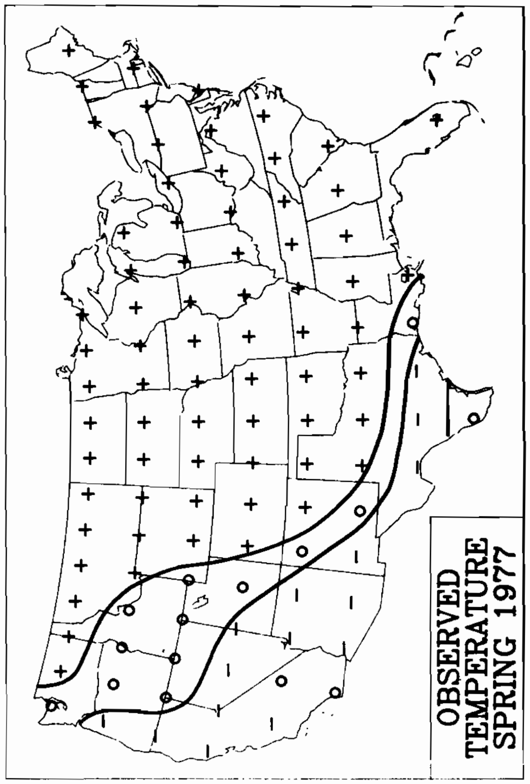
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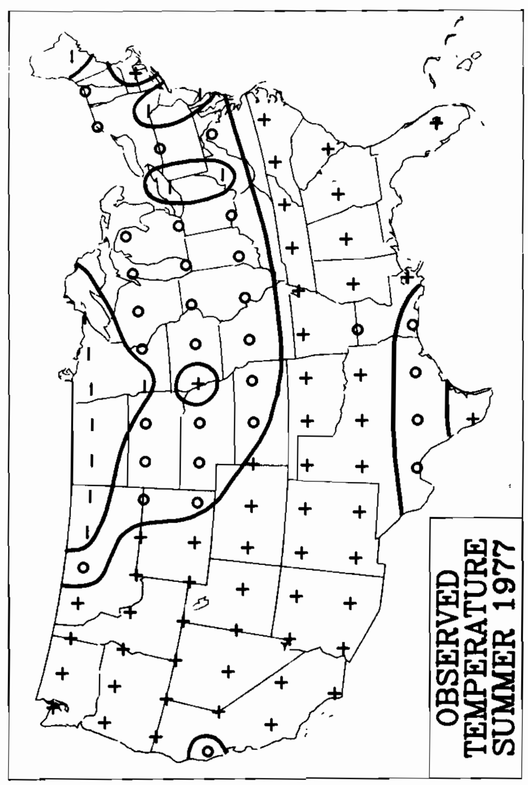
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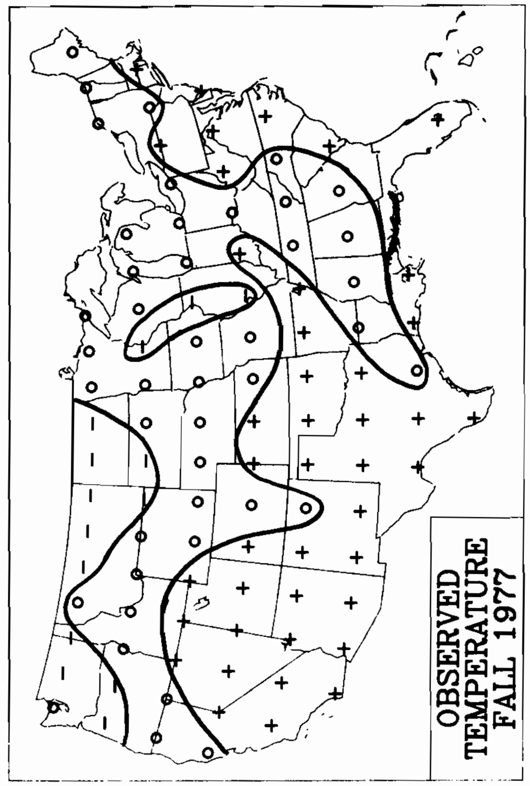
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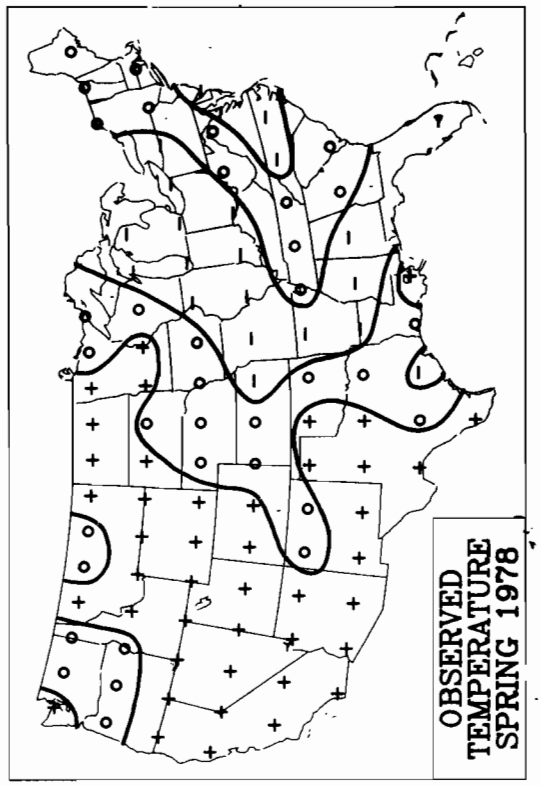
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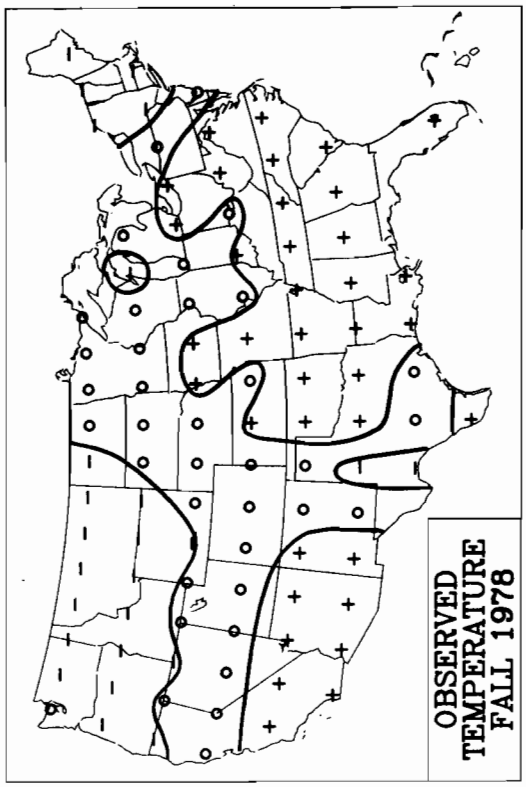
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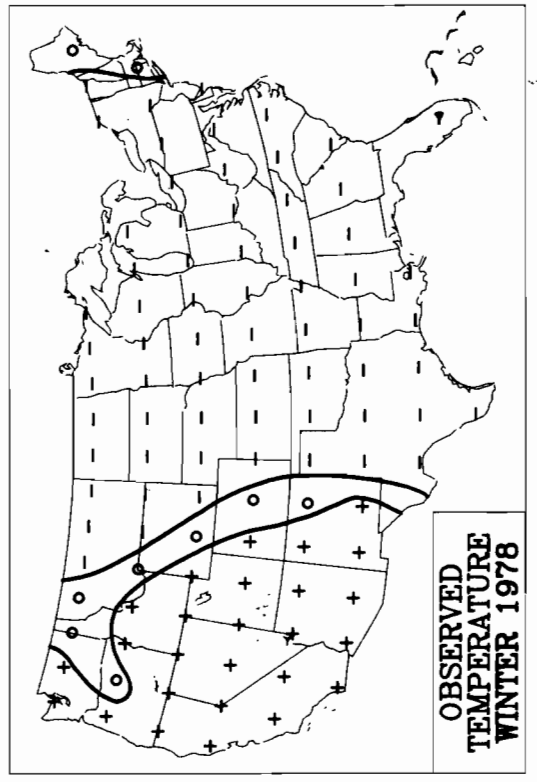
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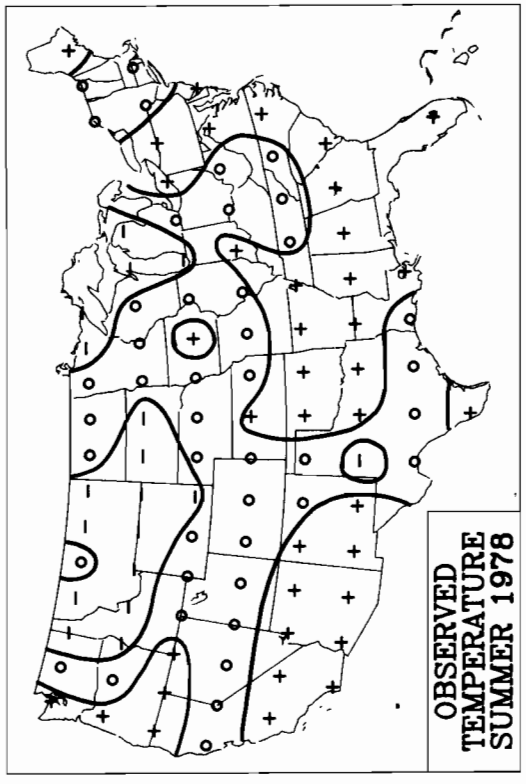
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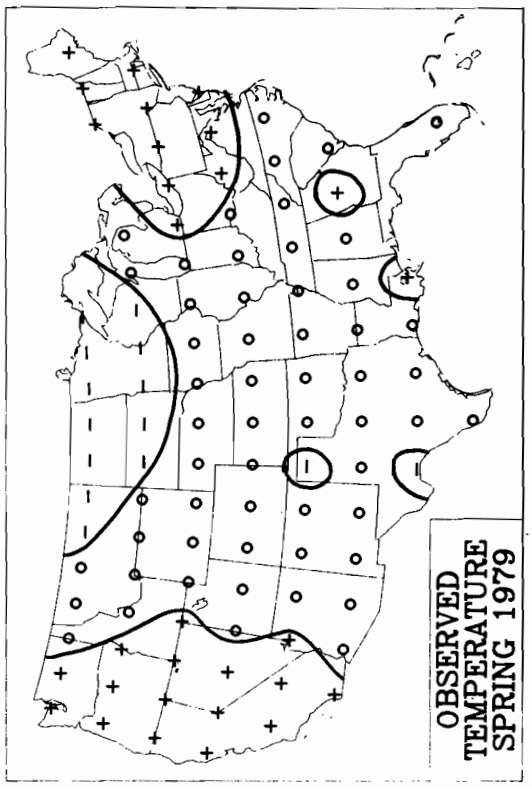
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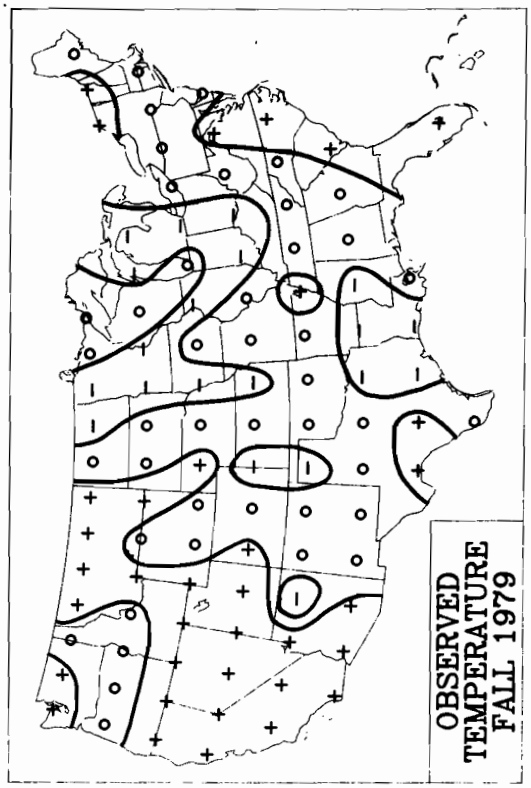
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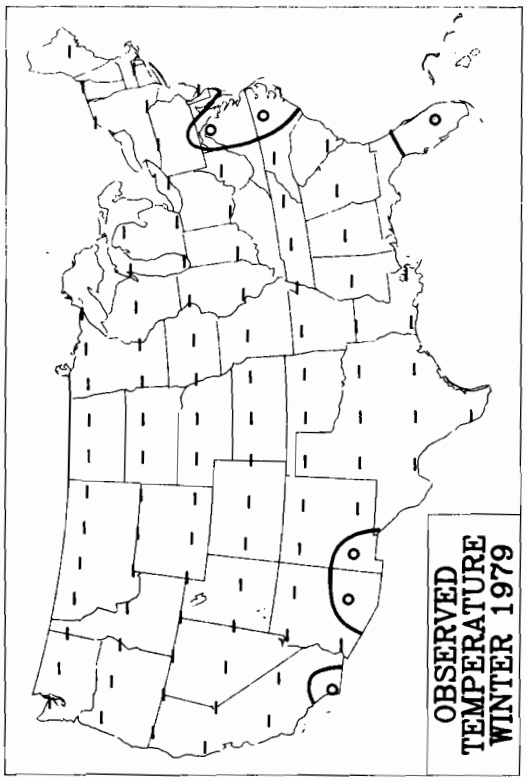
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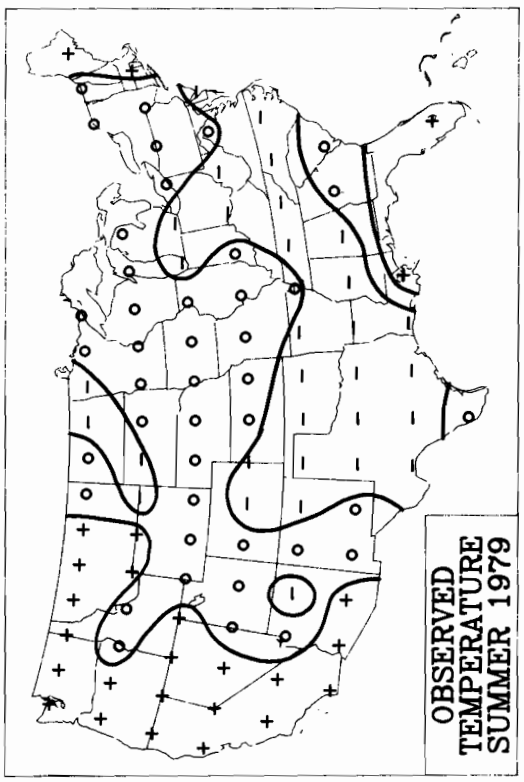
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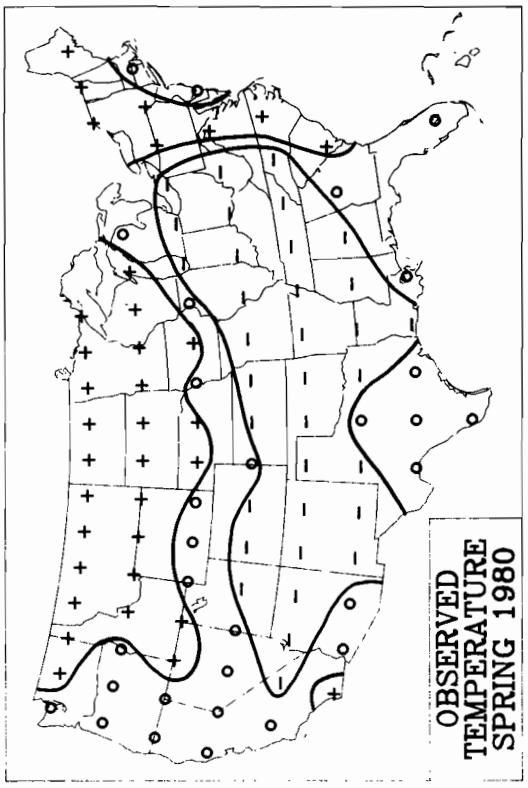
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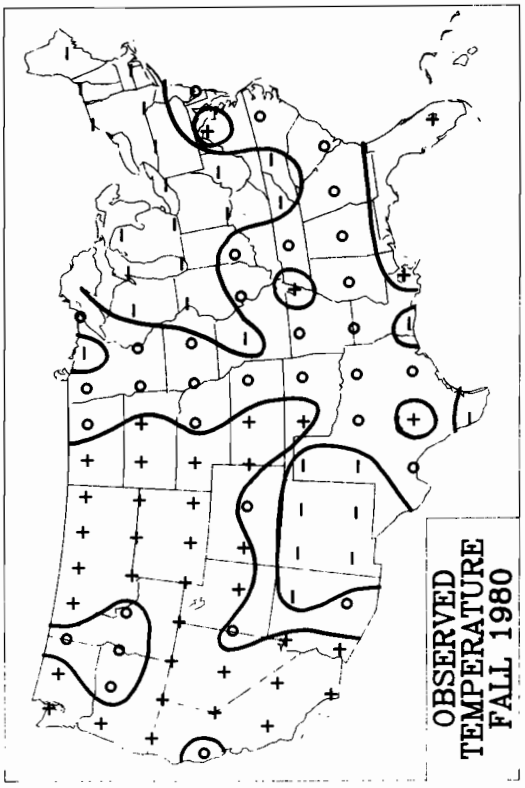
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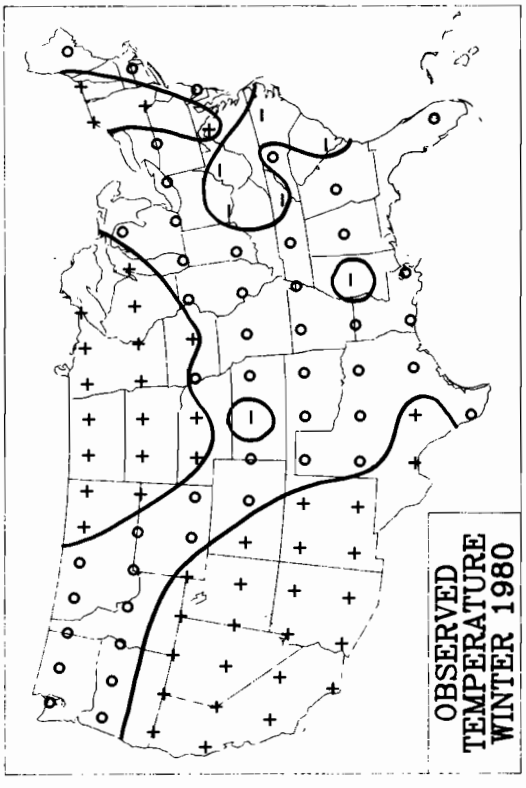
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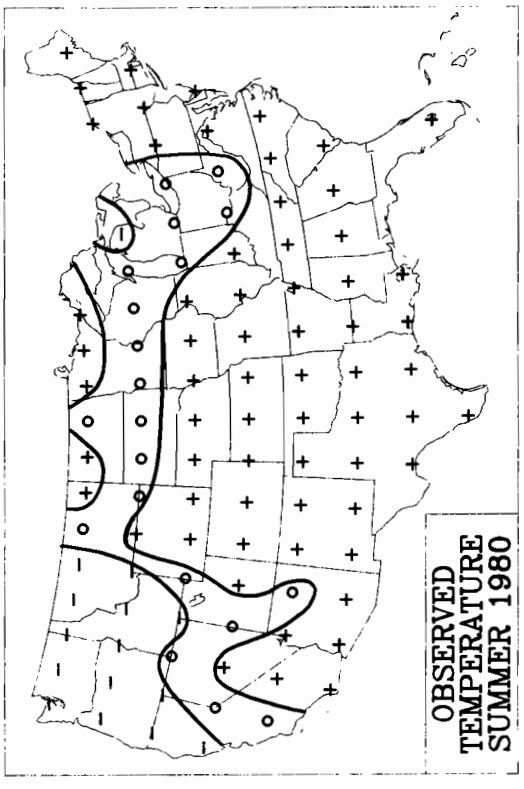
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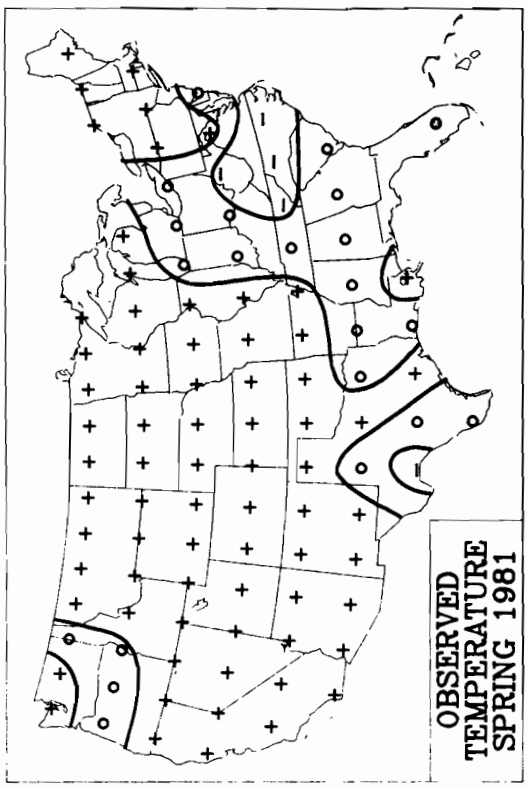
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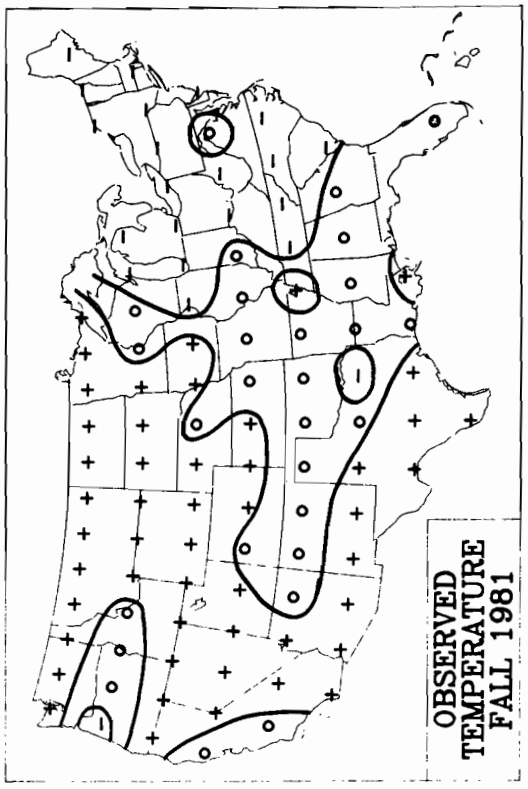
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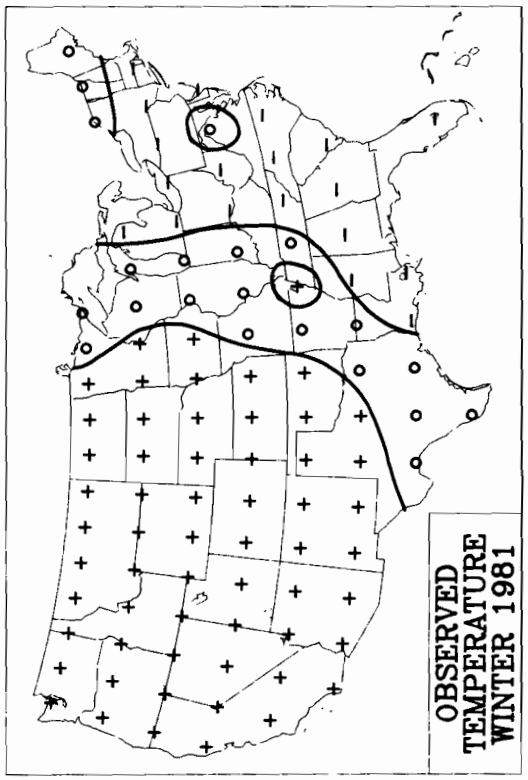
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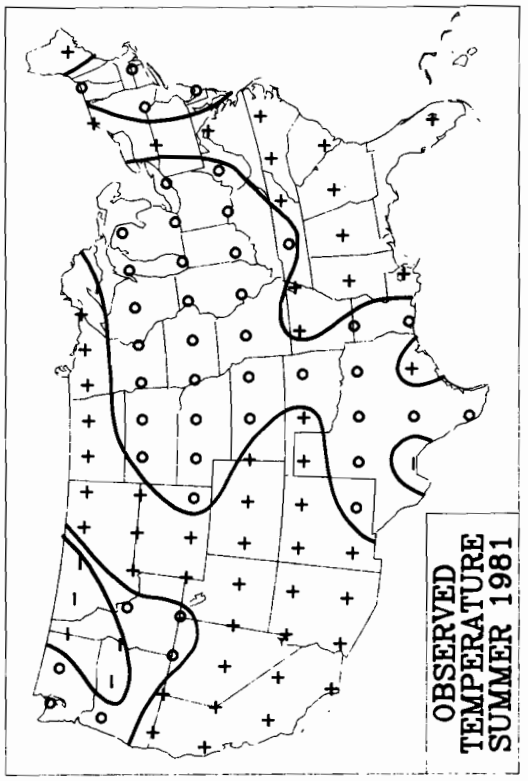
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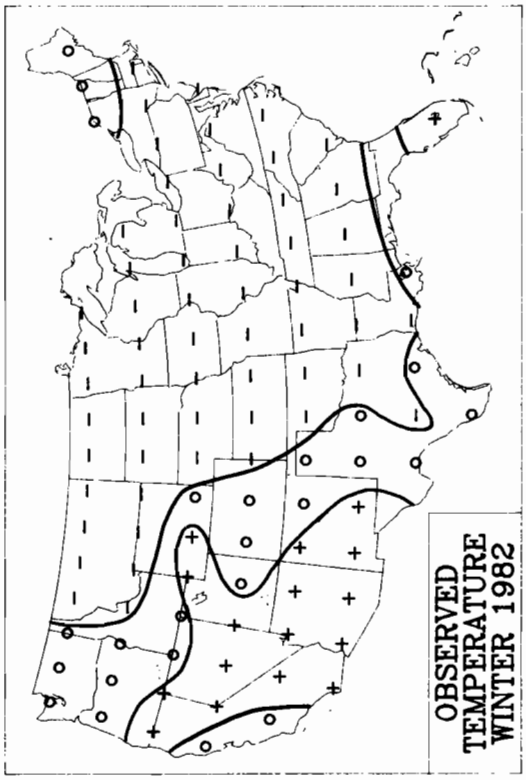
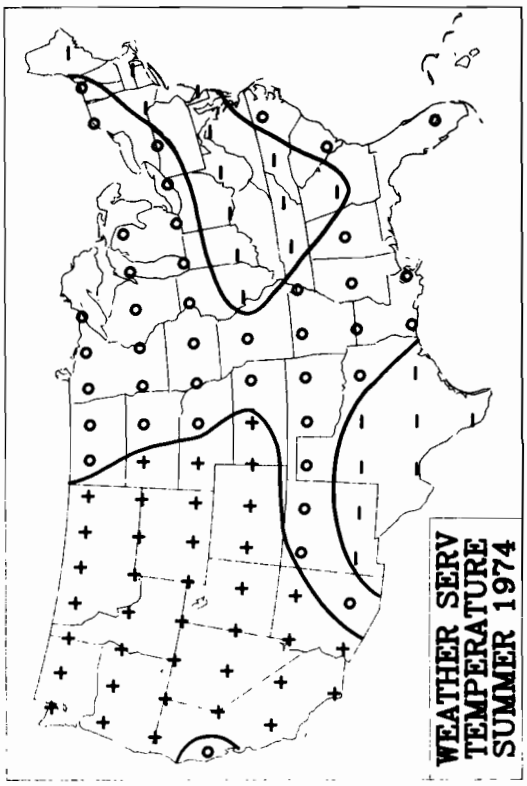
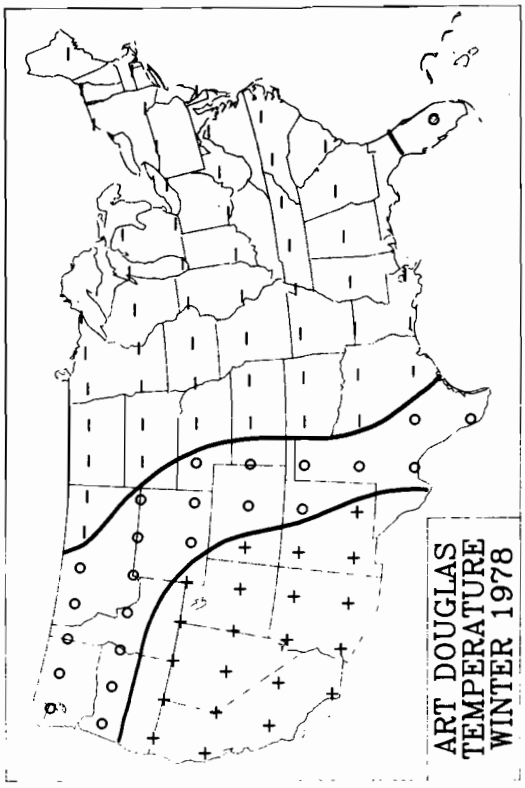
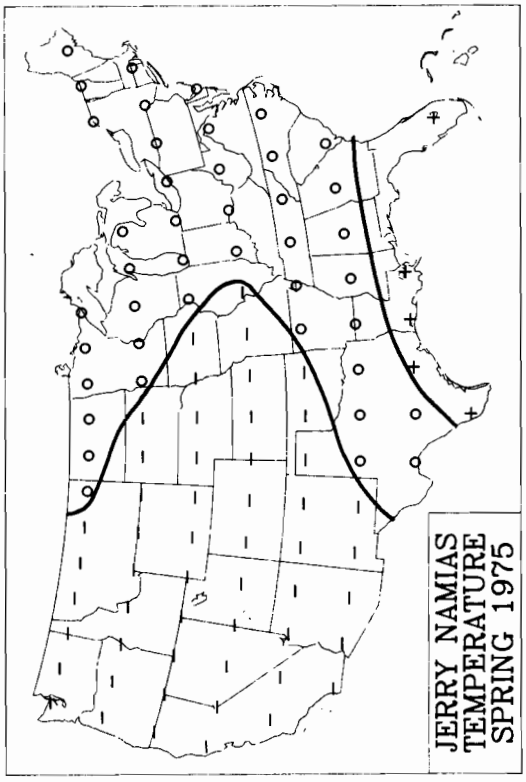
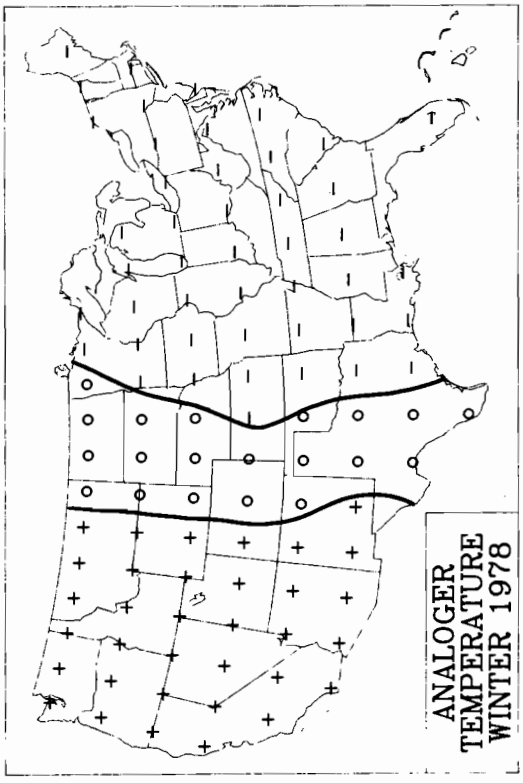

OBSERVED
TEMPERATURE
WINTER 1982


WEATHER SERV
TEMPERATURE
SUMMER 1974

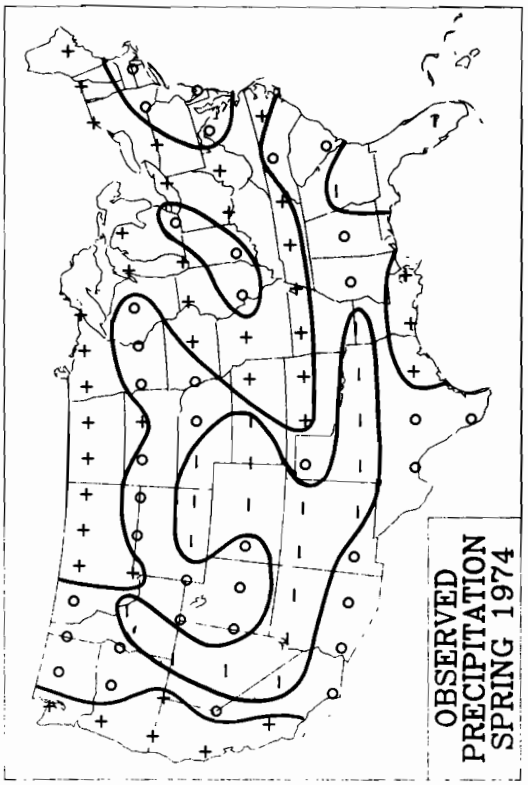

ART DOUGLAS
TEMPERATURE
WINTER 1978

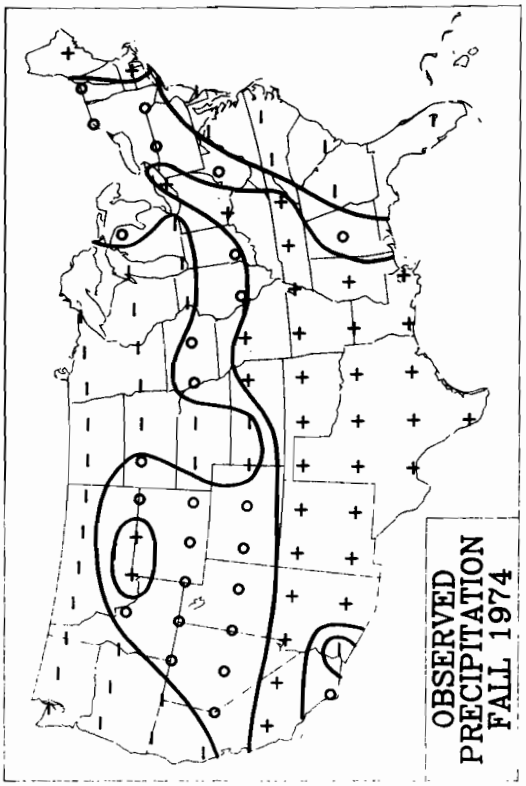

JERRY NAMIAS
TEMPERATURE
SPRING 1975

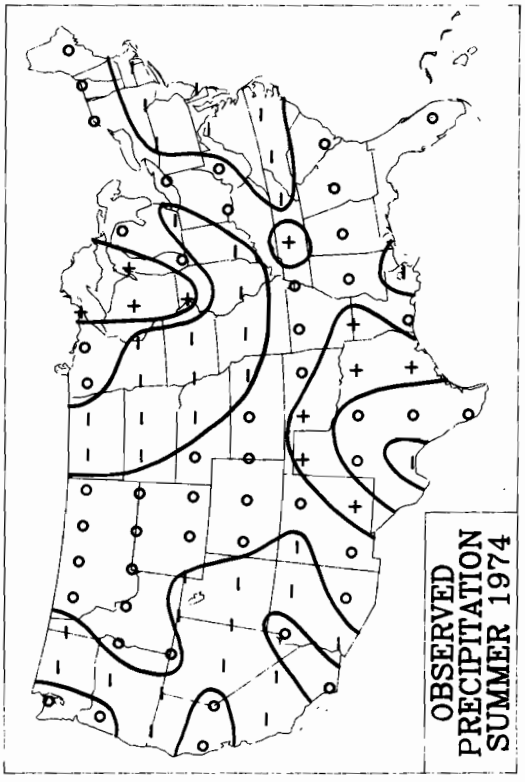

ANALOGER
TEMPERATURE
WINTER 1978

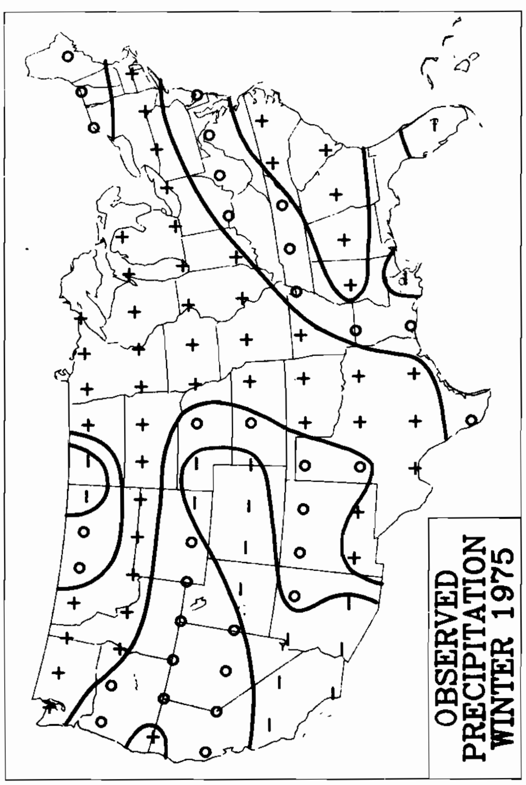
25. Gallery of Predicted and Observed Precipitation Patterns

There are two less observed precipitation maps than the observed temperature maps, hence there are only 32 maps here. As in §24, we add four maps showing the best precipitation forecasts of the four human forecasters. It is clear, on inspection of these precipitation maps, that the quality of the best precipitation skill is lower than that of the best temperature maps: Whereas the u values for the temperature scores were in the 70-80 range, for precipitation they are in the 40-60 range. For temperature, m was in the 20-30 range, while the precipitation m was in the 50-60 range. Clearly there is a considerable disparity of skill in predicting these two different types of fields. This was seen also in §§7, 10.


OBSERVED
PRECIPITATION
SPRING 1974


OBSERVED
PRECIPITATION
FALL 1974


OBSERVED
PRECIPITATION
SUMMER 1974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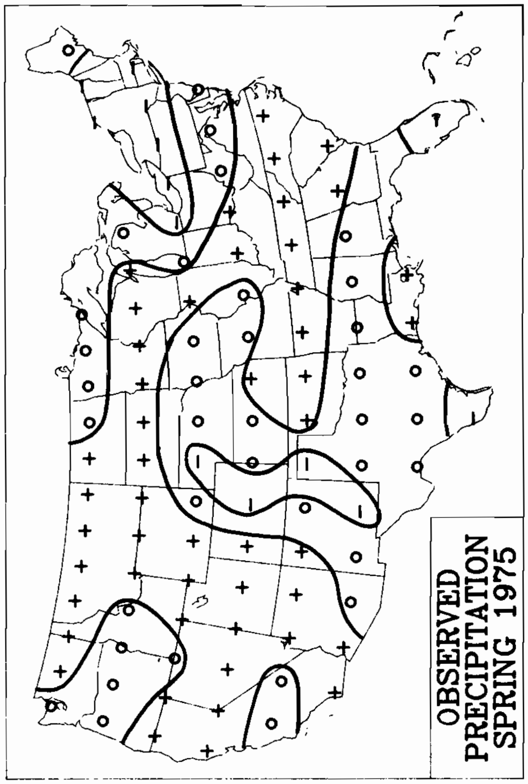
PRECIPITATION
WINTER 1975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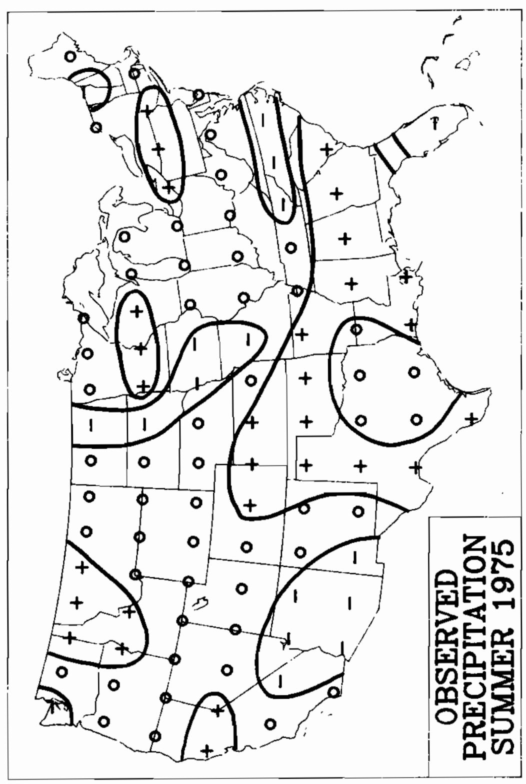
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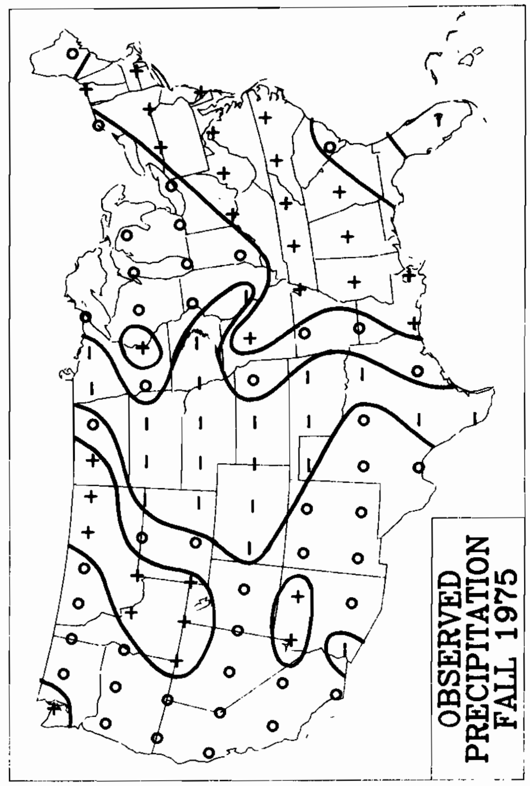
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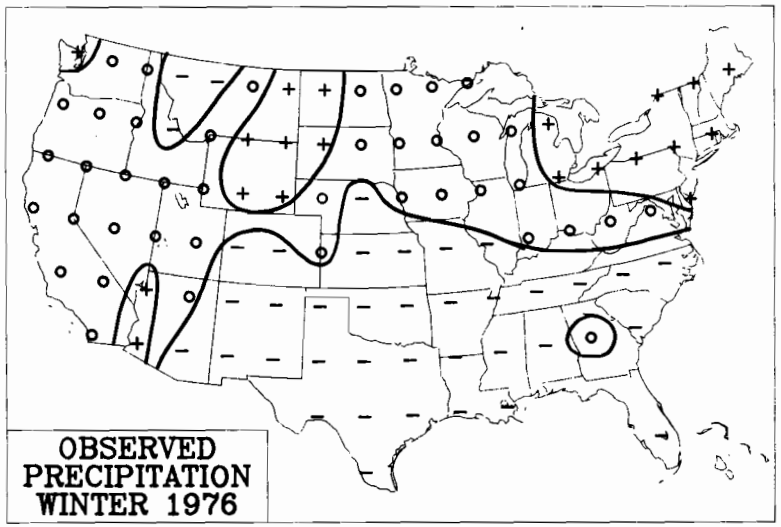
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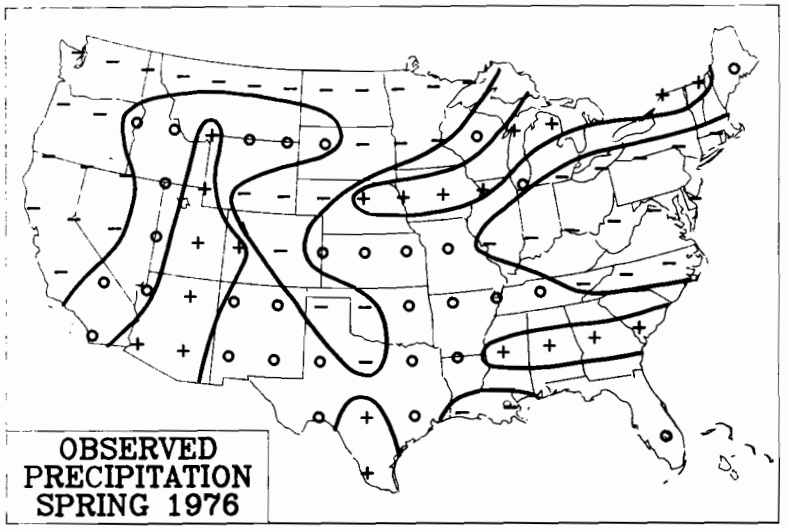
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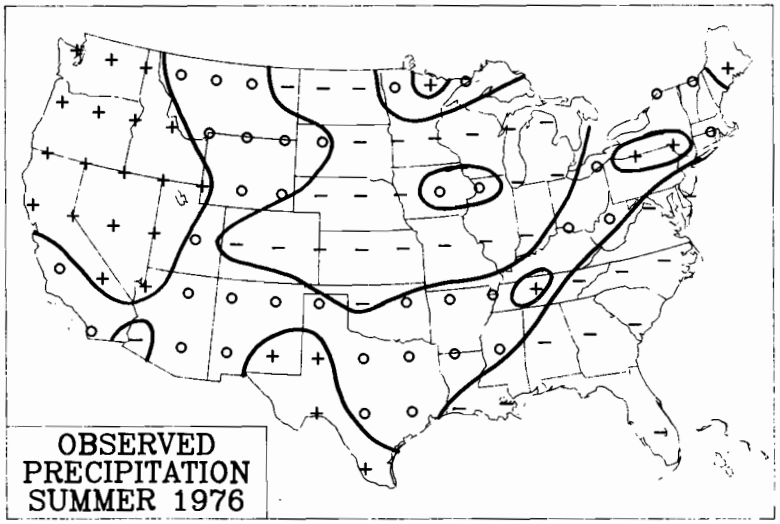
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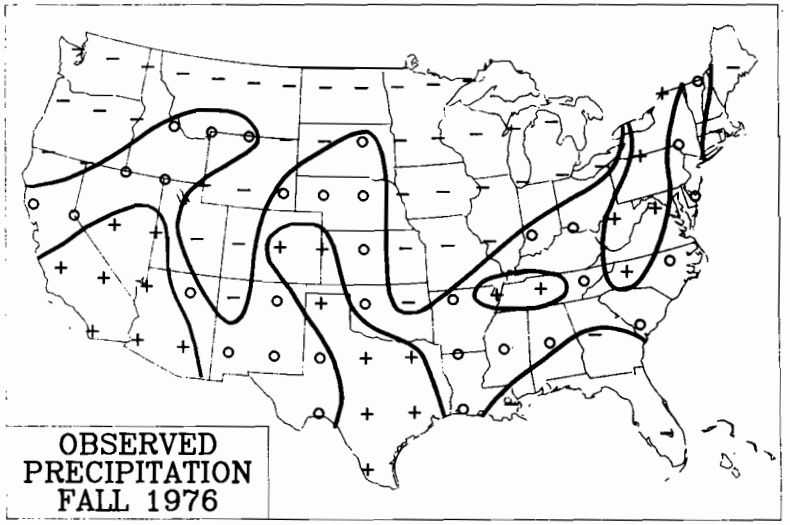
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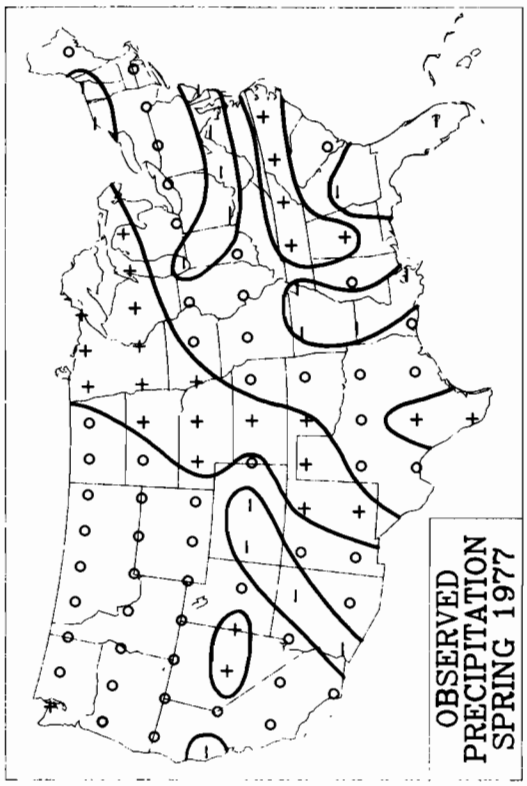
FALL 1976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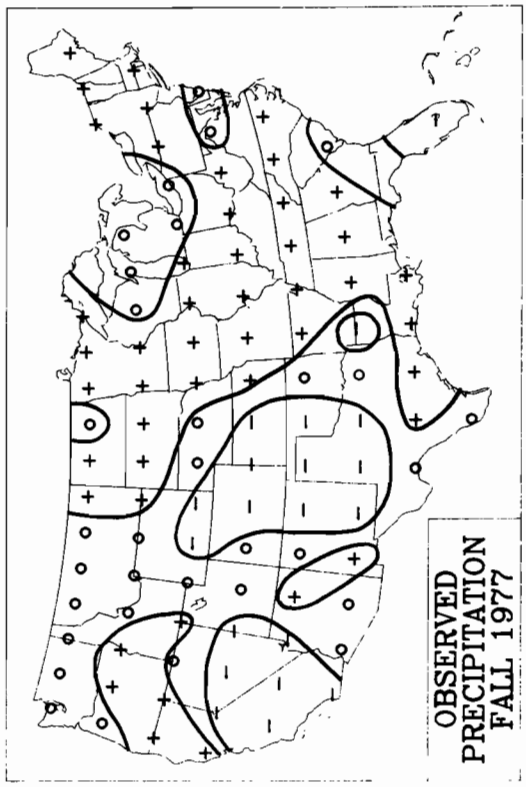
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PRECIPITATION
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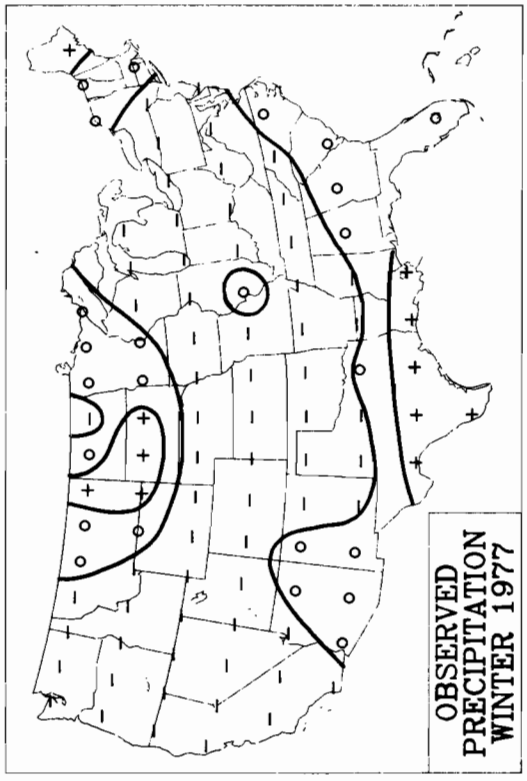
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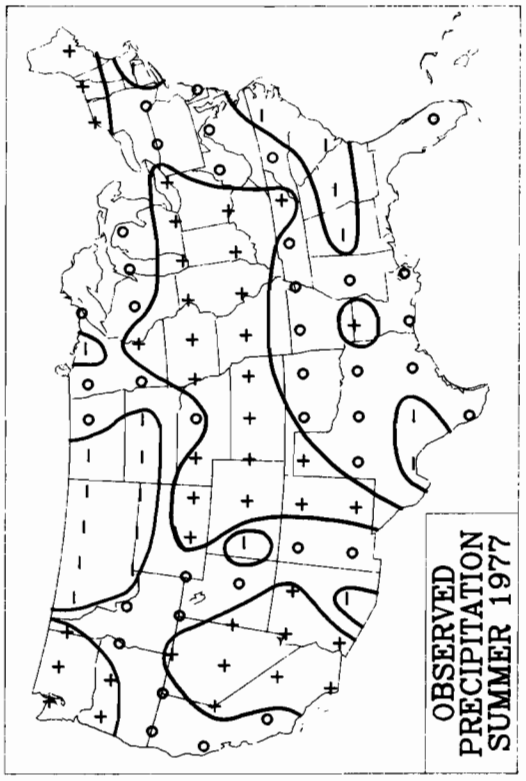
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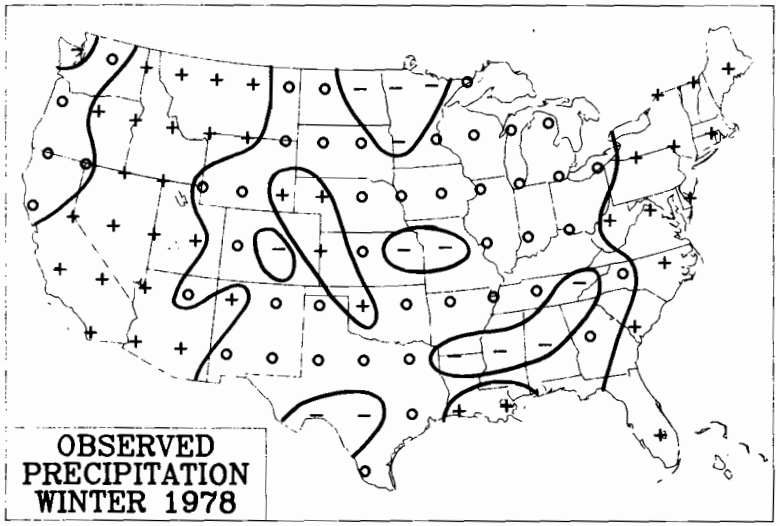
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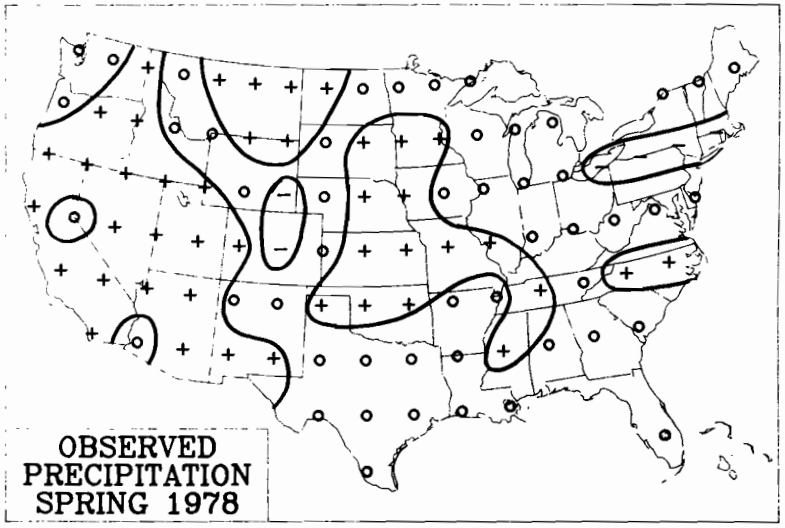
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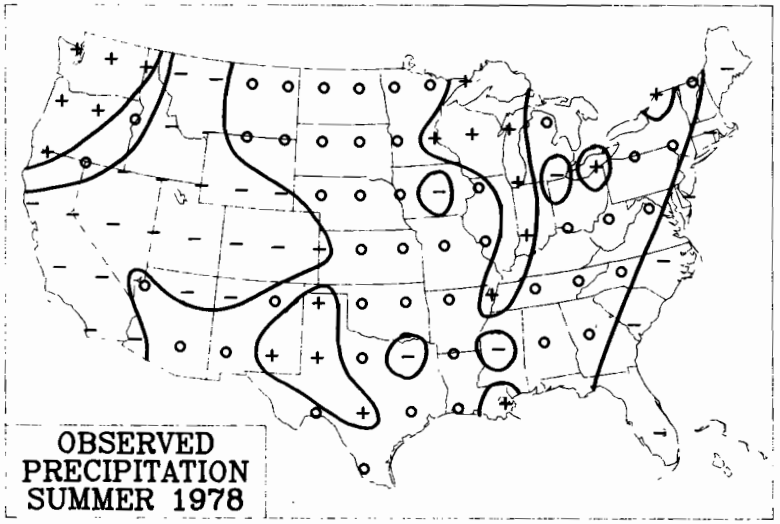
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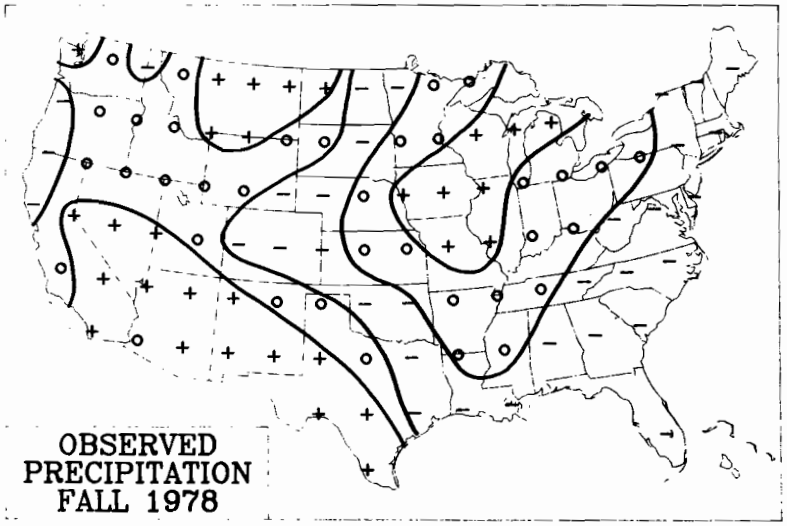
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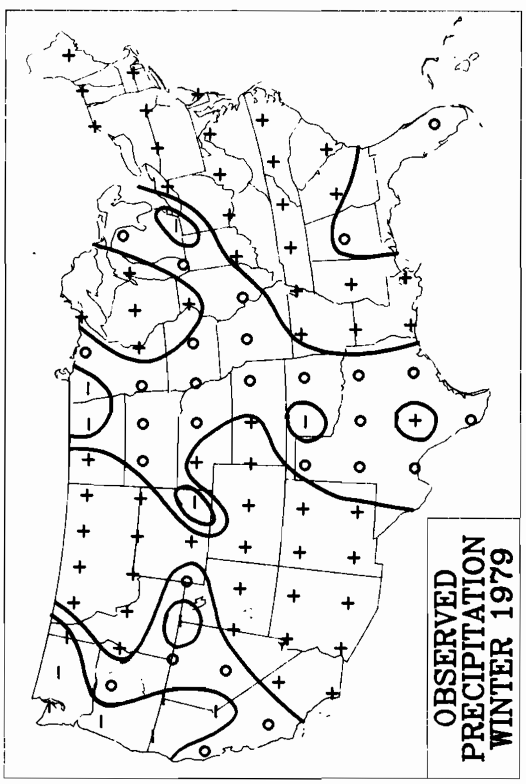
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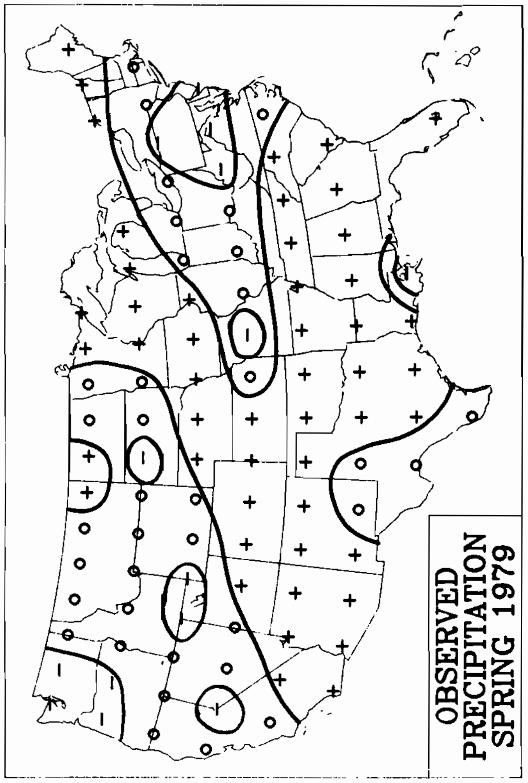
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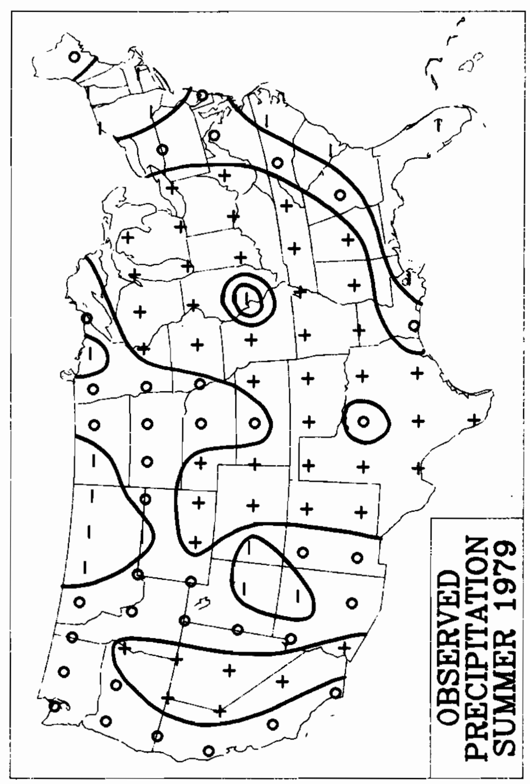
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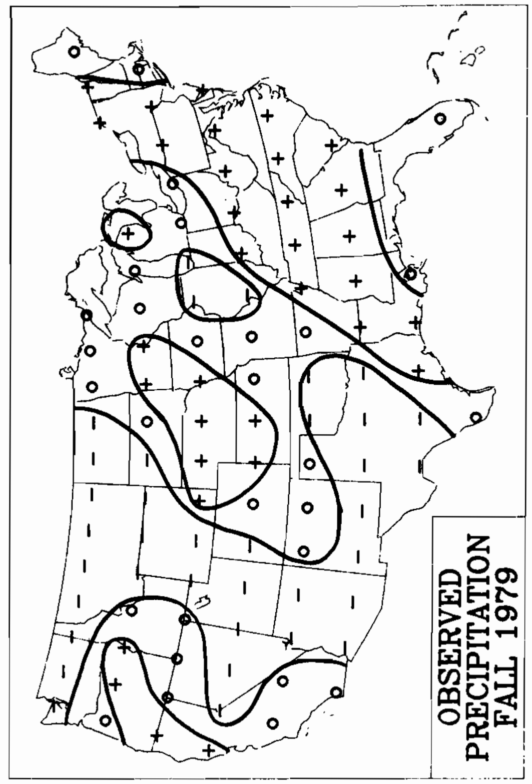
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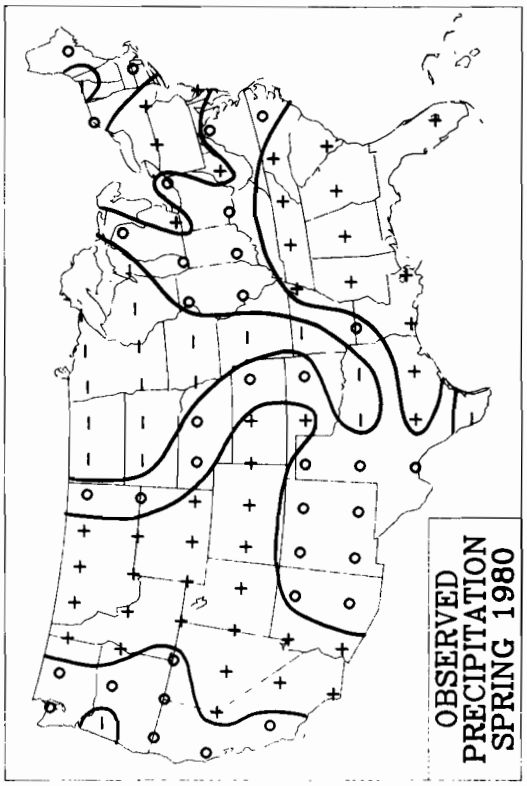
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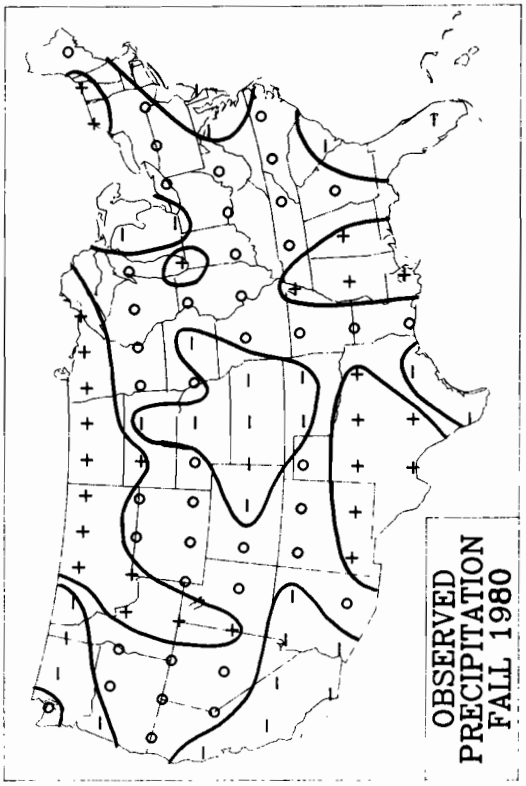
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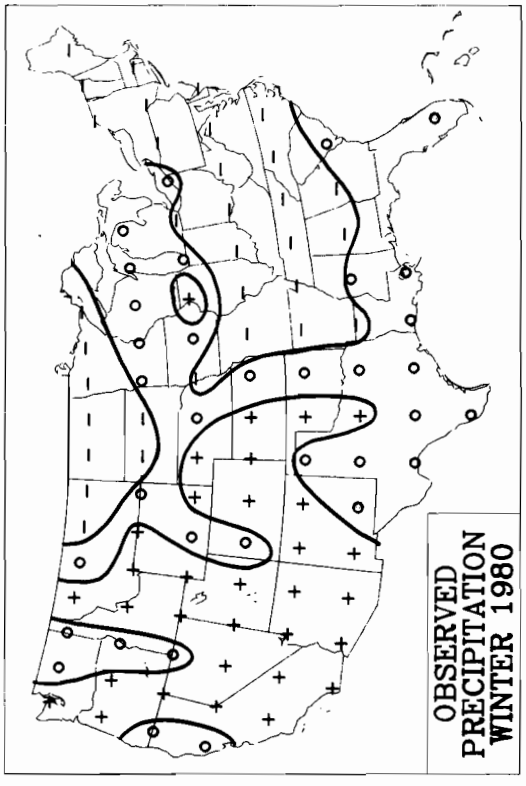
PRECIPITATION
FALL 1980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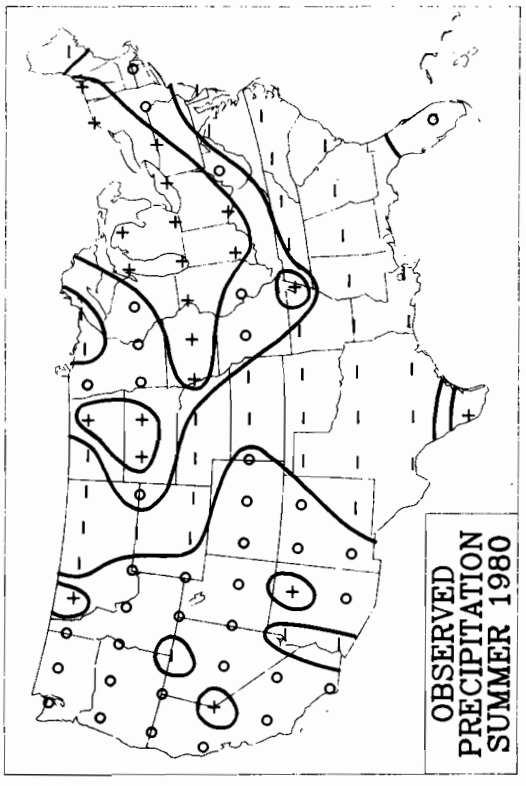
PRECIPITATION
WINTER 1980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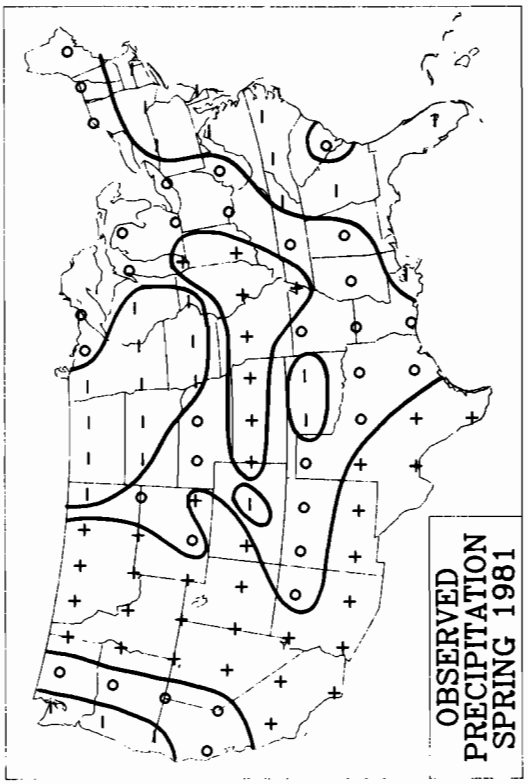
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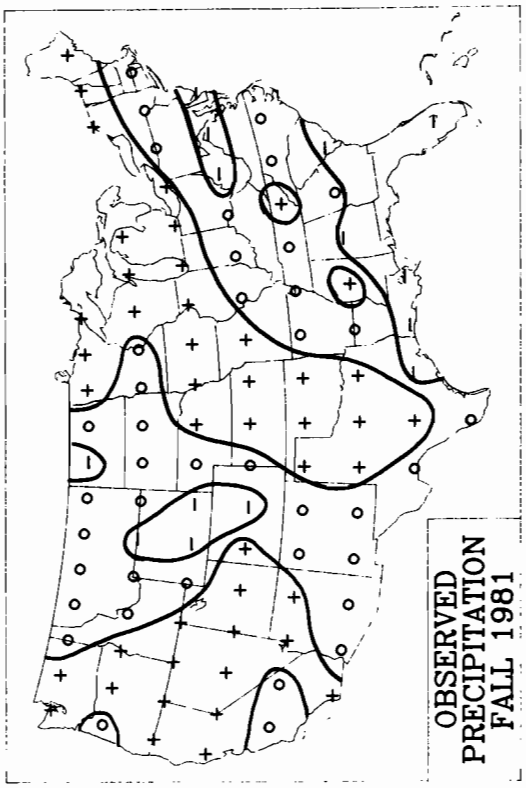
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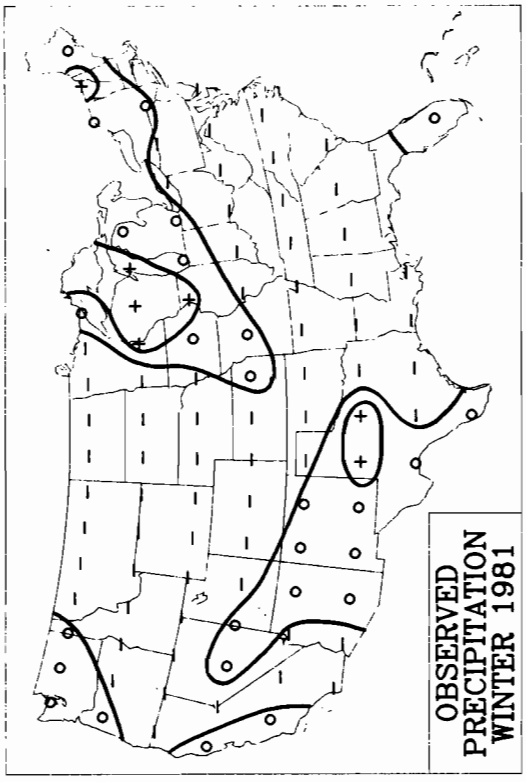
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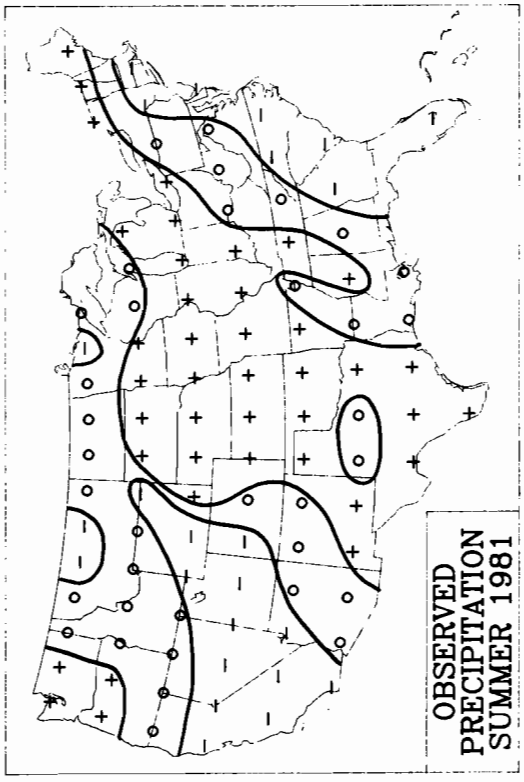
WINTER 1981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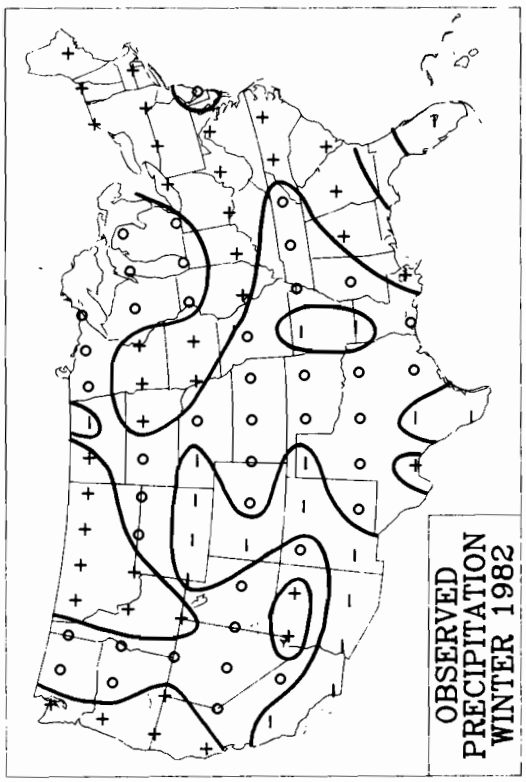
SUMMER 1981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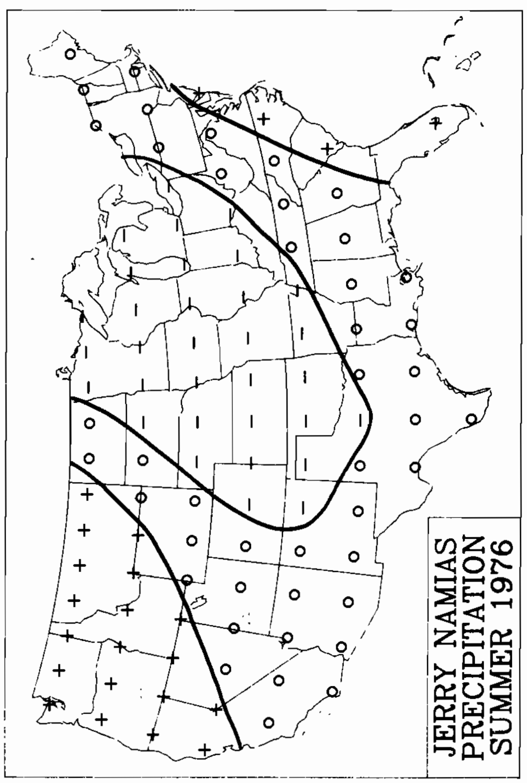
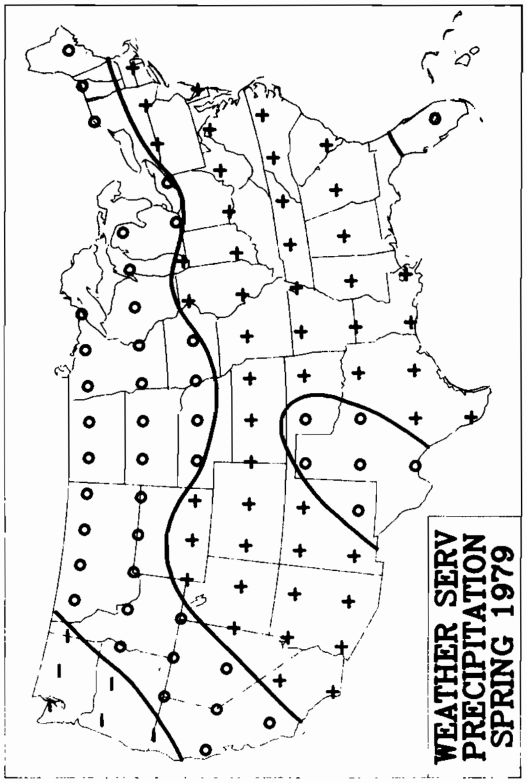
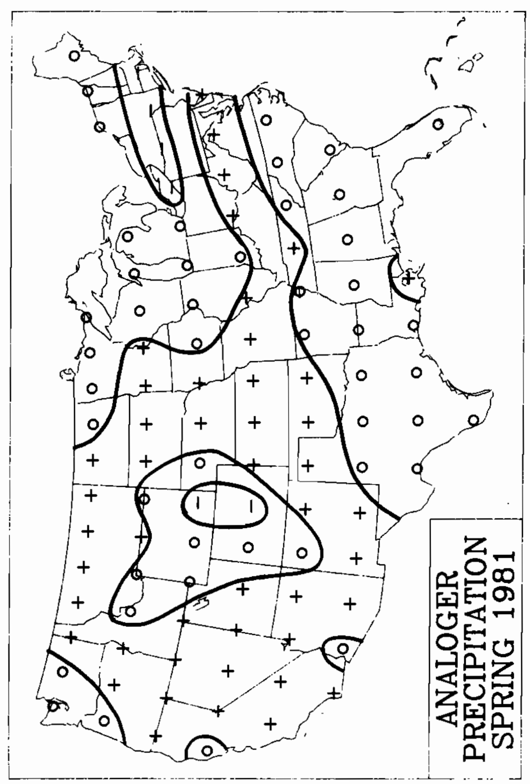
WINTER 1982


JERRY NAMIAS
PRECIPITATION
SUMMER 1976


WEATHER SERV
PRECIPITATION
SPRING 1979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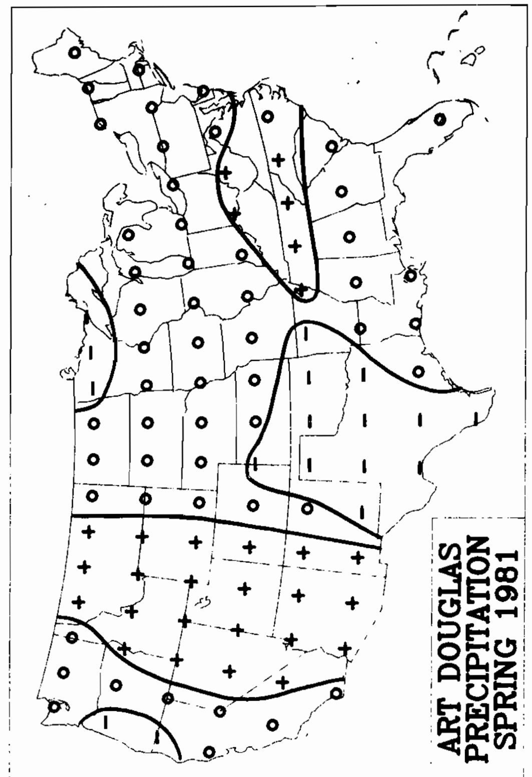
PRECIPITATION
SPRING 1981


ART DOUGLAS
PRECIPITATION
SPRING 1981

26. Geographic vs Equidistant Grids

The geographic grid of points, as shown in Fig. 10.1, was used in all our verification work in this study. The question has occasionally arisen concerning the possible uneven weighting this grid would give to a forecast verification, as a function of location in the grid. The question is prompted by the observation that there is a slight crowding together of station points over the northern tier of the geographic grid, relative to the points in the southern tier. It could be, for example, that a forecaster, doing poorly in the northern tier, would be penalized more there as compared to a similar poor performance in the south. Conversely, doing well in the north would count up more of a u-score than doing comparably well in the south.

A preliminary investigation of this question was made, and is based on the design of a new grid, by Art Douglas, which we will call the equidistant grid. It is depicted in Fig. 26.1. On comparing Figs. 10.1 and 26.1 we can see that there has been a definite uniformization of the spacing of the grid points, now evident in Fig. 26.1. How much of an effect does this new spacing of points have on a forecaster's skill scores? The only rigorous way to answer this question is to have the forecaster's efforts, over several years, evaluated in this new grid system along with the old. However, a simple and somewhat approximate estimate of the effect can be made at once, as follows.

As a first step, the two grids on Figs. 10.1 and 26.1 are superimposed. To each point of the equidistant grid we associate precisely one point of the geographic grid. While we will not develop these associations in detail, we may say in general that in this process some geographic grid points were dropped and some were used twice. The points dropped from the geographic grid were in the northern tier: 2, 6, 11, 14, 19, 24, 29, 39, 45, 52, 63. The points in the geographic grid counted twice were in the southern tier: 79, 82, 84, 85, 86, 87, 88, 89, 90, 91. With these associations in place, we went through the Weather Service's Forecasts from winter 1974 to fall 1981 and re-verified the forecasts (now transformed to the equidistant grid) against the observations (also transformed to the equidistant grid).

The results of the grid transformations on the Weather Service's scattering of temperature forecast verification points in the uv plane are shown* in Fig. 26.2. The geographic grid's uv scores are shown by the plus marks; the equidistant grid's uv scores by the circle marks. As the eye sweeps over the sets of pluses and circles, the immediate impression is that the two sets of marks are co-extensive: they appear to have the same average location, the same spread, and even the same shape. The conclusion is that the change from the geographic to the equidistant grid apparently has produced no significant change in the overall properties of forecast skill as manifested in the Weather Service's uv diagram. A similar conclusion can be drawn for the overall pattern of precipitation forecast skill shown in Fig. 26.3.

While a more rigorous examination of this question could be made (e.g., by means of the benchmark and empirical forecasters applied to the §§24, 25-recorded eight-year observation fields), simultaneously, over the two grid systems, we would anticipate that any changes wrought in uv diagram point sets

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* This study was done just before the winter 1982 observations were available. Hence the missing winter 1982 points in Figs. 26.2, 26.3.

would be minor in the sense that they would not materially affect the averages on which the rankings of forecaster skill and field predictability have been based, in this study.

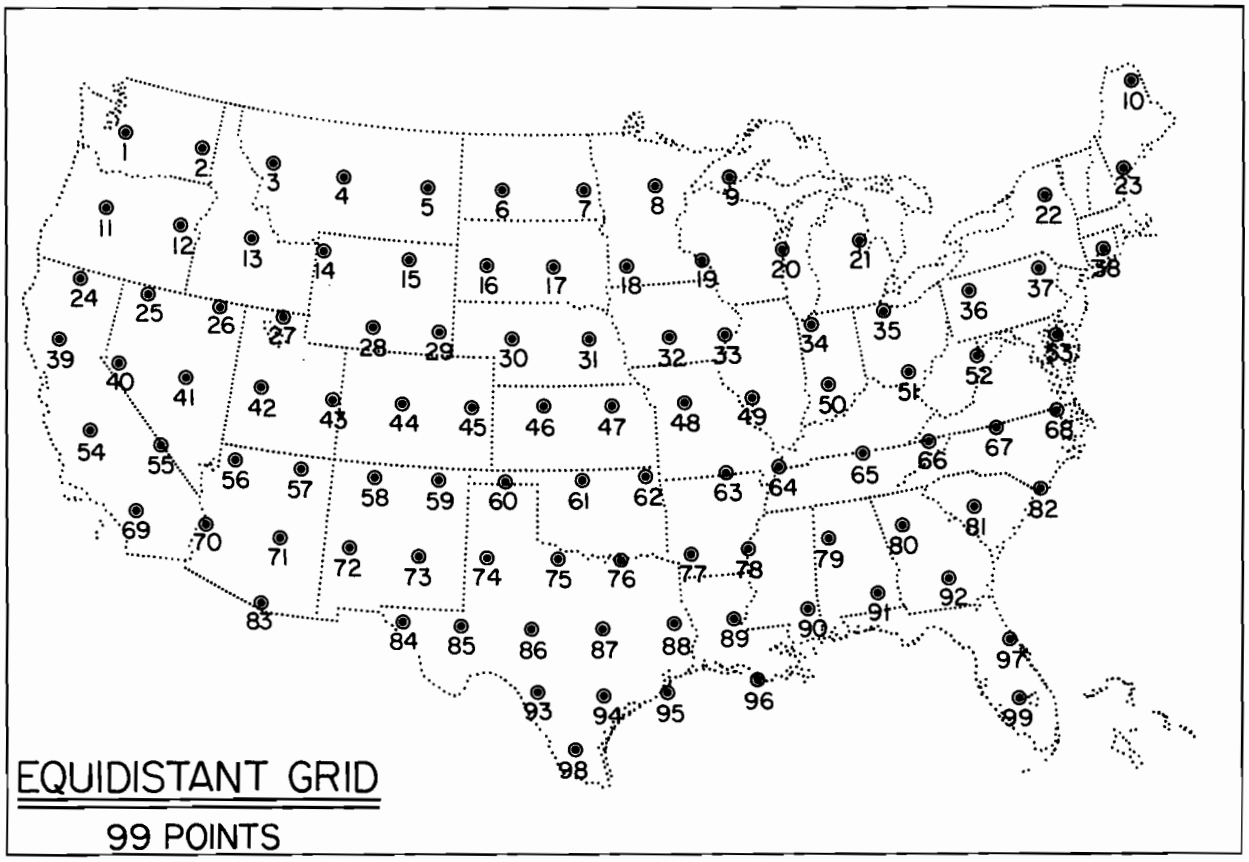

Fig 26.1

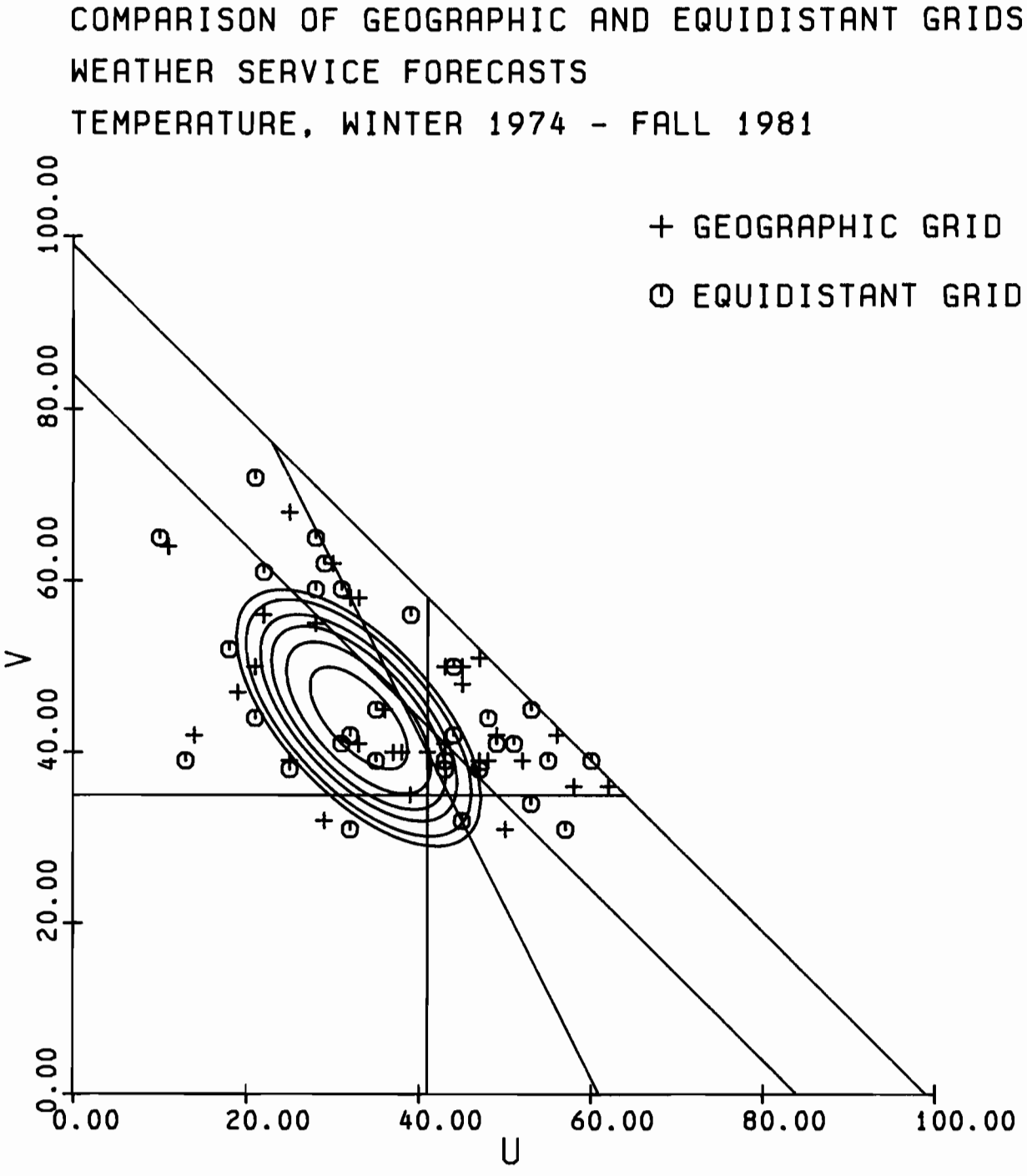
COMPARISON OF GEOGRAPHIC AND EQUIDISTANT GRIDS
WEATHER SERVICE FORECASTS
TEMPERATURE, WINTER 1974 - FALL 1981
+ GEOGRAPHIC GRID
⊙ EQUIDISTANT GRID
V
U
0.00
20.00
40.00
60.00
80.00
100.00

Fig 26.2

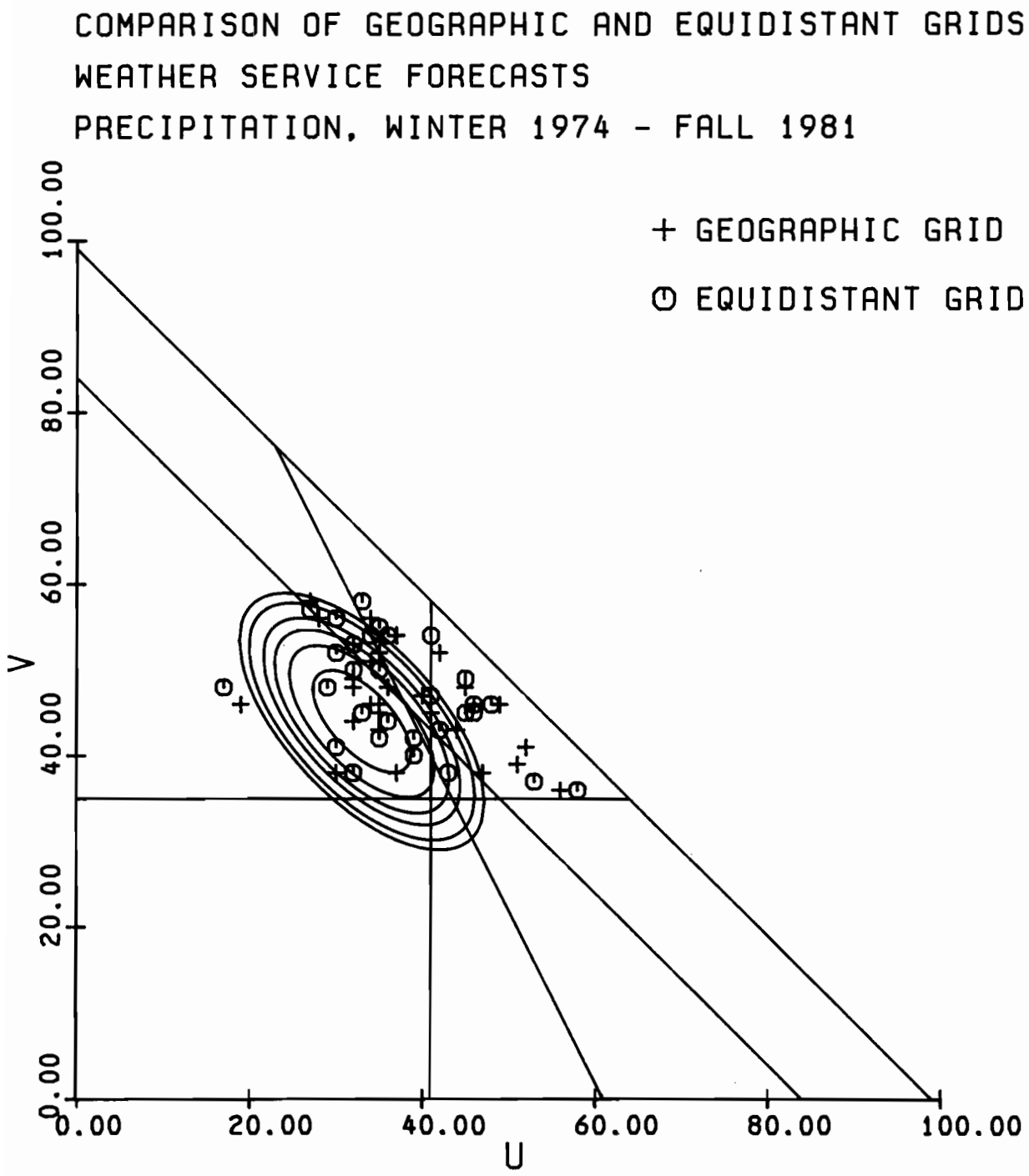
COMPARISON OF GEOGRAPHIC AND EQUIDISTANT GRIDS
WEATHER SERVICE FORECASTS
PRECIPITATION, WINTER 1974 - FALL 1981
+ GEOGRAPHIC GRID
⊙ EQUIDISTANT GRID
100.00
80.00
60.00
40.00
20.00
0.00
V
0.00
20.00
40.00
60.00
80.00
100.00
U

Fig 26.3